Microfoundations of the New Keynesian Phillips Curve in an Open Emerging Economy.

Zouhair Ait Benhamou

EconomiX

Paris Nanterre University
zouhair.aitbenhamou@gmail.com [*]

March 6, 2017

Abstract

We propose in this paper a new Keynesian model for a small, open emerging economies, where the Phillips Curve incorporates openness to trade. The model argues that integration in global trade exerts downward pressure on an economy's price level, thanks to increased competition from foreign, imported goods, and consumers' preference for diversity. The proposed model incorporates nominal rigidities, firm-specific capital and investment cost of adjustment. We formulate a micro-founded framework for the trade balance and exchange rate. Furthermore, increased competition from import goods also weakens the effects of monetary policy, which shows in a subsequent welfare analysis of various monetary policy regimes.

1 Introduction

Obstfeld & Rogoff (1995)argue that the literature on open macroeconomics suffered hitherto from inherent contradictions: the mainstream models derived from the Mundell-Fleming (1962-1968) consisted of an economy system of two markets, one for domestic output, and the other for foreign trade. It sought to describe transmission mechanisms of macroeconomic policies by means of national account identities. Although it was empirically robust and was widely used by policymakers, it did not have a strong theoretical background. Frankel & Razin (1987) comprehensively enumerate the Mundell-Fleming model limitations. First, it lacks clear micro-foundations, since it does not provide an explicit definition of agents economic behaviour. Second, there are no inter-temporal resources constraints, which limits the model's dynamic scope. The absence of inter temporal decision-making schedule also precludes forward-looking agent decision rules, and limits further the model's ability to provide predictions in the short and medium run. Third, as reported in Obstfeld (2000) output in the Mundell-Fleming model is defined as a aggregate demand, and makes no provisions for a supply-side definition of aggregate production.

On the other side if the literature, inter-temporal models have been devised on sound theoretical bases. In an open economy environment, we look to Backus, Kehoe & Kydland (1992) and their extension of the standard Real Business Cycle (RBC) framework to a multi-country setting. Their paper was designed to account for co-movements between output and household

1

consumption observed among OECD economies. Their extended RBC model predicts high correlation between consumption and output, and they conclude to the need for explicit trading frictions, in order to improve their model's ability to replicate co-movements and global trade. A similar conclusion is shared in Mendoza (1991) whose RBC model is applied to Canada as a proxy for a small open economy. Backus & al (1992) omit however to discuss issues of macroeconomic policies and their effects on trade flows. While the RBC framework is a state-of-the-art inter-temporal model, one should keep in mind that it describes agents' optimal reaction to exogenous, temporary shocks. Applications of macroeconomic policies are thus limited. Furthermore, given its focus on real fluctuations, the RBC framework precludes any analysis on exchange rates or nominal variables, which limits its scope and relevance in a comprehensive setting for the study of global trade flows. Thus theoretical models fail therefore to incorporate macroeconomic policy effects on foreign trade exchange. It becomes thus necessary to account conciliate between two requirements: on the one hand, the proposed model has to be consistent and based on sound theoretical bases. On the other hand, it has to produce relevant economic policy analysis and account for the stylised facts displayed by a comprehensive set of variables.

With Obstfeld & Rogoff (2000) the new mainstream in the literature on open economy macroeconomics is established as a synthesis of the inter-temporal approach and price stickiness. The literature conciliates between the two features *via* the use of monopolistic competition and price adjustment sluggishness. This new mainstream model is built using monopolistic competition *à la* Blanchard & Kiyotaki (1987) and make use of the Dixit & Stiglitz (1977) consumption index. Imperfect competition between intermediate consumption goods endows small intermediate firms with some measure of market power, and they become price-setter. Elasticity of substitution on the other hand insures imperfect competition can always converge to competition. Intermediate firms also face sluggish price adjustment. The literature chooses either Rotemberg (1982) to describe firms facing real costs of price adjustment, or Calvo (1983) where a fraction of intermediate firms update their prices randomly. Price sluggishness insures the consumer's money balance affects their real demand, which opens the way to monetary policy having real and persistent effects on output. Nonetheless there are limitations to the Obstfeld-Rogoff approach, which boil down to the considered time horizon. Using the inter-temporal approach means agents' optimisation schedules create variable paths. In the case of households, their consumption path is likely to be function of relative prices and distortions thereto, as noted in Vègh (2013). The Obstfeld-Rogoff model is built on a one-period advanced price-setting, which is insufficient in mapping out expected paths for model variables, and thus assess exogenous shocks or macroeconomic policy effects. In that sense, the inter-temporal approach needs to be supplemented with an RBC model *à la* Backus *et al.* (1992) where agents optimising schedule focuses on variable paths, instead of relying on a two-periods specification. In addition, the Obstfeld-Rogoff model focuses on transmission mechanisms at the global level, their subsequent results miss out on the dynamic effects of imported consumption goods for instance, particularly so for small open economies. Consequently, the mainstream model needs to be retooled to fit a multi-period optimisation framework, where price sluggishness is persistent enough. As reported in Lim & McNelis (2008) a pure forward-looking model within the new Keynesian model can allow for a greater scope in analysis the impact of macroeconomic policy in an open economy environment.

With the Phillips curve, the new Keynesian framework establishes a direct link between present and expected inflation on the one hand, and utilisation of production capacity, or output gap on the other. When adapted to account for an open environment setting, it account for the effects of international trade and/or capital mobility. Razin & Yuen (2002) extend the standard closed-economy Phillips curve to an open economy with trade and capital mobility. They conclude that opening an economy to trade flattens the Phillips curve, and thus weaken the inflation-output gap tradeoff it describes. Gali & Monacelli (2005) laid out a fairly extensive new Keynesian model that articulates well the issues raised in Obstfeld & Rogoff (1995). They

offer a tractable framework designed to assess the effects of monetary policy on welfare and volatility of exchange rate and terms of trade. Though they conclude that their model is nearly identical to the closed economy standard new Keynesian model, they point out that variable equilibrium conditions are sensitive to the small open economy's openness to trade, as well as substitutability between domestic and foreign goods. Their results show policymakers in small open economies are faced with a tradeoff between welfare targets and exchange rate stability. For instance, a policy of strict domestic CPI inflation targeting on behalf of monetary authorities yields significant volatility in nominal exchange rate as well as terms of trade. On the other hand, the focus on domestic inflation, rather than a broad-based CPI inflation as defined in a Taylor monetary rule is shown to generates superior welfare benefits. The Gali-Monacelli framework has markedly improved upon the Obstfeld-Rogoff framework in the literature on open economy macroeconomics, but misses out on three aspects. First, their model borrows heavily from the new Keynesian workhorse, where output is entirely consumed, and there are no capital markets. Ireland (2001) argues that the inclusion of physical capital with adjunct costs of adjustment improve on the model's ability to replicate the behaviour of interest rates. Christiano, Trabandt & Walentin (2010) discuss the issue where an increase in nominal rates may paradoxically boost inflation if borrowing constraints are included in the model. In the context of working capital, firms may pass on increases in interest rate to their marginal cost, thus boosting inflation. Second, it is doubtful labour costs are are a pertinent proxy for real marginal costs in emerging economies, where imperfect market structures are prevalent. In that respect, Woodford (2005) develops an argument relevant to our paper, he posits that firm-specific capital can introduce significant changes to the New Keynesian Phillips Curve (NKPC). He argues that once a capital rental market is assumed to exist, firms engage in strategic interactions, and the predicted slope of the Phillips curve for inflation to the output gap changes dramatically, and may join the argument made in Christiano & al (2010). Third, the Gali-Monacelli model assumes a constant degree of home bias in consumption preferences for households. Rumler (2007) tests the Phillips curve for a set of relatively small open economies in the Euro area. He concludes that open economies tend to adjust their prices more frequently, which is in line with the model's predictions. A similar exercise is carried out in Mihailov, Rumler & Scharler (2011) the parameter that denotes home bias is found not to be statistically significant for many in the country sample, and regardless of the proposed econometric specification. Home bias needs therefore to be endogenous within the proposed open economy new Keynesian framework.

We propose to build a model around the new Keynesian Phillips curve that takes explicitly into account openness to trade. In this small, open emerging economy, consumers have imperfect access to all goods in the universe. Contrary to the literature, we assume there are no significant differences between domestic and foreign goods, as all available goods in the world can be produced at home. Domestic intermediate firms decide to produce a non-negative fraction of their respective goods, while consumers makeup for the shortfall with imports. Imperfect access to intermediate goods generates nominal and real frictions relevant to our paper for four main reasons. First, it establishes a direct link between openness to trade on the one hand, and CPI inflation on the other hand. Romer (1993) establishes a link between openness to trade and inflation through issues of pre-commitment on monetary policy. A large, less open economy has a greater incentive to expand, and thus to settle for a higher equilibrium rate of inflation. We use the new Keynesian model to argue that increased openness to trade reduces inflation, a continuation of some of the results put forward in Razin & Yuen (2002). A small economy fully open to trade aligns with global prices, and the domestic price index declines as a result. Domestic firms' market power is diluted due to consumers' preference for diversity and increased elasticity of substitution. Intermediate prices converge to the competitive level, which exerts downward pressure on the aggregate price level and CPI inflation. Second, in our model firms rely on labour and capital to produce their intermediate output. They face investment and capital costs of adjustment following Hayashi (1982). Wang & Wen (2010) argue that firm-

specific investment is more volatile than aggregate capital accumulation, which is evidence for the existence of installation and adjustment costs at the firm level. These real rigidities translate into a sub-optimal level of capital, and intermediate goods are not as capital-intensive as firms desire. This means openness to trade depends on firm-specific cost of adjustment, and illustrates the point made by Ireland (2001) about the relevance of capital stock with regards to interest rates in a new Keynesian model. Third, the proposed model offers a fully-fledged definition of exchange rate and trade balance variables, in contrast to the literature's reliance on national accounting identities. Our model defines both variables as an expression of the gap between available goods and prices in an imperfectly open economy, and desired levels by households in a fully open and integrated economy in global trade. We focus particularly on trade imbalances, and offer trade balance deficit decomposition between consumption and investment goods. The differences in investment and consumption trade balance dynamics illustrate the ambiguous effects openness to trade can have on small, open emerging economies. Acquisition of capital unit through investment is sustainable in the medium run, since it contributes to accumulate capital goods and stock. By contrast, a deficit mainly driven by consumption goods imports is unsustainable. Fourth, the modified new Keynesian framework allows for an enumeration of possible monetary policy instruments - alternative specifications to the Taylor (1993) monetary rule. As discussed in Romer (1993) discretionary monetary policy generates a depreciation of the real exchange rate, and expected benefits from an unanticipated monetary expansion are decreasing in openness to trade. While a monetary rule can yield superior benefits, alternative specifications have different impacts on welfare. We use Gali & Monacelli (2005) and Gali (2008) methods to assess the impact of various monetary policy rules on a small open emerging economy. They derive quantitative results using calibrated value for Canada on their model, and conclude that all their baseline calibration yields suboptimal outcomes for all proposed alternative policy regimes. They conclude that a hybrid regime of domestic inflation-targeting and pegged exchange rate yields a better outcome for the economy.

The paper is outlined as follows: the first section describes the economic functions that define agents in a small open emerging economy. It presents the new Keynesian model in its alternative specification, with imperfect access to trade and capital cost of adjustment. These elements are key in formulating a modified new Keynesian Phillips curve with openness to trade as an explicit component. In particular, it shows that the domestic bias can be endogenous and linked to firms' capital instalment schedule. The section also presents results derived for the alternative Phillips and IS curves in our modified new Keynesian model. The second section focuses on monetary policy implementation à la Gali-Monacelli. We start with a standard Taylor (1993) rule to describe the whole economy and its predictions as to how macroeconomic variables react to exogenous shocks. The section then offers three alternative monetary policy regimes: CPI and domestic CPI inflation targeting, as well as a fixed exchange-rate regime. A welfare analysis is carried out to illustrate the tradeoffs facing monetary authorities. The section also shows how openness to trade weakens the monetary policy effects on output and other real aggregates. The third section concludes.

2 The Model

The proposed model expands on the new Keynesian framework in order to formulate an alternative specification the New Phillips Curve equation. In order to do so, the model presented in this paper does away with two key components favoured in the literature: domestic bias and national accounting. In essence, we introduce two significant alterations to the new Keynesian workhorse. The first deals with domestic bias, which is endogenous in our paper and is the result of intermediate firms' optimisation schedule. The second introduces capital accumulation as a key component in accounting for trade balance and exchange rate dynamics. Thus with imperfect access to available goods worldwide and capital costs of adjustment, we show that the

tradeoff between inflation and output gap can incorporate openness to trade as well as exchange rate dynamics.

2.1 Firms

Our paper is modelled after the new Keynesian framework as presented in Ireland (2001, 2004) and Gali & Monacelli (2005). The production sector is made up of a continuum of small, intermediate firms. Each one produces a specific output denoted $C_t(i)$, and exerts monopolistic market power over its pricing. Each intermediate firm combines productivity, labour and capital in a Cobb-Douglas production function, which writes:

$$C_t(i) = Z_t N_t(i)^{1-\alpha} \left(\upsilon_t(i) K_{t-1}(i) \right)^{\alpha} \tag{1}$$

Variable $\upsilon_t(i)$ refers to capital capacity utilisation. This addition introduces more variability in capital accumulation, and thus has an impact on the firm's cost structure. At the aggregate level, more variable capital, coupled with costs of adjustment, is bound to have an impact on the output gap. Contrary to the Gali-Monacelli model, we assume domestic firms can produce all available intermediate goods in the global market. These firms decide to produce a portion of their intermediate good, where $\mu_t(i)$ denotes the domestic bias. A small value for $\mu_t(i)$ means that good i is not fully produced at home, and therefore has to be imported. The domestic bias in essence works against those intermediate goods with a low $\mu_t(i)$. All intermediate consumption goods are consolidated in a Dixit-Stiglitz (1977) consumption index, which writes;

$$C_t = \left[\int_0^1 \mu_t(i) C_t(i)^{\frac{\theta_t - 1}{\mu_t(i)\theta_t}} \, di \right]^{\frac{\theta_t}{\theta_t - 1}} \tag{2}$$

θ_t refers to a time-varying elasticity of substitution between intermediate goods. The Dixit-Stiglitz provides a framework where intermediate goods are imperfect substitute, hence the existence of price-setting firms. For $\lim \mu_t(i) \to 0$ then intermediate good i is not produced at home, and consumers need to import it. Consumers seek to minimise the distance between the aggregate nominal value of the consumption bundle and the nominal cost of all intermediate goods. Firms face a consumer demand that writes thus:

$$\min_{C_t(i)} P_t C_t - \int_0^1 P_t(i) C_t(i) di \tag{3}$$

$$C_t(i) = \left(\frac{P_t(i)}{P_t} \right)^{\frac{\mu_t(i)\theta_t}{\theta_t - 1 - \mu_t(i)\theta_t}} C^{\frac{\mu_t(i)}{1 + \mu_t(i)\theta_t - \theta_t}} \tag{4}$$

Where $P_t(i)$ and P_t refer respectively to intermediate and index prices. Note that if $\mu_t(i) = 1$ intermediate demand reverts to standard form. Given each firm's individual profit-making schedule, optimal pricing under flexible pricing writes:

$$\max_{C_t(i)} D_t(i) = P_t(i) C_t(i) - TC_t(i) \tag{5}$$

$$P_t(i) = \mu_t(i) \frac{\theta_t}{\theta_t - 1} MC_t(i) \tag{6}$$

Equation (6) shows that intermediate firms set their prices equal to their marginal cost, augmented with their markup, as captured by consumers' elasticity of substitution θ_t.

Furthermore intermediate firms 'markup is also a function of their respective openness to trade. As $\mu_t(i)$ gets closer to unity, the intermediate firm is fully open to trade, and thus faces little competition from foreign, imported goods. Conversely, an autarkic firm faces a strong competition from imported goods, and given consumers' preferences for diversity, that firm needs to reduce its price. In this framework therefore, firms fully integrated in global trade need not adjust their prices downward because they are already in line with global prices.

Intermediate demand described in equation (4) is key to the model laid out in this section. It describes the quantity of consumptions goods expressed by households given the degree of openness to trade (or alternatively, domestic bias). This means households express their preferences on two levels: the amount of consumption goods available on the domestic market, and an ideal consumption bundle were the economy to be fully integrated in global trade markets. We define trade variables as the shortfall between those two states: for differences in consumption units, we formulate a trade balance variable. As for differences in relative prices for the same good, the real exchange rate is introduced thus in our model.

2.2 Trade Balance

The literature treats the trade balance as a national accounting identity, and Gali & Monacelli (2005) proceed in a similar fashion, denoting the trade balance in their model as net exports. Their model defines the trade balance as the difference between domestic production and household expenditure, relative to the latter. We present an alternative specification to trade balance within the model. Similar to the Gali-Monacelli setup, the trade balance in our model is influenced by terms of trade or the real exchange rate - but it incorporates domestic bias as a variable, rather than a parameter. The proposed definition for the trade balance proceeds in two steps. First, we look at the amount of consumption good households import in order to make up for the domestic bias. Second, we also account for investment flows intermediate firms require in order to produce capital-intensive goods. The trade balance for a given intermediate good denotes the difference between the quantity desired by the consumer, denoted $C_t^\star(i)$ and what is available to them in the domestic market $C_t(i)$. Equation (4) is re-written in two stages: first, we compare it with its alternative when intermediate good i is fully produced at home. Second, we re-write the imperfect openness intermediate demand as function of the standard, new Keynesian equation. The expression writes:

$$C_t(i) = \left(\frac{P_t(i)}{P_t}\right)^{\frac{\mu_t(i)\theta_t}{\theta_t - 1 - \mu_t(i)\theta_t}} C^{\frac{\mu_t(i)}{1 + \mu_t(i)\theta_t - \theta_t}} \tag{7}$$

$$C_t^\star(i) = \left(\frac{P_t(i)}{P_t}\right)^{-\theta_t} C_t \tag{8}$$

$$C_t^\star(i) = C_t(i)^{\frac{1 + \mu_t(i)\theta_t - \theta_t}{\mu_t(i)}} \tag{9}$$

Second, the consumer seeks to reduces the gap between the nominal cost of its intermediate good expenditure under the two regimes. That is, consumers seek to reduce the gap between the quantities available in the current state, and the scenario where the intermediate good is fully produced at home. The minimisation problem writes:

$$\min_{C_t(i)} \mathfrak{L}\left[P_t^\star(i)C_t^\star(i) - \frac{\theta_t}{\theta_t - 1}P_t(i)C_t(i)\right] \tag{10}$$

The trade balance for consumer good $C_t(i)$ writes:

$$TB_t^C(i) = \frac{P_t(i)}{P_t^\star(i)}\left[\frac{(\theta_t - 1)(1 - \theta_t + \mu_t(i)\theta_t)}{\mu_t(i)\theta_t}\right] \tag{11}$$

Equation (11) writes an intermediate good-specific trade balance as a function of its openness to trade (or domestic bias) elasticity of substitution, and the *intrinsic exchange rate* for the same good between existent openness to trade and full integration regimes. This is different from the *bilateral exchange rate* in the sense that our model defines the real exchange rate as the gap between domestic and foreign prices for the same good. A small domestic bias - alternatively, a large $\mu_t(i)$ means that consumers need not import intermediate goods to supplement their aggregate consumption index. Therefore, trade balance deficit would be low to nonexistent if it is fully integrated in global trade. We depict on figure 1 the relationship between openness to trade and good-specific trade balance as reported in equation (11).
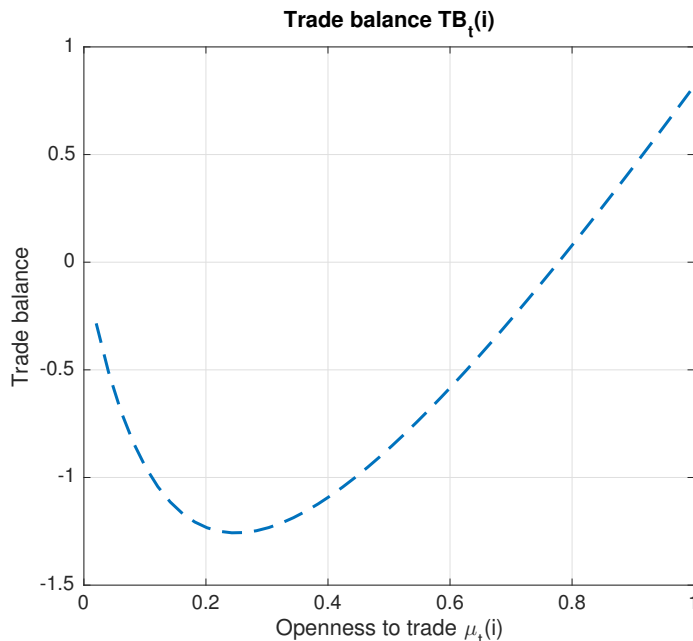

Figure 1: Trade balance deficit and openness to trade: consumption goods

Figure 1 depicts a U-shaped relationship between openness to trade and trade balance. When an intermediate good is unavailable in the domestic market, households need to import it to satisfy their consumption. In this model, goods with a high domestic bias (or low $\mu_t(i)$) generate a trade balance deficit, given the imperfect access in the domestic market. It also shows however that when trade openness increases, trade balance deficit initially deteriorates, and then subsides. Recall that households value diversity. This means that when additional goods become available on the domestic market, consumers start shifting their demand on to new, rarer goods. This widens the trade balance deficit, up to a point. When it reaches its nadir, the trade balance deficit starts to contract, thanks to the substitution effect. Households shed their dependance on imports to satiate their desire for diversity, as more goods are now available on domestic markets. The aggregate consumption goods trade balance writes thus:

$$TB_t^C = \int_0^1 \mu_t(i) TB_t^C(i) di \tag{12}$$

So far we have focused on consumption because the new Keynesian model workhorse in the literature precludes the existence of capital markets. Recall that intermediate firms combine capital and labour to produce their goods. In our model, openness to trade is determined by capital accumulation tradeoffs at the firm level. If the domestic market is unable to satisfy their requirements, they turn to the rest of the world, and import capital in order to supplement their investment schedule.

2.3 Investment

Each individual intermediate firm seeks to maximise its lifetime value subject to capital accumulation and costs of adjustment. We adapt the Hayashi (1982) framework in order to introduce costs of adjustment due to openness to trade, and the optimisation programme writes:

$$\max \mathbb{V} : \mathbb{E} \sum_{t=0}^{\infty} \beta^t \left[D_t(i) - I_t(i) - \frac{\phi_k}{2} \left(\frac{I_t(i)}{K_{t-1}(i)} - \delta_t(i) \right)^2 - \mu_t(i)\phi_\mu \left(\frac{I_t(i)}{I_{t-1}(i)} - 1 \right) I_{t-1}(i) \right] \quad (13)$$

$$K_t(i) = [1 - \delta_t(i)] K_{t-1}(i) + I_t(i) \quad (14)$$

5　　The firm maximises equation (13) subject to the capital accumulation law of motion equation (14). Thus it means the firm seeks to maximise the discounted flows of net value from its profits $D_t(i)$ net of investment, cost of investment, and cost of investment due to trade exposure, which follows properties laid out in Turnovsky (2000). The model also incorporates capital adjustment costs as a function of the change in investment per Smets & Wouters (2007). First order conditions allow us to derive the dynamic properties to openness to trade at the firm level, which write:

$$\mu_t(i) = \beta \mathbb{E}\mu_{t+1}(i) \frac{\mathbb{E}I_{t+1}(i)}{I_t(i)} + \frac{q_t - 1}{\phi_\mu} - \frac{\phi_k}{\phi_\mu} \left(\frac{I_t(i)}{K_{t-1}(i)} - \delta_t(i) \right) \quad (15)$$

Equation (15) is a critical component in this model. The literature treats the domestic bias as a fixed, structural parameter. In this model however, it is a variable endogenous to each domestic firm. Present openness to trade writes as the discounted, expected value of future openness to trade, increased with the value of an additional unit of capita net of costs of adjustment. In other terms, equation (15) means that present openness to trade increases in expected benefits from future exposure to trade, as well as present marginal value of capital (Tobin's Q) net of costs of adjustments captured by $\phi_{k,\mu}(.)$. This means the domestic bias is inversely related to capital intensity in intermediate goods. We derive first order conditions for capital in order describe the dynamics of Tobin's Q. The result writes:

$$q_t = \beta \mathbb{E} \left[(1 - \delta_{t+1}(i)) q_{t+1} + \frac{\partial D_{t+1}(i)}{\partial K_t(i)} - \frac{\partial \phi_{kt+1}(i)}{\partial K_t(i)} \right] \quad (16)$$

$$q_t = \mathbb{E}\psi_{t+1}(i)q_{t+1} \quad (17)$$

Equation (17) represents the equivalent of the Euler equation for a firm. Present capital value is equal to the discounted value of future capital valuation net of depreciation, increased with capital benefits to profits net of costs of adjustment. Caballero (1997) posits the q-value is proportional to investment, so both equations (15) and (17) can be combined to yield the following expression:

$$\mu_t(i) = \frac{\mathbb{E}\mu_{t+1}(i)}{\mathbb{E}\psi_{t+1}(i)} + \frac{q_t - 1}{\phi_\mu} - \frac{\phi_k}{\phi_\mu} \left(\frac{I_t(i)}{K_{t-1}(i)} - \delta_t(i) \right) \quad (18)$$

Equation (18) is a neater expression for trade openness dynamics. It expresses present openness to trade as a function of its expected future value *relative* to its net benefit, augmented with present benefit of the q-value net of costs of adjustment.

　　Investment trade balance is defined in a manner similar to that of consumption goods. Intermediate firms may need to import more capital than available on domestic markets, or they may scale back their investment schedule in the face of costs of adjustment to global trade. We thus define investment goods trade balance as the gap between effective and optimal, cost-free level of investment. In order to do so, we re-arrange terms in equation (18) and express

investment as a function of other variables. Investment writes thus as a fraction of capital that incorporates depreciation and the q-value, as well as net future benefit from openness to trade.

$$I_t(i) = K_{t-1}(i) \left[\delta_t(i) + \frac{q_t - 1}{\phi_k} + \frac{\phi_\mu}{\phi_k} \left(\frac{\mathbb{E}\mu_{t+1}(i)}{\mathbb{E}\psi_{t+1}(i)} - \mu_t(i) \right) \right] \tag{19}$$

$$I_t(i)^\star = K_{t-1}(i) \left[\delta_t(i) + \frac{q_t - 1}{\phi_k} \right] \tag{20}$$

Equation (20) is a special case of equation (19), where $\phi_\mu = 0$ meaning there are no cost of adjustment due to openness to trade. Investment trade balance is thus a function of net benefits
5 to future instalments of capital units, and the expression writes:

$$TB_t^I(i) = I_t(i) - I_t(i)^\star \tag{21}$$

$$TB_t^I(i) = \frac{\phi_\mu}{\phi_k} K_{t-1}(i) \left[\frac{\mathbb{E}\mu_{t+1}(i)}{\mathbb{E}\psi_{t+1}(i)} - \mu_t(i) \right] \tag{22}$$

Equation (22) describes investment trade balance as the growth differential in expected openness to trade, expressed in units of capital stock. The proposed micro-founded trade balance variable sums over consumption and investment goods. Imperfect openness to trade compels consumers to import fractions of intermediate goods in order to complete their consumption
10 bundle. Firms import capital units in order to supplement their investment schedule. A trade balance deficit thus differentiates between consumption and investment, and yields interesting results in terms of its sustainability. An investment-driven deficit is bound to be sustainable, since it means the small, open emerging economy imports capital units to expand its production capacity. It also means that a more capital-intensive production would satisfy domestic demand,
15 and thus reduce its reliance on imported goods. On the other hand, if the deficit is consumption-driven, it means domestic production is unable to keep up with aggregate demand, which is not sustainable in any form.

Results reported above seek to provide the working elements of the new Keynesian model adapted to a small, open emerging economy. It introduces imperfect competition in order to
20 endow intermediate firms with price-setting market power. It also formulates costs of adjustment in order to introduce real rigidities needed to provide the alternative Phillips curve, which will show openness to trade and capital cost of adjustment as vehicles of additional dynamics.

2.4 Pricing & Phillips Curve

As mentioned before, the new Keynesian workhorse model makes use of imperfect competi-
25 tion and price sluggishness in order to introduce nominal rigidities in a general equilibrium model, and thus offers a micro-founded framework to the Phillips curve. We focus on a purely forward-looking specification of the Phillips equation, contrary to the Fuhrer & Moore (1995) specification with lagged past inflation. Ireland (2001) estimates the structural parameters in his new Keynesian model, and finds the attached coefficient to past inflation to be statistically
30 not significant. It is also more rigorous to assume that agents do not take into account lagged values in their inflation/output gap tradeoff. This choice can be further justified by the fact that inflation persistence can be replicated thanks to real rigidities, thus providing a more consistent theoretical background.

In order to build our alternative Phillips curve, we choose to implement the cost of adjustment
35 mechanism devised by Rotemberg (1982) and as presented in Bénassy (2001). It is preferable to the more mainstream Calvo (1983) partial indexation mechanism for two main reasons. First, although there are similarities to both, higher orders of approximation yield differentiated impacts on welfare. Lombardo & Vestin (2008) argue that the Rotemberg mechanism entails real

costs to changing prices, whereas Calvo assumes firms set re-set their prices randomly. The Rotemberg mechanism thus is more apropos, given the fact that when a shock occurs, agents increase their expenditure of scarce resources, which reduces social welfare. Second, there are significant differences in mean duration for CPI price changes between emerging and developed economies. Klelow & Malin (2010) use microeconomic studies to show that the degree of price stickiness varies within their selected sample, where European and US economies tend to have more stable prices than those labelled high-inflation, emerging economies. We posit that market structures in emerging economies are such that firms are not faced with a random adjustment of prices, but rather deal with a cost to updating their prices. Therefore, the lifetime penalty for changing logged prices for the firm writes:

$$\min_{p_t(i)} \mathbb{E} \sum_{t=0}^{\infty} \beta^t \left[\frac{\phi_1}{2} \left(p_t(i) - \bar{p}_t(i) \right)^2 + \frac{\phi_2}{2} \left(p_t(i) - p_{t-1}(i) \right)^2 \right] \tag{23}$$

The individual firm incurs costs over time for two component. The first is the penalty for deviating from the socially desirable price level, that is, the flexible pricing setup and optimal capacity utilisation per equation (1). The second component describes the cost incurred by the firm when it seeks to change its price from one period to the other. Minimisation of equation (23) with respect to $\pi_t(i)$ yields:

$$\pi_t(i) = \beta \mathbb{E} \pi_{t+1}(i) - \frac{\phi_1}{\phi_2} \left[\mu_t(i) + \theta_t - o(\upsilon_t(i)) \right] \tag{24}$$

Where $P_t(i)$ and $o(\upsilon_t(i))$ are the firm-specific inflation rate and capacity utilisation, respectively. Equation (24) describes a firm-specific, forward-looking Phillips Curve augmented with an openness to trade component. In order to consolidate these curves into an aggregate Phillips Curve, we define the inflation rate as a weighted sum of firm-specific inflation rates with their respective openness to trade, namely:

$$\pi_t = \int_0^1 \mu_t(i) \pi_t(i) di \tag{25}$$

The new Keynesian Phillips Curve augmented with openness to trade writes thus:

$$\pi_t = \beta \mathbb{E} \pi_{t+1} - \beta \mathbb{E} \pi_{t+1} \left(\frac{\mathbb{E} \psi_{t+1} - 1}{\mathbb{E} \psi_{t+1}} \right) - \frac{\phi_1}{\phi_2} \left[\mu_t + \theta_t - o(\upsilon_t) \right] \tag{26}$$

This alternative Phillips curve is different from the standard specification and that offered in the Gali-Monacelli on several aspects. First, the domestic bias is no longer constant and is endogenous. Openness to trade shows clearly to exercise downward pressure on inflation. Second, thanks to real capital costs of adjustment, the proposed Phillips curve introduces real rigidities and can adequately capture the counter-intuitive impact of an inflationary increase in interest rates, as discussed in Christiano & al (2010). An increase in nominal interest rates may bring about a decline in future net capital benefits, and thus increasing costs. Firms will then pass these additional costs on their prices, hence generating more inflation. In the open economy setting, these dynamics make sense: at the firm level, production of less capital-intensive goods means a more autarkic domestic production. At the aggregate level, an increase in nominal interest rates compels individual firms to reduce the size of their respective capital instalments. Since they cannot instantaneously adjust their capital stock due to costs of adjustment, they pass on the expenditure to their marginal cost and prices.

Given the production function used by individual firms in equation (1), the minimisation of production costs writes:

$$\frac{R_t K_{t-1}(i)}{W_t N_t(i)} = \frac{\alpha}{1-\alpha} \upsilon_t(i) \tag{27}$$

What differentiates firms in terms of cost structure is their respective capital utilisation, as well as the firm-specific output gap. The flexible pricing formula in equation (6) writes thus:

$$P_t(i) = \mu_t(i) \frac{\theta_t}{\theta_t - 1} \frac{W_t^{1-\alpha} R_t^{\alpha}}{(1-\alpha) Z_t} \left(\frac{1-\alpha}{\alpha v_t(i)} \right)^{\alpha} \tag{28}$$

Equation (28) shows up on the new Keynesian Phillips Curve with openness to trade, cost-push and output gap, expressed in terms of capital utilisation.

5   Equation (26) shows an alternative specification to the New Keynesian Phillips Curve. We have introduced an explicit component that seeks to capture the effects of openness to trade in determining inflation. Openness to trade in our model is the outcome of a tradeoff between investing in capital on the one hand, and expected benefits net of costs of adjustment. Following a similar argument in Christiano & *al.* (2010) an increase in nominal interest rates, designed to
10   reduce inflation, may have the opposite effect. Firms face costs of adjustment in their investment schedule. As a result of the Hayashi mechanism, firms pass on capital costs of adjustment to their marginal cost, and thus generate inflation.

     This section has been dedicated to formulate an alternative new Keynesian Phillips curve. It incorporates openness to trade as well as real rigidities that can adequately replicate the effects
15   of increased integration in global trade on the one hand, and inefficient capital utilisation. We also provide a micro-founded framework for the trade balance on consumption and investment goods. The second component to the new Keynesian synthesis is the IS-equation, which combines production capacity with real expected interest rates. In the section below we proceed in a similar fashion in formulating a micro-founded IS equation with explicit additional components
20   of global trade.

2.5   Consumers and IS equation.

We follow Ireland (2001) and McCallum & Nelson (1999) in their attempt to conciliate the standard Keynesian model with a general equilibrium setting. Given the fact that the IS-equation represents aggregate demand's sensitivity to real interest rates, it makes sense to use
25   the representative household's utility function, which combines consumption, real balance, and labour, respectively. The lifetime utility function writes:

$$U(.) = \mathbb{E} \sum_{t=0}^{\infty} \beta^t \left[A_t \frac{C_t^{1-\sigma}}{1-\sigma} + V_0 \frac{(M_t/P_t)^{1-\gamma}}{1-\gamma} - \frac{N_t^{1+\varphi}}{1+\varphi} \right] \tag{29}$$

A_t is a demand shock, defined as follows:

$$a_t = \ln A_t \Rightarrow a_t = \rho_a a_{t-1} + \epsilon_t^a \tag{30}$$

Households seek to maximise their utility function in equation (29) subject to their budget resources:

$$P_t C_t + Q_t B_t \leq B_{t-1} + W_t N_t \tag{31}$$

30   Consumption is valued at aggregate price P_t which combines domestic and imported goods. First order conditions yield the log-linearized Euler equation, which writes:

$$c_t = \mathbb{E} c_{t+1} - \frac{1}{\sigma} \left(i_t - \mathbb{E} \pi_{t-1}^{\star} + \ln \beta \right) + \frac{1 - \rho_A}{\sigma} a_t \tag{32}$$

Equation (32) rewrites the standard Euler equation in log-linear form. It is the basis for the new Keynesian IS equation, and will show the standard components of output gap, domestic inflation and the real exchange rate, following Gali & Monacelli (2005). In order to introduce

the output gap component in the Euler equation, we follow Ireland (2001) and Christiano & al. (2010) in their treatment of steady-state allocations in the small emerging economy as a social welfare optimisation problem. It is assumed the social planner allocates resources efficiently with no monopoly or market power over intermediate goods, and solves for the following problem:

$$\max \mathbb{E} \sum_{t=0}^{\infty} \beta^t \left[A_t \frac{C_t^{1-\sigma}}{1-\sigma} - \frac{N_t^{1+\varphi}}{1+\varphi} \right] \tag{33}$$

subject to:

$$\frac{C_t + I_t}{Z_t} = N_t^{1-\alpha} (\upsilon_t K_{t-1})^{\alpha} \tag{34}$$

Consumption and investment are expressed relative productivity, in order to represent constant fractions of output, per Christiano & al (2010). These variables are re-arranged in order to simplify computations and come up with the socially desirable output level. The natural level of logged consumption writes:

$$\bar{y}_t = \psi_0 + \psi_a a_t + \psi_z z_t + \psi_k k_{t-1} \tag{35}$$

where all ψ_x for $x \in [a, z, k]$ are non-negative. Given the definition of the output gap as the difference between actual and socially desirable levels of production, the IS equation writes:

$$\tilde{o}_t = \mathbb{E}\tilde{o}_{t+1} - \frac{1}{\sigma} \left(i_t - \mathbb{E}\pi_{t+1}^{\star} + \ln \beta \right) + \varphi_a a_t + \varphi_z z_t + \varphi_k \Delta k_t \tag{36}$$

Where $\tilde{o}_t$ denotes the output gap, and Δk_t capital growth rate. Recall the total consumption expenditure by households comprises goods that are imperfectly opened to trade, and the shortfall is made up of imported quantities. We thus need to rewrite the IS equation in an open economy, where output gap is function of domestic inflation. We establish the relationship between the two measures of CPI inflation as follows:

$$\pi_t = \pi_t^{\star} + (1 - \mu_t) \left(\frac{\theta_t - 1}{\theta_t} \right) c_t - \psi_t e_{t-1} \tag{37}$$

Equation (37) illustrates the dynamics described in the section earlier. Domestic inflation π_t is decreasing in aggregate openness to trade, captured by μ_t. The relationship between the two variables is indirect, as openness to trade affects aggregate consumption thanks to increased variety in intermediate goods, as well as elasticity of substitution. A fully integrated economy in global trade synchronises its inflation worldwide, and we get $\pi_t = \pi_t^{\star}$. Imperfect access to foreign goods has an impact on domestic prices as well, which generates exchange rate dynamics. Equation (37) shows that the effect of the latter is lagged, which is due to costs of adjustment discussed earlier in equation (23).

This section has been devoted to formulating an alternative new Keynesian framework, where trade dynamics are explicitly incorporated in the Phillips curve and IS equations. The same micro-founded framework also allows us to formulate an alternative specification to the trade balance, as well as the dynamics between domestic and worldwide inflation on the one hand, and the real exchange rate on the other hand. As mentioned before, an economy defined by imperfect competition and sluggish prices produces sub-optimal levels of output, and so monetary policy is likely to have a real effect on output. Following the Gali-Monacelli model, we compare the welfare implications of three monetary policy regimes: two Taylor rules with domestic and CPI inflation, as well as a policy regime where the exchange rate is pegged.

3 Monetary policy regimes

As mentioned earlier, the model describes a small, open emerging economy where individual firms exert monopoly power over their intermediate goods, and face price costs of adjustment. Households also have an imperfect access to all available goods worldwide, and resort to import some of these to supplement their aggregate consumption bundle. The combined effects of monopolistic competition and imperfect access to intermediate goods generate output below its optimal level, and given sluggish price adjustment, monetary policy has an impact on real variables. Therefore, given the existence of market power distortions in the model, optimal monetary policy can replicate the flexible price equilibrium allocation, following Rotemberg & Woodford (1999) and Gali & Monacelli (2005). Monetary policy in an open economy can also be subject to foreign distortion sources, per Obstfeld & Rogoff (1995). We focus on the dynamic effects of changes in nominal interest rates on model variables. We propose a simple Taylor (1993) rule to depict monetary policymakers' preferences over output gap and inflation as a first step to complete the model and describe the model's dynamics.

We use the specification provided by Ireland (2004) and the policy rate writes:

$$r_t = \rho_r r_{t-1} + \rho_\pi \pi_t^\star + \rho_o \tilde{o}_t + \epsilon_t^r \tag{38}$$

The proposed Taylor rule displays standard components encountered in the literature. In this case, the policy rate is affected by its lagged value in order to smooth it over time, as well as inflation, the output gap and monetary shocks. The model is simulated in order to provide a first overview of its predictions. We focus first on CPI inflation and aggregate trade balance and their respective responses to exogenous shocks stemming from productivity, openness to trade and the policy rate over a period of forty quarters.
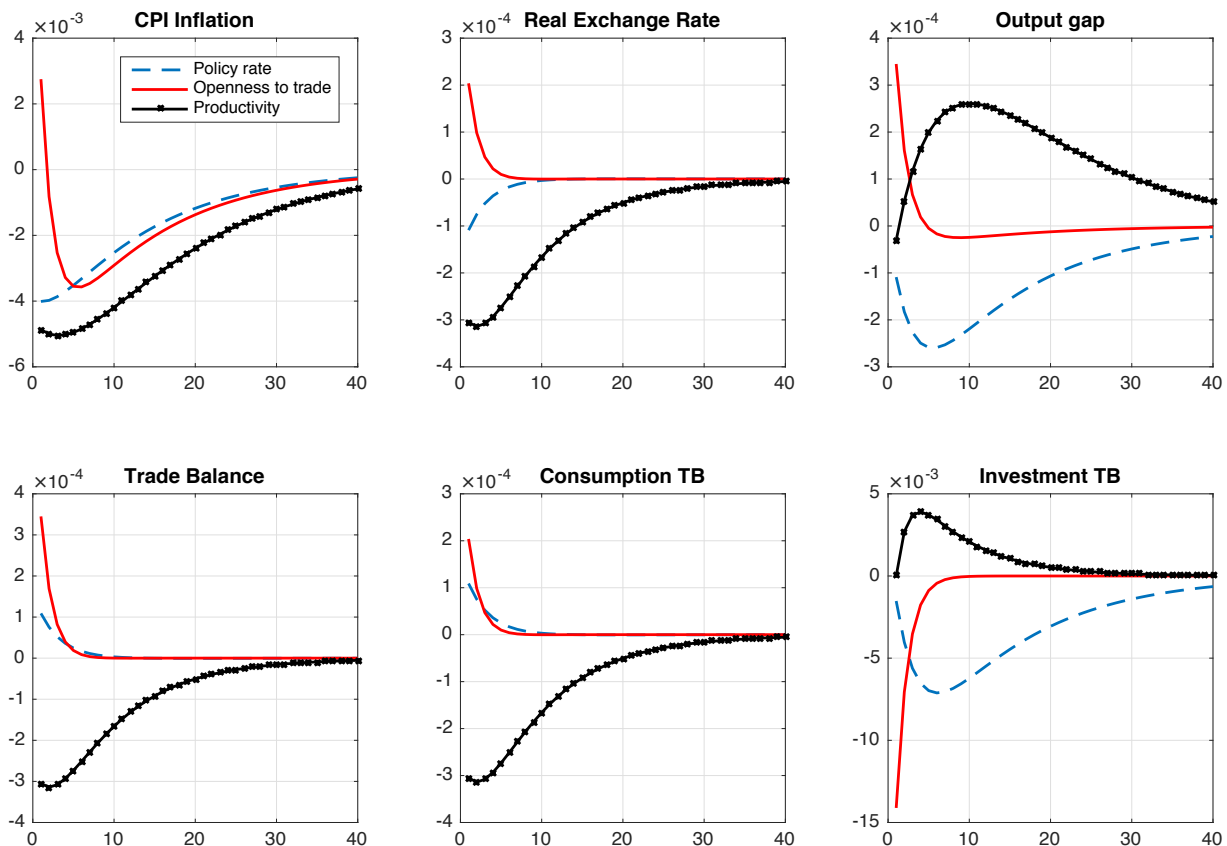

Figure 2: CPI, output gap and trade variables: IRF to exogenous shocks.

We report the impulse response functions for six variables in order model to three exogenous shocks in figure 2. We focus on productivity, openness to trade and policy rate shocks as exogenous sources of disturbance. Given the fact that we are interested in monetary policy in an open economy environment, we have selected inflation, exchange rate, output gap and three
5   measures for the trade balance. The top left panel in figure 2 reports CPI inflation response to the three exogenous shocks. Impulse response to the policy rate and productivity is a standard result frequently encountered in the new Keynesian literature. The policy rate shock in particular shows that inflation is quite responsive to an increase in interest rate, which operates through the IS equation of our model. The effects of a temporary increase in productivity conform
10 with the literature's findings, since firms reduce their prices as they produce cheaper goods. Another way to look at it is to consider the natural level of output to be that of the flexible prices regime, or the RBC level of output. A temporary increase in productivity pushes the natural level of output higher, resulting in a negative output gap. Indeed, firms cannot adjust their effective level of production contemporaneously to the natural level, thus producing at a
15 sub-optimal level. Given the specification of the Phillips curve, inflation is bound to go down. Yet contrary to the policy rate shock, there is no adverse impact on production or consumption variables, since the productivity shock pushes up the production boundary. In comparison to the policy rate and productivity shocks however, CPI inflation behaviour *vis-à-vis* openness to trade is more ambiguous. An intuitive prediction would be that prices go down when more
20 goods are produced in the domestic market. However, recall that autarkic firms are pressured into practising low prices because of competition from imported goods. When more intermediate firms open themselves to global trade, they can adjust their prices to the world level, and that means lower competition and higher prices. The model prediction offers a mixture of these two results; after a temporary shock, CPI increases in the first period, but then reverses quickly and
25 converges to its steady-state. Overall, the cumulative impact of increased openness to trade has a negative impact on CPI inflation, which means that eventually, the first prediction stands. The model account for the second prediction as prices briefly increase in the initial period, as firms increase their prices to match the worldwide price level. New available goods respond to consumers' preference for diversity, which drives prices down. Notice however that if all firms
30 become fully open to global trade, production converges to the socially desirable level, and output steady-state increases such that monetary policy may lose its effectiveness.

     The bottom row panel in figure 2 describes trade balance dynamics with respect to the same three exogenous shocks for consumption, investment and aggregate trade balance variables. We have elaborated in the introduction on the relevance of a trade balance decomposition
35 between imported consumption goods and investment capital units. A temporary increase in productivity has a negative impact on the trade balance, meaning that it generates a deficit. This is due to the fact that consumption trade balance deficit dominates over investment. Thus productivity shocks generate a substantial trade deficit, a result that has been documented well in the RBC-based literature, such as Aguiar & Gopinath (2007), as well as Garcia-Cicco, Pancrazi
40 & Uribe (2010). The common wisdom in the RBC literature is that exogenous shocks can be consolidated into trend productivity, which is key to account for excessive consumption volatility relative to output, and counter-cyclical trade balance. The difference with the RBC literature however is that our model does not rely on shocks to trend productivity in order to account for this stylised fact. Indeed, our model makes use of households' preference for diversity to
45 account for their increased demand for imported goods. As the economy grows more productive, households increase their consumption, including imported goods. Their consumption pattern changes outweigh the productivity impact on output, hence the widening trade balance deficit. Investment's reaction to productivity shocks is the opposite, though. A temporary increase in productivity means that capital units become more productive, and firms are less reliant on
50 additional units of capital to sustain their production. As a result, they import fewer units of capital, or investment, hence an improved trade balance. However these dynamics are not

large enough to affect the aggregate trade balance, which can be partially accounted for with consumers' elasticity of inter-temporal substitution. Openness to trade shocks generate the opposite effects, with widening investment trade balance deficits and increasing consumption trade balance surpluses. As mentioned before, increased openness to trade is linked to firms'
5 increased reliance on capital unit for their production schedule. An exogenous shock of that nature creates an incentive for individual firms to increase their instalments of capital units, and thus increase their demand for foreign investment. This generates a trade deficit. Consumption benefits differently from a trade shock: consumers have a wider access to diversified goods on the domestic market, so they come to rely less on imported goods. Again, consumption behaviour
10 dominates and the aggregate trade balance tends to replicate its impulse response. Notice however that investment is significantly more sensitive to openness to trade than productivity shocks. That is so because our model postulates that firms decide to open to trade when they are capital-intensive. For the third source of exogenous shocks on trade balance variables,we look at the effect of policy rate shocks. As mentioned above, CPI inflation is brought drown
15 with increased interest rate thanks to households' reduction of consumption. This is readily verifiable in consumption good trade balance, as it improves after a policy rate shock. Notice however that the same policy rate shock generates an investment trade balance deficit. This is due to the combined factors of shifting resources from consumption to savings due to increasing interest rates, as well as flows of imported investment capital units.

20   The new Keynesian model posits that production can be sub-optimal because of imperfect competition, and in our model, imperfect openness to trade. A fully integrated economy in the global trade is one where all intermediate firms produce goods available elsewhere in the rest of the world, that is, in a fully flexible price setting. Output will therefore be at variance with its optimal level, hence our interest in the output gap variable. The middle top panel describes
25 the effects of exogenous shocks on the output gap. The policy rate shock generates a negative output gap, which is due to the contraction in household expenditure, a standard result in the new Keynesian literature. As monetary authorities increase the policy rate, households shift their consumption into the future, hence driving aggregate demand down. As a result, production is below its natural level, hence the negative output gap reported in figure 2. Openness to trade
30 generates a positive output gap, that is, production is above its natural level, thanks to firms' changing production schedule. Increased openness to trade means that individual firms have more incentives to produce goods that were only available abroad. Therefore output increases above its natural level, which is indeed the case given the fact that openness to trade does not feature in equation (35). The shock effect quickly dissipates as production converges quickly to
35 its steady-state.

     The model proposed a micro-founded framework for the trade balance as well as the real exchange rate. The middle top panel reports that variable's reaction to exogenous shocks. As mentioned before, increasing productivity brings down prices for domestic goods. This means *ceteris paribus* exported goods - valued at local prices- become less expensive, and thus the
40 exchange rate depreciates. The small emerging economy becomes more productive, and thus catches up with the rest of the world, its domestic production becomes less expensive, and thus improves its competitiveness. It is also worth pointing out that the disturbance generated by a productivity shock is quick persistent. A similar effect is also observed after a policy rate shock, where the exchange rate also depreciates, though not as much as it does with the productivity
45 shock, nor as persistent. Increasing interest rates discourage consumption, and that include consumption of domestic goods. Declining aggregate demand prompt domestic firms to lower their prices, which means that domestic goods become cheaper relative to imported ones, hence the depreciation in the exchange rate. In contrast to productivity shocks, the policy rate effects dissipates quite quickly. Finally, the effects of openness to trade are to the opposite of those
50 discussed earlier. Increased openness to trade means that firms are no longer under competition from imported goods, and can thus increase their prices to match worldwide price levels. This

means that increased integration in global trade will generate an appreciation in the exchange rate, as domestic and global prices converge in the small open emerging economy we study.

The results reported and discussed in figure (2) show that as far as the selected three exogenous shocks are concerned, the model is a cogent fit for the literature on macroeconomic fluctuations in emerging economies. The proposed model is able to replicate the RBC-based predictions that productivity shocks generate trade balance deficits without resorting to the trend shock hypothesis. Our model has also provided a complement of predictions for nominal variables, as well as a preview of how monetary policy regimes can achieve their aims. We can now proceed and look at the welfare implications of various monetary policy regimes, and compare them against what policymakers seek to achieve.

3.1 Welfare losses - monetary policy regimes

Monetary policymakers can generate different results depending on which policy rule they favour. in Gali & Monacelli (2005) monetary policy is carried out with respect to the cost of deviation from the steady state. We restrict our attention to a few policy regimes and expound on their respective impact on inflation, output gap and the trade balance. In addition to the standard Taylor rule proposed in equation (38), we propose two alternative policy regimes: a CPI inflation-only targeting rule, and a pegged exchange rate. In this section, the model is run twice with those two policy regimes, and we compare the effects of productivity shocks on CPI inflation, output gap and the aggregate trade balance. The three rules write thus:

$$r_t = \rho_r r_{t-1} + \rho_\pi \pi_t^\star + \rho_o \tilde{o}_t + \epsilon_t^r \tag{39}$$

$$r_t = \rho_r r_{t-1} + \rho_\pi \pi_t + \epsilon_t^r \tag{40}$$

$$e_t = 0 \tag{41}$$

The model is run with the three policy rules, and impulse responses to productivity shocks for the three selected variables are reported in figure 3 below:
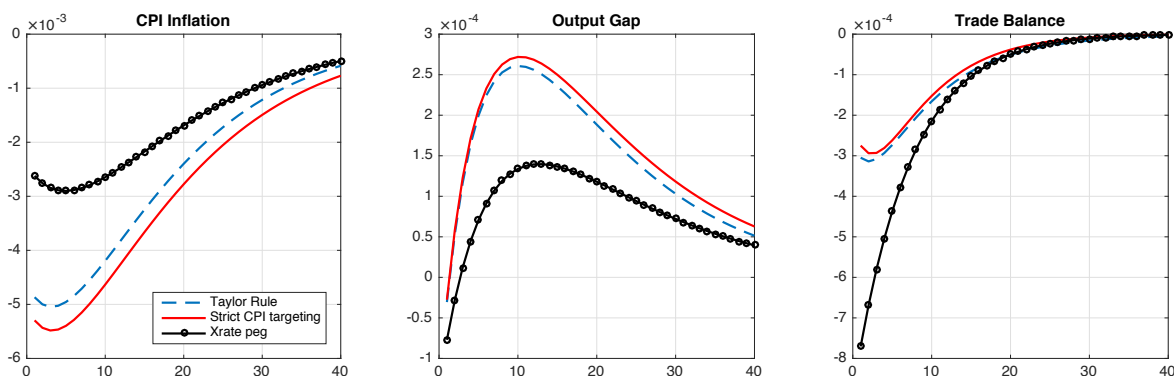

Figure 3: Impulse response to productivity shocks under alternative monetary policy rules.

Both rules (39) and (40) yield substantially similar outcomes. Depending on whether the output gap is included in the rule, variable reactions to a technology shock does not differ much. Under CPI-based rules, all three variables are more sensitive to real shocks under the strict CPI targeting regime in comparison to the standard Taylor rule. On the other hand, the fixed exchange rate regime shows that a real shock does not have that much of an impact on CPI inflation and the output gap. Conversely, productivity shocks generate a larger, more significant trade balance deficit.

4 Conclusions

In dealing with macroeconomic fluctuations in a small, open emerging economy, the literature has displayed some shortcomings. The literature holds two opposite views with respect to open macroeconomics: one is built on inter-temporal optimisation that is the RBC model, the second is built around the Obstfeld-Rogoff framework. The literature posits that fluctuations in emerging economies are generated by shocks to trend productivity, which is the case in Aguiar & Gopinath (2007), and Garcia-Cicco, Pancrazi & Uribe (2010). Within the RBC framework, this assumption is needed in order to induce a consumption pattern among households. When a shock to trend productivity occurs, households anticipate a permanent increase in their flow of future income, and thus increase their present consumption. In the context of an open economy, a productivity shock generates a trade balance deficit. The shortcomings of the RBC framework are well-documented, in particular in terms of macroeconomic policy. On the other side of the literature, Obstfeld & Rogoff (1995) are more interested in channels of transmission of exogenous shocks for larger economies. A new Keynesian framework is therefore needed to replicate short-run fluctuations in emerging economies, able to account for nominal variables' stylised facts.

In this paper we have proposed a modified new Keynesian framework along the lines of Gali & Monacelli (2005). In particular, we offer an alternative specification to the New Keynesian Phillips Curve with an explicit component for openness to trade. Open economy new Keynesian macroeconomics postulates that the domestic bias is a constant structural parameter, which is not assumption sustained by econometric estimations. We argue that the domestic bias can be endogenous, and link it to individual firms' investment schedule. We have proposed a model for a small, open emerging economy where households have an imperfect access to intermediate goods available worldwide. Households supplement their consumption bundle with imported goods, which creates competition for domestic goods. Firms maximise their lifetime value subject to capital accumulation, and taking under consideration costs of adjustment. Their openness to trade is therefore conditioned by their inter-temporal tradeoff of expected returns from capital instalments. We argue that real rigidities are necessary in order to incorporate openness to trade in the Phillips curve.

The proposed model replicates some results encountered in the RBC literature regarding productivity shocks and the trade balance. a temporary increase in productivity generates additional demand that current levels of output are not sufficient to satisfy. In the new Keynesian setting, this is due to the fact that production is at sub-optimal level, and is hindered by real and nominal rigidities. These two outcomes are obtained due to the existence of monopolistic competition and sluggish price adjustment. Given the fact that aggregate demand cannot be satisfied with domestic output, households import foreign goods, thus generating a trade balance deficit. Similarly a productivity shock generates a depreciation in the real exchange rate, thanks to its deflationary effect on domestic prices. Our model elaborates on both the RBC and new Keynesian models with a trade balance decomposition between consumption and investment goods. The model also looks at the effects of openness to trade, and shows that increased integration in global trade reduces inflation, and induces households to depend less on imported goods. It also means that increased integration in global trade generates an appreciation in the exchange rate, as domestic prices line up with the worldwide level. These dynamics allow for richer environment, particularly so for policymaking applications.

In addition to describing dynamics within an open economy setting, the model also offers some policy rule comparisons. We look at how monetary authorities devise their policy rules, and how variables behave under various policy regimes. We conclude that monetary authorities are faced with a tradeoff between price and exchange rate stability.