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**Does Export Pricing Explain 'Fear of Floating' in Small Open
Emerging Market Economies?**

By

Mai Farid, University of York

**Department of Economics and Related Studies
University of York
Heslington
York, YO10 5DD**

Does Export Pricing Explain ‘Fear of Floating’ in Small Open Emerging Market Economies?*

Mai Farid**
University of York
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Abstract

Trade data on East Asian EMEs shows the predominant use of Dollar Currency Pricing (DCP). Using a DSGE model with six-stage vertical production chain, staggered prices, and cross-border trade in intermediate inputs, we aim to provide an alternative explanation for ‘fear of floating’ by EMEs. We examine interactions between firms’ pricing rules and the transmission of external shocks under different exchange rate regimes. We find that weak input substitution and DCP of exports eliminate expenditure-switching and the allocative role of exchange rate adjustment, resulting in ‘exchange rate dis-connect’, and hence ‘fear of floating’ by EMEs.

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Keywords: Vertical production chain; Staggered price contracts; Input Substitution; External Currency Pricing; Monetary Policy

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**E-mail: makf500@york.ac.uk

1 Introduction

Many East Asian emerging market economies (EMEs) peg their currencies to the dollar explicitly or implicitly, a phenomenon referred to as ‘fear of floating’.¹ Floating exchange rate regimes tend to be heavily managed, especially in developing countries and emerging markets, such as Hong Kong, Indonesia, Korea, Malaysia, Philippines, Singapore and Thailand. The exchange rate regimes ranged from a currency board hard peg in Hong Kong to a crawling peg in Indonesia. Thus, the volatility of East Asian currencies are usually much lower compared to industrial countries currencies. A vast literature associated ‘fear of floating’ with the extent to which debt is denominated in foreign currency, where a weakening of the domestic currency has negative balance sheet effects on borrowers as experienced during the 1997 Asian crisis. A far from complete account of this literature includes Céspedes *et al.* (2004), Devereux *et al.* (2006), Gertler *et al.* (2007) and Elekdag and Tchakarov (2007), among others. Yet little attention is given to the macroeconomic implications of EME-specific structural trade features and exporters’ optimal pricing decisions in driving their choice of a fixed exchange rate regime. We argue that trade features specific to small open EMEs can explain why these economies experience ‘fear of floating’. We do so by focusing on small open EMEs operating in an integrated world economy with high global trade and interdependent production process along a vertical production and trade chains.²

This paper contributes to the literature by examining the role of four stylised trade features particular to small open EMEs in providing an alternative perspective on ‘fear of floating’. In particular, we analyse the transmission mechanism of external shocks in a dynamic stochastic general equilibrium model with the following structural production and trade features for emerging markets: (i) high share of processing trade in EMEs, (ii) weak input substitution between domestic and imported factor inputs, (iii) the predominant use of the US dollar in pricing exports, also known as ‘external currency pricing’, and (iv) partial exchange rate pass-through (ERPT) into domestic prices. To our knowledge, no previous theoretical study has attempted to explain ‘fear of floating’ by small open EMEs within a vertical production and trade framework and attributes this phenomenon to EMEs production and trade features, with the exception of Cook and Devereux (2006b) and Shi and Xu (2008). While both studies considered vertical trade and external currency pricing, our framework tailored for a small open EME introduces and exam-

¹As explained by Hausmann *et al.* (2001) and Calvo and Reinhart (2002).

²The terms ‘vertical production’ and ‘vertical processing’ are used interchangeably.

Country	Exports (%)		Imports (%)	
	1992	2003	1992	2003
East Asia:	30.6	42.7	27.9	42.9
Emerging Asia⁴	22.3	44.2	32.4	49.6
NAFTA	25.4	21.5	25.5	22.3
Europe	45.3	36.2	46.6	34.8
World	100	100	100	100

Table 1: World Trade in Parts and Components in Regional Share
Source: UN Commodity Trade Statistics Database (1992, 2003).

ines both vertical production and trade, where imported factor inputs' prices are subject to partial exchange rate pass-through.

We first examine the high share of *processing trade* in EMEs, where world nations are becoming more interdependent through a vertical production and trading chains involving intermediate goods that cross borders multiple times. This led to the rising share of processing trade in EMEs over the years, which comprises 50% of trade in East Asia the focus of this study.³ Vertical trade or vertical processing is defined as importing all or part of raw materials, accessories or packaging materials from abroad and re-exporting the finished products after processing or assembly by enterprises within the domestic economy. Using data on world exports and imports of parts and components from UN Commodity Trade Statistics Database, Table 1 presents the increasing trend in processing trade in East Asia's share from 32% in 1992 to approximately 50% in 2003.

Another trade feature our model reflects is the link between an increasing percentage of processing trade in East Asia and *low elasticity of substitution* between domestic and imported inputs in traded sector production. The importance of imported factor inputs in production for EMEs has been studied by Kose (2002) and Fraga *et al.* (2003). Both studies in examining the trade structures in EMEs find that the majority of imports in EMEs are used as intermediate factor inputs instead of consumption good, where the share of consumption in total imports in EMEs accounts for 13%. In addition, a comprehensive study by Sanchez (2007) estimates a sign-restricted Vector Autoregressive (VAR) analysis for 15 EMEs and finds low input substitution between domestic and imported inputs. In some cases, factor inputs are found to be perfect complements. The interaction between weak input substitution of factor inputs and staggered prices at each stage of production is reflected in our

³See for example, Feenstra (1998), Hummels *et al.* (1998), Hummels *et al.* (2001) and Yi (2003).

Country	Korea		Thailand	
	1995	2000	1995	2000
Exports in (%)				
US \$	88.1	84.8	91	87
Other major external currencies	9.7	7.9	4.9	7.7
Imports in (%)				
US \$	79.4	80.4	80.7	79
Other major external currencies	17.2	15.1	13.9	15.6

Table 2: Evidence on External Currency Pricing in EMEs
Source: Cook and Devereux (2006b).

framework through the expenditure-switching effect of exchange rate adjustment becoming of secondary importance, minimising the benefits of a flexible exchange rate regime for EMEs. This implies that in our model with weak input substitution and price rigidity a flexible exchange rate regime does not fulfill its promise of stabilising real or nominal macroeconomic variables. Thus, the expenditure-switching role of exchange rate adjustment depends on the degree of input substitutability between factor inputs in production.

Our model investigates another EME trade-related feature, that is the predominant use of the US Dollars as the invoicing trade currency in their export pricing. Cook and Devereux (2006a) in an attempt to account for the East Asian crisis of 1997-1999, confirm the predominant use of US Dollar pricing or *external currency pricing* of exports in Korea and Thailand. In addition, McKinnon and Schnabl (2004) estimates show the predominant weight of the US Dollar in East Asia's currency baskets. Using data for Korea and Thailand, Table 2 shows that the majority share of trade is invoiced in US dollars compared to other major external currencies, namely Japanese Yen, Euros, and British Pounds.

This EME-specific feature explains the slow response of exports to large real exchange rate depreciation during the East Asian crisis due to export prices being fixed to the US Dollar (\$). In the short run and assuming staggered prices, export prices are fixed in terms of the currency of invoice, therefore the devaluation of the domestic currency does not improve the domestic economy's competitiveness, and thus does not translate into an increase in exports. Therefore, we argue that the combination of vertical production and trade, weak input substitution, and the predominant use of the US Dollar in pricing exports as trade features distinguishing EMEs present an alternative explanation for 'fear of floating' to debt dollarisation as explored by the literature.

Lastly, we study the decline in the degree of *exchange rate pass-*

through (ERPT) into domestic prices in EMEs. This can be explained in light of Taylor’s hypothesis, which links this decline to the low inflation environment that has been achieved by many countries and in particular in EMEs since the 1990s. Using a staggered pricing model with monopolistic competition, Taylor (2000b) concludes that the low and stable inflation results in less persistent inflation. Several empirical studies accounted for the decline in ERPT in developing countries and EMEs, these include Choudhri and Hakura (2001), Devereux and Yetman (2003), Frankel *et al.* (2005), and Ca’Zorzi *et al.* (2007). These studies conclude that importers do indeed price-to-market in the sense that pass-through of exchange rate changes to retail import prices is incomplete. We follow the same modelling technique and introduce to our model monopolistic firms importing factor inputs for traded good production, which allows us to examine incomplete/partial exchange rate pass-through into domestic prices.

The effectiveness of the exchange rate as a shock absorber is limited by the degree of ERPT. For the nominal exchange rate to be an effective shock absorber, its depreciation will have to generate an increase in the real exchange rate, which in turn has an expenditure-switching effect. A necessary assumption to obtain this result is that the Law of One Price (LOOP) must hold. However, in the presence of ‘pricing-to-market’ (PTM), where prices are set in the local currency of the buyer, a change in the nominal exchange rate does not affect sticky prices, resulting in real exchange rate movements to be primarily driven by fluctuations in the nominal exchange rate. In this case, the cost markup fluctuates endogenously and in response to exchange rate movements, rather than nominal prices themselves.⁵

To study the role of the aforementioned production and trade features to explain fear of floating in EMEs, we construct a six-sector dynamic stochastic general equilibrium (DSGE) model with vertical production and trade chains. The composite and differentiated sectors of both non-traded and traded goods are linked through a vertical input-output production chain, implying allocative movements in the relative price of goods. While firms in the composite and differentiated intermediate imported good sectors sell imported goods to the traded good sector as a factor input. Firms producing differentiated non-traded, traded and imported goods are monopolistic competitors, while firms producing the composite goods are perfectly competitive. Vertical trade is introduced to the model through the traded good sector which uses intermediate

⁵This phenomenon has been examined by various studies among them Dornbusch (1987), Krugman (1986), Knetter (1993), Betts and Devereux (2000), and Lane and Ganelli (2003).

imported inputs in its production, and re-exports its output to the international goods market.⁶ In order to isolate the role of vertical production and trade chains in the transmission of external shocks for the small open EME and for simplicity, the model assumes zero international capital mobility. In our modelled economy, the central bank follows a simple interest rate targeting rule, which represents different exchange rate regimes.

Our framework follows the lead of Blanchard (1983) in presenting the production chain with staggered prices at various stages of production. Huang and Liu (2006) extend Blanchard's (1983) multiple stages of production to incorporate the interdependence of nations on factor inputs through a vertical trade chains stretching across many stages of production, and involving goods that cross borders multiple times. Thus, Huang and Liu (2006) construct a two-country general equilibrium model with price rigidity, imperfect competition among firms and optimising agents to study international monetary policy transmission. Huang and Liu (2006) find that once empirically important vertical production and trade chains are incorporated in a DSGE model, an independent monetary expansion can be mutually beneficial to both countries regardless of its source or pricing assumption. We extend Huang and Liu's (2006) framework to study the aforementioned structural production and trade features of small open EMEs, which include: vertical production and trade, weak input substitution between domestic and imported factor inputs, the predominant use of the US Dollar in pricing traded goods, and partial ERPT into domestic prices. We use this framework to study the transmission mechanism of external shocks with three pricing specifications by firms in the intermediate traded and imported sectors and under two alternative exchange rate regimes by the modelled EME.

We explore three pricing decisions by firms in the intermediate traded and imported sectors to examine the role of external currency pricing for exports and the degree of exchange rate pass-through for imports in the transmission of external shocks, namely a foreign demand and imports price shocks under different exchange rate policies. *Model I* acts as a benchmark model with six-stage production structure with price rigidity at each stage, and vertical trade through an intermediate imported good, where firms producing the traded good choose producer currency pricing (PCP). In this case, the LOOP holds for both the traded and imported

⁶Hummels et al. (2001) define *vertical trade* or vertical specialisation as follows: (i) where a good is produced in two or more sequential stages. (ii) two or more countries provide value-added during the production of the good. (iii) at least one country must use imported inputs in its stage of the production process, and some of the resulting output must be exported.

goods. The benchmark model focuses mainly on the role of weak input substitution between domestic and imported factor inputs in traded good production in the transmission of external shocks across the production chain and under different exchange rate regimes. In contrast, *Model II* retains all structural features presented in the benchmark model but varies the price decision of the traded good to external currency pricing (ECP), while the intermediate imported good trades at the LOOP. This case focuses on the effect of external currency pricing of traded goods on the behavior of the nominal exchange rate in response to external shocks. *Model III* draws a distinction between the pass-through of exchange rate changes into import prices through local currency pricing (LCP) and into export prices through external currency pricing while keeping all other structural features of the previous two models the same. Under these three alternative price-setting decisions we examine the macroeconomic implications in response to external shocks when the monetary authority follows a floating or a fixed exchange rate regime. In addition, we conduct several robustness checks to key parameters to study how sensitive the results are to varying specifications of these parameters. We calibrate *Models I, II, and III* to a subset of emerging market economies, particularly South Korea, Malaysia, and Thailand. Key structural parameters of the model, including the share of intermediate goods into the production of finished goods, the elasticity of substitution between domestic and imported factor inputs, the degree of external currency pricing, and the length of nominal contracts of staggered prices are calibrated for EMEs.

Our main finding is that the choice of a fixed exchange rate regime for a small open EME, a phenomenon known as ‘fear of floating’ is justified by its vertical production and trade chains, as well as domestic firms’ pricing decisions. These trade features are: high share of vertical trade, weak substitution between domestic and imported inputs, partial exchange rate pass-through into domestic prices, and external currency pricing for its traded goods. Our model reveals that these production and trade features provide a rationale for ‘fear of floating’ or managing exchange rate fluctuations in small open EMEs. Through numerical simulations in response to external shocks and under different exchange rate regimes, the model indicates that EMEs’ specific production and trade features weaken the expenditure-switching effect of exchange rate adjustment, which helps explain ‘exchange rate disconnect’ phenomenon captured by the model, where exchange rate fluctuation has little impact on macroeconomic variables. In addition, the model suggests that external currency pricing limits the desirability of exchange rate flexibility and provides an incentive for fixing the exchange rate, since exchange

rate fluctuations has little impact on exports and relative price of imported inputs facing domestic firms, and thus affecting the marginal cost through the multiplier effect across the production chain.

The paper is organised as follows. Sections 3 to 5 present the economic agents and the vertical input-output production and trade structure model with price rigidity. Section 6 presents the model's market clearing conditions. Section 7 discusses the model's parametrisation. Sections 8 to 10 examine the equilibrium dynamics through numerical simulations in response to shocks. Section 11 presents the results of robustness exercises to key parameters driving the model predictions. Section 12 concludes.

2 A Model with Vertical Production and Trade Chains

The economy is inhabited by infinitely lived households. Households' preferences are defined over consumption good and leisure and is subject to a preference shock. The preference shock shifts the marginal utility of goods and marginal disutility of labour. Utility is additively separable in consumption and leisure.

Figure 1 depicts a flow chart of the vertical production and trade structure of goods, labour, and income in the modelled small open EME. The economy is characterised by a six-stage production structure with the following sectors: composite and differentiated non-traded finished good sectors, composite and differentiated intermediate traded good sectors and composite and differentiated intermediate imported good sectors. The composite and differentiated non-traded and traded good sectors are vertically linked in an input-output production chain. The composite and differentiated intermediate traded sectors are linked to the global economy through a vertical trade chain by importing factor inputs to produce the differentiated traded good and exporting the composite traded good to the international goods market.

The economy is exposed to external shocks, namely a foreign demand and imports price shocks. The monetary authority sets the nominal interest rate following a simple Taylor-type rule, allowing for flexible and fixed exchange rate regimes. We explore different optimal pricing decisions by firms in the intermediate traded and imported good sectors. In addition, we examine interactions between these price specifications and the transmission of external shocks for the small open EME under different exchange rate regimes.

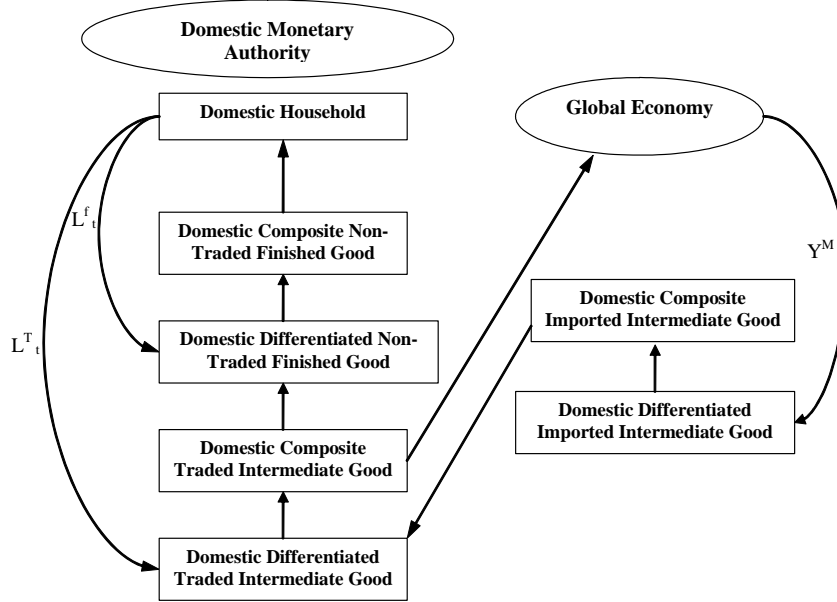


Figure 1: Flow Chart of the Small Open EME with Vertical Production and Trade Chains

3 Households

The economy is composed of a continuum of infinitely-lived individuals, whose total is normalised to unity. Households are assumed to have identical preferences over consumption of goods and supply of labour. In addition, households own all firms and borrow from the domestic capital market through one-period domestic bond to smooth consumption over time by transferring resources across periods. Thus, we assume that international capital mobility is zero. We adopt the simplifying assumption that money plays the role of a unit of account, in terms of which prices of goods and labour services are quoted. Hence, money does not appear in either the consumer's utility function or the budget constraint.⁷

The objective of the representative household is to maximize the discounted sum of the expected utility derived from consuming goods and supplying labour services, given by:

$$E_t \sum_{t=0}^{\infty} \beta^t U(C_t, L_t)$$

⁷This modelling strategy has been adopted by recent research work, such as Galí and Monacelli (2005) and McCallum and Nelson (2000), among others.

where C_t is the quantity consumed of the consumption good and L_t denotes labour hours supplied. The period utility $U(C_t, L_t)$ is assumed to be continuous and twice differentiable with $U_{c,t} \equiv \frac{\partial U(C_t, L_t)}{\partial C_t} > 0$, $U_{cc,t} \equiv \frac{\partial^2 U(C_t, L_t)}{\partial C_t^2} \leq 0$, $U_{l,t} \equiv \frac{\partial U(C_t, L_t)}{\partial L_t} \leq 0$, and $U_{ll,t} \equiv \frac{\partial^2 U(C_t, L_t)}{\partial L_t^2} \leq 0$. The representative consumer's instantaneous utility function is given by:

$$U(C, L) \equiv E_t \sum_{t=0}^{\infty} \beta^t \left[\frac{e^{\xi_t} C_t^{1-\sigma}}{1-\sigma} - \chi \frac{L_t^{1+\varphi}}{1+\varphi} \right] \quad 0 < \beta < 1, \quad \varphi \geq 1 \quad (1)$$

where E is an expectation operator, C_t is real consumption of the composite non-traded good and is equivalent to total production of the composite non-traded good Y_t^N , and L_t denotes labour hours supplied.⁸ The preference shock is denoted by ξ_t and follows a first-order autoregressive process $\xi_t = \rho_\xi \xi_{t-1} + \varepsilon_t^\xi$, where ε_t^ξ is serially uncorrelated independent and identically distributed process with mean-zero, standard error σ_ξ , and $\rho_\xi < 1$. Household related structural parameters are: $\beta \in (0, 1)$ the subjective discount factor, σ the coefficient of relative risk aversion in consumption, φ the intertemporal elasticity of marginal disutility with respect to labour supply, χ is coefficient on labour in the utility function.

Thus, the representative household's objective is to maximise its utility represented by the utility function in (1) subject to a series of budget constraints for period $t = 0, 1, 2, \dots, \infty$, given by:

$$P_t^N C_t + E_t \{Q_{t,t+1} B_{t+1}\} \leq W_t L_t + \Pi_t + B_t + T_t \quad (2)$$

The above budget constraint implies that the representative household consumes the composite non-traded good at the price P_t^N and holds one-period nominally riskless domestic discount bonds B_t purchased in period t and maturing in period $t + 1$. $Q_{t,t+1}$ is the stochastic discount factor for one-period ahead nominal payoffs for the household, being the domestic bond's price. Household consumption and bond holding decisions are financed by its total wage income given by nominal wage rate per unit of labour supplied $W_t L_t$, total profits from differentiated non-traded, traded and importing firms in each period Π_t , and lump sum transfers T_t . Thus, the right hand side of equation (2) represents the nominal value of financial wealth the household takes into period t . The representative household satisfies its intertemporal budget constraint in (2) and transversality conditions or no-Ponzi game in (3); a necessary condition for optimality which eliminates the possibility of households financing consumption indefinitely by borrowing:

⁸We do not model household consumption of foreign goods. This is due to its small share in total imports in EMEs, which ranges from 13% to 21.3% according to Kose (2002) and Fraga *et al.* (2003), respectively.

$$\lim_{s \rightarrow \infty} E_t \left[\Pi_{s=0}^{t+s-1} \left(\frac{1}{1+r_{t+s}} \right) B_{t+s} \right] = 0 \quad (3)$$

where $R_t = \frac{1}{E_t Q_{t,t+1}}$ is defined as the gross return on a riskless one-period domestic discount bond paying off one unit of domestic currency in $t+1$, where $R_t = (1+r_t)$. In order to isolate the role of vertical production and trade chains in the transmission of external shocks for the small open EME and for simplicity, the model assumes zero international capital mobility.

The household optimisation problem is to choose a strategy $\{C_t, L_t, B_t\}_{t=0}^{t=\infty}$ which maximize its expected lifetime utility defined by equation (1) subject to an intertemporal budget constraint in equation (2) and transversality condition (3). Thus, the household utility maximisation problem is given by:

$$\max_{\{C_t, L_t, B_t\}} U(C, L) \equiv E_t \sum_{t=0}^{\infty} \beta^t \left[\frac{e^{\xi_t} C_t^{1-\sigma}}{1-\sigma} - \chi \frac{L_t^{1+\varphi}}{1+\varphi} \right], \quad 0 < \beta < 1$$

$$\text{s.t. } P_t^N C_t + E_t \{Q_{t,t+1} B_{t+1}\} \leq W_t L_t + \Pi_t + T_t + B_t$$

Solving the household utility maximisation problem yields the following optimality conditions:

$$\chi \frac{L_t^\varphi}{\xi_t C_t^{-\sigma}} = \frac{W_t}{P_t^f} \quad (4)$$

$$\beta R_t E_t \left\{ \left(\frac{C_{t+1}}{C_t} \right)^{-\sigma} \frac{P_t^N}{P_{t+1}^N} \frac{\xi_{t+1}}{\xi_t} \right\} = 1 \quad (5)$$

Equation (4) represents the labour supply decision by the household, and equation (5) is the stochastic Euler equation for the purchase of bonds.

4 Firms in a Vertical Production Chain

The production chain is composed of six-stage production chain, each consisting of a continuum of firms producing composite and differentiated goods. The composite and differentiated non-traded and traded good sectors are vertically linked via an input-output production chain. The composite and differentiated intermediate traded sectors are linked to the global economy through a vertical trade chain by importing factor inputs to produce the differentiated traded good and exporting the composite traded good to the international goods market. Final non-traded goods are consumed by households, while intermediate traded goods are

used as factor inputs in the production of the final non-traded good, as well as exported to the global economy. All firms are price takers in the input markets. Wages are determined in a competitive labour market. Differentiated non-traded, traded and imported goods producing firms are monopolistic competitors and their optimal price decisions are set à la Calvo (1983). Thus, differentiated non-traded, traded and imported intermediate goods' prices adjust with the probability $(1 - \omega^N)$, $(1 - \omega^T)$, and $(1 - \omega^M)$ respectively.

4.1 Composite Non-traded, Intermediate Traded and Intermediate Imported Goods

Each of the following aggregate goods, namely non-traded finished good Y_t^N , intermediate traded good Y_t^T , and intermediate imported good Y_t^M is a composite of differentiated goods. We generally denote each of the differentiated goods by the following notation $Y_{h,t}^f$. The composite good $Y_{h,t}^f$ is indexed by $h \in (0, 1)$, where $f = N, T, M$ and $h = j, i, k$, where non-traded finished good is denoted by N superscript and index j , intermediate traded good is distinguished by a T superscript and index i , and intermediate imported good represented by M superscript and index k . Differentiated goods are combined into an aggregate output index making use of the following constant elasticity of substitutions (CES) technology:

$$Y_t^f = \left[\int_0^1 Y_{h,t}^f \frac{\theta^f - 1}{\theta^f} dh \right]^{\frac{\theta^f}{\theta^f - 1}}, \quad f = N, T, M \text{ and } h = j, i, k \quad (6)$$

where $\theta^f > 1$ is the elasticity of substitution between differentiated goods $Y_{h,t}^f$, and the term $\frac{\theta^f - 1}{\theta^f}$ represents the price markup rate for each sector, where $f = N, T, M$ for the non-traded, intermediate traded and imported good, respectively.

Firms producing the aggregate good solve the following cost minimisation problem, given by:

$$\begin{aligned} & \min_{Y_{j,t}^f} \int_0^1 P_{h,t}^f Y_{h,t}^f dh \\ & \text{subject to } Y_t^f = \left[\int_0^1 Y_{h,t}^f \frac{\theta^f - 1}{\theta^f} dh \right]^{\frac{\theta^f}{\theta^f - 1}} \end{aligned}$$

where $P_{h,t}^f$ is the price of f^{th} good, and $Y_{h,t}^f$ is the demand function for the f^{th} good. The cost minimisation problem yields the demand function

for the differentiated good $Y_{h,t}^f$, which is equivalent to household demand for the non-traded good, total domestic and foreign demand for the intermediate-traded good in equations (21) and (22), and intermediate traded sector demand for the imported good in equation (19). Adopting general notation, we represent the demand for the differentiated good as follows:

$$Y_{h,t}^f = \left(\frac{P_{h,t}^f}{P_t^f} \right)^{-\theta^f} Y_t^f \quad (7)$$

To obtain P_t^f , the corresponding price index for aggregate good, substitute the above equation defining $Y_{h,t}^f$ into the expression for the composite good in (6), which yields the minimum cost per unit of output index, given individual good's prices $P_{h,t}^f$:

$$P_t^f = \left[\int_0^1 P_{h,t}^f \quad 1^{-\theta^f} dh \right]^{\frac{1}{1-\theta^f}} \quad (8)$$

4.2 Differentiated Non-traded Finished Good Production

Firms in the differentiated non-traded sector produce differentiated goods indexed by $j \in (0, 1)$. A typical firm j uses a Cobb-Douglas production function combining homogenous labour services $l_{j,t}^N$ and a composite intermediate traded good $Y_{i,t}^{D,T}$ using a constant returns to scale technology characterised by diminishing marginal product and constant elasticity of substitution, given by:

$$Y_{j,t}^N = Y_{i,t}^{D,T} \quad \phi \quad [A_t^N l_{j,t}^N]^{1-\phi} \quad (9)$$

where $\log A_t^N = \rho_N \log A_{t-1}^N + \varepsilon_t^N$

where ϕ is the share of intermediate traded good in total factor inputs used in producing the non-traded good, and (log) productivity $\log A_t^N = a_t^N$ is a stage-specific labour augmenting technology shock identical for all non-traded good producers. The technology shock follows a first-order autoregressive process, where $a_t^N = \rho_N a_{t-1}^N + \varepsilon_t^N$. In specifying the technology shock, we assume no growth trend in productivity. Thus, the technology factor follows a log-stationary process, where ε_t^N is a white noise process, independent of all other shocks with variance σ_N^2 , and a persistence coefficient $\rho_N < 1$.

Firms are price takers in the input market and monopolistic competitors in the differentiated non-traded finished good market. Each

firm meets a downward sloping demand curve given by household consumption for the non-traded good presented in equation (7). Without loss of generality and by assuming symmetry among firms, the cost minimisation problem for the differentiated non-traded good producing firm yields the following demand for labour services and intermediate traded goods, respectively:

$$l_{j,t}^N = (1 - \phi) \frac{V_t^N}{W_t} \int_0^1 Y_{j,t}^N dj \quad (10)$$

$$Y_{i,t}^{D,T} = \phi \frac{V_t^N}{P_t^T} \left(\frac{P_{i,t}^T}{P_t^T} \right)^{-\theta^T} \int_0^1 Y_{j,t}^N dj \quad (11)$$

$$\text{where } V_t^N = \Phi P_t^T \phi \left(\frac{W_t}{A_t^N} \right)^{1-\phi} \quad (12)$$

$$\text{and } \Phi = \frac{1}{\phi^\phi (1 - \phi)^{1-\phi}} \quad (13)$$

where V_t^N is the nominal marginal cost of non-traded good production, θ^T is the elasticity of substitution between differentiated intermediate traded goods indexed by i , W_t is the nominal wage rate for labour input, P_t^T is the price index of the intermediate traded good, and the term $\left(\frac{P_{i,t}^T}{P_t^T} \right)^{-\theta^T}$ is the price of the i th intermediate traded good relative to the price index of all such goods, where the demand for the intermediate traded input will be higher, the lower its price relative to the price index of all such goods, governed by θ^T the elasticity of substitution between differentiated intermediate traded goods.

Due to the presence of a vertical input-output production chain, an important mechanism at work is the productivity multiplier associated with the intermediate traded good denoted by Φ . From equation (13), the multiplier depends on the share of the intermediate traded factor input in producing the non-traded good, which interacts with staggered prices in the non-traded sector generating endogenous rigidity through its marginal cost, as shown in equation (12). This plays a key role in driving the transmission mechanism of shocks along the production chain and through the modelled economy.

4.3 Optimal Price-setting for the Differentiated Non-traded Good

Each firm producing the differentiated non-traded good sets its price in a staggered fashion in the spirit of Calvo (1983). In this framework, $(1 - \omega^N)$ fraction of firms adjust their prices optimally. Thus, ω^N is the

probability that firm j does not change its price in period t . Hence, firms resetting the price choose the new price $P_t^{N(*)}$ to maximize their expected present value of future stream of real profit subject to its production technology (9), and meeting the demand for the good (7), as follows:

$$\begin{aligned} \max_{\{Y_t^N\}} \Pi &= E_t \sum_{s=0}^{\infty} (\omega^N \beta)^s Q_{t,t+s} \left[P_t^{N(*)} Y_{j,t+s}^N - V_{t+s}^N Y_{j,t+s}^N \right] \\ \text{s.t. } Y_{j,t}^N &= Y_{i,t}^T \phi \left[A_t^N l_{j,t}^N \right]^{1-\phi} \\ \text{and } Y_{j,t}^N &= \left(\frac{P_{j,t}^N}{P_t^N} \right)^{-\theta^N} Y_t^N \end{aligned}$$

A typical non-traded good producing firm discounts its future stream of profit at the rate $\beta^s Q_{t,t+1}$, while it takes as given the paths of marginal cost V_t^N , total demand for non-traded good Y_t^N , and aggregate price index for the sector P_t^N , where $(P_{j,t}^N/P_t^N)^{-\theta^N}$ is the relative price of the j th non-traded good to its price index P_t^N , where the higher the price of the j th non-traded good $P_{j,t}^N$ relative to the price index of such goods the lower the demand for the j th good. Thus, firms producing the differentiated non-traded good optimal price decision is given by:

$$P_t^{N(*)} = \mu^N \sum_{s=0}^{\infty} \frac{E_t \left[(\omega^N \beta)^s Q_{t,t+s} V_{t+s}^N Y_{t+s}^N \right]}{E_t \left[(\omega^N \beta)^s Q_{t,t+s} Y_{t+s}^N \right]} \quad (14)$$

where $\mu^N = \frac{\theta^N}{\theta^N - 1}$

Equation (14) states that firms adjusting their prices will choose a price that is equal to the desired markup μ^N over a weighted average of the future marginal cost V_{t+s}^N . Thus, $P_t^{N(*)}$ is the average price of the non-traded good producing firms allowed to reset their prices in period t . As $\omega^N \rightarrow 0$, prices become perfectly flexible as all firms are able to reset their prices at each period, hence $P_t^{N(*)} \rightarrow \mu^N V_t^N$. Since the monopolistic markup $\mu^N > 1$, prices are set above the marginal cost resulting in output to be inefficiently low due to the assumption of monopolistic competition. At symmetric equilibrium, $(1 - \omega^N)$ firms adjusting their prices at period t choose the same reset price $P_t^{N(*)}$, while ω^N firms not adjusting their price choose last period's price P_{t-1}^N .⁹ Thus, the average price and inflation of the non-traded goods are respectively given by:

⁹Note that the j subscript is dropped due to assuming symmetry among firms.

$$P_t^N = \left[\omega^N (P_{t-1}^N)^{1-\theta^N} + (1-\omega^N) (P_t^{N(*)})^{1-\theta^N} \right]^{\frac{1}{1-\theta^N}} \quad (15)$$

$$\widehat{\pi}_t^N = \beta E_t \{ \widehat{\pi}_{t+1}^N \} + \kappa^N \{ \widehat{v}_t^N \} \quad (16)$$

Equation (16) is the log-linear expression for the New-Keynesian Phillips curve for the non-traded sector, linking current non-traded good inflation ($\widehat{\pi}_t^N$) to expected future non-traded good inflation and to the real marginal cost (\widehat{v}_t^N), where $\kappa^N = \frac{(1-\omega^N)(1-\omega^N\beta)}{\omega^N}$.

4.4 Differentiated Intermediate Traded Good Production

The share of EMEs in vertical trade with the global economy has been increasing over the years, as evident from Table 1. The main characteristic defining vertical trade or vertical specialisation as pointed out by Hummels *et al.* (2001) is that countries are linked sequentially to produce goods, in the sense that imported intermediate goods are used by the domestic economy to produce its intermediate traded goods that are re-exported to the global economy. We model vertical trade as an integral feature describing the production process of the modelled economy and study the role of vertical trade in EMEs' optimal choice of exchange rate regime.

Each firm produces a differentiated intermediate traded good $Y_{i,t}^T$ indexed by $i \in (0, 1)$. A typical firm i uses a constant elasticity of substitution (CES) production function using homogenous labour services $l_{i,t}^T$ and the composite intermediate imported good Y_t^M as factor inputs. A CES production function highlights the role of substitutability between domestic and imported factor inputs. Hence, the intermediate traded production technology is given by:

$$Y_{i,t}^T = \left[\alpha_T^{\frac{1}{\gamma}} (A_t^T l_{i,t}^T)^{\frac{\gamma-1}{\gamma}} + (1-\alpha_T)^{\frac{1}{\gamma}} (Y_t^M)^{\frac{\gamma-1}{\gamma}} \right]^{\frac{\gamma}{\gamma-1}} \quad (17)$$

$$\text{where } \log A_t^T = \rho_T \log A_{t-1}^T + \varepsilon_t^T$$

where α_T is the share of domestic labour in producing the intermediate traded good. In the case $\alpha_T > 0.5$, this represents home bias in production to domestic factor inputs. The (log) productivity $\log A_t^T = a_t^T$ is a stage-specific labour augmenting technology shock identical for all intermediate traded good producers. The technology shock follows a first-order autoregressive process, where $a_t^T = \rho_T a_{t-1}^T + \varepsilon_t^T$. In specifying the technology shock, we assume no growth trend in productivity.

Thus, the technology factor follows a log-stationary process, where ε_t^T is a white noise process, independent of all other shocks with variance σ_T^2 , and a persistence coefficient $\rho_T < 1$. The elasticity of substitution between domestic labour and imported intermediate goods is denoted by γ , and generally $\gamma \geq 0$. When $\gamma = 0$, the imported intermediate goods are complementary to domestic labour in producing the domestic good. In this special case, the production function can be characterised by a fixed proportional technology or a Leontief technology, and is given by:

$$Y_{i,t}^T = \min \left[\frac{A_t^T l_{i,t}^T}{\lambda}, Y_t^M \right]$$

That is, producing one unit of the intermediate traded good requires λ units of domestic labour and one unit of imported intermediate goods. We focus on the case of weak elasticity of substitution between domestic and imported factor inputs, where γ is close to but not equal to zero.

Without loss of generality and by assuming symmetry across firms, the cost minimisation problem for firms producing the intermediate traded good using the production function in (17) yields the following demand for factor inputs, namely labour and intermediate imported goods:

$$l_{i,t}^T = \alpha_T \frac{1}{A_t^T} \left(\frac{V_t^T}{W_t} \right)^\gamma \int_0^1 Y_{i,t}^T di \quad (18)$$

$$Y_t^M = (1 - \alpha_T) \left(\frac{V_t^T}{S_t P_t^{M*}} \right)^\gamma \int_0^1 Y_{i,t}^T di \quad (19)$$

$$\text{where } V_t^T = \left[\alpha_T (W_t)^{1-\gamma} + (1 - \alpha_T) (S_t P_t^{M*})^{1-\gamma} \right]^{\frac{1}{1-\gamma}} \quad (20)$$

where V_t^T is the intermediate good producing firm's nominal marginal cost, W_t is the nominal wage rate for labour input, S_t is the nominal exchange rate measured by home currency price of foreign currency and P_t^{M*} is the foreign currency price for the intermediate imported good.

The intermediate traded good is sold domestically as a factor input in the production of non-traded goods, and is re-exported to world economy, where the intermediate traded good and imported goods are imperfect substitutes. Each intermediate traded good producing firm meets a downward slopping demand curve given by equation (11) representing domestic demand $Y_{i,t}^{D,T}$, and its foreign counterpart representing foreign demand for the intermediate traded good $Y_{i,t}^{x,T}$. Equations (21) and (22) represent the domestic and foreign demand functions for the

intermediate traded good, after substituting for the marginal cost, as follows:

$$Y_{i,t}^{D,T} = (1 - \alpha_x) \left(\frac{\phi}{1 - \phi} \right)^{1-\phi} \left(\frac{P_{i,t}^T}{P_t^T} \right)^{-\theta T} \left(\frac{W_t}{A_t^N P_t^N} \right)^{1-\phi} \left(\frac{P_t^T}{P_t^N} \right)^{\phi-1} \int_0^1 Y_{j,t}^N dj \quad (21)$$

$$Y_{i,t}^{x,T} = \alpha_x \left(\frac{\phi}{1 - \phi} \right)^{1-\phi} \left(\frac{P_{i,t}^{T*}}{P_t^{T*}} \right)^{-\theta T} \left(\frac{W_t^*}{A_t^* P_t^*} \right)^{1-\phi} \left(\frac{P_t^{T*}}{P_t^*} \right)^{\phi-1} X_t \quad (22)$$

where α_x is the share of exports in intermediate traded good output. Variables with a star represent the foreign counterpart¹⁰ for defined domestic variables, such as P_t^{T*} being the foreign currency price for the intermediate traded good, W_t^* denoting foreign nominal wage rate, P_t^* corresponding to the foreign consumer price index, A_t^* is labour augmenting technology shock identical for all foreign good producers, and X_t is a foreign demand shock. The foreign demand shock follows a first-order autoregressive process, where $\log(X_t) = \rho_x \log(X_{t-1}) + \varepsilon_t^x$. In specifying the foreign demand shock, we assume no growth trend in productivity. Thus, the foreign demand follows a log-stationary process, where ε_t^x is a white noise process, independent of all other shocks, with mean zero, variance σ_x^2 , and $\rho_x < 1$. Equation (21) defines the domestic demand for the intermediate traded good and states that the demand for intermediate traded good is higher, the lower its price relative to the price index of all such goods, the lower its price index relative to the overall price index (CPI), or the lower its price index relative to the cost of labour. The foreign demand function for the intermediate traded good in (22) is interpreted similarly.

In deriving the optimal price decision of firms producing the differentiated intermediate traded good, we refer the reader to Section 4.6 which explores various optimal price decisions by firms ranging from producer currency pricing (PCP) in *Model I* to external currency pricing (ECP) in *Model II*, while assuming that the imported good trades at the LOOP. Another scenario explored in *Model III* draws a distinction between the pass-through of exchange rate changes into import prices through local currency pricing (LCP) and into export prices through external currency pricing. We examine the macroeconomic implications of the small open EME in response to external shocks under two alternative exchange rate regimes, namely floating and fixed exchange rate regimes, with each of

¹⁰All foreign variables are taken as exogenous, since we are not modeling the world economy.

the three alternative optimal pricing decisions by firms producing the differentiated intermediate traded good presented in Section 4.6.

4.5 Differentiated Intermediate Imported Good

The vertical trade chain presented in our model links the domestic traded sector with the imported sector, where the latter is imported by monopolistically competitive firms. Each firm imports a differentiated good $Y_{k,t}^M$ indexed by $k \in (0, 1)$ to meet the demand for intermediate imported inputs by the intermediate traded sector presented in equation (19):

$$Y_t^M = (1 - \alpha_T) \left(\frac{V_t^T}{S_t P_t^{m^*}} \right)^\gamma \int_0^1 Y_{i,t}^T di \quad (23)$$

where V_t^T defined in equation (20) is the domestic traded good producing firm's nominal marginal cost, W_t is the nominal wage rate for labour input, S_t is the nominal exchange rate measured by home currency price of foreign currency and $P_t^{m^*}$ is the foreign currency price for imported intermediate goods.

Please refer to Section 4.6, where we derive and explore alternative optimal price decision of firms producing the differentiated intermediate imported good. In particular, we study the law of one price as well as local currency pricing for the intermediate imported good in *Models I*, *II*, and *III*.

4.6 Optimal Price-setting Decisions for Differentiated Intermediate Traded and Imported Good Producers

Firms in the differentiated non-traded, traded and imported good sectors are monopolistic competitors and their optimal price decisions are set à la Calvo (1983). This implies that firms are monopolistic competitors in the output market and price-takers in the input market. Thus, differentiated non-traded, traded and imported intermediate goods' prices adjust with the probability $(1 - \omega^N)$, $(1 - \omega^T)$, and $(1 - \omega^M)$ respectively. In this section we focus on the optimal price setting decision of firms producing differentiated intermediate traded and imported goods. In section 4.3, we have derived the price decision for the differentiated non-traded good sector. In the discussion to follow we are keeping the pricing decision of the non-traded sector same as derived earlier while examining three alternative pricing assumptions for the differentiated intermediate traded and differentiated intermediate imported goods. In *Models I* and *II* we study producer currency pricing (PCP) and external currency pricing (ECP) for the intermediate traded good, respectively,

while assuming that the LOOP holds for the imported good implying complete ERPT into domestic prices. In contrast, *Model III* assumes external currency pricing for the intermediate traded good and local currency pricing for the intermediate imported goods, implying partial ERPT into both export and import prices.

4.7 Model I: PCP for Differentiated Traded Good and LOOP for the Differentiated Imported Good

Firms producing differentiated traded good solve a similar profit maximisation problem to the one differentiated non-traded good producing firms solved earlier in section 4.3. Each firm sets price in a staggered fashion in the spirit of Calvo (1983). In this framework, $(1 - \omega^T)$ fraction of firms adjust their prices optimally, where ω^T is the probability that firm i does not change its price in period t . Hence, firms resetting their price choose the new price $P_t^{T(*)}$ to maximize their expected present value of future stream of real profits subject to production technology (17), and meeting domestic and foreign demand for the intermediate traded good in equations (21) and (22), as follows:

$$\begin{aligned} \max_{\{Y_t^T\}} \Pi &= E_t \sum_{s=0}^{\infty} (\omega^T \beta)^s Q_{t,t+s} \left[P_t^{T(*)} - V_{t+s}^T \right] Y_{i,t+s}^T \\ \text{s.t. } Y_{i,t}^T &= \left[\alpha_T^{\frac{1}{\gamma}} (A_t^T l_{i,t}^T)^{\frac{\gamma-1}{\gamma}} + (1 - \alpha_T)^{\frac{1}{\gamma}} (Y_{k,t}^M)^{\frac{\gamma-1}{\gamma}} \right]^{\frac{\gamma}{\gamma-1}} \\ \text{and } Y_{i,t}^T &= Y_{i,t}^{D,T} + Y_{i,t}^{x,T} \end{aligned}$$

A typical differentiated intermediate traded good producing firm discounts its future stream of profit at the rate $\beta^s Q_{t,t+1}$, while it takes as given the paths of marginal cost V_t^T derived in equation (20), domestic and foreign demand for Y_t^T , and aggregate price index of the sector P_t^T . Thus, the differentiated intermediate traded good producing firm optimal price decision under the assumption of producer currency pricing is represented by:

$$\begin{aligned} P_t^{T(*)} &= \mu^T \sum_{s=0}^{\infty} \frac{E_t \left[(\omega^T \beta)^s Q_{t,t+s} V_{t+s}^T Y_{t+s}^T \right]}{E_t \left[(\omega^T \beta)^s Q_{t,t+s} Y_{t+s}^T \right]} \quad (24) \\ \text{where } \mu^T &= \frac{\theta^T}{\theta^T - 1} \end{aligned}$$

Equation (24) states that firms producing the differentiated intermediate traded good resetting their prices will choose an optimal price that is equal to the desired constant markup μ^T over a weighted average of

the future marginal cost V_{t+s}^T . Thus, $P_t^{T(*)}$ is the average price of firms at the differentiated intermediate traded stage allowed to reset their prices in period t . As the probability of firms in this sector not resetting their price tends to zero, i.e. $\omega^T \rightarrow 0$, the differentiated intermediate traded good prices become perfectly flexible. In this case, all firms in the differentiated traded sector are able to reset their prices at each period, implying that $P_t^{T(*)} \rightarrow \mu^T V_t^T$. Since the monopolistic markup $\mu^T > 1$, prices are set above the marginal cost and so output is inefficiently low. At symmetric equilibrium, all intermediate traded good producing firms adjusting their prices at period t choose the same price, while firms not adjusting their price choose last period's price.¹¹ Thus, the price index of intermediate traded good under the assumption of producer currency pricing is given by:

$$P_t^T = \left[\omega^T (P_{t-1}^T)^{1-\theta^T} + (1 - \omega^T) \left(P_t^{T(*)} \right)^{1-\theta^T} \right]^{\frac{1}{1-\theta^T}} \quad (25)$$

We note that as the price of the differentiated intermediate traded good is set in producer currency pricing, the LOOP holds not only for each of the differentiated traded goods, but also for the composite traded good. Thus, the LOOP implies that $P_t^T = S_t P_t^{T*}$, where P_t^{T*} corresponds to the price of the traded good expressed in foreign currency. Hence, the New-Keynesian Phillips curve for the traded sector is represented by:

$$\hat{\pi}_t^T = \beta E_t \{ \hat{\pi}_{t+1}^T \} + \kappa^T \{ \hat{v}_t^T \} \quad (26)$$

where $\kappa^T = \frac{(1-\omega^T)(1-\omega^T\beta)}{\omega^T}$. The New-Keynesian Phillips curve in equation (26) implies that the real marginal cost is the key driving variable for the forward-looking inflation process, with current inflation a function of expected future inflation.

4.8 Model II: ECP for the Differentiated Traded Good and LOOP for the Differentiated Imported Good

We now consider the case where firms producing the differentiated intermediate traded good price-discriminate markets in different countries and set the currency of trade invoicing in US dollars. In this case, the LOOP does not hold. This implies that the firms have monopolistic power over their good to set their prices in an external currency or Dollar currency pricing (DCP). As documented by both McKinnon and

¹¹Note that the i subscript is dropped due to assuming symmetry among differentiated intermediate traded good producing firms.

Schnabl (2004) and Cook and Devereux (2006b), trade in East Asia is predominantly done in US Dollars. Cook and Devereux (2006b) carry out a simple regression to investigate if prices are sticky in the invoicing currency, being the US Dollar. They undertake a simple pass-through regression of the monthly changes in exports and imports price indices on the monthly changes in the bilateral exchange rate to the US Dollar as well as other foreign currencies such as the Euro, Japanese Yen, and the Sterling Pound. They find that the coefficient on the US Dollar is large and highly significant for exports and imports price indices, implying that export pricing is sticky in the invoicing currency. The high correlation between the growth rate of the bilateral exchange rate to the US dollar with growth rates of monthly export and import price indices, suggest substantial pass-through of the exchange rate into these indices. Cook and Devereux (2006b) refer to this as Dollar Currency Pricing (DCP) or External Currency Pricing (ECP). Since the SOEME trades with the United States (US) and the rest of the world (ROW), thus we need to account for the exchange rate of the SOEME to both the US dollar and the ROW and unify external currency pricing to the US dollar. To highlight the role of using the dollar as the currency of invoice, we make the distinction between the exchange rate of the domestic currency of the small open emerging economy to both the US dollar, denoted by S_t , and to the rest of the world measured against the US dollar, denoted by S_t^{ROW}/S_t , being the dominant trading currency for the SOEME.

Hence, differentiated traded good producing firms resetting the price choose the new price $P_t^{T(*)}$ for its products to be sold at the domestic market, and $P_t^{T^*(*)}$ for its products to be exported, to maximize their expected present value of future stream of real profit subject to production technology (17), and meeting domestic and foreign demand for the intermediate traded good in equations (21) and (22), as follows:

$$\max_{\{Y_t^T\}} \Pi = E_t \sum_{s=0}^{\infty} (\omega^T \beta)^s Q_{t,t+s} \left\{ \left[P_{i,t}^{T(*)} - V_{i,t+s}^T \right] Y_{i,t+s}^{D,T} + \left[S_t P_{i,t}^{T^*(*)} - V_{i,t+s}^T \right] Y_{i,t+s}^{x,T} \right\}$$

A typical differentiated traded good producing firm discounts its future stream of profit at the rate $\beta^s Q_{t,t+1}$, while it takes as given the paths of marginal cost V_t^T in equation (20), domestic demand for the intermediate traded good $Y_t^{D,T}$, the price of which is determined in (25), and exports demand's $Y_t^{x,T}$ price is determined as shown below in DCP, and aggregate price index of the sector P_t^T . Note that we distinguish between export demand from the US in dollars $Y_t^{US,T}$ and exports demand from the rest of the world (ROW) in dollars $Y_t^{ROW,T}$, to highlight the role of

using the dollar as the currency of invoice. So, the total demand for exports is given by: $\left(\frac{P_t^T}{P_t^N}\right) Y_t^{x,T} = \left(\frac{P_t^{s,T}}{P_t^N/S_t}\right) Y_t^{US,T} + \left(\frac{P_t^{ROW,T}}{P_t^N/S_t} \frac{S_t^{ROW}}{S_t}\right) Y_t^{ROW,T}$. Thus, the solution to firm i 's profit maximisation problem gives the following optimal price setting rules under the assumption of external currency pricing for the domestic and foreign market respectively:

$$P_t^{T(*)} = \mu^T \sum_{s=0}^{\infty} \frac{E_t \left[(\omega^T \beta)^s Q_{t,t+s} V_{t+s}^T Y_{t+s}^{D,T} \right]}{E_t \left[(\omega^T \beta)^s Q_{t,t+s} Y_{t+s}^{D,T} \right]} \quad (27)$$

$$P_t^{T^{*}(*)} = \mu^T \sum_{s=0}^{\infty} \frac{E_t \left[(\omega^T \beta)^s Q_{t,t+s} V_{t+s}^T Y_{t+s}^{x,T} \right]}{E_t \left[(\omega^T \beta)^s Q_{t,t+s} S_{t+s} Y_{t+s}^{x,T} \right]} \quad (28)$$

$$\text{where } \mu^T = \frac{\theta^T}{\theta^T - 1}$$

Firms following external currency pricing selling their products to the domestic market set their price as derived in equation (27), which is the same as in the case of producer currency pricing; while firms exporting their good set their pricing decision as in equation (28), where the price depends on the marginal cost (V_t^T) adjusted for currency units (S_t). Thus, the domestic and foreign optimal price setting rules state that intermediate traded good producing firms adjusting their prices will choose an optimal price that is equal to the desired constant markup μ^T over a weighted average of the future marginal cost V_{t+s}^T . Thus, $P_t^{T(*)}$ and $P_t^{T^{*}(*)}$ is the average price of intermediate traded good selling at home and foreign markets for firms allowed to reset their prices in period t . As $\omega^T \rightarrow 0$ and intermediate traded good prices become perfectly flexible, then all differentiated traded good producing firms are able to reset their prices at each period, hence $P_t^{T(*)} \rightarrow \mu^T V_t^T$ and $P_t^{T^{*}(*)} \rightarrow \mu^T \frac{V_t^T}{S_t}$. At symmetric equilibrium, all differentiated traded good producing firms adjusting their prices at period t choose the same price, while firms not adjusting their price choose last period's price.¹² Thus, the average price of intermediate traded good under the assumption of pricing-to-market in the domestic market and external currency pricing at the foreign market is respectively given by:

¹²Note that the i subscript is dropped due to assuming symmetry among firms.

$$P_t^T = \left[\omega^T (P_{t-1}^T)^{1-\theta^T} + (1 - \omega^T) (P_t^{T(*)})^{1-\theta^T} \right]^{\frac{1}{1-\theta^T}} \quad (29)$$

$$P_t^{T*} = \left[\omega^T (P_{t-1}^{T*})^{1-\theta^T} + (1 - \omega^T) (P_t^{T*(*)})^{1-\theta^T} \right]^{\frac{1}{1-\theta^T}} \quad (30)$$

4.9 Model III: ECP for the Differentiated Traded Good and LCP for the Differentiated Imported Goods

We explored in *Model II* the case where the differentiated intermediate traded good is invoiced at external currency pricing while the differentiated imported good is selling at the LOOP. Now, we relax the assumption of LOOP for the imported good and allow for the possibility of local currency pricing (LCP). Hence this model focuses on the role of partial ERPT into both differentiated intermediate traded goods which price is set at ECP and differentiated intermediate imports which price is set at LCP. Firms importing foreign factor inputs solve a similar profit maximisation problem to the one differentiated non-traded good producing firms solved earlier in section (4.3). Each firm in the differentiated intermediate imported stage sets price in a staggered fashion in the spirit of Calvo (1983). In this framework, $(1 - \omega^M)$ fraction of firms adjust their prices optimally. Thus, ω^M is the probability that firm k does not change its price in period t . Hence, firms resetting the price choose the new price $P_t^{M(*)}$ to maximize their expected present value of future stream of profit subject to meeting the demand for the good (19), as follows:

$$\max_{\{Y_t^M\}} \Pi = E_t \sum_{s=0}^{\infty} (\omega^M \beta)^s Q_{t,t+s} \left[P_t^{M(*)} - V_{t+s}^m \right] Y_{k,t+s}^M$$

$$\text{s.t. } Y_{k,t}^M = (1 - \alpha_T) \left(\frac{V_t^T}{S_t P_t^{M*}} \right)^\gamma \int_0^1 Y_{i,t}^T di$$

$$\text{and } Y_{k,t}^M = \left(\frac{P_{k,t}^M}{P_t^M} \right)^{-\theta^M} Y_t^M$$

A typical differentiated intermediate foreign good importing firm discounts its future stream of profit at the rate $\beta^s Q_{t,t+1}$, while it takes as given the paths of its marginal cost being the foreign price of the imported good $V_t^M = S_t P_t^{M*}$, total demand for imported good by the

traded good sector Y_t^M , and aggregate price index of the sector P_t^M , where $(P_{k,t}^M/P_t^M)^{-\theta^M}$ is the price of the k^{th} differentiated intermediate imported good relative to the price index of all such goods, where the demand for the k^{th} differentiated intermediate imported input will be higher, the lower its price relative to the price index, governed by θ^M the elasticity of substitution between differentiated imported goods. Solving firm k 's profit maximisation problem gives the following optimal price decision:

$$P_t^{M(*)} = \mu^M \sum_{s=0}^{\infty} \frac{E_t [(\omega^M \beta)^s Q_{t,t+s} V_{t+s}^M Y_{t+s}^M]}{E_t [(\omega^M \beta)^s Q_{t,t+s} Y_{t+s}^M]} \quad (31)$$

where $\mu^M = \frac{\theta^M}{\theta^M - 1}$

Equation (31) states that firms adjusting their prices will choose a price that is equal to the desired markup μ^M over a weighted average of the future marginal cost V_{t+s}^M being the foreign price of the imported good. The staggered optimal pricing decision for the differentiated imported good allows for delay between movements in the nominal exchange rate and the adjustment of imported goods prices, thus affecting the dynamics of domestic prices. The more staggered the domestic price for the differentiated imported good the lower will be the rate of ERPT, implying partial ERPT. While as $\omega^M \rightarrow 0$, the differentiated imported good prices become perfectly flexible, then all firms importing the differentiated foreign input are able to reset their prices at each period, hence $P_t^{M(*)} \rightarrow \mu^M V_t^M$, implying complete ERPT.

At symmetric equilibrium, all firms adjusting their prices at period t choose the same price, while firms not adjusting their price choose last period's price P_{t-1}^M .¹³ Thus, the average price of differentiated imported goods is given by:

$$P_t^M = \left[\omega^M (P_{t-1}^M)^{1-\theta^M} + (1 - \omega^M) (P_t^{M(*)})^{1-\theta^M} \right]^{\frac{1}{1-\theta^M}} \quad (32)$$

5 The Monetary Authority

The instrument of the monetary policy authority is the short-term nominal interest rate R_t .¹⁴ Following Taylor (1993), the nominal interest rate rule is a linear function of the gap between the inflation rate and

¹³Note that the k subscript is dropped due to assuming symmetry among firms.

¹⁴As the monetary policy rule is specified as an interest rate rule, we can abstract from money. This provides another reason for treating money as a unit of account than explicitly representing money in the utility function or the budget constraint.

its target and the gap between real output and long-run output levels. This paper adopts a variant of Taylor (1993). The monetary authority sets the interest rate in response to the deviation of non-traded good price inflation, being the inflation of aggregate consumption basket for the representative household, or CPI inflation in our model π_t^N from its steady state level $\bar{\pi}^N$ and the nominal exchange rate S_t from its steady state level \bar{S} . Due to the focus of this paper on the transmission of external shocks in a model with a vertical production and trade chains for the small open EME, and to isolate the model from other shocks we ignore a monetary policy shock in the policy rule. Thus, the monetary policy rule is given by:

$$\left(\frac{r_t}{\bar{r}}\right) = \left(\frac{P_t^N}{P_{t-1}^N} \frac{1}{\bar{\pi}^N}\right)^{\gamma_{\pi^N}} \left(\frac{S_t}{\bar{S}}\right)^{\gamma_s} \quad (33)$$

where the parameter γ_{π^N} defines the stance the monetary authority towards CPI stability and in turn exchange rate policy, where the higher the parameter $\gamma_{\pi^N} \rightarrow \infty$, the more strict the monetary authority is on the deviation of CPI from its steady state level of inflation $\bar{\pi}^N$. Thus, the monetary authority is said to follow a flexible exchange rate regime or a *float*. The parameter γ_s is the weight the monetary authority puts on nominal exchange rate stability, where the higher the parameter $\gamma_s \rightarrow \infty$, the more strict the monetary authority is on the deviation of S_t from its steady state level \bar{S} . In this case, the monetary authority follows a fixed or *pegged* exchange rate regime.

6 Market Clearing and Equilibrium Conditions

The equilibrium system of equations for *Model I* consists of 23 endogenous variables, out of which 2 are state variables, 14 are static variables and 7 are forward looking variables. While the equilibrium system of equations for *Model II* consists of 28 endogenous variables, out of which 2 are state variables, 18 are static variables and 8 are forward looking variables. Moreover, the equilibrium system of equations for *Model III* consists of 30 endogenous variables, out of which 3 are state variables, 16 are static variables and 11 are forward looking variables. Endogenous variables in the model are C_t, L_t, B_t, W_t for the representative household; $Y_t^N, Y_t^{D,T}, l_t^N, P_t^N, V_t^N$ and π_t^N for finished non-traded good producers $j \in (0, 1)$; $Y_t^T, Y_t^{x,T}, l_t^T, P_t^T, V_t^T$ for intermediate traded good producers; Y_t^M, P_t^M, V_t^M for intermediate imported good producers; together with the nominal interest rate r_t , nominal and real exchange rates S_t, rer_t , terms of trade τ_t , relative prices q_t, z_t , net exports nx_t and gross domestic product Y_t , which satisfy the following conditions: (i) the household's allocations solve its utility maximisation problem when taking prices and

wages as given; (ii) finished non-traded good producer's allocations solve its profit maximisation problem, when taking all input prices except its own as given; (iii) intermediate traded good producer's allocations solve its profit maximisation problem, when taking all input prices except its own as given; (iv) markets for bonds, labour, and each good along the production chain clears; (v) monetary authority short-term interest rate rule is described by the general rule in (33).

Due to the assumption of zero international capital mobility, the only bond in our small open emerging market economy is the domestic discount bond B_t , where its market clearing condition is $B_t = 0$ for all t . This implies that net exports, denoted by NX_t , is equal to zero $NX_t = 0$, which ensures that the balance of payments identity is satisfied. In addition, the market clearing condition for the final non-traded good Y_t^N is given by:

$$Y_t^N = C_t \quad (34)$$

In the small open EME model presented above, and in the absence of government expenditure and investment, the real gross domestic product is defined as the sum of the value added of each sector plus net exports, where in the case of a vertical input-output production structure the value added of the six-sector production chain is that of the non-traded finished sector. Thus, we calculate the real gross domestic product using the value added approach with the non-traded good price as the numeraire, which is represented by:

$$Y_t = Y_t^N + NX_t \quad (35)$$

where $NX_t = 0$

The labour market clearing condition for labour in both the final non-traded and intermediate traded good sectors, given by equations (10) and (18), is given by:

$$L_t = l_t^N + l_t^T \quad (36)$$

where $l_t^N = \int_0^1 l_{j,t}^N dj$ and $l_t^T = \int_0^1 l_{i,t}^T di$

Thus, in equilibrium labour, goods and bonds markets clear and the monetary policy is specified. Tables 3, 4 and 5 present the log-linearised equilibrium conditions around the steady state for Models I, II and III presented above.¹⁵

¹⁵We use lowercase letters with a hat to denote log-linearised variables around their steady state.

$$\begin{aligned}
\hat{y}_t &= \hat{y}_t^N + \hat{n}x_t \\
\text{where } \hat{q}_t &= \hat{p}_t^T - \hat{p}_t^N \\
\hat{c}_t &= E_t \{ \hat{c}_{t+1} \} - \frac{1}{\sigma} \left(\hat{r}_t - E_t \{ \hat{\pi}_{t+1}^N \} + E_t \{ \hat{\xi}_{t+1} - \hat{\xi}_t \} \right) \\
\hat{w}_t - \hat{p}_t^N &= \sigma \hat{c}_t + \varphi \hat{l}_t - \hat{\xi}_t \\
\hat{y}_t^N &= \phi \hat{y}_t^{D,T} + (1 - \phi) \hat{l}_t^N + (1 - \phi) \hat{a}_t^N \\
\hat{l}_t^N &= -\phi \varphi \hat{l}_t + (1 - \phi \sigma) \hat{c}_t + \phi \hat{q}_t + \phi \hat{\xi}_t - (1 - \phi) \hat{a}_t^N \\
\hat{y}_t^{D,T} &= [(1 - \phi) \varphi] \hat{l}_t + [(1 - \phi) \sigma + 1] \hat{c}_t + (\phi - 1) \hat{q}_t - (1 - \phi) [\hat{\xi}_t + \hat{a}_t^N] \\
\hat{\pi}_t^N &= \beta E_t \{ \hat{\pi}_{t+1}^N \} + \kappa^N \left\{ [(1 - \phi) \varphi] \hat{l}_t + [(1 - \phi) \sigma] \hat{c}_t + \phi \hat{q}_t - (1 - \phi) [\hat{\xi}_t + \hat{a}_t^N] \right\} \\
\hat{y}_t^T &= (1 - \delta) \hat{l}_t^T + \delta \hat{y}_t^M + (1 - \delta) \hat{a}_t^T \\
\text{where } \delta &= (1 - \alpha^T)^{\frac{1}{\gamma}} \left(\frac{Y^M}{Y^T} \right)^{\frac{\gamma-1}{\gamma}} \\
\hat{l}_t^T &= (-\gamma \varphi \rho) \hat{l}_t - (\gamma \sigma \rho) \hat{c}_t + (\gamma \rho) \hat{z}_t + \hat{y}_t^T + (\gamma \rho) \hat{\xi}_t - \hat{a}_t^T \\
\text{where } \rho &= (1 - \alpha^T) \left(\frac{SP^{M*}}{v^T} \right)^{(1-\gamma)} = (1 - \alpha^T) \left(\frac{1}{v^T} \right)^{(1-\gamma)} \\
\hat{z}_t &= \hat{p}_t^M - \hat{p}_t^N \\
\hat{y}_t^M &= [\gamma (1 - \rho) \varphi] \hat{l}_t + [\gamma (1 - \rho) \sigma] \hat{c}_t + [\gamma (\rho - 1)] \hat{z}_t + \hat{y}_t^T - [\gamma (1 - \rho)] \hat{\xi}_t \\
\hat{\pi}_t^T &= \beta E_t \{ \hat{\pi}_{t+1}^T \} + \kappa^T \left\{ [(1 - \rho) \varphi] \hat{l}_t + [(1 - \rho) \sigma] \hat{c}_t + \rho \hat{z}_t - (1 - \rho) \hat{\xi}_t \right\} \\
\hat{y}_t^{x,T} &= -\mu [\hat{p}_t^{T*} - \hat{p}_t^*] + \hat{x}_t \\
\hat{n}x_t &= \left(\hat{q}_t + \hat{y}_t^{x,T} \right) - (\hat{z}_t + \hat{y}_t^M) = 0 \\
\widehat{rer}_t &= \hat{s}_t + \hat{p}_t^* - \hat{p}_t^N \\
\hat{\tau}_t &= \hat{s}_t + \hat{p}_t^{M*} - \hat{p}_t^T \\
\hat{p}_t^M &= \hat{s}_t + \hat{p}_t^{M*} \\
\hat{y}_t^T &= \hat{y}_t^{D,T} + \hat{y}_t^{x,T} \\
\hat{l}_t &= \left[\frac{l^N}{l} \right] \hat{l}_t^N + \left[\frac{l^T}{l} \right] \hat{l}_t^T \\
\hat{r}_t &= \gamma_{\pi^N} \hat{\pi}_t^N + \gamma_s \hat{s}_t
\end{aligned}$$

Table 3: Equilibrium Conditions for Model I

7 Parametrisation

This section reports the benchmark parameter values used in solving the model. The model is calibrated using emerging market economies data, and in particular for South Korea, Malaysia and Thailand. Benchmark parameters are summarised in Table 6.

7.1 Preferences

This section specifies the parameters that govern household consumption, labour supply, and asset holding decisions. Some standard parameter values govern household preferences, such as the intertemporal elasticity of substitution in consumption, which is assumed to be 0.5, implying a coefficient of relative risk aversion σ of 2 as reported by Backus *et al.* (1994). Devereux *et al.* (2006) use a quarterly discount factor β of 0.985. Following Christiano *et al.* (1997), we set the elasticity of labour supply parameter φ to unity. The parameter χ measures the weight on labour supply and therefore leisure in the utility function, which is set to unity.

7.2 Vertical Production and Trade Chain

Production in the modelled economy is characterised by composite and differentiated non-traded and composite and differentiated traded sectors which are vertically linked in an input-output production chain. The parameter $\phi = 0.62$ governs the share of traded good input in non-traded good production. This share is consistent with Sanchez's (2007) estimate for 15 EMEs. In addition, we set the share of labour in traded good production $\alpha_T = 0.3$, which implies that the share of imported inputs in the production of Y_t^T is 0.7, as estimated by Cook and Devereux (2006a) for Malaysia and Thailand. The elasticity of substitution between domestic labour and imported intermediate inputs in the differentiated traded good sector is set to $\gamma = 0.05$. This represents the case of weak input substitution between domestic and imported factor inputs in traded good production.

The degree of differentiated non-traded and intermediate traded good price rigidity is governed by the parameters ω^N and ω^T , respectively. Evidence by Bils and Klenow (2004) and Ortega and Rebei (2006) shows considerable degree of heterogeneity in price setting practices across different sectors. Due to limited sectoral data for EMEs, we follow estimates for sectoral price rigidity by Phaneuf and Rebei (2008) and Cook and Devereux (2006b). The parameters ω^N and ω^T are the probabilities that non-traded and traded good prices do not change are taken as 0.63347 and 0.82800, respectively. These probabilities imply that

$$\begin{aligned}
\hat{y}_t &= \hat{y}_t^N + \hat{n}x_t \\
\text{where } \hat{q}_t &= \hat{p}_t^T - \hat{p}_t^N \\
\hat{c}_t &= E_t \{ \hat{c}_{t+1} \} - \frac{1}{\sigma} \left(\hat{r}_t - E_t \{ \hat{\pi}_{t+1}^N \} + E_t \{ \hat{\xi}_{t+1} - \hat{\xi}_t \} \right) \\
\hat{w}_t - \hat{p}_t^N &= \sigma \hat{c}_t + \varphi \hat{l}_t - \hat{\xi}_t \\
\hat{y}_t^N &= \phi \hat{y}_t^{D,T} + (1 - \phi) \hat{l}_t^N + (1 - \phi) \hat{a}_t^N \\
\hat{l}_t^N &= -\phi \varphi \hat{l}_t + (1 - \phi \sigma) \hat{c}_t + \phi \hat{q}_t + \phi \hat{\xi}_t - (1 - \phi) \hat{a}_t^N \\
\hat{y}_t^{D,T} &= [(1 - \phi) \varphi] \hat{l}_t + [(1 - \phi) \sigma + 1] \hat{c}_t + (\phi - 1) \hat{q}_t - (1 - \phi) \hat{\xi}_t - (1 - \phi) \hat{a}_t^N \\
\hat{\pi}_t^N &= \beta E_t \{ \hat{\pi}_{t+1}^N \} + \kappa^N \left\{ [(1 - \phi) \varphi] \hat{l}_t + [(1 - \phi) \sigma] \hat{c}_t + \phi \hat{q}_t - (1 - \phi) [\hat{\xi}_t + \hat{a}_t^N] \right\} \\
\hat{y}_t^T &= (1 - \delta) \hat{l}_t^T + \delta \hat{y}_t^M + (1 - \delta) \hat{a}_t^T \\
\hat{l}_t^T &= (-\gamma \varphi \rho) \hat{l}_t - (\gamma \sigma \rho) \hat{c}_t + (\gamma \rho) \hat{z}_t + \hat{y}_t^T + (\gamma \rho) \hat{\xi}_t - \hat{a}_t^T \\
\text{where } \rho &= (1 - \alpha^T) \left(\frac{1}{v^T} \right)^{(1-\gamma)} \\
\hat{z}_t &= \hat{p}_t^M - \hat{p}_t^N \\
\hat{y}_t^M &= [\gamma (1 - \rho) \varphi] \hat{l}_t + [\gamma (1 - \rho) \sigma] \hat{c}_t + [\gamma (\rho - 1)] \hat{z}_t + \hat{y}_t^T - [\gamma (1 - \rho)] \hat{\xi}_t \\
\hat{\pi}_t^T &= \beta E_t \{ \hat{\pi}_{t+1}^T \} + \kappa^T \left\{ [(1 - \rho) \varphi] \hat{l}_t + [(1 - \rho) \sigma] \hat{c}_t + \rho \hat{z}_t - (1 - \rho) \hat{\xi}_t \right\} \\
\hat{y}_t^{US,T} &= -\mu \left[\hat{p}_t^{\$,T} - \hat{p}_t^{*(\$-CPI)} \right] + \hat{x}_t^{US} \\
\hat{y}_t^{ROW,T} &= -\mu \left[\hat{p}_t^{ROW,T} - \hat{p}_t^{*(ROW-CPI)} \right] + \hat{x}_t^{ROW} \\
\hat{n}x_t &= \left(\hat{q}_t^{\$} + \hat{y}_t^{US,T} \right) + \left(\hat{q}_t^{ROW} + \hat{y}_t^{ROW,T} \right) - \left(\hat{z}_t + \hat{y}_t^M \right) = 0 \\
\text{where } \hat{q}_t^{\$} &= \hat{p}_t^{\$,T} - \left(\hat{p}_t^N - \hat{s}_t \right) \text{ and } \hat{q}_t^{ROW} = \hat{p}_t^{ROW,T} + s \widehat{ROW} - \hat{s}_t - \left(\hat{p}_t^N - \hat{s}_t \right) \\
\widehat{rer}_t &= \hat{s}_t + \hat{p}_t^* - \hat{p}_t^N \\
\hat{\tau}_t &= \hat{s}_t + \hat{p}_t^{M*} - \hat{p}_t^T \\
\hat{p}_t^M &= \hat{s}_t + \hat{p}_t^{M*} \\
\hat{q}_t + \hat{y}_t^T &= \left(\hat{q}_t + \hat{y}_t^{D,T} \right) + \left(\hat{q}_t^{\$} + \hat{y}_t^{US,T} \right) + \left(\hat{q}_t^{ROW} + \hat{y}_t^{ROW,T} \right) \\
\hat{l}_t &= \left[\frac{l^N}{l} \right] \hat{l}_t^N + \left[\frac{l^T}{l} \right] \hat{l}_t^T \\
\hat{r}_t &= \gamma_{\pi^N} \hat{\pi}_t^N + \gamma_s \hat{s}_t
\end{aligned}$$

Table 4: Equilibrium Conditions for Model II

$$\begin{aligned}
\hat{y}_t &= \hat{y}_t^N + \hat{n}x_t \\
\text{where } \hat{q}_t &= \hat{p}_t^T - \hat{p}_t^N \\
\hat{c}_t &= E_t \{ \hat{c}_{t+1} \} - \frac{1}{\sigma} \left(\hat{r}_t - E_t \{ \hat{\pi}_{t+1}^N \} + E_t \{ \hat{\xi}_{t+1} - \hat{\xi}_t \} \right) \\
\hat{w}_t - \hat{p}_t^N &= \sigma \hat{c}_t + \varphi \hat{l}_t - \hat{\xi}_t \\
\hat{y}_t^N &= \phi \hat{y}_t^{D,T} + (1 - \phi) \hat{l}_t^N + (1 - \phi) \hat{a}_t^N \\
\hat{l}_t^N &= -\phi \varphi \hat{l}_t + (1 - \phi \sigma) \hat{c}_t + \phi \hat{q}_t + \phi \hat{\xi}_t - (1 - \phi) \hat{a}_t^N \\
\hat{y}_t^{D,T} &= [(1 - \phi) \varphi] \hat{l}_t + [(1 - \phi) \sigma + 1] \hat{c}_t + (\phi - 1) \hat{q}_t - (1 - \phi) \hat{\xi}_t - (1 - \phi) \hat{a}_t^N \\
\hat{\pi}_t^N &= \beta E_t \{ \hat{\pi}_{t+1}^N \} + \kappa^N \left\{ [(1 - \phi) \varphi] \hat{l}_t + [(1 - \phi) \sigma + 1] \hat{c}_t + \phi \hat{q}_t - (1 - \phi) [\hat{\xi}_t + \hat{a}_t^N] \right\} \\
\text{where } \kappa^N &= \frac{(1 - \omega^N)(1 - \omega^N \beta)}{\omega^N} \\
\hat{y}_t^T &= (1 - \delta) \hat{l}_t^T + \delta \hat{y}_t^M + (1 - \delta) \hat{a}_t^T \\
\hat{l}_t^T &= (-\gamma \varphi \rho) \hat{l}_t - (\gamma \sigma \rho) \hat{c}_t + (\gamma \rho) \hat{z}_t + \hat{y}_t^T + (\gamma \rho) \hat{\xi}_t - \hat{a}_t^T \\
\text{where } \rho &= (1 - \alpha^T) \left(\frac{1}{v^T} \right)^{(1 - \gamma)} \\
\hat{z}_t &= \hat{p}_t^M - \hat{p}_t^N \\
\hat{y}_t^M &= [\gamma (1 - \rho) \varphi] \hat{l}_t + [\gamma (1 - \rho) \sigma] \hat{c}_t + [\gamma (\rho - 1)] \hat{z}_t + \hat{y}_t^T - [\gamma (1 - \rho)] \hat{\xi}_t \\
\hat{\pi}_t^T &= \beta E_t \{ \hat{\pi}_{t+1}^T \} + \kappa^T \left\{ [(1 - \rho) \varphi] \hat{l}_t + [(1 - \rho) \sigma] \hat{c}_t + \rho \hat{z}_t - (1 - \rho) \hat{\xi}_t \right\} \\
\text{where } \kappa^T &= \frac{(1 - \omega^T)(1 - \omega^T \beta)}{\omega^T} \\
\hat{y}_t^{US,T} &= -\mu \left[\hat{p}_t^{\$,T} - \hat{p}_t^{*(\$CPI)} \right] + \hat{x}_t^{US} \\
\hat{y}_t^{ROW,T} &= -\mu \left[\hat{p}_t^{ROW,T} - \hat{p}_t^{*(ROWCPI)} \right] + \hat{x}_t^{ROW} \\
\hat{n}x_t &= \left(\hat{q}_t^{\$} + \hat{y}_t^{US,T} \right) + \left(\hat{q}_t^{ROW} + \hat{y}_t^{ROW,T} \right) - \left(\hat{z}_t + \hat{y}_t^M \right) = 0 \\
\text{where } \hat{q}_t^{\$} &= \hat{p}_t^{\$,T} - \left(\hat{p}_t^N - \hat{s}_t \right) \text{ and } \hat{q}_t^{ROW} = \hat{p}_t^{ROW,T} + s \widehat{ROW}_{-s_t} - \left(\hat{p}_t^N - \hat{s}_t \right) \\
\widehat{rer}_t &= \hat{s}_t + \hat{p}_t^* - \hat{p}_t^N \\
\hat{r}_t &= \hat{s}_t + \hat{p}_t^{M*} - \hat{p}_t^T \\
\hat{\pi}_t^m &= \beta E_t \{ \hat{\pi}_{t+1}^m \} + \kappa^m \{ \hat{v}_t^m \} \\
\text{where } \hat{v}_t^m &= \hat{s}_t + \hat{p}_t^{m*} - \hat{p}_t^N, \quad \kappa^m = \frac{(1 - \omega^m)(1 - \omega^m \beta)}{\omega^m} \\
\hat{y}_t^T &= \hat{y}_t^{D,T} + \left(\hat{p}_t^{\$,T} - \hat{p}_t^T \right) + \hat{y}_t^{US,T} + \left(\hat{p}_t^{ROW,T} - \hat{p}_t^T \right) + \hat{y}_t^{ROW,T} \\
\hat{l}_t &= \left[\frac{l^N}{l} \right] \hat{l}_t^N + \left[\frac{l^T}{l} \right] \hat{l}_t^T \\
\hat{r}_t &= \gamma_{\pi^N} \hat{\pi}_t^N + \gamma_s \hat{s}_t
\end{aligned}$$

Table 5: Equilibrium Conditions for Model III

Description	Parameter	Value		
Household's subjective discount factor	β	0.985		
Coefficient of relative risk aversion	σ	2		
Intertemporal elasticity of labour	φ	1		
Coefficient in the utility function on labour	χ	1		
Share of traded in non-traded good production	ϕ	0.62		
Share of labour in traded good production	α_T	0.3		
Elasticity of substitution between factor inputs	γ	0.05		
Probability y_t^N price doesn't change	ω^N	0.63347		
Probability y_t^T price doesn't change	ω^T	0.82800		
Elasticity of substitution for differentiated goods	$\theta^N, \theta^T, \theta^M$	11		
<i>Exchange rate pass-through (ERPT)</i>				
Probability y_t^M price does not change	ω^M	0	<i>full ERPT</i>	<i>partial ERPT</i>
				0.82800
<i>Exchange rate regime</i>				
Weight in Taylor rule on CPI inflation	γ_{π^N}	999	<i>float</i>	<i>peg</i>
Weight in Taylor rule on nominal exchange rate	γ_s	0		0
				999

Table 6: Calibration of the Benchmark Model for Emerging Market Economies

the non-traded good price is reset every 2.9 quarters on average, while traded good price is re-optimised every 5 quarters. While the degree of imported input price rigidity is governed by the parameter ω^M , which takes the value 0.82800 to represent the case of partial ERPT and 0 for the case of full ERPT. The elasticity of substitution between varieties of differentiated non-traded, traded and imported goods θ^N , θ^T , and θ^M is set to 11, as calibrated in Devereux *et al.* (2006). The choice of θ^N , θ^T , and θ^M implies a steady state mark-up in each of two sectors of 10%, as reported by Basu and Fernald (1997).

7.3 Monetary Policy

The monetary authority follows a variant of the Taylor-rule presented in equation (33) where the monetary authority sets the interest rate in response to the deviations of CPI inflation π_t^N from its steady state target $\bar{\pi}^N$ and nominal exchange rate from its steady state level \bar{s} . We consider two exchange rate regimes: a floating and a fixed exchange rates policy. Hence, the weights assigned to the various objectives in the monetary authority's interest rate rule are $\gamma_{\pi^N} = 999$ and $\gamma_s = 0$ in the case the monetary authority targets CPI stability and thus follows a floating exchange rate regime. In contrast, if the monetary authority targets

nominal exchange rate stability and thus follows a fixed exchange rate regime, then the weight it assigns to individual objectives in its interest rate rule are $\gamma_{\pi^N} = 0$ and $\gamma_s = 999$.

8 Dynamics of the Model

Through numerical simulations, we analyse the macroeconomic effects in response to external shocks for the small open EME according to our baseline calibration presented in Table 6. We consider two external shocks, these are: foreign demand and imports price shocks under two alternative exchange rate regimes - a flexible and fixed exchange rate regimes. In addition, we undertake robustness checks on the sensitivity of the model to different calibrations of key parameters driving the results, these are: the elasticity of substitution between domestic and imported factor inputs γ , and the degree of exchange rate pass-through into imports ω^M . First-order approximations were used to compute moments and impulse response functions presented below via Dynare where the model is solved using the method of generalised Schur decomposition.¹⁶ The choice of first-order approximation of the model is primarily driven by the model featuring monopolistic competition, which creates first-order distortion, the effect of which on the model dynamics dominates those of higher order approximations for small shocks. Thus, it is sufficient for our analysis of the transmission mechanism of external shocks to EMEs to examine the first-order approximation of the system of equations following small shocks.

To address the question whether export pricing explains ‘fear of floating’ by small open EMEs, we study three alternative models each presents a different optimal price-setting decision for both/one of exports and/or imports sectors *Model I* is our benchmark model, where differentiated traded good prices are rigid in producer’s currency pricing and differentiated imported goods are priced at the LOOP, implying full exchange rate pass-through. *Model II* considers a variation in the optimal price decision of differentiated traded goods, namely external currency pricing (ECP), while differentiated imported goods are priced at the LOOP. *Model III* examines the case where differentiated traded good price is rigid in ECP and differentiated imported goods are staggered due to monopolistic importing firms following local currency pricing, which allows us to study partial exchange rate pass-through into domes-

¹⁶Using generalised Schur decomposition we are able to reduce the equilibrium system of equations into blocks of equations, separating the system into stable and unstable blocks of equations. Then, the stable solution is obtained by solving the unstable block forward and the stable block backwards. See Klein (2000) and Collard and Juillard (2003) for details of the solution method.

tic production costs. Due to the monopolistic power of both intermediate traded and imported goods firms over their differentiated goods, which are imperfect substitutes to each other, the firms are able to price discriminate resulting in partial exchange rate pass-through into domestic prices.

9 Foreign Demand Shock

9.1 Model I: PCP for Traded Good and LOOP for the Imported Good

In the benchmark model, the traded good price is rigid in producer currency pricing and the intermediate imported good is set at the LOOP. This implies that both exports and imports are selling at the LOOP in the international goods market. Therefore, *Model I* focuses mainly on the role of weak input substitution between domestic and imported factor inputs in a vertical production and trade chains. Within this framework, we study the macroeconomic effects of a persistent positive foreign demand shock under flexible and fixed exchange rate regimes given the price setting of tradeables, as presented in Figure 2. In Figure 2, the impulse responses of the benchmark model under a flexible exchange rate regime are depicted by a dotted line, while a fixed exchange rate regime are represented by a solid line.

Following an unexpected positive foreign demand shock, and under a floating exchange rate regime the nominal and real exchange rate depreciate, as shown in panel (I and L). In the absence of the assumption of weak input substitution between factor inputs, and when traded good prices are set in PCP, the exchange rate plays a key role in facilitating relative price adjustment in response to a positive foreign demand shock. However, the assumption of weak input substitution between factor inputs in the traded sector as in (17) weakens the adjustment role of exchange rate and thus producer expenditure-switching between domestic and imported factor inputs is of secondary importance and limited by the low degree of inputs' substitutability. This is represented from Figure 8, which presents various degrees of input substitution and shows that with higher degree of input substitution exchange rate flexibility allows for relative price adjustment.

In response to the shock and under both policy regimes, traded sector output increases, and so does its demand for factor inputs, accompanied by a slight drop in its slowly adjusting price due to PCP from equation (25), and producer price index (PPI), as shown in panels (D-G). From equation (16) for the non-traded good price inflation, and given the drop in the marginal cost of non-traded good production triggered

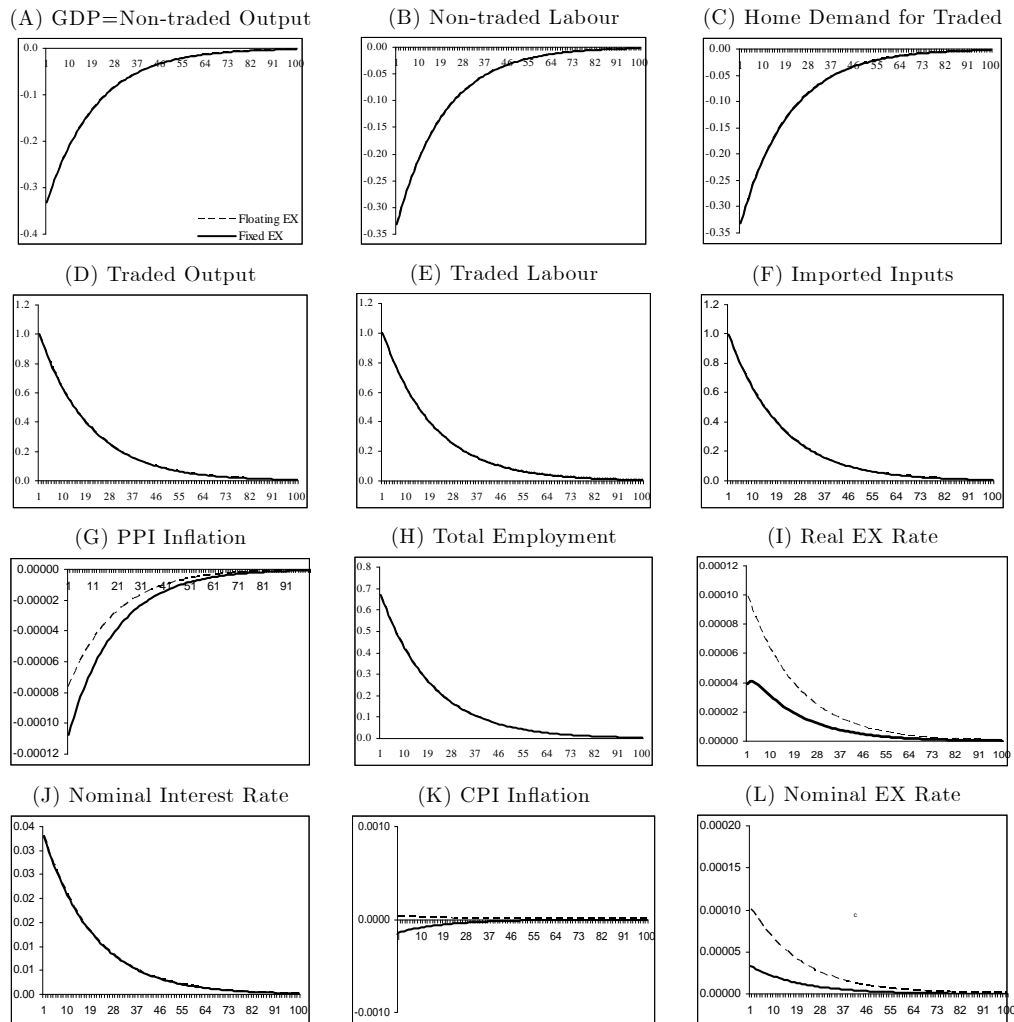


Figure 2: Model I Impulse Responses to Foreign Demand Shock
 Note: The horizontal axis on the diagrams shows the time horizon, where one period in the model is equivalent to one quarter and the vertical axis shows the extent of the response of macroeconomic variables to the shock studied measured in percent.

by the drop in real wages and PPI, CPI is stabilised under both regimes, as shown in panels (G and K). Due to the presence of a vertical production structure and the expansion of the intermediate traded sector to meet the unexpected increase in foreign demand, the non-traded sector shrinks, resulting in a drop in the non-traded sector labour employment and demand for intermediate traded input, panels (A-C). Nevertheless, under both exchange rate regimes the positive impact of the foreign demand shock on traded sector employment dominates the drop in non-traded sector employment, which results in an overall increase in total employment as shown in panels (B, E and H).

From equation (35) defining gross domestic product, and given vertical input-output production structure, GDP equates to non-traded sector output, where we use non-traded good price as the numeraire. In the presence of a vertical production structure and the expansion of the intermediate traded sector to meet the unexpected increase in foreign demand results in both non-traded sector production and GDP dropping, panel (A). Thus, the nominal interest rate under both exchange rate regimes slightly rises, implying a contractionary monetary policy, panel (J). Under a floating exchange rate regime, the nominal exchange rate depreciates followed by expected appreciation, which triggers an increase in exports which translates into a 1 percent increase in traded sector output, panel (D). Overall and under both flexible and fixed exchange rate regimes, a positive foreign demand shock to the traded sector is equivalent to a negative income shock leading to a decline in consumption and a rise in total employment, where total non-traded output is equal to consumption, as shown in panels (A and H). Considering the benchmark case presented in Model I, we can see that when the economy is constrained by weak input substitution between domestic and imported factor inputs, this mutes the expenditure-switching effect of exchange rate adjustment, where both exchange rate regimes yield similar responses of real macroeconomic variables to the foreign demand shock.

9.2 Model II: ECP for the Intermediate Traded Good and LOOP for the Imported Good

Model II presents the case where the intermediate traded good price is set in external currency pricing (ECP) being the dollar, while the imported good is priced at the LOOP, implying complete ERPT into domestic prices. Hence, *Model II* assumes weak input substitution between factor inputs in the traded sector, while introducing an empirically relevant feature to East Asian small open EMEs that is intermediate traded good prices being sticky in the invoicing trade currency, being the dollar.

Within this framework, we study the macroeconomic effects of a persistent favorable foreign demand shock under flexible and fixed exchange rate regimes given *Model II* price setting of tradeables, as presented in Figure 3. In Figure 3, the impulse responses of *Model II* under a flexible exchange rate regime are depicted by a dotted line, while a fixed exchange rate regime are represented by a solid line.

Following an unexpected positive foreign demand shock originating from US demand for the domestic traded good, flexible exchange rate regime delivers almost insignificant nominal exchange rate depreciation. This result is due to the assumption of external currency pricing of the traded good, while under a fixed exchange rate regime the nominal exchange rate is stabilised by default, as shown in panel (L). Under the assumption of external currency pricing for the intermediate traded good in equation (28), modest nominal exchange rate depreciation does *not* translate into an increase in ROW exports, as shown in panel (N), where the demand for the traded good by ROW is not affected by the exchange rate adjustment in the case of a flexible exchange rate regime. Moreover, nominal exchange rate depreciation does not impact the demand for intermediate imported inputs, which is expected to drop due to its higher price compared to the domestic factor input. However, due to the assumption of weak input substitution between factor inputs in the traded sector, this inhibits the adjustment role of exchange rate and thus does not induce substitution between domestic and imported factor inputs, as shown in panel (E and F). Rather, a positive foreign demand shock has a negative income effect where aggregate output and consumption decline while total employment rises, as shown in panels (A and H).

In response to a positive US demand shock for the intermediate traded good and under both exchange rate regimes traded sector output increases with an increase in the demand for its factor inputs due to the assumption of weak input substitution, as shown in panels (D-F). The combination of exchange rate depreciation and weak input substitution between factor inputs increases the price of the imported input, and therefore PPI modestly rises (drops) under flexible (fixed) exchange rate regime, panel (G). With a vertical production structure and in response to a positive foreign demand shock, non-traded good production drops and so does the demand for its factor inputs due to the increase in its cost of production from equation (12) given by a rise (slight drop) in PPI and real wages, resulting in an increase (slight drop) in CPI inflation under flexible (fixed) exchange rate regime, panels (A-C, G, K and M). We note that there is a monotonic relation between the nominal exchange rate and CPI. Therefore, under a flexible exchange rate regime, and given the interest rate rule in equation (33), the rise in CPI

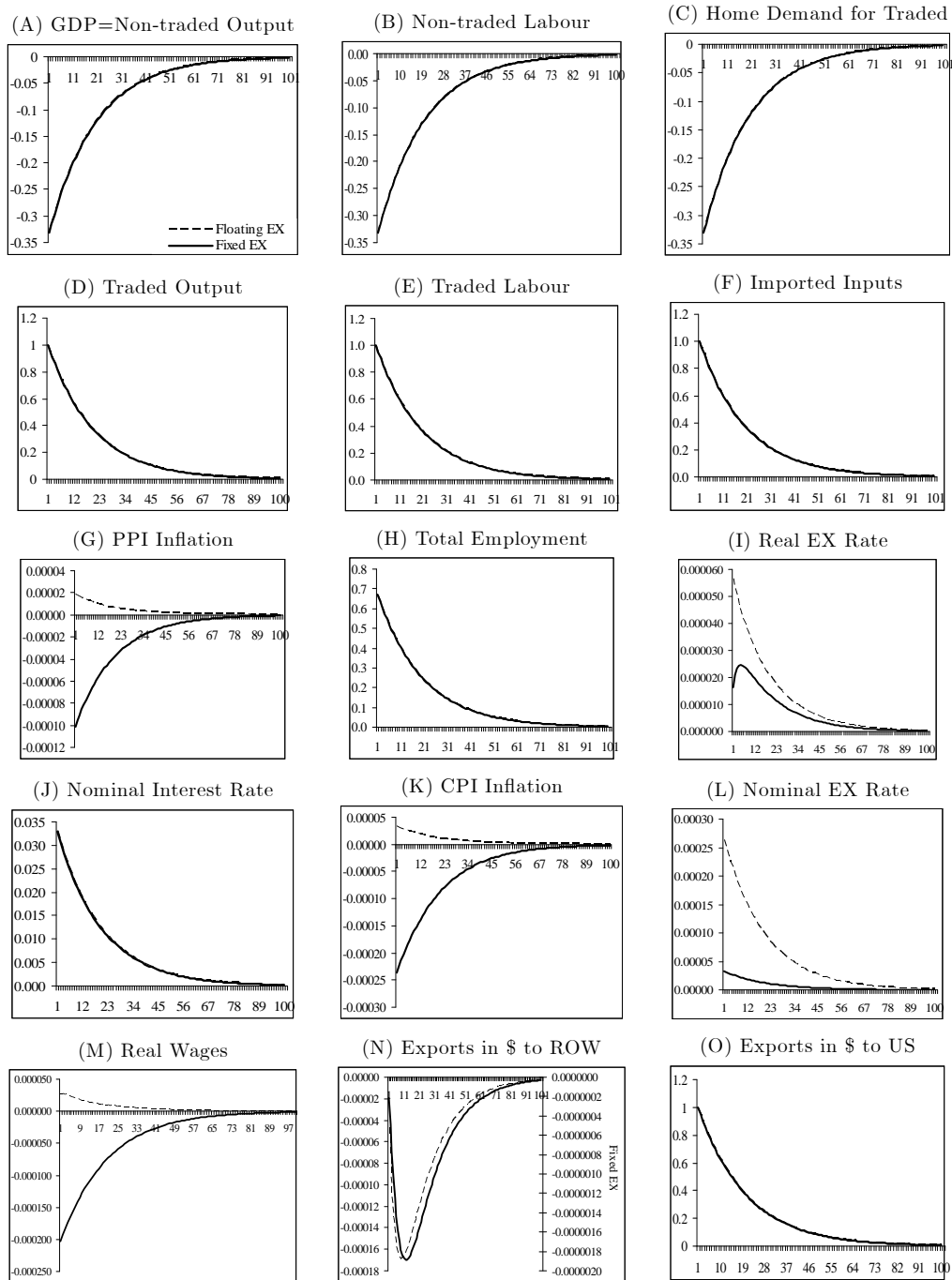


Figure 3: Model II Impulse Responses to Foreign Demand Shock
 Note: The horizontal axis on the diagrams shows the time horizon, where one period in the model is equivalent to one quarter and the vertical axis shows the extent of the response of macroeconomic variables to the shock studied measured in percent.

inflation coupled with nominal exchange rate depreciation results in a contractionary monetary policy and thus a drop in GDP, panels (A and J).

9.3 Model III: ECP for the Intermediate Traded Good and LCP for Imported Goods

Model III presents the case where the intermediate traded good price is set in external currency pricing, while the imported good is set in local currency pricing (LCP) implying partial ERPT into domestic prices. Hence, we build *Model III* on the assumption of weak input substitution among factor inputs in the traded sector, ECP of the traded good and delayed ERPT into imports prices, since all these features are trade-related features relevant to East Asian small open EMEs. *Model III* enables us to study the macroeconomic effects of a positive US demand shock under flexible and fixed exchange rate regimes given tradeables price setting decisions presented in Figure 4. In Figure 4, the impulse responses of *Model III* under a flexible exchange rate regime are depicted by a dotted line, while a fixed exchange rate regime are represented by a solid line.

Under a floating (fixed) exchange rate regime and following a positive foreign demand shock to the intermediate traded sector, the nominal exchange rate appreciates (stabilised by default) and the terms of trade deteriorates (fairly stabilised) due to the high correlation between the nominal exchange rate and the terms of trade, as shown in panels (L and M). Thus, the model captures high correlation between the nominal exchange rate and the terms of trade, as shown by Obstfeld and Rogoff (2000b) to be driven mainly by sticky relative prices of imports to exports.

Exchange rate adjustment should trigger producers' 'expenditure-switching' between factor inputs, however, the joint effect of weak input substitution assumption between domestic and imported factor inputs in the traded good sector and ECP of the traded good, in addition to partial ERPT via LCP of the imported good weaken the allocative role of exchange rate adjustment. Therefore, no expenditure switching between factor inputs in the traded sector, as shown in panels (E and F).

Unlike the strong link between nominal exchange rate and CPI adjustment captured in Models *I* and *II* which assume weak input substitution and ECP for the traded good, in *Model III* this tight link is broken. The factor driving this difference between Models *I* and *II* on the one hand and *Model III* on the other hand is the assumption of partial ERPT introduced to *Model III*, where local currency pricing of the imported good by monopolistic importers causes partial exchange rate

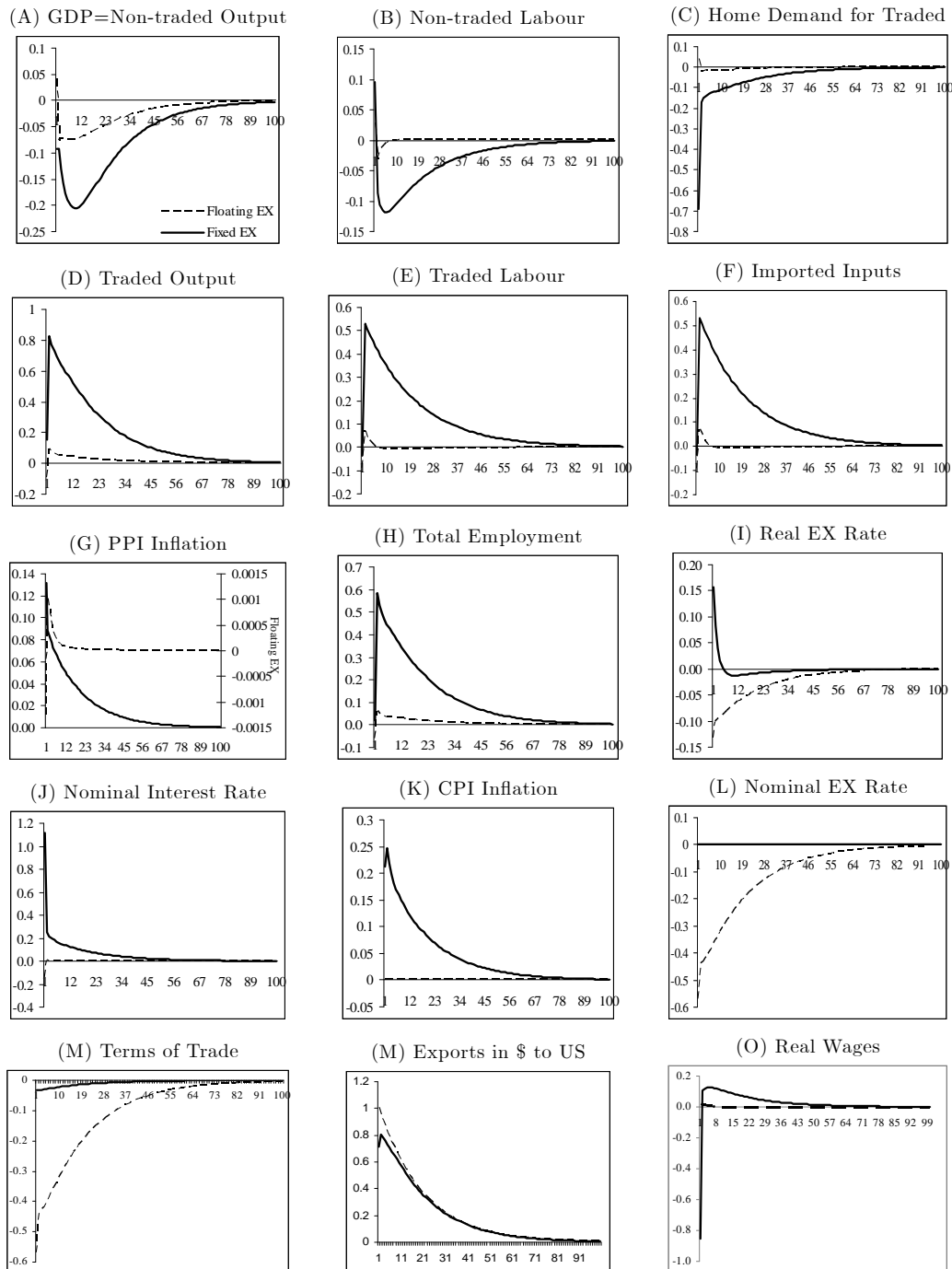


Figure 4: Model III Impulse Responses to Foreign Demand Shock
 Note: The horizontal axis on the diagrams shows the time horizon, where one period in the model is equivalent to one quarter and the vertical axis shows the extent of the response of macroeconomic variables to the shock studied measured in percent.

pass-through into domestic prices which feeds into PPI and thus CPI and results in dampened response of prices across the production chain compared to nominal exchange rate adjustment, panels (G, K and L).

Under both exchange rate regimes and following a positive foreign demand shock, the traded sector increases its output which in turn increases the demand for its factor inputs, as shown in panels (D-F). However, the extent of the response of the traded sector to the positive demand shock in Model *III* varies significantly depending on the monetary policy adopted by the central bank. Model *III* assumes weak input substitution between factor inputs in the traded sector, external currency pricing of the traded good and partial ERPT into import prices. Thus, unlike Models *I* and *II* where the traded sector fully responds to the 1 percent increase in foreign demand for its output under both exchange rate regimes, with the assumption of partial ERPT in Model *III* the traded sector shows a modest increase of 0.1% and a deteriorating terms of trade under floating exchange rate regime while 0.8% increase in traded output production and almost stabilised terms of trade under a fixed exchange rate regime, as shown in panels (D and M). This result is due to the speed of ERPT of import prices being irrelevant under a peg, which explains the higher demand for the imported input under the fixed regime of 0.5% compared to a floating exchange rate regime of 0.07%, panel (F). In addition, the monetary policy objective of targeting exchange rate stabilisation under a fixed regime reflects on stabilising the terms of trade, while under a floating exchange rate regime the central bank aims to stabilise CPI at the expense of nominal exchange rate appreciation which results in worsening terms of trade for the domestic economy.

Considering nominal variables, the presence of partial ERPT has major implications on the results of Model *III* under alternative exchange rate regimes. With a floating (fixed) exchange rate regime resulting in nominal exchange rate appreciation (stabilised by default), PPI is stabilised (increases), and CPI inflation is stabilised by default (increases), thus the nominal interest rate is stabilised with only an initial drop of 0.2% (increases), implying a stabilised monetary policy (contractionary) monetary policy, as shown in panels (G, and J-L). Overall a positive foreign demand shock is equivalent to a negative income shock to the small open EME under both exchange rate regimes, where aggregate output and consumption decline while total employment rises, as shown in panels (A and H). However, a fixed exchange rate regime depresses aggregate output and consumption and increases total employment more than a flexible exchange rate regime due to inhibiting the allocative role of exchange rate adjustment.

	GDP	T-Output	REX	NEX	CPI	PPI
Model I						
Floating EX	1.06	3.21	0.0003	0.0003	0.0001	0.0002
Fixed EX	1.06	3.21	0.0002	0.0001	0.0004	0.0003
Model II						
Floating EX	1.06	3.20	0.0002	0.0008	0.0001	0.0001
Fixed EX	1.06	3.20	0.0001	0.0001	0.0008	0.0003
Model III						
Floating EX	0.71	1.34	0.38	1.88	0.0014	0.045
Fixed EX	1.17	2.97	0.08	0.0008	0.67	0.30

Table 7: Macroeconomic Volatility to +ve Foreign Demand Shock Under Alternative Exchange Rate Regimes

The model captures empirically relevant vertical production and trade chains in EMEs, where the expansion of the traded sector in response to a positive foreign demand shock for its output is transmitted, through the interdependent input-output production structure, to the non-traded sector resulting in its decline. The contraction of the non-traded sector causes the demand for its factor inputs to drop under both regimes, as shown in panels (A-C) of Figure 4. Nonetheless, under both exchange rate regimes the positive impact of the foreign demand shock on traded sector employment dominates the drop in non-traded sector unemployment, which results in an overall increase in total employment as shown in panels (B, E and H).

Model III through a different framework provides an alternative perspective than that proposed by Devereux and Engel (2002) to reconcile high exchange rate volatility with exchange rate ‘disconnect’. ‘Exchange rate disconnect’ describes the fact that volatile nominal exchange rates appear to have little impact on overall macroeconomic behavior. Devereux and Engel (2002) achieve this result by introducing LCP with other market imperfection, namely incomplete international financial markets driven by noise traders in financial markets. While we are able to achieve the same result by introducing relevant trade features to small open EMEs. To give further evidence for ‘exchange rate disconnect’ in *Model III*, Table 7 presents the theoretical standard deviations of macroeconomic variables. From Table 7 and in the case of *Model III* under a floating exchange rate regime, we note minimal macroeconomic variability compared to a more pronounced exchange rate volatility. This result is consistent with Dornbusch (1987) that price stickiness magnifies the response of the exchange rate to fundamentals. In addition, our result is in accordance with Betts and Devereux (2000) finding that when firms in

the traded good sector price-discriminate markets in different countries, the volatility of the exchange rate is higher than in the case of setting the price at the Law Of One Price. Thus, ‘exchange rate disconnect’ captured by *Model III* provides grounds for ‘fear of floating’ by emerging market economies, since exchange rate adjustment does not affect macroeconomic variables in the small open EME, where firms engage in external currency pricing for its traded goods.

10 Imported Inputs Price Shock

We analyse the results of imported inputs price shock through a 1% unexpected increase in the price of the intermediate imported good. Wickens (2008) defines terms of trade as the relative price of imports expressed in domestic currency to exports prices, $TOT_t = (S_t P_t^{M^*} / P_t^T)$. This shock has two conflicting effects in our model. On the one hand, an increase in imported inputs price results in improving terms of trade, which implies nominal exchange rate depreciation, resulting in increasing domestic traded goods competitiveness in the international goods market. Thus, it is perceived as a positive imports price shock improving the domestic economy’s competitiveness. On the other hand, since our model assumes a vertical trade chain, where nations trade in intermediate factor inputs to re-export their products, and with the assumption of weak input substitutability between domestic and imported inputs, the same shock can be interpreted as a negative cost-push shock to the traded sector as a result of the increase in its’ production cost. Therefore, the results of the three models with various specifications for the firm’s price-setting decision will depend on which of the two effects (positive imports price or the negative cost-push shock) dominates, given alternative exchange rate regimes.

10.1 Model I: PCP for Traded Good and LOOP for the Imported Good

In the benchmark model, the traded good price is rigid in producer currency pricing and the intermediate imported good is set at the LOOP. This implies that both exports and imports are selling at the LOOP in the international goods market. Therefore, *Model I* focuses mainly on the role of weak input substitution between domestic and imported factor inputs in a vertical production and trade structure. Within this framework, we study the macroeconomic effects of a imported inputs price shock under flexible and fixed exchange rate regimes presented in Figure 5. In Figure 5, the impulse responses of the benchmark model under a flexible exchange rate regime are depicted by a dotted line, while

a fixed exchange rate regime are represented by a solid line.

Given the modelled vertical production and trade structure, an unexpected rise in imported inputs price not only affects the marginal cost of primary factors of production across the production chain of the domestic economy, but also affects the marginal cost of production through movements in the exchange rate as intermediate goods cross borders between nations via exports and imports.¹⁷ Under both exchange rate regimes, the effect of imported inputs price rise shock on the traded sector is equivalent to a negative productivity shock, where output and demand for factor inputs, namely labour and imported inputs, fall in the traded sector, panels (D-F). On the one hand, a 1% increase in the price of imported inputs directly affects the marginal cost of producing the traded good in the small open EME. However, as the traded sector sets its price in PCP, and given staggered price setting in the sector, where only a fraction of the firms in the sector are able to reset their price to accommodate the rise in the marginal cost. Thus, the traded good price index does not rise fully until the end of the contract duration because of the pattern of price adjustment in the sector, as shown in panel (G). In this model, an imported input price shock under a floating (fixed) exchange rate regime results in nominal exchange rate appreciation (stabilisation by default), as shown in panel (L). Given the assumption of weak input substitution of factor inputs in the traded sector and the rise in its marginal cost driven by the increase in imported input price minimises producer's expenditure-switching. Therefore, the negative cost-push implications of the imports price shock on the marginal cost of producing traded goods dominates the improvement in competitiveness implied by improved terms of trade leading to a drop in traded good output.

The vertical input-output production structure plays a key role in the transmission of the shock, where the contraction of exports market for the traded good is compensated by an expansion of domestic demand for the traded good by the non-traded sector, panel (A and C). This is accompanied by an increase in the demand for non-traded factor inputs based its production function in (9), as shown in panels (B and C). The increase in the cost of production of the first-stage of production (traded) affects the marginal cost of producing the second-stage of production (non-traded), therefore the rise in PPI feeds into further rise in CPI due to the multiplier effect of the intermediate traded good amplifying the shock throughout the production chain, panels (G and K).

The implication for monetary policy depends on the exchange rate regime followed by the central bank. Given the interest rate rule in

¹⁷The latter effect is beyond the scope of this study, for this we need a two-country model.

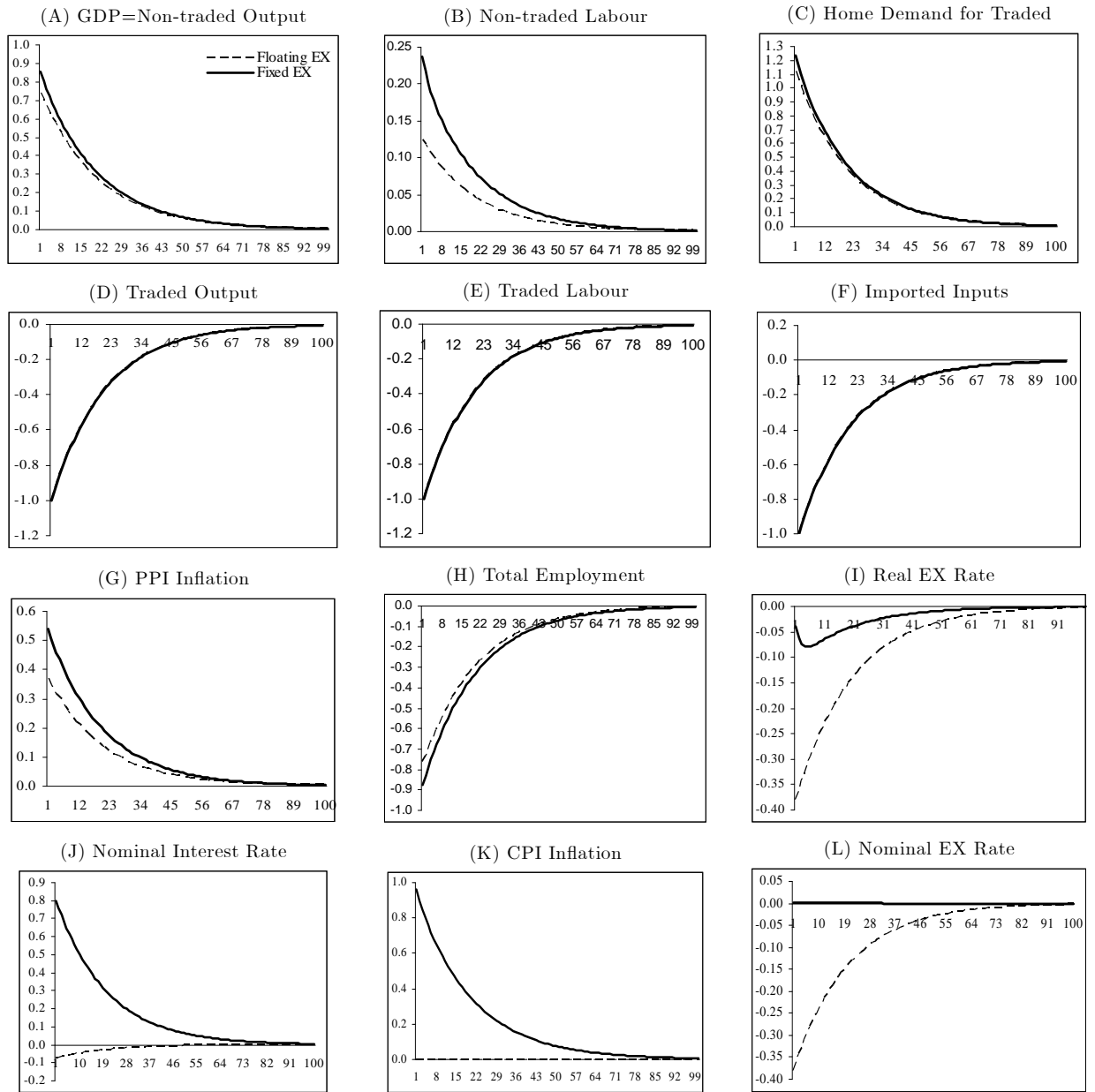


Figure 5: Model I Impulse Responses to Imported Inputs Price Shock
 Note: The horizontal axis on the diagrams shows the time horizon, where one period in the model is equivalent to one quarter and the vertical axis shows the extent of the response of macroeconomic variables to the shock studied measured in percent.

equation (33) and under a floating exchange rate regime, which targets stabilising CPI inflation at the expense of exchange rate volatility, the nominal interest rate falls by 0.1%, which stimulates aggregate output. While following a fixed exchange rate regime results in a contractionary monetary policy, where the increase in PPI results in a further rise in CPI due to the multiplier effect of the rise in the cost of production across the production chain, panel (A and J). Under both exchange rate regimes, imported inputs price shock results in an overall drop in total employment, where the drop in traded sector employment outweighs the increase in non-traded sector employment, panels (B, E and H).

10.2 Model II: ECP for Traded Good and LOOP for the Imported Good

Model *II* presents the case where the intermediate traded good price is set in external currency pricing, being the dollar, while the imported good is priced at the LOOP, implying complete ERPT into domestic prices. Hence, Model *II* assumes weak input substitution between factor inputs in the traded sector, while introducing an empirically relevant feature to East Asian small open EMEs that is intermediate traded good prices being sticky in dollars. Within this framework, we study the macroeconomic effects of imported inputs price shock under flexible and fixed exchange rate regimes, as presented in Figure 6. In Figure 6, the impulse responses of Model *II* under a flexible exchange rate regime are depicted by a dotted line, while a fixed exchange rate regime are represented by a solid line.

Under a floating exchange rate regime, an unexpected 1% rise in imported inputs price is equivalent to a negative productivity shock in the traded sector, which output and demand for factor inputs drop due to the assumption of weak inputs substitution among its factors of production and the shock increasing the cost of its primary factor inputs, as shown in panels (D-F). The increase in the price of imported inputs increases the marginal cost of producing the traded good in the small open EME. However, as the traded sector sets its price in ECP, implying that their prices are sticky in their exports invoicing currency being the dollar, therefore responds only persistently to the shock increasing its marginal cost of production. To avoid the multiplier effect amplifying the effect of intermediate traded good price increase on final non-traded good price inflation due to vertical input-output production structure, the monetary authority stabilises PPI in order to achieve its primary objective of stabilising CPI, as shown in panels (G and K) of Figure 6. In this model, an imported input price shock under a floating exchange rate regime results in 1% nominal exchange rate appreciation, where the

exchange rate fully absorbs the shock, as shown in panel (L). It is worth noting that with exchange rate appreciation, exports are expected to drop, as traded goods will become more expensive. However, due to the assumption of external currency pricing, where traded good prices are sticky in their exports invoicing currency, being the dollar, exports in dollars to the ROW rises and exports to the US drops by a small amount and only very briefly, panels (N and O) of Figure 6.

Given the modelled vertical production chain, the contraction of the exports market for the traded good, due to nominal exchange rate appreciation, results in an expansion in the non-traded sector, and thus an increase in non-traded sector demand for labour and intermediate traded inputs, panels (A-C). Since the shock mainly affects the marginal cost of the traded good sector, the drop in labour employment by the traded sector outweighs the increase in labour employment by the non-traded sector, with an overall drop in total employment, seen in panels (B, E and H). Based on the interest rate rule in (33) governing monetary policy and under a floating exchange rate regime, the nominal interest rate slightly drops to maintain CPI stability, which implies an expansionary monetary policy, panel (J). The expansionary monetary policy stimulates aggregate output, as shown in panel (A).

Under a fixed exchange rate regime and in response to imported inputs price shock, the nominal exchange rate is stabilised by default, panel (L) of Figure 6. Since the traded goods are sticky in the invoice currency, being the dollars, the marginal cost and in turn the price of traded output rise in response to the increase in its imported input price, however, the increase is less than one for one in response to the shock, where PPI increases to 0.5% instead of the full increase of 1% due to the shock. With the assumption of external currency pricing, and even though the exchange rate is stabilised, exports to ROW and the US persistently decline, panels (N and O). The overall effect of the shock on the traded sector is determined by the net demand for the traded good by the domestic and foreign markets defined in equations (21) and (22), respectively. The drop in foreign demand for the traded good outweighs the increase in domestic demand for the traded input by the non-traded sector, panels (C, N and O). Thus, the net effect is a drop in traded sector output and in turn a drop in the sector's demand for labour and intermediate imported inputs, as seen from panels (D-F). Given the vertical production structure and the assumption of complete ERPT into imported inputs price, an increase in the marginal cost of traded good production and the rise in PPI results into a further rise in CPI inflation due to the multiplier effect via the price of the intermediate traded factor input, panels (G and K). Thus, under a fixed exchange

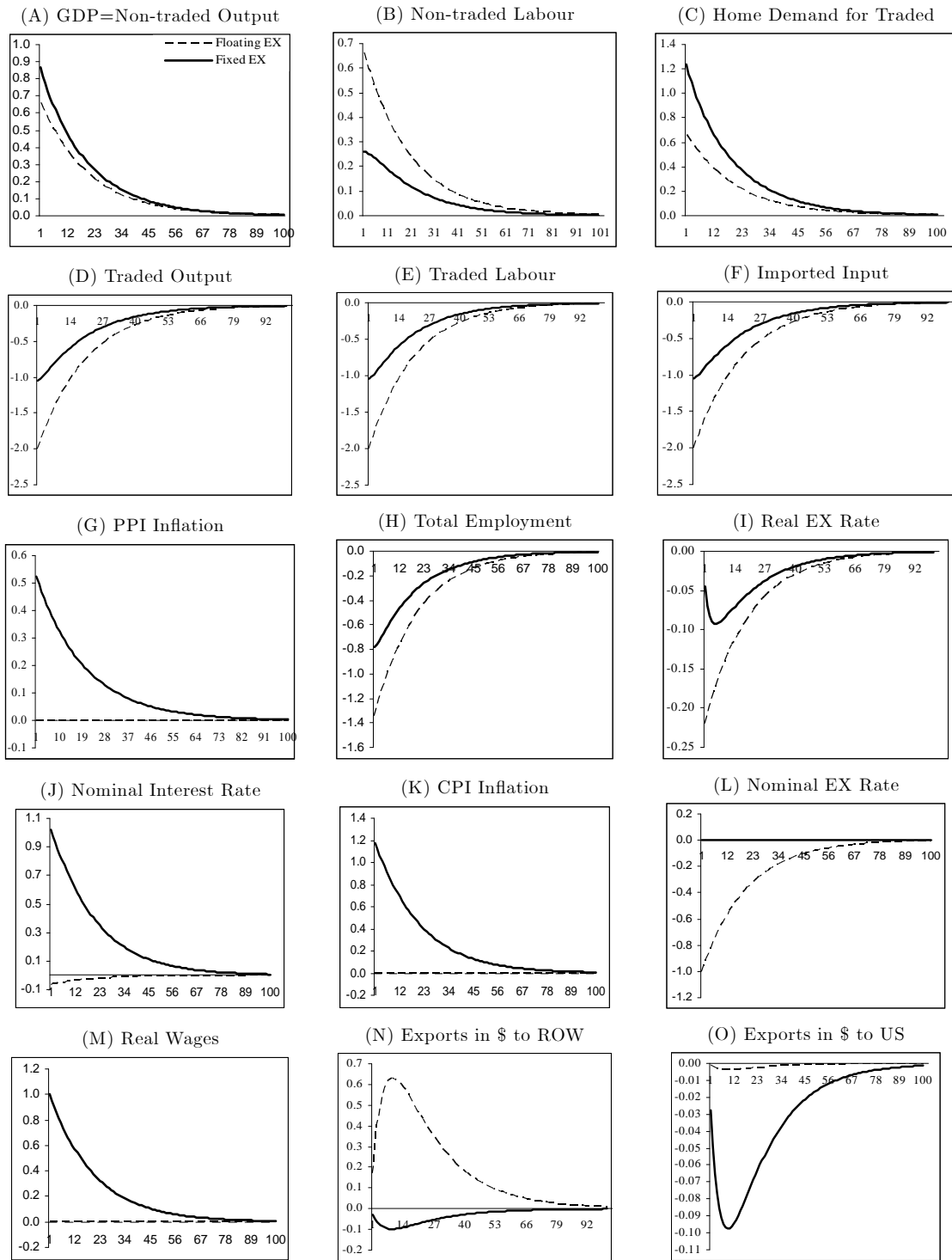


Figure 6: Model II Impulse Responses to Imported Inputs Price Shock

Note: The horizontal axis on the diagrams shows the time horizon, where one period in the model is equivalent to one quarter and the vertical axis shows the extent of the response of macroeconomic variables to the shock studied measured in percent.

rate regime the nominal exchange rate is stabilised at the expense of an increase in CPI inflation, which in turn results in an increase in the nominal interest rate, implying a contractionary monetary policy, panel (G, J and K).

Overall and under the two alternative monetary policy regimes, Model *II* with external currency pricing for the traded good provides similar qualitative pattern of responses to imported inputs price shock to Model *I* with producer currency pricing for the traded good. However, the introduction of the assumption of ECP in Model *II* acts as an amplification device for the shock in the case of a floating exchange rate regime increasing the initial impact of the shock and persistence of macroeconomic variables, but yields the same results in the case of a fixed exchange rate regime where exchange rate adjustment is absent by default.

10.3 Model III: ECP for the Traded Good and LCP for the Imported Good

Model *III* presents the case where the intermediate traded good price is set in external currency pricing, while the imported good is set in local currency pricing implying partial ERPT. Hence, we build *Model III* on the assumption of weak input substitution among factor inputs in the traded sector, ECP of the traded good and delayed ERPT into imports prices. Within this framework, *Model III* enables us to study the macroeconomic effects of a imported inputs price shock under flexible and fixed exchange rate regimes, as presented in Figure 7. In Figure 7, the impulse responses of Model *III* under a flexible exchange rate regime are depicted by a dotted line, while a fixed exchange rate regime are represented by a solid line.

Under a floating exchange rate regime, an unexpected 1% rise in imported inputs price is equivalent to a negative productivity shock in the traded sector, resulting in a decline in traded good output, panel (D). One channel for the transmission of the shock is changing the marginal cost mix for the traded sector, where the demand for the imported input decreases due to its rising price. However in comparing imported inputs in panel (F) of *Model II* in Figure 6 to panel (F) of *Model III* in Figure 7, we note the effect of partial ERPT into imports prices, where in the latter the drop in imported inputs is less significant and more persistent. Given the assumption of weak input substitution, the decline in the demand for the imported input induces a drop in the demand for labour by the traded sector, as seen in panels (E and F). In addition, due to the pricing decisions of firms in the traded and imported good sectors, where the traded good is set in external currency pricing and the imported input is set in local currency pricing resulting in partial

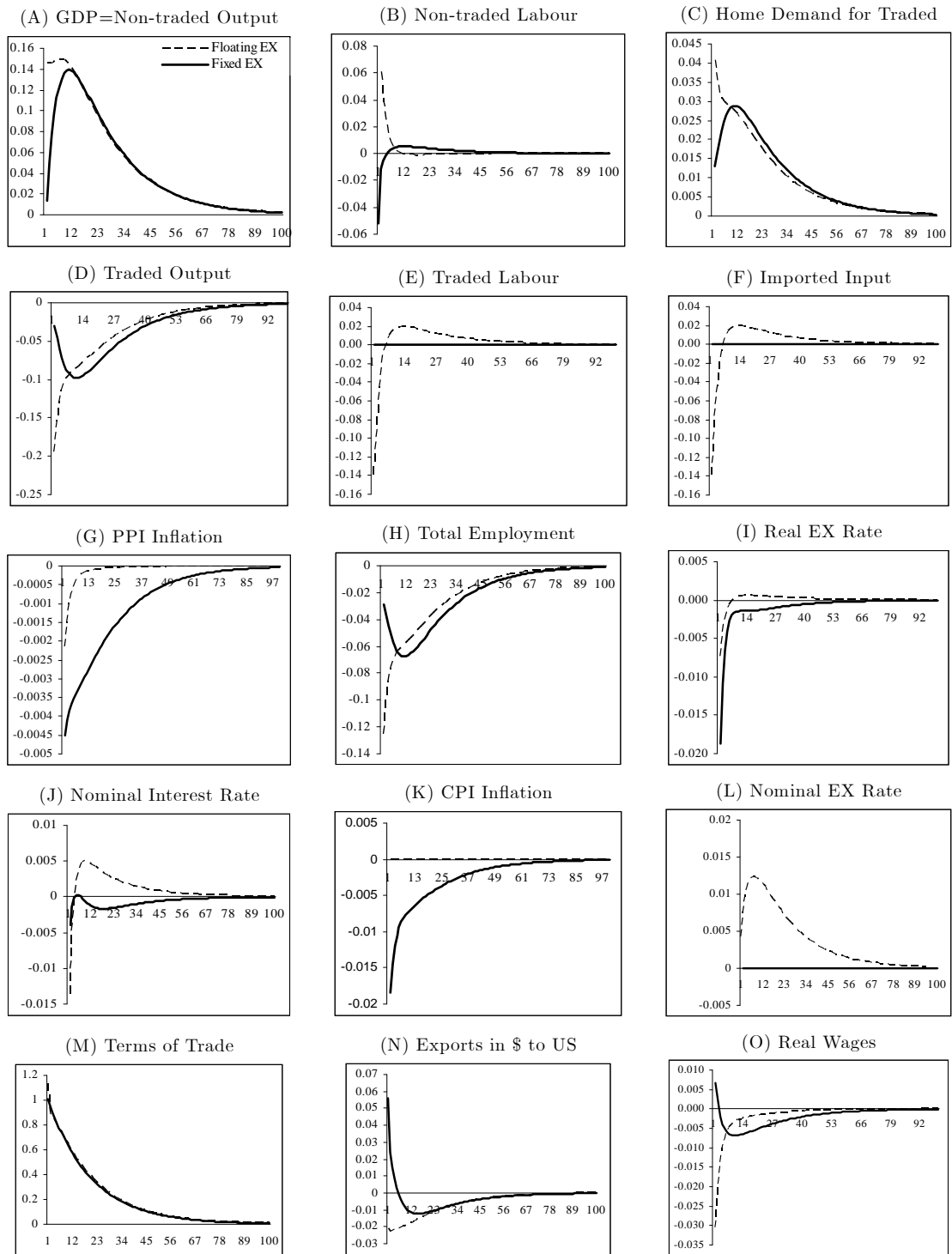


Figure 7: Model III Impulse Responses to Imported Inputs Price Shock
 Note: The horizontal axis on the diagrams shows the time horizon, where one period in the model is equivalent to one quarter and the vertical axis shows the extent of the response of macroeconomic variables to the shock studied measured in percent.

exchange rate pass-through into domestic prices minimising the negative cost-push impact on Model *III*. Therefore, producer price index is almost stabilised due to sticky imported input prices and the drop in real wages under a floating exchange rate regime, as in panels (G and O) of Figure 7. Another channel for the transmission of the imported input price shock in Model *III* is that it results in nominal exchange rate depreciation under a floating exchange rate regime, as shown in panel (L). However, due to the assumption of external currency pricing, where traded good prices are sticky in their exports invoicing currency, being the dollar, exports persistently drop, panel (N) of Figure 7. Thus, in Model *III* the assumption of ECP for exports and LCP for imported inputs erodes the benefits of exchange rate adjustment that a floating exchange rate regime provides, where exports do not respond to exchange rate depreciation or improved terms of trade, as seen in panel (N). Thus, the slight contraction of the exports market for the traded good, results in an expansion in the non-traded sector, and thus an increase in non-traded sector demand for labour and intermediate traded good, as shown in panels (A-C). Based on the interest rate rule in (33) governing monetary policy and under a floating exchange rate regime, the nominal interest rate briefly drops then increases to maintain CPI stability, which implies a brief initial expansionary monetary policy followed by a contractionary policy, panel (J and K). The expansionary monetary policy stimulates aggregate output, as shown in panel (A).

Under a fixed exchange rate regime the exchange rate is stabilised by default and thus its adjustment role is confined, panel (L) of Figure 7. An unexpected 1% increase in imported inputs price affects the factor input mix by the traded good sector through its marginal cost. However, since the degree of exchange rate pass-through is irrelevant to a fixed exchange rate regime, where exchange rate adjustment is absent, the demand for the traded sector factor inputs is not affected by the shock, which explains their stable response as in panels (E and F). Thus, the negative cost-push effect of the rise in imported good prices on the traded sector is muted due to the fixed exchange rate regime adopted by the monetary policy and the assumption of partial ERPT into domestic prices and external currency pricing of traded goods. Given the staggered price-setting for both the domestic traded and imported goods and therefore persistent price adjustment, results in a drop in PPI, as in panel (G). Moreover, our model with a vertical production structure and a multiplier effect to the drop in PPI results in an amplified drop in CPI inflation, where each stage of production assumes staggered price-setting and thus a persistent price adjustment (G and K). In addition, the presence of a vertical production structure and the contraction of the

exports market for the traded good results in an expansion of the non-traded sector demand for the traded input with a drop in the demand for the sector’s labour due to the rise in real wages and the fall in PPI causing a change in the factor input mix by the non-traded sector, panels (A-C, G and O). Thus, the net effect of the imported input price shock on the traded sector is a drop in its output, as in panel (D). However, the negative cost-push shock on the traded good sector is much less under a fixed exchange rate regime than a floating exchange rate regime. This is due to the irrelevance of the degree of ERPT to the fixed exchange rate regime which allowed stabilising the demand for the traded sector factor inputs despite the increase in the imported input price. Thus, under a fixed exchange rate regime, the combination of exchange rate stabilisation and decline in CPI inflation results in an expansionary monetary policy, which stimulates aggregate economic activity, panel (A and J).

By examining the two alternative exchange rate regimes in response to the imported input price shock, our model (Model *III*) reveals that once empirically relevant production and trade features of small open EMEs are accounted for, such as weak input substitutability between domestic and imported inputs, external currency pricing of the traded goods, and partial ERPT into domestic prices, a floating exchange rate regime allowing for exchange rate adjustment does not maintain exports and results in a contractionary monetary policy. While a fixed exchange rate regime in response to a cost-push shock results in an expansionary monetary policy which stimulates economic activity and boosts exports since exporters engage in export currency pricing. Thus, introducing export currency pricing by firms producing the traded good may offers an alternative perspective on the phenomena of ‘fear of floating’ experienced by many small open EMEs based on production and trade structure specific to these economies.

11 Sensitivity Analysis

To examine the robustness of our three alternative models, namely Models *I*, *II* and *III*, we analyse the sensitivity of each model predictions to varying the specifications of two key parameters. These are: γ as the key parameter for the degree of input substitution between domestic labour and the intermediate imported good in the traded sector and ω^M determining the degree of exchange rate pass-through into domestic prices. We also compare each of the three models predictions in response to a foreign demand shock under floating and fixed exchange rate regimes when varying the degree of input substitution.¹⁸ In addition, we study

¹⁸We examined the sensitivity of the models to the degree of input substitution in response to imported inputs price shock. We find that the response of the model to

Model *III* predictions in response to a foreign demand and imported inputs price shocks under floating and fixed exchange rate regimes when varying the degree of exchange rate pass-through.

11.1 Degree of Input Substitution

Figure 8 compares the impulse responses of Model *I* to a positive foreign demand shock under a floating and fixed exchange rate regimes and under various specifications for the degree of input substitution in the traded sector. Figures 8, 9 and 10 correspond to the impulse responses of Models *I*, *II* and *III* to the foreign demand shock, respectively. In these three figures, the lowest degree of input substitution $\gamma = 0.05$ is depicted by a solid line, the highest degree of input substitutability $\gamma = 1.6$ is represented by a dotted line, while the intermediate level of input substitutability $\gamma = 0.7$ is plotted as a dashed line.

Figure 8, presents the results of Model *I* in response to a positive foreign demand shock, when varying the degree of input substitution. Model *I* assumes weak input substitution between factor inputs and producer currency pricing of the traded good. Under a floating exchange rate regime and in response to the shock, Model *I* suggests that the higher the degree of input substitution between domestic and imported factors of traded good production, the higher nominal exchange rates depreciates in response to the foreign demand shock, panel (E) of Figure 8. This result is due to higher degree of input substitution triggering production expenditure-switching role for the exchange rate. This result is obtained when relaxing the weak input substitution assumption allowing for producer expenditure-switching and following a floating exchange rate regime which strengthens the exchange rate adjustment role. In contrast, under a fixed exchange rate regime and given that the primary objective of the monetary authority is exchange rate stabilisation, the nominal exchange rate is stabilised since its adjustment role is absent by default, panel (J) of Figure 8. Regardless of the degree of input substitution in the traded sector, under both flexible and fixed exchange rate regimes, a positive foreign demand shock to the traded sector is equivalent to a negative income shock putting pressure on PPI and CPI and therefore leading to a rise in the nominal interest rate, which in turn results in a decline in aggregate output, as shown in panels (A-D and F-I) of Figure 8. In addition, under a fixed exchange rate regime, the higher the degree of input substitution the lower CPI inflation, since it allows for producer expenditure-switching, panel (H).

various degrees of input substitution between domestic and imported factor inputs does not change the results of our three models. Thus, the results are similar to our previous analysis of a imported inputs price shock.

Therefore, monetary policy is more contractionary the lower the degree of input substitutability, and less contractionary as we relax the input substitutability assumption, panel (G). This implies that weak input substitution between domestic and imported factor inputs puts pressure on PPI and CPI inflation through the production chain and in turn on the monetary policy, panels (B-D and G-I) of Figure 8.

Figure 9, presents the results of Model *II*, which assumes weak input substitution between factor inputs and external currency pricing of the traded good, when varying the degree of input substitution. We note that the results of Model *II* is similar to that of Model *I* under both exchange rate regimes. This implies that varying the degree of input substitution does not vary the results for the two models, when assuming external currency pricing for the domestic traded good. This result is mainly driven by the pricing assumption for the traded good, where ECP of the traded good eliminates the adjustment role of the exchange rate, therefore we obtain almost identical results under both exchange rate regimes to those presented for Model *I* in section 11.1. and Figure 8.

Figure 10 Model *III* highlights the interactions between two pricing assumptions, these are external currency pricing for the traded good and local currency pricing for the imported input while varying the degree of input substitution. Under a floating exchange rate regime and following a positive foreign demand shock to the intermediate traded sector, the nominal exchange rate persistently appreciates the higher the degree of input substitution between factor inputs, as shown in panel (E) of Figure 10. This regime allows for exchange rate adjustment, which triggers producer's 'expenditure-switching'. Thus, the joint effect of a fixed exchange rate regime and partial ERPT via LCP of the imported good results in a drop in PPI the higher the degree of input substitutability in the traded sector, panel (D) of Figure 10. However, the presence of the multiplier effect across the production chain as well as ECP of the traded good, the decline in PPI does not translate into a decline in CPI with a net effect of an insignificant increase in CPI inflation the higher the degree of input substitution, panel (C). Unlike the strong link between nominal exchange rate adjustment and CPI captured in Models *I* and *II*, with partial ERPT into imports prices in Model *III* this tight link is broken, permitting exchange rate adjustment without sacrificing CPI and PPI stability, in the case of a flexible exchange rate regime as in panels (C-E) of Figures 8, 9, and 10. While a fixed exchange rate regime stabilises the exchange rate by default, and therefore weakens the allocative role of exchange rate adjustment, and thus the results are not affected significantly by varying the degree of input substitution between domestic and imported factor inputs. Therefore, following a fixed

Model I: Benchmark Model

Floating Exchange Rate Regime

Fixed Exchange Rate Regime

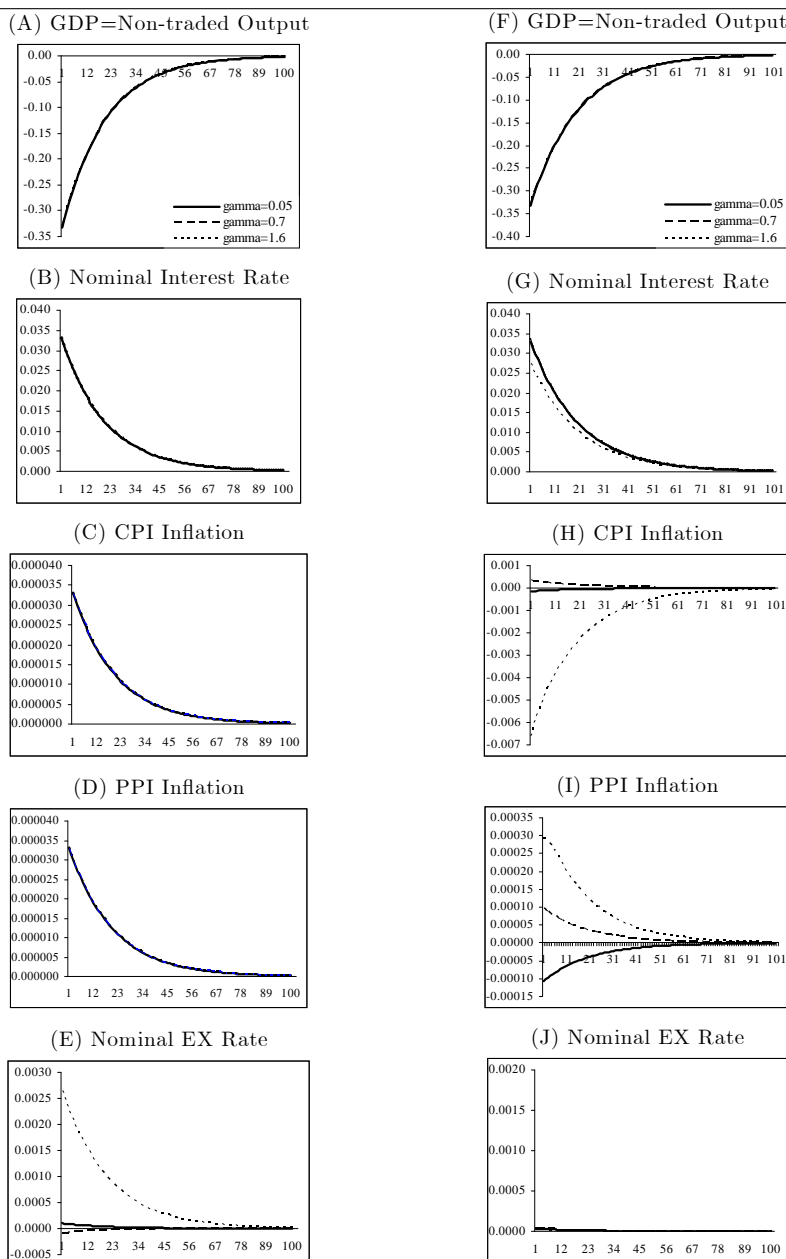


Figure 8: Degree of Input Substitution in Model I Following Foreign Demand Shock

Note: The horizontal axis on the diagrams shows the time horizon, where one period in the model is equivalent to one quarter and the vertical axis shows the extent of the response of macroeconomic variables to the shock studied measured in percent.

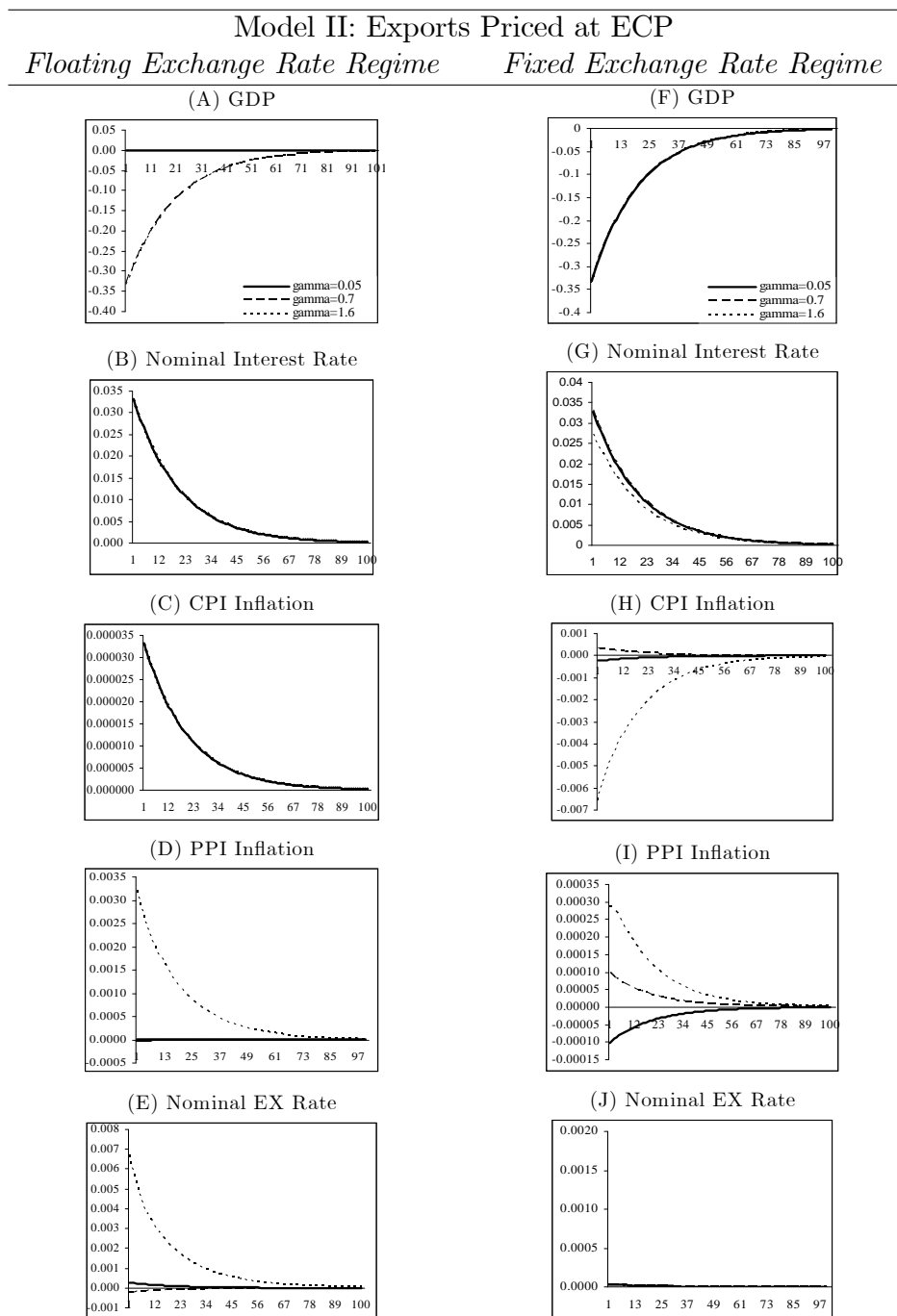


Figure 9: Degree of Input Substitution in Model II Following Foreign Demand Shock

Note: The horizontal axis on the diagrams shows the time horizon, where one period in the model is equivalent to one quarter and the vertical axis shows the extent of the response of macroeconomic variables to the shock studied measured in percent.

exchange rate regime, PPI and CPI inflation persistently increase in response to the shock, as shown in panel (H-J) of Figure 10. Overall and under both regimes, relaxing the assumption of weak input substitution results in a more contractionary monetary policy.

11.2 Degree of Exchange Rate Pass-through

Figure 11 presents the results of *Model III* under the assumption of weak input substitution between domestic and imported inputs, where ECP for the intermediate traded good and LCP for the intermediate imported good are assumed following a positive foreign demand shock. In Figure 11, the impulse responses of *Model III* with complete ERPT is depicted by a solid line, while partial ERPT is represented by a dotted line. Under complete ERPT and a floating exchange rate regime, the nominal exchange rate fully absorbs the foreign demand shock, therefore the nominal exchange rate sharply appreciates followed by expected depreciation, panel (E). Under this scenario, PPI and CPI are stabilised, while the nominal interest rate rises implying a contractionary monetary policy, panel (B). The contractionary monetary policy results in a drop in the overall economic activity, as shown in panel (A). While with the assumption of partial ERPT and under a float, nominal exchange rate adjustment is not fully passed onto PPI because the traded good price is rigid in the invoicing currency, being the dollar. Therefore, PPI drops slightly then is quickly stabilised while CPI inflation is stabilised by default, panels (C and D). However, partial ERPT of the exchange rate into imported inputs prices under a floating exchange rate regime delivers less pronounced and more persistent results compared to the case of full ERPT, including an expansionary monetary policy followed by a rise in nominal interest rate and a lower drop in economic activity, panels (A and B). Thus, partial ERPT delivers an expansionary monetary policy compared to a contractionary monetary policy under complete ERPT. This implies that the response of the monetary authority to the foreign demand shock is sensitive to the degree of ERPT, where partial ERPT interacts with ECP for exports and LCP for imports which reduces price level and relative prices adjustment to the shock. In contrast, a fixed exchange rate regime by default stabilises the nominal exchange rate under both full and partial exchange rate pass-through, panel (J). Given the vertical input-output production structure and the multiplier acting as an amplifying device across the production chain, an increase in PPI increases results in a more pronounced increase in CPI, panels (H and I). In addition, the interest rate under a fixed exchange rate regime increases regardless of the degree of ERPT and results in a drop in economic activity, panels (A and B). However, under full ERPT the

Model III: Exports Priced at ECP and Imports Priced at LCP
Floating Exchange Rate Regime *Fixed Exchange Rate Regime*

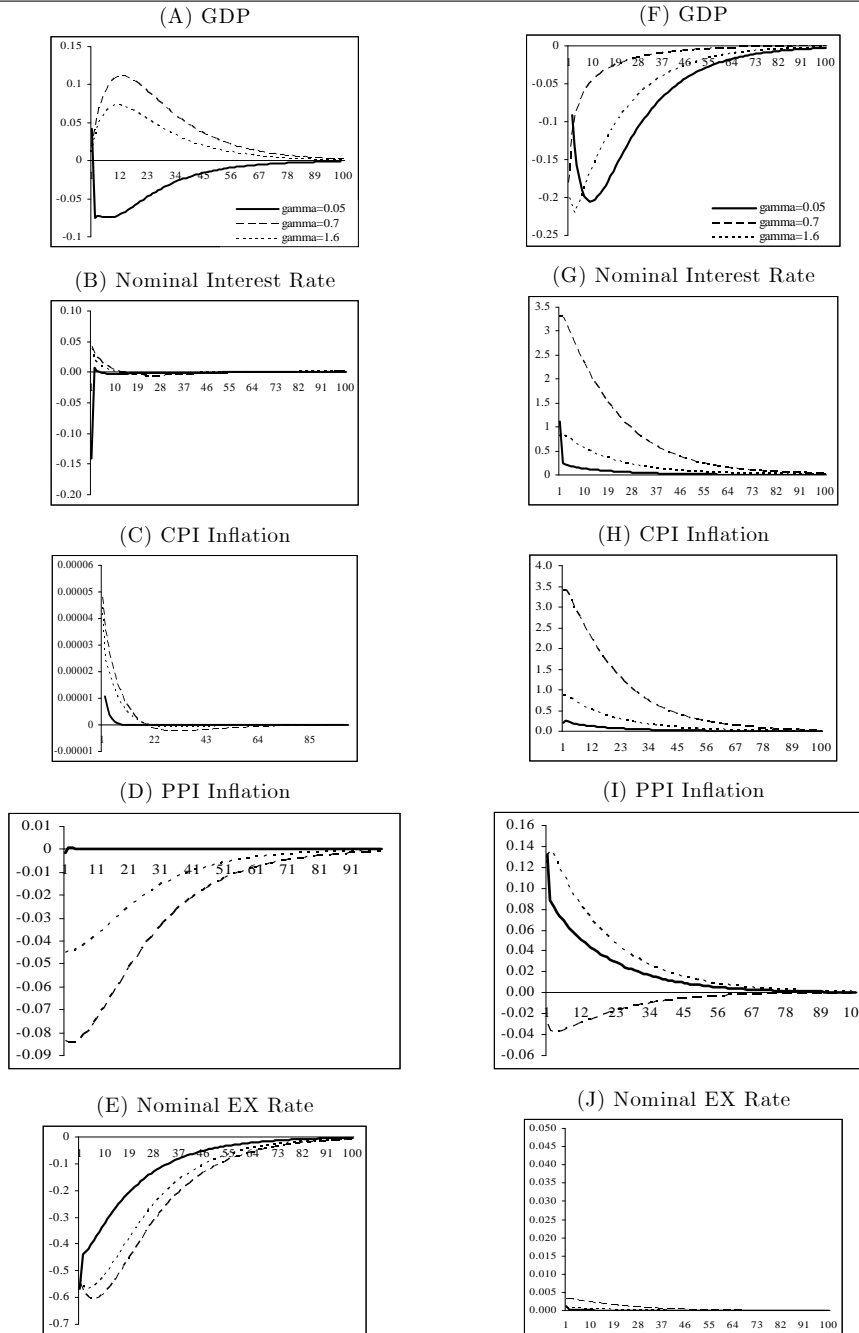


Figure 10: Degree of Input Substitution in Model III Following Foreign Demand Shock

Note: The horizontal axis on the diagrams shows the time horizon, where one period in the model is equivalent to one quarter and the vertical axis shows the extent of the response of macroeconomic variables to the shock studied measured in percent.

drop in GDP is more than in the case of partial ERPT, which is caused by delayed relative price adjustment to changes in the exchange rate in the case of delayed ERPT and thus aggregate economic activity in response to the shock. Overall, we note that changing the degree of ERPT does not affect macroeconomic variables in *Model III* in response to the shock, this is due to the irrelevance of the degree of ERPT for a monetary policy following a fixed exchange rate regime.

Figure 12 presents the results of *Model III* under the assumption of weak input substitution between domestic and imported inputs, ECP for the intermediate traded good and LCP for the intermediate imported good in response to imported inputs price shock. In Figure 12, the impulse responses of *Model III* with full ERPT is depicted by a solid line, while delayed ERPT is represented by a dotted line. Under a floating exchange rate regime and in response to the shock, the nominal exchange rate appreciates in response cost-push shock originating from the unexpected rise in imported inputs price, however, with full ERPT the appreciation of the exchange rate is more pronounced compared to the case of partial ERPT, panel (E). This result is due to the full adjustment role of the exchange rate to take effect under a floating exchange rate regime and full ERPT into domestic prices. Given external currency pricing of the traded good and full ERPT for intermediate imported goods, PPI slightly drops while CPI is stabilised by default, panels (C and D). Under this scenario, the nominal interest rate is stabilised overall with the exception of an initial increase at the outset of the shock. The positive effect due to increase in the home economy's competitiveness in the international market dominates the negative impact of the cost-push shock due to the rise in imported inputs price, which stimulates economic activity and results in an increase in GDP, panels (A and B). This result is obtained due to the interaction of ECP of the traded good which weakens exchange rate adjustment role and the complete impact of full ERPT from taking effect. In contrast, in the presence of ECP and partial ERPT assumption, PPI inflation persistently drops and much less than in the case of full ERPT resulting in an expansionary then quickly stabilised monetary policy (C and D). Therefore, aggregate output is higher under ECP with full ERPT than delayed ERPT, panel (A).

In contrast, a fixed exchange rate regime stabilises the nominal exchange rate by default, therefore the adjustment role of the exchange rate is absent, panel (J). Due to a 1% unexpected rise in imported inputs price shock, the majority of adjustment to the shock is undertaken by prices, therefore PPI and CPI drop due to the pricing assumptions of the traded and imported goods, where the former is priced at exter-

Model III: Exports Priced at ECP and Imports Priced at LCP
Floating Exchange Rate Regime *Fixed Exchange Rate Regime*

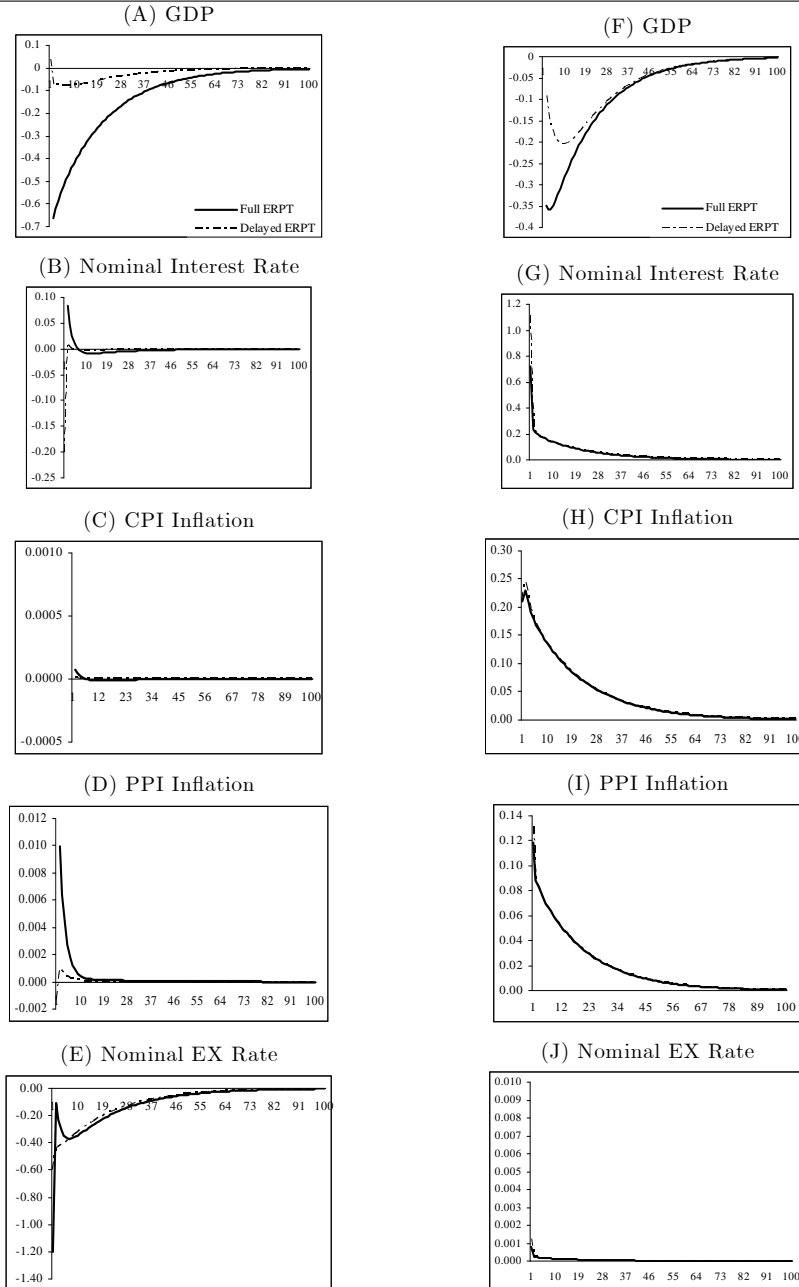


Figure 11: Degree of Exchange Rate Pass-through in Model III Following Foreign Demand Shock

Note: The horizontal axis on the diagrams shows the time horizon, where one period in the model is equivalent to one quarter and the vertical axis shows the extent of the response of macroeconomic variables to the shock studied measured in percent.

Model III: Exports Priced at ECP and Imports Priced at LCP
Floating Exchange Rate Regime *Fixed Exchange Rate Regime*

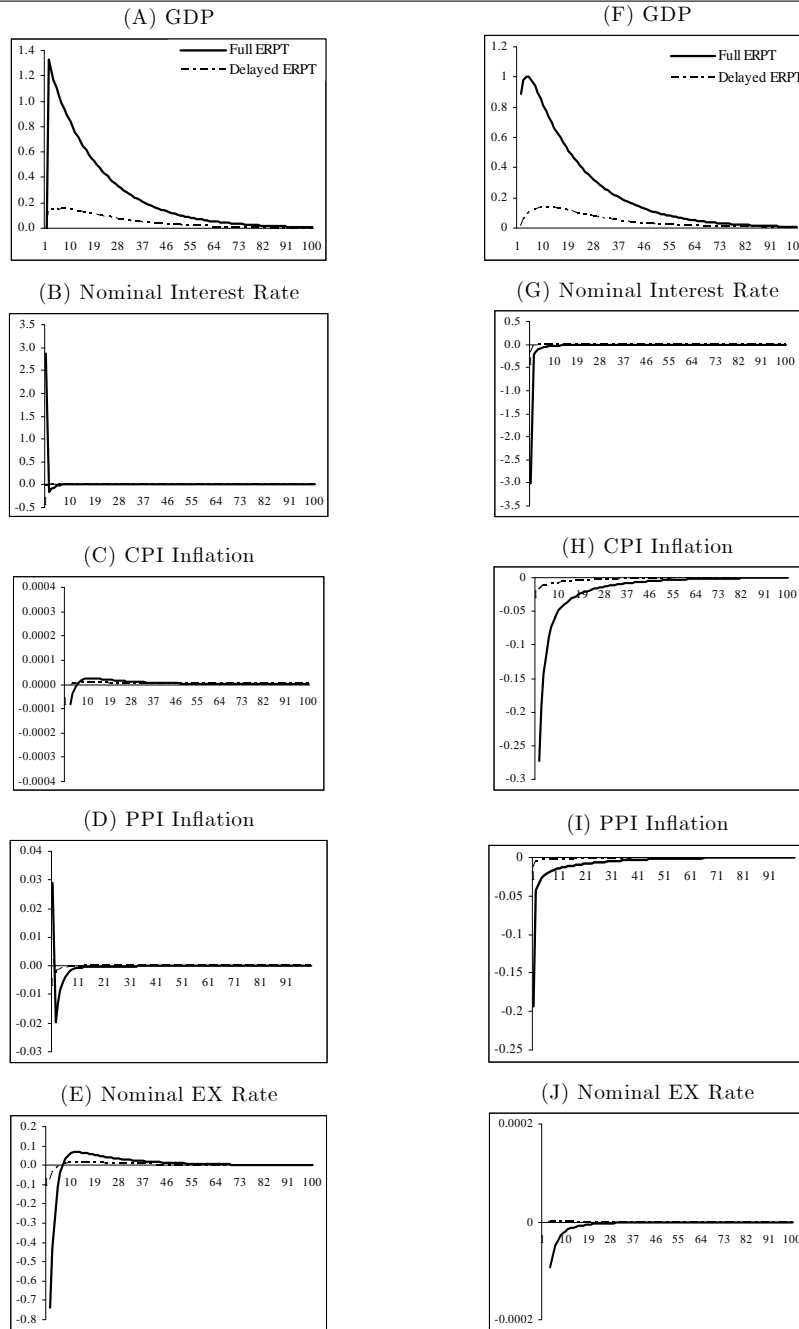


Figure 12: Degree of Exchange Rate Pass-through in Model III Following Imported Inputs Price Shock

Note: The horizontal axis on the diagrams shows the time horizon, where one period in the model is equivalent to one quarter and the vertical axis shows the extent of the response of macroeconomic variables to the shock studied measured in percent.

nal currency pricing and the latter is priced at local currency pricing. Overall, a more pronounced response to prices under full ERPT than partial ERPT, panels (H and I). Thus, the monetary policy under both degrees of ERPT is expansionary, however the drop in nominal interest rate is higher under full ERPT compared to delayed ERPT, panel (G). Therefore, aggregate output increases under both degrees of ERPT, however the magnitude of the increase is higher with full ERPT than partial ERPT, since full ERPT allows for complete exchange rate pass-through into domestic prices, panel (A). Overall, the reaction of *Model III* to both a foreign demand and imports price shocks, given external currency pricing of exports and local currency pricing of imports, under the assumption of complete ERPT is amplified compared to partial ERPT.

12 Conclusion

Many East Asian emerging market economies follow a fixed exchange rate regime explicitly or implicitly. The literature attributes ‘fear of floating’ in these economies to the balance sheet effect or foreign currency denomination of external debt. In this paper, we developed a fully micro-founded DSGE model for the small open EME in an attempt to provide an alternative perspective for ‘fear of floating’. We argue that specific production and trade features can help explain the lack of exchange rate flexibility in EMEs. These EME structural features are: high share of processing trade, weak input substitution between domestic and imported factor inputs, predominant use of the US dollar in pricing exports representing another aspect of dollarisation, and partial exchange rate pass-through into domestic prices. Through the developed framework, we examined the interactions between various price-setting rules by firms in the intermediate traded and imported sectors and the transmission of the external shocks, namely a foreign demand and imports price shocks under different exchange rate regimes.

Introducing empirically relevant vertical production and trade structure for EMEs takes account of intermediate imported inputs role in exposing intermediate traded good producing firms’ marginal cost to currency fluctuations, thus affecting the marginal cost across the vertical production chain and hence consumer’s real wealth when exposed to external shocks. Thus, our model with vertical production and trade chains, external currency pricing for the traded good and delayed exchange rate pass-through into imported inputs price reveals that weak input substitution between domestic and imported factor inputs plays a key role in weakening the expenditure-switching effect of exchange rate adjustment, and helps explain ‘exchange rate disconnect’ phenomenon

captured by *Model III*, where exchange rate adjustment does not affect macroeconomic variables. This provides grounds for ‘fear of floating’ by emerging market economies, where a monetary policy following a floating exchange rate regime and allowing for exchange rate adjustment which does not affect macroeconomic variables in the small open EME. This result is driven by two factors, weak input substitution between domestic and imported factor inputs and firms producing the traded good engage in external currency pricing, which implies that their prices are sticky in the invoicing currency being the US Dollar. This result is consistent with Dornbusch (1987) showing that price stickiness magnifies the response of the exchange rate to fundamentals.

In addition, the model demonstrates that a central mechanism at work is the predominant use of US Dollar in pricing exports in East Asian EMEs, which breaks the link between increasing domestic exports as the domestic currency depreciates. This trade feature when modelled suggests that external currency pricing limits the desirability of exchange rate flexibility and provides an incentive for fixing the exchange rate, since exchange rate fluctuations has little impact on exports and on the relative price of imported inputs affecting the marginal cost of production across the production chain. This result is due to traded goods staggered prices in the invoicing currency, which eliminates the allocative role of the exchange rate and limits relative price adjustment. Furthermore, a newly imported trade feature for small open EMEs is partial ERPT into domestic prices, therefore we examine imported inputs price shock or cost-push shock exposing intermediate traded good producing firms’ marginal cost to currency fluctuations. By studying the two alternative exchange rate regimes in response to the shock, our model suggests that once empirically relevant production and trade features of small open EMEs are accounted for, such as weak input substitutability between domestic and imported inputs, external currency pricing of the traded goods, and partial ERPT into domestic prices, a floating exchange rate regime allowing for exchange rate adjustment does not maintain exports and results in a contractionary monetary policy. While a fixed exchange rate regime in response to a cost-push shock results in an expansionary monetary policy which stimulates economic activity and boosts exports since exporters engage in export currency pricing. Thus, introducing export currency pricing by firms producing the traded good may offers an alternative perspective on the phenomena of ‘fear of floating’ experienced by many small open EMEs based on their production and trade structures. Thus, understanding the transmission and propagation of world price fluctuations to emerging market economies’ specific vertical production and trade structures is crucial in the design and conduct of

macroeconomic policy of EMEs.

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