Inflation and globalisation: a modelling perspective

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Abstract

This paper examines some standard open-economy New Keynesian models to address the question of how globalisation affects the inflation process. Specifically, it investigates how the Phillips curve for consumer price inflation in a country is affected by openness, and how the optimal choice of monetary policy is influenced by openness. The paper compares models that assume producer currency pricing with ones that assume local currency pricing. It also considers the role of financial market completeness.

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In the past decade there has been much discussion among policymakers and policy-oriented economists on the role of globalisation in inflation. Inflation is a monetary phenomenon, and a general equilibrium phenomenon. The effects of globalisation on inflation depend on the structure of the macroeconomy and on monetary policies. For example, suppose a country has its own currency, and it successfully and rigidly targets its inflation rate – for example, at a 2% annual rate. Globalisation will not affect the inflation rate at all under this scenario. Inflation is 2% no matter how globalized it becomes. In this note, in the context of a simple open-economy New Keynesian macroeconomic model, we suggest three different ways of thinking about the effects of an economy's openness on inflation: (1) How openness might affect the policymaker's assessments of the relative costs of inflation, output gaps and possibly exchange rate misalignments (that is, how the policymaker's objectives are influenced by openness). (2) How the Phillips curve is affected by openness (that is, how the constraints facing the policymaker are influenced by globalisation). (3) How the equilibrium inflation rate, which depends on the policy choices and the Phillips curve, is influenced by globalisation.

One way to assess the potential effects of globalisation is to build a full and empirically plausible general equilibrium macroeconomic model, and then assess how the stochastic process for inflation would change under the hypothetical experiment of the economy becoming more open. For a given set of exogenous shocks, one could predict how the unconditional mean of inflation changes, and how the dynamics of inflation changes in response to various shocks.

While that approach is certainly useful, this note examines the *tradeoffs* – in the policymaker's loss function and in the Phillips curve – in the simple two-country open economy New Keynesian model of Engel (2011). There are two direct channels through which the world economy influences local inflation – through the foreign output gap, and through exchange rate changes. We propose a logical framework for assessing the question and to clarify some of the discussion in the literature, but not necessarily to provide a realistic answer.

To illustrate the point of this note, consider Ball (2006), who inveighs against much of the literature on this topic, which he views as having committed many logical fallacies. Ball concludes that globalisation does not play much, if any, role in inflation determination. In some contexts, that conclusion is certainly correct. For example, the central bank that always rigidly targets 2% inflation presumably does not consider there to be a tradeoff among objectives concerning the output gap, inflation and exchange rate misalignment – its only objective is to minimize deviations from its target inflation rate. In this case, as noted already, there is no influence of globalisation on inflation. However, real world central banks must make tradeoffs, and globalisation influences these tradeoffs.

Ball does not examine the question in the context of a model. Consider Ball's criticism of Borio and Filardo (2007), who estimate a Phillips curve that includes the foreign as well as the domestic output gap: "This story is dubious on both theoretical and empirical grounds. In mainstream theories, output affects inflation because it affects firms' marginal costs. Rises in marginal cost are passed through into higher prices. Marginal costs for a country's firms depend on their own output levels, not foreign output." However, in mainstream theory, such as the model in Engel (2011), the foreign output gap does matter for home inflation precisely because the foreign output gap influences domestic marginal cost. Ceteris paribus, an increase in the foreign output gap will generally raise domestic inflation by increasing demand for home goods, which drives up the home real wage.

While this note does not strive to build a realistic model, the model of Engel (2011) seems to have some quite implausible channels through which exchange rates affect inflation, arising from its assumption of complete markets. So, we also consider two simple versions of the model in which financial markets are not complete – indeed, one in which trade is balanced period by period. These help to illuminate channels through which globalisation might affect inflation in real world economies.

1. The Model and the Phillips Curve Equations

The model is from Engel (2011), which in turn is based heavily on Clarida et al. (2002) and Benigno (2004). The model assumes two countries, each inhabited with a continuum of households, normalized to a total of one in each country. Households have utility over consumption of goods and disutility from provision of labour services. In each country, there is a continuum of goods produced, each by a monopolist. Households supply labour to firms located within their own country, and get utility from all goods produced in both countries. Each household is a monopolistic supplier of a unique type of labour to firms within its country. We assume at this point that there is trade in a complete set of nominally-denominated contingent claims.

Monopolistic firms produce output using only labour, subject to technology shocks. Each firm uses labour inputs from every household within its country. Nominal wages are flexible, but nominal prices are sticky and set according to a Calvo pricing mechanism.

We allow for different preferences in the two countries. Home agents may put a higher weight in utility on goods produced in the Home country. Home households put a weight of $\nu / 2$ on Home goods and $1-(\nu / 2)$ on Foreign goods (and vice-versa for Foreign households). This is a popular assumption in the open-economy macroeconomics literature, and can be considered as a short-cut way of modelling "openness". A less open country puts less weight on consumption of imported goods, and in the limit the economy becomes closed if it imports no goods.

We will focus on Home consumer price inflation, which is a weighted average of inflation in the Home country of Home-produced goods and imported (Foreign-produced) goods:

(1) $$\pi_t = (\nu / 2)\pi_{Ht} + [1-(\nu / 2)]\pi_{Ft} .$$

Engel (2011) considers two types of price-setting behaviour. Producer-currency pricing (PCP) entails each firm setting one price for its goods, in its own currency. Alternatively, under local-currency pricing (LCP) each firm sets two prices: one in the Home currency for sale to Home consumers and one in the Foreign currency for sale to Foreign consumers.

1.1 PCP

Under PCP, the dynamics of inflation for Home goods prices are given by:

(2) $$\pi_{Ht} = \delta(w_t - p_{Ht} - a_t) + \beta \mathrm{E}_t \pi_{Ht+1} .$$

Here, w_t is the log of the wage in the Home country, p_{Ht} is the log of the price of Home goods in Home currency, and a_t is the log of the marginal and average product of labour. Thus inflation depends on the real wage, $w_t - p_{Ht}$, relative to the marginal product of labour, a_t, and expectations of future inflation. δ is smaller the less frequent is price adjustment.

Home currency inflation of imported goods, π_{Ft}, is equal to the Foreign inflation rate of those goods, π^*_{Ft}, plus the change in the exchange rate, $e_t - e_{t-1}$, by the law of one price. That is,

(3) $$\pi_{Ft} = \pi^*_{Ft} + e_t - e_{t-1} ,$$

where:

(4) $\pi_{Ft}^{*} = \delta(w_t^{*} - p_{Ft}^{*} - a_t^{*}) + \beta E_t \pi_{Ft+1}^{*}$,

for Foreign currency inflation of Foreign goods, with variables defined analogously to those in (2).

1.2 LCP

Under LCP, equation (2) still determines the Home consumer price inflation of Home goods. The consumer prices of Foreign goods are set in Home currency by Foreign firms under LCP, and we have:

(5) $\pi_{Ft} = \delta(w_t^{*} - p_{Ft} + e_t - a_t^{*}) + \beta \mathrm{E}_t \pi_{Ft+1}$.

2. Openness and Inflation in Complete Markets Model

Clearly, Home consumer price inflation depends on the global economy through imported goods inflation. However, global factors also influence the Home real wage, which from equation (2) determines Home CPI inflation of Home-produced goods.

In all cases, the rate of inflation ultimately depends on the excess of the real wage over the marginal product of labour. If all prices are flexible and the economy achieves efficient allocations, real wages should equal the marginal product of labour. But in Keynesian models, prices are sticky and output is demand-determined, which means that the equilibrium real wage may either exceed or fall short of the marginal product of labour.

2.1 PCP

Under PCP, we have:

(6) $\pi_{Ht} = \delta\left[\left((\sigma / D) + \phi\right)\tilde{y}_t^R + (\sigma + \phi)\tilde{y}_t^W\right] + \beta \mathrm{E}_t \pi_{Ht+1} + u_t$.

Here, $\tilde{y}_t^W$ is equal to the average of the Home and Foreign output gaps, $(\tilde{y}_t + \tilde{y}_t^{*})/2$, while $\tilde{y}_t^R \equiv (\tilde{y}_t - \tilde{y}_t^{*})/2$. The parameter σ is the inverse of the intertemporal elasticity of substitution, while ϕ is the inverse of the Frisch elasticity of labour supply. Also, $D \equiv \sigma\nu(2-\nu) + (\nu-1)^2$. The term u_t refers to a "cost-push" shock, as in Clarida et al., that arises from time-varying labour-market conditions.

From this equation, we can see the effect of the foreign output gap on inflation of Home-produced goods (holding the Home output gap and expected future inflation constant):

(7) $\partial\pi_{Ht} / \partial\tilde{y}_t^{*} = \delta\sigma(1-(1/D))/2 = \delta\sigma(\sigma-1)\nu(2-\nu)/2D$.

In the empirically plausible case of $\sigma > 1$, we find that inflation of Home-produced goods increases with a rise in the Foreign output gap. Intuitively, an increase in Foreign demand raises demand for Home goods, which increases demand for Home labour. This pushes up the real wage above the marginal product of labour leading to inflationary pressure.

A well-known result in Clarida et al. (2002) is that the Foreign output gap does not influence inflation of Home-produced goods, precisely in this model. Clarida et al. (2002) define output gaps in a way that is useful for their analysis but does not correspond to the usual definition for empirical work. Under Engel's (2011) definition, the Home and Foreign output gaps are the differences between actual and the output potential of each country when resources are used efficiently in the global economy. Under Clarida et al.'s definition, the Home potential output takes the actual level of Foreign output as given. Hence, an increase in Foreign output, perhaps caused by a monetary expansion, lowers Home potential output. (The mechanism is that the increase in Foreign output improves Home's terms of trade. The increase in Home wealth reduces Home labour supply, thus reducing Home's potential output under this definition.) The key point is that no matter how the term "output gap" is defined, an increase in Foreign demand raises inflation of Home-produced goods. Under Engel's definition of output gap, this is reflected as the effect of the Foreign output gap on Home inflation. Under Clarida et al.'s definition, the increase in Foreign demand lowers Home potential output, thus raising the Home output gap and increasing Home inflation.

Economies are more open when ν is close to 1 (and most closed when $\nu = 2$). From equation (7), we can see that the effect of the Foreign output gap on inflation of Home goods is maximized when the economies are most open.

Home CPI inflation is also influenced by inflation of imported goods, $\pi_{Ft} = \pi^*_{Ft} + e_t - e_{t-1}$. Of course, these receive a greater weight in Home CPI inflation the more open the economy. We have:

(8) $$\pi^*_{Ft} = \delta\left[-\left((\sigma / D) + \phi\right)\tilde{y}^R_t + (\sigma + \phi)\tilde{y}^W_t\right] + \beta \mathrm{E}_t \pi^*_{Ft+1} + u^*_t .$$

The effect of the Foreign output gap on Foreign inflation is given by

(9) $$\partial \pi^*_{Ft} / \partial \tilde{y}^*_t = \delta[\phi + \sigma(1 + (1/D))/2] .$$

When $\sigma > 1$, the effect of the Foreign output gap on Foreign inflation is smaller the more open the economy, as we would expect. However, the rate of inflation of Foreign goods plays a larger role in determining Home inflation when the economy is more open. Recall that Foreign inflation receives a weight of $1-(\nu/2)$. We find $[1-(\nu/2)](\partial \pi^*_{Ft} / \partial \tilde{y}^*_t)$ is maximized the more open the economy, and of course is zero when the economy is closed.

Combining the effects of the Foreign output gap on inflation of Home-produced goods and imported goods, and holding the exchange rate constant, we find:

(10) $$\partial \pi_t / \partial \tilde{y}^*_t = (\nu/2)\partial \pi_{Ht} / \partial \tilde{y}^*_t + [1-(\nu/2)]\partial \pi^*_{Ft} / \partial \tilde{y}^*_t = \delta[[1-(\nu/2)]\phi + \sigma(1 + (1-\nu)(1/D))/2] .$$

The Foreign output gap has its maximal impact on Home CPI inflation when the economy is most open, $\nu = 1$.

Finally, under PCP, exchange rate changes are passed one-for-one into import prices. These, of course, have a larger role in Home inflation the more open the economy.

2.2 LCP

Under local-currency pricing, we have

(11) $$\pi_{Ht} = \delta\left[\left((\sigma / D) + \phi\right)\tilde{y}^R_t + (\sigma + \phi)\tilde{y}^W_t + \left((D - (\nu - 1))/2D\right)m_t\right] + \beta \mathrm{E}_t \pi_{Ht+1} + u_t$$

(12) $$\pi_{Ft} = \delta\left[-\left((\sigma / D) + \phi\right)\tilde{y}^R_t + (\sigma + \phi)\tilde{y}^W_t + \left((D + \nu - 1)/2D\right)m_t\right] + \beta \mathrm{E}_t \pi_{Ft+1} + u^*_t .$$

Here, m_t represents the currency misalignment – the undervaluation of the domestic currency. It is a measure of the ratio of Foreign to Home prices of identical goods: $m_t \equiv e_t + p^*_{Ht} - p_{Ht} = e_t + p^*_{Ft} - p_{Ft}$. Under symmetric Calvo pricing, the price differential paid by Foreign versus Home consumers is equal for both Home- and Foreign-produced goods.

It is apparent from comparison of (11) and (12) to (6) and (8) that the Foreign output gap's influence on Home inflation is the same under LCP as under PCP.

Under PCP, a change in the exchange rate, $e_t - e_{t-1}$, is passed directly into Home inflation of imported Foreign goods. But under LCP, Home consumer prices of Foreign-produced goods are set in the Home currency, so there is no direct effect of the exchange rate change on Home inflation.

However, currency misalignments affect Home inflation. We have:

(13) $\partial\pi_{Ht} / \partial m_t = \delta((\sigma - 1)\nu + 1)(2 - \nu) / 2D$

(14) $\partial\pi_{Ft} / \partial m_t = \delta((\sigma - 1)(2 - \nu) + 1)\nu / 2D$

(15) $\partial\pi_t / \partial m_t = (\nu / 2)\partial\pi_{Ht} / \partial m_t + [1 - (\nu / 2)]\partial\pi_{Ft} / \partial m_t = \delta\sigma\nu(2 - \nu) / 2D$.

Not surprisingly, the impact of currency misalignment on Home CPI inflation is largest when the country is most open ($\nu = 1$), and the effect is zero when the economy is closed ($\nu = 2$).

But why do currency misalignments have an effect on inflation? That is, from equations (11) and (12), it is apparent that these exchange rate effects work through some channel other than output gaps. Even when the Home and Foreign output gaps are zero, a currency misalignment influences exchange rates. This channel arises because of the influence of asset markets. Under the well-known equilibrium condition when markets are complete, we have:

(16) $\sigma c_t - \sigma c_t^* = m_t + (\nu - 1)s_t$,

where $s_t = p_{Ft} - p_{Ht} = p_{Ft}^* - p_{Ht}^*$, so that $m_t + (\nu - 1)s_t$ is equal to the real exchange rate. Under complete markets, a Home depreciation that increases m_t redistributes resources toward Home consumers. This wealth redistribution reduces the incentive for Home households to work, thus increasing the Home real wage. From equation (2), this increase in the Home real wage leads to an increase in inflation. The same redistribution will tend to lower the Foreign real wage, but less than one-for-one with the depreciation. Hence, the Home currency cost of Foreign goods also rises, which from equation (5) leads to an increase in π_{Ft} .

How realistic is this channel? Of course, in the real world, markets are not complete. However, even with a small number of assets traded, the distributional effects of complete markets can be replicated. Engel and Matsumoto (2009) show how a Home depreciation can have identical wealth effects as in equation (16) if each country holds a portfolio of nominal bonds in which they hold no net debt, but are debtors in their own currency and creditors in the other country's currency. A Home depreciation then redistributes wealth to Home consumers.

This may not be a plausible channel through which exchange rates influence inflation for a variety of reasons. It is worthwhile examining how the Phillips curves are affected when this channel is cut off. So we turn next to models in which trade is continuously balanced and there is no trade in financial assets. Henceforth, we will consider only models with LCP, since we are primarily concerned here about the influence of exchange rate misalignments on inflation.

3. Openness and Inflation in Balanced Trade Models

Under balanced trade and local-currency pricing, we find:

(17) $\pi_{Ht} = \delta\left[\left(\sigma(\nu - 1) + 2 - \nu + \phi\right)\tilde{y}_t^R + (\sigma + \phi)\tilde{y}_t^W + \left((D - (\nu - 1)) / 2\right)m_t\right] + \beta \mathrm{E}_t\pi_{Ht+1} + u_t$

(18) $\pi_{Ft} = \delta\left[-\left(\sigma(\nu-1)+2-\nu+\phi\right)\tilde{y}_t^R + (\sigma+\phi)\tilde{y}_t^W + \left(1+\nu-D\right)/2\right)m_t\Big] + \beta E_t\pi_{Ft+1} + u_t^*$.

We find that the influence of the Foreign output gap on Home inflation is slightly different under this formulation compared to the complete markets case:

(19) $\partial\pi_{Ht} / \partial\tilde{y}_t^* = \delta(\sigma-1)(2-\nu)/2$

(20) $\partial\pi_{Ft} / \partial\tilde{y}_t^* = \delta[(\sigma\nu+2-\nu)/2+\phi]$

(21) $\partial\pi_t / \partial\tilde{y}_t^* = (\nu/2)\partial\pi_{Ht} / \partial\tilde{y}_t^* + [1-(\nu/2)]\partial\pi_{Ft} / \partial\tilde{y}_t^* = \delta\left[(2-\nu)(\sigma\nu+1-\nu)/2+\phi\right]$.

The wealth distribution is different under balanced trade than under complete markets, but the qualitative conclusions on the influence of the Foreign output gap on inflation is the same: Assuming $\sigma > 1$, a higher Foreign output gap raises π_{Ht}, and this effect is larger the more open the economy. A higher Foreign output gap also increases π_{Ft}, but this effect is smaller the more open the economy. But overall, the effect of the Foreign output gap on Home CPI inflation is larger the more open the economy when $\sigma > 1$.

Notice from equations (17) and (18) that currency misalignments still influence inflation, even when output gaps are zero. That is because there is still a wealth redistribution effect of an undervalued Home currency, and it works in the same direction as in the complete markets model. Here the effect comes through the influence of exchange rates on profits of exporters. A Home depreciation increases the revenue for Home firms that are selling in the Foreign country and have priced in Foreign currency, while it reduces the revenues for Foreign firms. This wealth redistribution from Foreign to Home works through the same channels as in the complete markets model to influence inflation. We find:

(22) $\partial\pi_{Ht} / \partial m_t = \delta((\sigma-1)\nu+1)(2-\nu)/2$

(23) $\partial\pi_{Ft} / \partial m_t = \delta(\nu-(\sigma-1)\nu(2-\nu))/2$

(24) $\partial\pi_t / \partial m_t = (\nu/2)\partial\pi_{Ht} / \partial m_t + [1-(\nu/2)]\partial\pi_{Ft} / \partial m_t = \delta\nu(2-\nu)\left[(\sigma-1)(\nu-1)+1\right]/2$.

In this formulation, the effect on wages of a currency misalignment may be greater than the misalignment – that is, a 1% misalignment may lead to a greater than 1% increase in Home real product wages and a greater than 1% decline in Foreign real product wages. The overall effect is still at its maximum when the economy is most open.

Even with balanced trade, exchange rates still influence inflation rates through wealth effects. However, we might inquire about the effects of openness on inflation if these wealth effects were not present at all. Devereux and Engel (2002) consider a global economy in which some goods are sold by distributors. These distributors purchase goods directly from exporters, who set the price in the exporter's currency. They sell them to domestic consumers, but price in the domestic consumer's currency. The distributor is taking on exchange rate risk, because when the exporter's currency appreciates unexpectedly, the distributor pays more for the goods but does not pass along that increase to the consumer.

In this symmetric model with the two countries of equal size, when exactly half of all exports are sold to distributors and the other half are sold directly to consumers (and priced LCP), exchange rate fluctuations have no wealth effect. A home depreciation, for example, increases the value of sales from Home firms that export directly to the Foreign consumer. But Home distributors of imported Foreign goods lose when the Home currency depreciates – they must pay more for the imports but do not pass along that cost increase to the Home consumers. Under balanced trade, the net wealth effect for the Home country is zero – the gain in wealth by the exporters is balanced off by the loss of wealth by the distributors.

In this case, we find:

(25) $\pi_{Ht} = \delta\left[\left(\sigma(\nu-1)+2-\nu+\phi\right)\tilde{y}_t^R + (\sigma+\phi)\tilde{y}_t^W\right] + \beta \mathrm{E}_t \pi_{Ht+1} + u_t$

(26) $\pi_{Ft} = \delta\left[-\left(\sigma(\nu-1)+2-\nu+\phi\right)\tilde{y}_t^R + (\sigma+\phi)\tilde{y}_t^W + m_t\right] + \beta \mathrm{E}_t \pi_{Ft+1} + u_t^*$.

Comparing these Phillips curves to equations (17) and (18) with no distributors, we find that the effects of output gaps are the same in both cases, but the currency misalignment no longer affects real product wages. Instead, the only effect of a larger m_t is to increase the Home currency cost of Foreign output, thus putting upward pressure on π_{Ft}. So we find simply:

(27) $\partial\pi_{Ht} / \partial m_t = 0 \qquad \partial\pi_{Ft} / \partial m_t = \delta \qquad \partial\pi_t / \partial m_t = \delta[1-(\nu/2)]$.

In this case, we can conclude that openness affects domestic inflation in three ways. First, when an economy is more open, the Foreign output gap has a greater effect on Home inflation by pushing up domestic wages and therefore inflation of Home-produced goods. Second, the Foreign output gap influences the price of imported goods. While the Foreign output gap has a smaller effect on Foreign inflation the more open the economies, the effect on Home inflation is nonetheless larger because greater openness implies a larger import share. Finally, currency misalignments affect inflation by increasing the Home currency cost of imports, which pushes up inflation of those goods. That effect increases with openness again simply because imports are a larger share of consumption.

4. The Effects of Openness on Loss Functions

The Phillips curves can be thought of as the constraints facing policymakers. Openness might also affect the objectives of policymakers that aim to maximize welfare of households. Here we follow Engel (2011) and consider policymaking under cooperation. We examine how openness affects the weight policymakers put on inflation relative to other objectives (output gaps and currency misalignments).

In the model of Engel (2011), under PCP, the loss function for the policymaker can be expressed as the expected present discounted value of Ψ_t, where

(28) $\Psi_t \propto \left[(\sigma/D)+\phi\right](\tilde{y}_t^R)^2 + (\sigma+\phi)(\tilde{y}_t^W)^2 + (\xi/2\delta)\left((\pi_{Ht})^2 + (\pi_{Ft}^*)^2\right)$.

Here, ξ is the elasticity of substitution for consumers among different varieties of goods produced within a country. Openness does not influence $\xi/2\delta$. The only role that openness plays in this loss function is in the parameter $D \equiv \sigma\nu(2-\nu)+(\nu-1)^2$. Assuming $\sigma > 1$, D is larger the more open the economies are. This increased openness reduces the influence of $(\tilde{y}_t^R)^2$ in the loss function.

First, consider why relative output gaps matter at all. Suppose the world output gap were zero, but one country's output gap was positive and the other's was negative. One country is producing excessive output, and the other's is insufficient. This production arrangement is clearly inefficient, but in terms of its impact on welfare, the effect is smallest when economies are most open. In the extreme case of complete openness, the inefficient production structure does not have an allocative effect across households in the two countries. Households in each country have the same consumption basket, and will consume more of the goods from the country that overproduces and fewer from the country that underproduces. As the economies become less open, the relative output gap causes further distortions not only to the production structure but to optimal consumption distribution. High Home output and low Foreign output, for example, hurts Foreign households more than Home households when there is home bias in consumption.

Hence, from a global perspective, openness reduces policymakers' concerns about output gaps relative to the weight put on inflation.

Under LCP, Engel (2011) finds

(29)

$$\Psi_t \propto \left[\frac{\sigma}{D}+\phi\right](\tilde{y}_t^R)^2+(\sigma+\phi)(\tilde{y}_t^W)^2+\frac{\nu(2-\nu)}{4D}m_t^2+\frac{\xi}{2\delta}\left(\frac{\nu}{2}(\pi_{Ht})^2+\frac{2-\nu}{2}(\pi_{Ft})^2+\frac{\nu}{2}(\pi_{Ft}^*)^2+\frac{2-\nu}{2}(\pi_{Ht}^*)^2\right)$$

The influence of openness on the tradeoff between output gaps and inflation is the same under LCP as under PCP. Now, as Engel (2011) emphasizes, in addition to output gaps and inflation, policymakers must also be concerned about the losses from currency misalignments. Those are maximized when the economies are most open.

As Engel (2011) notes, currency misalignments cause a loss through their effects on consumption allocation. When Home and Foreign output gaps are zero, then aggregate output in each economy is at an efficient level. Moreover, if all inflation rates are zero, then there is no output misallocation within each country. Even in this case, currency misalignments cause misallocation because the complete markets equilibrium condition (16) shows that when $m_t \neq 0$, there will be incomplete consumption risk sharing, so $c_t \neq c_t^*$. In this symmetric model, equal Home and Foreign consumption is optimal for the global policymaker, so they would like to drive currency misalignments to zero.

When trade is balanced, under LCP, we find

(30)

$$\Psi_t \propto \left[(\sigma-1)(\nu-1)^2+\phi\right](\tilde{y}_t^R)^2+(\sigma+\phi)(\tilde{y}_t^W)^2+\frac{\nu(2-\nu)D}{4}m_t^2+(\sigma-1)\nu(2-\nu)(\nu-1)m_t y_t^R$$
$$+\frac{\xi}{2\delta}\left(\frac{\nu}{2}(\pi_{Ht})^2+\frac{2-\nu}{2}(\pi_{Ft})^2+\frac{\nu}{2}(\pi_{Ft}^*)^2+\frac{2-\nu}{2}(\pi_{Ht}^*)^2\right).$$

Although the magnitudes are somewhat different, the qualitative role of openness on the tradeoffs between output gaps and inflation, and currency misalignments and inflation are similar to the complete markets case. As economies become more open, the weight policymakers put on $(\tilde{y}_t^R)^2$ declines. Also, as economies become more open, the weight put on m_t^2 increases, as we would expect.

Interestingly, there is another term in the loss function that involves $m_t y_t^R$. Notice that this term has $y_t^R=(y_t-y_t^*)/2$, which is the average of the actual output difference, not the output gap difference. This is another channel through which currency misalignment leads to consumption misallocation, in the case when trade is balanced. Recall that under balanced trade, there was a wealth effect from a Home depreciation, as Home firms gain revenue from foreign sales. This tends to benefit Home consumers, and the benefit is larger the greater is Home output relative to Foreign output. That is because, unless the economies are perfectly open, Home consumers benefit more from an increase in Home output than Foreign consumers. But note that when economies are perfectly open, $\nu=1$, this effect disappears. Under complete openness, an increase in Home output does not benefit Home consumers under balanced trade. So this component of the loss function is zero either when economies are completely closed $\nu=2$, or completely open, $\nu=1$.

Finally, in the model with distributors, the wealth effects of currency misalignments disappear. In this case, the loss function is simply

$$(31) \quad \Psi_t \propto \left[(\sigma-1)(\nu-1)^2+\phi\right](\tilde{y}_t^R)^2+(\sigma+\phi)(\tilde{y}_t^W)^2+\frac{\xi}{2\delta}\left(\frac{\nu}{2}(\pi_{Ht})^2+\frac{2-\nu}{2}(\pi_{Ft})^2+\frac{\nu}{2}(\pi_{Ft}^*)^2+\frac{2-\nu}{2}(\pi_{Ht}^*)^2\right)$$

This is the same as in the balanced trade model, except that currency misalignments have no welfare effect.

Conclusions

In each of these models, we could go further. We could determine a monetary policy for the central bank. As in many models, we might set an ad hoc interest-rate rule, or we might instead determine the optimal policy by minimizing the loss subject to the constraints presented by the Phillips curves. In either case, with a monetary policy rule in hand, we can then take the Phillips curves, the goods market equilibrium conditions and the financial market equilibrium conditions and solve for the endogenous variables. We can solve for equilibrium inflation, and then perform the comparative static exercise of asking how greater openness affects steady-state inflation. We could also see the influence of openness on the dynamic response of inflation to shocks – productivity shocks, cost-push shocks, and possibly monetary policy shocks.

The model examined here is not a realistic model, so we cannot easily draw real world conclusions about the effects of openness on inflation from this study. Instead, the objective here is to suggest a blueprint for analysis of the influence of openness on inflation. We can go beyond asking how openness influences inflation in equilibrium, which depends both on the structure of the economy and the monetary policy rule. We can look at the influence of inflation on the Phillips curve, which shows role of the economic structure; and, we can see how openness influences the objectives of policymakers, which demonstrates the role of monetary policy. Here we have found that openness matters for inflation because the foreign output gap influences domestic inflation, and potentially also because exchange rates affect aggregate demand through wealth effects.

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