

# Inflation and financial globalisation

Michael B Devereux<sup>1</sup>

## Abstract

The size of gross external portfolio holdings has among many countries increased substantially over the recent past. Over the same period the volatility of inflation has declined in most countries. Many previous papers argue that financial globalisation has led to improved policy-making and lower inflation. This paper makes the case that there could be causation running in the other direction. We present theory and empirical evidence indicating that more stable inflation leads to a substantial rise in the size of gross international financial positions, and an increase in financial globalisation.

Keywords: Inflation, Financial Globalisation

JEL classification: E4, E5

---

<sup>1</sup> NBER, CEPR and University of British Columbia. This is a write-up of my presentation at the BIS Conference on "Globalisation and inflation dynamics in Asia and the Pacific", 18–19 June 2012 in Hong Kong. It is based on joint research with Ozge Senay and Alan Sutherland.

## 1. Introduction

Data on external asset positions shows that the gross size of country portfolios has increased substantially over the past four decades. Over the same period the volatility of inflation has declined in most countries as monetary authorities have shifted the focus of monetary policy towards inflation stabilisation and away from output stabilisation. Are these two phenomena related? Has the increased monetary policy focus on nominal stability resulted in greater financial globalisation?

There has been a substantial literature on the relationship between financial globalisation and inflation. But the literature for the most part has focused on the causation going in the other direction. As an example, many authors have suggested that increasing globalisation in goods and financial markets has led to a decline in national inflation rates, either through direct market mechanisms or by influencing the behavior of monetary authorities. Rogoff (2004, 2006) suggests that increasing economic openness may steepen the trade-off between inflation and output, and reduce the equilibrium inflation rate chosen by monetary authorities. Chen et al. (2009) find empirical evidence that increasing openness, by reducing non-competitive distortions in domestic markets, reduces the inflation bias in monetary policy. In addition, it has been suggested that there are direct disinflationary forces imparted by international trade (Pain et al. 2006, Borio and Filardo 2007). Alternatively, financial globalisation could affect inflation indirectly by imposing a ‘disciplining effect’ on domestic monetary policy.

This link is explicitly tested in Tytell and Wei (2004). They find evidence that financial globalisation has led to lower inflation rates. Related research by Kose et al. (2007) suggest that there are ‘collateral’ benefits of financial globalisation coming from its effect on the quality of domestic economic policy. Stark (2011) also conjectures that financial globalisation was a contributing factor in improved monetary policy performance in OECD countries.

These hypotheses are quite plausible. Through these or other mechanisms, it is quite likely that financial globalisation would influence the level or variability of inflation. But the link may also go the other way. That is the subject of the paper that is summarized in the present discussion (Devereux, Senay and Sutherland, 2012 - hereafter DSS). The paper argues that there is a strong theoretical case for the hypothesis that more stable inflation leads to a substantial rise in the size of gross international financial positions, and as a result, an increase in financial globalisation.

In DSS we find that monetary policy which reduces the variability of domestic inflation leads to an increase in the diversification of international portfolios, generating higher gross external assets and liabilities. We show that this result is highly robust across a wide variety of modeling specifications and parameter assumptions. In addition, we provide some preliminary empirical evidence for this link.

Our approach is to provide a theoretical investigation of the impact of monetary policy and nominal stability on the size of external asset positions in a general theoretical model in which gross external financial positions are endogenous.

The theoretical model is a two-country DSGE structure with Calvo-style sticky prices. The benchmark model with a standard Taylor rule displays home bias in equity holdings while each country holds a long position in bonds denominated in their own currency. By varying the feedback coefficient on inflation in the Taylor rule it is possible to analyze the relationship between the anti-inflation stance of monetary policy, the variance of inflation and equilibrium portfolio positions. In the baseline parameterization of the model, as the policy feedback coefficient on inflation is increased, the variance of inflation falls and the absolute size of equilibrium gross positions in both equities and bonds increase. So the model predicts a negative relationship between the variance of inflation and the size of equity and bond portfolio positions. This negative relationship appears to be very robust across a wide range of parameter variations.

The underlying cause of this negative relationship can be explained in terms of simple expressions for equilibrium portfolios which show that the equilibrium gross portfolio position in any asset is proportional to the variability of home income relative to foreign income and inversely related to the variability of the asset return. Lower variability of asset returns compared to the variability of relative income implies that gross portfolios have to be larger in order to provide adequate hedging of income shocks. We show that the model implies that, as the feedback coefficient on inflation in the Taylor rule is increased, the variability of asset returns decreases compared to the variability of relative income. This leads to an increase in gross asset positions. We further show that the size of gross positions depends on the correlation between asset returns and cross-country income shocks. The more asset returns are correlated with income shocks the larger are equilibrium gross holdings. Our model shows that, when asset markets are incomplete (meaning there are fewer independent assets than there are sources of uncertainty) a reduction in inflation variability increases the correlation between asset returns and income shocks. In effect, inflation stabilisation moves equilibrium closer to the complete markets outcome. This tends to raise the size of equilibrium gross holdings. There are thus two effects which link a reduction in inflation variability to an increase in the size of gross portfolio positions, a return variability effect and a return-income correlation effect. The model shows that both effects contribute to an expansion of gross positions the more monetary policy focuses on inflation stabilisation.

The relationship between gross positions and inflation volatility can be investigated empirically using the Lane and Milesi-Ferretti (2001, 2007) data on gross external portfolio positions. In order to put our theoretical results in context, we first report panel regression estimates for advanced economies for the period 1970-2007 which show a statistically significant negative relationship between inflation variability and the size of gross portfolio positions. This empirical result appears to be quite robust to different specifications of the regression equation and different definitions of the variables. In particular the results are robust for overall gross positions and also the gross positions in bonds and equities separately.

DES represents part of a large literature on the theoretical and empirical underpinnings of international capital flows. On the theory side, Devereux and Sutherland (2010, 2011) and Tille and Van Wincoop (2010) develop techniques for computing equilibrium portfolios in DSGE models. Applications to the ‘home bias’ puzzle include Coeurdacier et al. (2010), Engel and Matsumoto (2009), Heathcote and Perri (2007), and Benigno and Nistico (2009). Empirically, Lane and Milesi-Ferretti (2008a,b) and Lane and Shambaugh (2010) have explored the determinants of international portfolio positions.

## 2. Empirical Evidence

Here we take some empirical evidence from DSS. That paper does some basic panel regression estimates of the relationship between gross positions and inflation variability. We estimated a panel regression of the following form

$$100 \ln(GP_{i,t} / GDP_{i,t}) = \beta_0 + \beta_1 \sigma_{i,t}(\pi) + \beta_2 Open_{i,t} \quad (1)$$

where  $GP_{i,t}$  is a measure of the size of the gross portfolio position of country  $i$  in period  $t$  and  $\sigma_{i,t}(\pi)$  is a measure of inflation variability for country  $i$  in period  $t$ .

We control for capital market frictions by including  $Open_{i,t}$  as a measure of financial openness in the above regression equation.

We focus on the total gross position,  $GP$ , which we define as

$$GP = \frac{(Total\ External\ Assets + Total\ External\ Liabilities)}{2}$$

We define  $\sigma_{i,t}(\pi)$  to be the standard deviation of the CPI inflation rate of country  $i$  for the period  $t-k$  to  $t$  where inflation is measured as the annual percentage change in the CPI measured at quarterly intervals. In the main results we report below we choose  $k$  to be six years, so  $\sigma_{i,t}(\pi)$  is the standard deviation of annual inflation based on the 24 quarterly observations of the CPI up to and including the final quarter of year  $t$ . Data on gross asset and liability positions is taken from Lane and Milesi-Ferretti (2007).

Column 1 of Table 1 reports the estimated coefficients for the case where country dummies and a time trend are included in the list of regressors. For this version of the estimation equation the estimated coefficient on the variability of inflation is negative and the coefficient on the Chinn-Ito index is positive.

The magnitude of the coefficient on inflation variability suggests that inflation variability has quite a large effect on the size of gross positions. For instance, a coefficient of  $-5.1$  implies that a fall in the standard deviation of annual inflation by 1 percentage point raises the size of gross portfolio positions by approximately 5% of GDP. The average range of the standard deviation of inflation over the sample period is approximately 5 percentage points, so these estimates suggest that changes in inflation variability might account for a change in the size of gross positions of approximately 25% of GDP, which is quite a large effect.

The coefficient on the Chinn-Ito index is also quite large. The Chinn-Ito index varies between  $-1$  and  $+2.5$  over the sample period, so a coefficient of  $7.2$  implies a change in gross portfolio positions of approximately 25% of GDP. Again this is a large effect.

Column 2 of Table 1 reports the results for a variant of the model where we correct for auto-correlation. The estimated coefficient on inflation variability continues to be negative and significant, but is somewhat smaller than the coefficient reported in Column 1. The coefficient on the Chinn-Ito index continues to be positive but is no longer significant.

Columns 3 and 4 repeat the AR(1) corrected regression for cases where the dependent variable is respectively equity-type assets and debt-type assets. The general message of these results, in terms of the coefficient signs, is similar to the results already reported for the total gross position, ie the coefficient on inflation variability is negative and the coefficient on the Chinn-Ito index is positive. Columns 5 to 7 report results for an extended sample of countries which includes a wider set of developed economies.

### 3. A model of monetary policy and gross portfolio positions

We analyse a model of two countries with multiple types of shocks. The full description of the model is given in the working paper by Devereux, Senay and Sutherland (2012). Here we simply state some of the main results which are used to construct international portfolio positions. We follow Devereux and Sutherland (2011) in computing the characteristics of the portfolios using a second-order approximation to the portfolio selection equations for the home and foreign country.

Define  $\Delta c$  as relative (log) consumption between a home and foreign country,  $q$  as the real exchange rate,  $\Delta y$  as relative (log) income,  $f$  as initial net foreign assets of home, and  $r_x$  as a vector of excess returns on the home portfolio. We allow for a portfolio of equities and bonds to be traded across countries.

Following Devereux and Sutherland (2011), we may write the orthogonality condition which determines the optimal bond and equity portfolio as follows:

$$E_t \left( \Delta c_{t+1} - \frac{1}{\rho} q_{t+1} \right) r_{x,t+1} = 0 \quad (2)$$

From each country's budget constraint, and optimal intertemporal consumption smoothing, we can obtain an expression for real exchange rate adjusted relative consumption in period  $t+1$  as

$$\Delta c_{t+1} - \frac{1}{\rho} q_{t+1} = (1 - \beta) \left[ \Gamma_{y,t+1} + \beta^{-1} 2f_t + 2\tilde{\alpha}' r_{x,t+1} \right] \quad (3)$$

where

$$\Gamma_{y,t+1} = E_{t+1} \sum_{j=0}^{\infty} \beta^j \left( \Delta y_{t+1+j} + \% \frac{(\rho - 1)}{\rho} q_{t+1+j} \right)$$

represents the present value of expected innovations to relative income, plus the present value of expected innovations to the real exchange rate. Here  $\beta$  is the time discount factor and  $\rho$  is the inverse elasticity of intertemporal substitution. Note that in the case of  $\rho = 1$ , the second term drops out, and innovations in current and expected future real exchange rates do not directly affect the value of  $\Delta c_{t+1} - \frac{1}{\rho} q_{t+1}$ .

Putting (3) together with the orthogonality condition (2), we may compute the expressions characterising the equilibrium portfolio as

$$\tilde{\alpha} = -\frac{1}{2} \Sigma_r^{-1} \text{cov}_t(r_{x,t+1}, \zeta_{y,t+1}) \quad (4)$$

Where  $\zeta_{y,t+1} = \Gamma_{y,t+1} - E_t \Gamma_{y,t+1}$  and where  $\Sigma_r$  is the co-variance matrix of  $r_{x,t+1} - E_t r_{x,t+1}$ . Thus, the optimal portfolio position is determined by the way in which innovations in the excess return vector co-vary with innovations in the expected present discounted value of relative income (adjusted by the real exchange rate).

DES show that equation (4) is equivalent to the following expressions for equilibrium asset holdings

$$\tilde{\alpha}_e = -\frac{1}{2} \text{corr}(\zeta_{y,t}, r_{x,t}^e | r_{x,t}^b) \frac{\text{StDev}(\zeta_{y,t} | r_{x,t}^b)}{\text{StDev}(r_{x,t}^e | r_{x,t}^b)} \quad (5)$$

$$\tilde{\alpha}_b = -\frac{1}{2} \text{corr}(\zeta_{y,t}, r_{x,t}^b | r_{x,t}^e) \frac{\text{StDev}(\zeta_{y,t} | r_{x,t}^e)}{\text{StDev}(r_{x,t}^b | r_{x,t}^e)} \quad (6)$$

These expressions show that the size of the gross position in asset  $i$  depends on two factors:

- (1)  $\text{corr}(\zeta_{y,t}, r_{x,t}^i | r_{x,t}^j)$ , the correlation of the return differential of asset  $i$  with innovations in the present value of relative income (conditional on the return differential of asset  $j$ )
- (2)  $\text{StDev}(\zeta_{y,t} | r_{x,t}^j) / \text{StDev}(r_{x,t}^i | r_{x,t}^j)$ , the standard deviation of innovations in the present value of relative income (conditional on the return differential of asset  $j$ )

relative to the standard deviations of returns on asset  $i$  (conditional on the return differential of asset  $j$ )

These expressions have a very intuitive explanation. Agents wish to hold a portfolio of assets which hedge against shocks to relative income,  $\zeta_y$ . The extent to which asset  $i$  provides a good hedge against relative income shocks depends on the correlation between the return on asset  $i$  and relative income shocks, ie  $corr(\zeta_{y,t}, r_{x,t}^i | r_{x,t}^j)$ . An asset which is (negatively) correlated with income shocks is a good hedging instrument and so will be held in the equilibrium portfolio with a positive gross position. The stronger the correlation the more of that asset will be held. But the amount of the asset that needs to be held to hedge income shocks also depends on the size of fluctuations in income relative to the size of fluctuations in the return on asset  $i$ , ie  $StDev(\zeta_{y,t} | r_{x,t}^j) / StDev(r_{x,t}^i | r_{x,t}^j)$ . The larger are fluctuations in income relative to fluctuations in the return on asset  $i$  the larger must be the gross position in asset  $i$  in order to provide the desired degree of hedging.

These two effects, (ie *the correlation effect* measured by  $corr(\zeta_{y,t}, r_{x,t}^i | r_{x,t}^j)$ , and *the variability effect* measured by  $StDev(\zeta_{y,t} | r_{x,t}^j) / StDev(r_{x,t}^i | r_{x,t}^j)$ ), are key to the interpretation of the link between inflation variability and the size of gross positions.

#### 4. Inflation and globalisation: main results

In DSS, this model is solved numerically, and then optimal portfolios are constructed as described above. That paper shows in detail how the portfolios depend on the correlation and variability terms as identified in (5) and (6). Rather than an extensive analysis of the calibration, computation methods and quantitative implications of the model, here we simply summarize the main results in words.

The key to the results lies in the impact of a ‘tighter’ monetary policy on both inflation variability and gross external portfolios simultaneously. By ‘tight’, we mean a monetary policy rule where the Central Bank adjusts interest rates in response to inflation and output gaps, and the parameter governing the response to inflation rises. In accord with realistic descriptions of policy, we assume that policy responds to CPI inflation.

What happens when monetary policy becomes tighter? The first and most direct effect is that the response of CPI inflation to various shocks in the model is dampened. This means that the volatility of inflation is reduced, in accord with what we see in the historical pattern of inflation over the last few decades for most countries. But the tighter monetary policy also affects equilibrium portfolios and therefore the size of gross external asset holdings.

The intuitive linkage between inflation stabilisation and external asset holdings can be related to the ‘correlation effect’ and the ‘variability effect’ defined above. The model in DSS includes both equity and nominal bond holdings for each of the two countries. A tighter monetary policy tends to reduce the standard deviation of relative equity returns, as it makes dividend payments more stable. It also reduces the standard deviation of relative bond returns, since relative nominal bond returns depend on relative CPI inflation directly. As a result, through the variability channel defined above, the absolute size of both external equity and external bond holdings rise. It also turns out that a tighter monetary policy in most cases increases the standard deviation of relative income, therefore giving a further boost to the size of gross external asset holdings (both in equity and debt).

At the same time, if a tight monetary policy improves the efficiency of asset prices in responding to fundamental shocks governing asset returns, then it can also be shown that the policy increases gross external asset holdings through the correlation effect. Thus,

through all the channels described in equations (5) and (6), a policy of inflation stabilisation will lead to an increase in financial globalisation.

## 5. Discussion

This research agenda suggests that a more aggressive monetary policy which reduces the variability of inflation in almost all cases leads to an increase in gross external assets and liabilities. Previous researchers have argued that the causation may go in the other direction. Econometric evidence such as Tytell and Wei (2004) finds that measures of financial globalisation have significantly negative coefficient estimates in cross country inflation (level) equations. By contrast, our empirical evidence finds that inflation variability is significant in panel regressions of financial globalisation. Sorting out the full set of causal links between the level of inflation, the variability of inflation, and financial globalisation is beyond the scope of this paper. Both inflation and international portfolio positions are endogenous and affected by all aspects of the macroeconomy, and it is difficult to obtain robust instruments for either variable. Moreover, our theory by no means precludes the possibility that there may be additional forces leading from international financial globalisation to inflation either directly or indirectly through endogenous monetary policy. Our main point is that evidence suggesting that increased capital market openness has been associated with reductions in average inflation rates does not necessarily establish the direction of causation, since we have shown that there are strong theoretical reasons to think that there may also be a link between inflation stability and the size of gross external financial positions.

The effect of inflation variability on gross external assets depends on the correlation and variability channels defined above. Are these channels empirically relevant? Our model predicts that a fall in the variance of the relative returns on bonds and equity will lead to a rise in gross external positions. The relative return on nominal bonds is represented by the variance of expected exchange rate changes. In fact, over the major period of financial globalisation discussed in this paper, as noted by Rogoff (2006), there was a decline in variability in nominal exchange rates between the major economies. Likewise, there is evidence of an increase in the co-movement of major world stock markets since the mid-1990s (see e.g. Kizys and Pierdzioch 2009). This should be associated with a fall in the variability of relative equity returns.

The second component of the variability effect is determined by the conditional variance of relative income across countries. One way to measure this would be to look at business cycle co-movement across countries. Here, the results of the literature are quite ambiguous. Heathcote and Perri (2002) and Stock and Watson (2003) find that business cycle co-movement among the major economies fell in the 1990's relative to earlier periods. In principle, this should lead to an increase in the conditional variance of relative income across countries. However, using a wider sample of countries, Kose, Prasad and Terrones (2003) find that correlations tended to increase over time during the 1960-99 period.

In the case of demand shocks, our model predicts that a fall in inflation variability will still lead to a rise in financial globalisation, even though it will cause a decline in the conditional variance of relative income. This is because the rise in gross holdings coming from the fall in the conditional variance of asset returns dominates the effect of the fall in the conditional variance of relative income. Thus, to establish the importance of inflation variability in gross external assets does not necessarily require a fall in business cycle co-movements.

**Table 1** Panel regression results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	G7	G7	G7	G7	G22	G22	G22
	Total	Total	Equities	Debt	Total	Equities	Debt
	portfolio	portfolio			portfolio		
Constant	-194.2*** (30.45)	-219.4*** (8.71)	-400.0*** (14.33)	-217.6*** (7.62)	-262.2*** (12.02)	-486.2*** (15.10)	-269.0*** (10.56)
StDev	-5.12*** (4.36)	-3.20*** (3.94)	-2.06* (1.65)	-3.45*** (3.92)	-1.11* (1.85)	-0.72 (0.83)	-1.10* (1.74)
Inflation							
Chinn-Ito	7.20*** (4.18)	2.38 (1.36)	6.18** (2.32)	1.87 (0.98)	2.77** (2.14)	2.47 (1.33)	3.17** (2.33)
Index							
Trend	4.41*** (24.35)	6.16*** (10.02)	8.75*** (12.13)	4.42*** (6.39)	7.46*** (18.13)	11.66*** (19.25)	5.82*** (12.31)
AR coeff		0.92	0.89	0.92	0.91	0.91	0.92
R <sup>2</sup>	0.94	0.99	0.99	0.99	0.99	0.99	0.98
St Err Est	20.62	7.73	11.77	8.38	10.07	14.51	10.58
F-stat	411.35	28.59	68.30	20.95	29.14	36.90	18.03
DW-stat	0.17	1.74	1.76	1.74	1.84	1.89	1.78

Column (1): simple OLS. Columns (2)-(7): OLS corrected for AR(1) residuals.

\*\*\* indicates significant at 1% level

\*\* indicates significant at 5% level

\* indicates significant at 10% level

t-stats in brackets

## References

- Benigno, P and S Nistico, (2009): “International portfolio allocation under model uncertainty”, *NBER Working Paper*, 14734.
- Borio, C and A Filardo (2007): “Globalisation and inflation: new cross-country evidence on the global determinants of domestic inflation”, *BIS Working Paper*, no 227.
- Chen, N, J Imbs, and A Scott, (2009): “Competition, globalisation, and the decline of inflation”, *SSRN working paper*.
- Chinn, M and H Ito (2007): “A new measure of financial openness”, unpublished manuscript, University of Wisconsin.
- Coeurdacier, N, R Kollman, and P Martin, (2010): “International portfolios, capital accumulation, and foreign asset dynamics”, *Journal of International Economics*, 80, pp 100–12.
- Devereux, M, O Senay and A Sutherland (2012): “Nominal stability and financial globalisation”, *NBER Working Paper*, 17796 .
- Devereux, M and A Sutherland (2010): “Country portfolio dynamics”, *Journal of Economic Dynamics and Control*, 34, pp 1325–42.
- Devereux, M and A Sutherland (2011): “Solving for country portfolios in open economy macro models”, *Journal of the European Economic Association*, 9.
- Engel, C and A Matsumoto (2009): “The international diversification puzzle when goods prices are sticky: It's really about exchange-rate hedging, not equity portfolios”, *American Economic Journal of Macroeconomics*, 1, pp 155–188.
- Heathcote, J and F Perri (2002): “Financial autarky and international business cycles”, *Journal of Monetary Economics*, 44, pp 423–51.
- Heathcote, J and F Perri (2007): “The international diversification puzzle is not as bad as you think”, *NBER Working Paper*, 13483.
- Kose, A, E Prasad, and M Terrones, (2003): “How does globalisation affect the synchronization of business cycles?”, *American Economic Review, Papers and Proceedings*, 93, pp 57–62.
- Kose, A, E Prasad, K Rogoff, and S-J Wei, (2007): “Financial globalisation: beyond the blame game”, *Finance and Development*, 44, 1.
- Kizys, R and P Pierdzioch, (2009): “Changes in the international comovement of stock returns and asymmetric macroeconomic shocks”, *Journal of International Financial Markets, Institutions and Money*, 19, pp 289–305.
- Lane, P and G-M Milesi-Ferretti (2001): “The external wealth of nations: Measures of foreign assets and liabilities for industrial and developing countries”, *Journal of International Economics* 55, pp 263–94.
- (2007): “The external wealth of nations mark II: Revised and extended estimates of foreign assets and liabilities, 1970–2004”, *Journal of International Economics* 73, pp 223–50.
- (2008a): “The Drivers of Financial Globalisation”, *American Economic Review Papers and Proceedings*, 98, pp 327–32.
- (2008b): “International Investment Patterns”, *Review of Economics and Statistics*, 90, pp 538–49.
- Lane, P and J Shambaugh (2010): “The long or short of it: determinants of foreign currency exposure in external balance sheets”, *Journal of International Economics*, 80, pp 33–44.

Pain, N, I Koske and M Sollie (2006): “Globalisation and inflation in the OECD economies”, OECD I-Library, 524.

Rogoff, K (2004): “Globalisation and global disinflation”, in *Monetary Policy and Uncertainty: Adapting to a Changing Economy*, Papers and Proceedings of the 2003 Jackson Hole Symposium.

——— (2006): “Impact of globalisation on monetary policy”, Jackson Hole Conference Paper.

Stark, J (2011): “Globalisation and monetary policy: from virtue to vice?”, Federal Reserve Bank of Dallas, mimeo.

Stock, J and M Watson, (2003): “Understanding changes in international business cycles”, *NBER Working Paper*, 9859.

Tille, C and E van Wincoop (2010): “International capital flows”, *Journal of International Economics*, 80, pp 157–75.

Tytell, I and S-J Wei (2004): “Does financial globalisation induce better macroeconomic policies?”, *IMF Working Paper*, 04-84.