Asset Prices, News Shocks and the Current Account *

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Abstract

The paper analyses the relationship between asset prices and current account positions for a broad set of 42 industrialized and emerging market countries. It models asset price shocks as news shocks to expectations about future fundamentals in a small two-country DSGE model, in order to derive identification restrictions, and uses a Bayesian VAR with sign restrictions to empirically test for their effect. Such shocks are found to exert sizeable effects on the current account positions of countries. Moreover, the effects are highly heterogeneous across countries, for instance with a 10% shock to domestic equity prices relative to the rest of the world worsening the US trade balance by 1.2 percentage points, but much less so for most other economies. We find that this heterogeneity appears to be linked to the financial market depth and equity home bias of countries. Moreover, the channels via wealth effects and via the real exchange rate are important for understanding the heterogeneity in the transmission.

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Keywords: asset prices; news shocks; current account; identification; Bayesian VAR; financial markets; home bias; wealth effects.

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1 Introduction

Current account positions have hardly ever been so dispersed globally as they are today, despite the 2007-09 financial crisis. It is not only that the largest economy, the United States, has been recording large current account deficits for several years, but other industrialized countries, such as the UK and Australia, and some emerging markets and transition economies have had similar or even larger deficits. By contrast, countries such as China, Japan and oil exporters register corresponding large trade surpluses. At the same time, asset prices have gone through a marked cycle over the past decade, with equity markets rising substantially in the second half of the 1990s and in 2002-06 and declining in 2001-02 and 2008. The financial market crisis of 2007-09 has made the importance of asset prices for the global economy more than apparent. Despite the financial crisis, the role of asset prices for the global economy will most likely increase further as financial markets deepen and emerging economies liberalize and integrate.

The paper analyses the relationship between asset price fluctuations and the trade balance for a broad set of 42 industrialized and emerging market economies. The objective is not only to grasp the magnitude of the effect of asset prices fluctuations on trade, but also to understand the channels through which this effect materializes. A rise in asset prices affects net exports through a wealth channel as households adjust saving and consumption decisions, and through an exchange rate and terms of trade channel, altering the relative prices of domestic and foreign goods. Equally importantly, asset prices may exert different effects across economies, as those with deeper yet more closed financial markets may respond more strongly.

A key challenge we face is the structural interpretation and identification of exogenous increases in asset price. Asset price fluctuations may reflect standard macroeconomic supply or demand shocks, or policy shocks (e.g. to technology, monetary policy and fiscal policy). Yet, the literature emphasizes that asset prices may exert a partly autonomous influence on the economy. A first such channel is via "news shocks", along the line of work by Beaudry and Portier (2006, 2007), in which asset prices adjust because of altered expectations about the likelihood of future outcomes (or "news"), such as to future productivity. Such changes in expectations should then, in turn, be reflected in today's asset prices as these represent the net discounted value of all future fundamentals.[1]

The focus of the paper is primarily empirical, so that the identification of asset price shocks is crucial to the validity of the empirical findings. We derive the sign restrictions for the structural VAR from a two-country DSGE model, in which exogenous fluctuations in asset prices are modelled as news shocks - i.e. anticipated changes to technology - following the approach proposed by Schmitt-Grohe and Uribe (2008) and Fukiwara et al. (2008). For plausible ranges of the parameters, we show that such news shocks yield theoretical impulse responses for relative (domestic minus foreign) consumption, output, inflation and interest rates in the short-run that can be strictly distinguished from common supply shocks (realized productivity), demand shocks (such as to government spending) and monetary policy shocks.

[1] This is also related to the work by Engel and Rogers (2006), who show that the large size of the US current account deficit is consistent with expectations of an increasing share of US output in the world. An alternative interpretation is that asset price movements may reflect rational bubbles, as in Kraay and Ventura (2005) and Ventura (2001), who argue that the sharp increase in asset prices over the past decade may largely have reflected a bubble, which was rational because of market expectations that this increase may be persistent.

We then employ a Bayesian VAR, following Canova and De Nicoló (2002), Uhlig (2005) and Peersman (2003), using the sign restrictions derived from this two-country DSGE model to test for the effect of exogenous asset price fluctuations in the data. This methodology not only requires imposing a relatively small and intuitive number of identification restrictions, but importantly it also allows us to distinguish asset price shocks from other types of shocks. Because we model exogenous asset price increases as news shocks, we use the terms news shocks and asset price shocks interchangeably throughout the paper.

For a core set of 16 industrialized countries during the period 1974-2007 and an extended sample of an additional 26 mostly emerging markets during 1990-2007, our empirical findings show that asset prices exert a sizeable effect on the trade balance of countries. The channels through which equity prices influence net exports are both through wealth effects on private consumption and to some extent through the exchange rate. An increase in asset prices tends to have a positive impact on short-term interest rates and inflation, and leads to an appreciation of the real effective exchange rate and an increase in consumption. Moreover, we find a large degree of cross-country heterogeneity in the impulse response pattern. The US trade balance is among the most sensitive as net exports, on average, decline by more than 1.2 percentage points in response to a 10% increase in US equity prices relative to the rest of the world. The trade balances of most other countries react substantially less.

Why is the effect of asset price shocks so different across countries and what explains the heterogeneity? We relate this cross-country pattern to financial openness and depth, trade openness as well as monetary policy and fiscal policy. While the analysis does not offer an empirical test of different hypotheses, its intention is to illustrate how different factors may influence the transmission of asset price shocks. As to the role of the financial channel, wealth effects of an asset price shock should be more important in an economy in which the size of financial wealth is larger, in which financial markets are more liquid and in which fewer households are liquidity constrained. Indeed, empirically the sensitivity of the trade balance appears to be more important in countries in which the equity wealth of households is relatively large, as well as in countries that have a higher home bias in their equity holdings. This applies for instance to the United States, which not only has a deep equity market, but where also a relatively large share of equity wealth is held domestically.

Another potential determinant is trade openness, as an asset price shock may have a larger effect on net exports through the wealth channel in more open economies. However, trade openness does not appear to be related in the expected way to the impact of asset price on net exports, and we find that the picture is also much more mixed for the role of monetary policy.

The paper is related to two fields of the literature. A first strand focuses on the drivers of the large and persistent global current account imbalances. Several papers emphasize the importance of a "saving glut" (Bernanke 2005) in many emerging markets and commodity-exporting countries, partly stemming from the underdevelopment and lack of integration of financial markets in those economies (Caballero et al. 2006, Ju and Wei 2006), as well as the increasing role of ensuing valuation effects on gross international asset positions (Gourinchas and Rey 2007, Lane and Milesi-Ferretti 2005) and a pre-cautionary motive as a rationale for high saving rates (e.g. Gruber and Kamin 2007, Chinn and Ito 2007). Other studies to explain the dispersion in current account positions stress the role of productivity differentials (e.g. Corsetti et al. 2006, Bussiere et al. 2005), or link it to the "great moderation" which has induced a decline in income volatility and uncertainty, at least prior to the current financial crisis (Fogli and Perri 2006).

As to the second area, a vast literature identifies and measures the effect of price changes in various financial assets on private consumption (e.g. Betraut 2002, Case et al. 2005). Most of this literature finds a significant effect of both equity wealth and housing wealth on private consumption. However, there is still substantial controversy as to the magnitude and precise functioning of this channel as for instance exemplified by the conflicting results found by Palumbo, Rudd, and Whelan (2006) and Lettau and Ludvigson (2004). The effect of such a wealth channel on the external dimension of countries, in particular the current account and the exchange rate, has so far received little attention in the literature. Fratzscher, Juvenal and Sarno (2007) focus on the United States, showing that in particular housing price shocks have been important drivers of the variation of the US trade balance, whereas exchange rates account for a much smaller share, while Fratzscher and Straub (2009) extend this empirical analysis to G7 economies and to equity markets. From a current policy perspective, this implies that an adjustment in the US dollar may do little to the US trade deficit, or that the US dollar decline would have to be very large as suggested by several studies (Blanchard et al. 2005, Obstfeld and Rogoff 2005, Krugman 2007, Fratzscher 2008).

The paper is organized as follows. Section 2 derives sign restrictions for the empirical identification of asset price shocks based on a two-country DSGE model. The empirical model, benchmark results and various robustness tests are presented in section 3. A discussion of the results and of the potential role for financial depth, trade openness and monetary and fiscal policies follows in section 4. Section 5 concludes.

2 Identification

In this section, we will present a two-country dynamic stochastic general equilibrium (DSGE) model with incomplete asset markets[2], which is utilized for deriving the identification restriction in the empirical part. In what follows, we describe the structure of the model.

2.1 Households

Representative households in the home country maximize lifetime utility by choosing purchases of the consumption good, C_t given the following quite standard utility index:

$$E_t\left[\sum_{k=0}^{\infty}\beta^k\left(\frac{1}{1-\sigma}\left(C_{t+k}\right)^{1-\sigma}-KL_t\right)\right],$$

where β is the discount factor, σ denotes risk aversion. Aggregate consumption C_t is defined across all home and foreign goods, and its functional form is given by the following constant elasticity aggregator:

$$C_t=\left[(\mu)^{\frac{1}{\theta}}\left(C_{H,t}\right)^{1-\frac{1}{\theta}}+(1-\mu)^{\frac{1}{\theta}}\left(C_{F,t}\right)^{1-\frac{1}{\theta}}\right]^{\frac{\theta}{\theta-1}}$$

[2]The literature typically analyzes DSGE models by the method of first order approximation around a non-stochastic steady state. It is well known, however, that up to a first order approximation, the structure of the optimal portfolio is indeterminate, because under no uncertainty all assets are perfect substitutes. Therefore, part of the literature confines its attention to asset market structures where the portfolio allocation is irrelevant. In the appendix, we describe the method by Devereux and Sutherland (2006) that obtains the optimal portfolio shares by means of a particular second order approximation. See also the discussion below.

where $C_{H,t}$ and $C_{F,t}$ are indices of individual home and foreign produced goods with elasticity of substitution between individual goods denoted by θ, and degree of home bias μ. The corresponding demand for domestic and foreign goods can be written as follows:

$$\begin{aligned} C_{H,t} &= \mu \left(\frac{P_{H,t}}{P_t} \right)^{-\theta} C_t, \\ C_{F,t} &= (1-\mu) \left(\frac{P_{F,t}}{P_t} \right)^{-\theta} C_t, \end{aligned}$$

Utility maximization is subject to following budget constraint in nominal terms:

$$P_t C_t + W_{t+1} = w_t L_t + \Pi_t + P_t \sum_{k=1}^{N} \alpha_{k,t-1} r_{k,t} \tag{1}$$

where W_t denoted the real value of nominal wealth for the home agent, w_t is the wage, and Π_t is the profit stream of the home firm accrues to the home country households. The final term represents the total return on the home country portfolio, which comprises N assets. The term $\alpha_{k,t-1}$ represents the real holdings of asset k, brought into period t from the period t-1, and $r_{k,t}$ is the period t real return on this asset. From the definition of wealth it must be that $W_t = \sum_{k=1}^{N} \alpha_{k,t-1}$, that is total period t-1 investment in assets must add up to beginning of period t wealth. The optimal consumption leisure trade-off implies:

$$\frac{w_t}{P_t} C_t^{-\sigma} = K \tag{2}$$

And the optimal portfolio is characterized by:

$$C_t^{-\sigma} = \beta E_t C_{t+1}^{-\sigma} r_{N,t+1} \tag{3}$$

$$\beta E_t C_{t+1}^{-\sigma} (r_{k,t+1} - r_{N,t+1}) = 0 \tag{4}$$

where $k = 1 ... N-1$.

Note that home equities represent a claim on home aggregate profits Π_t (defined below). The real payoff to a unit of the home equity purchased in period t as defined to be $\frac{\Pi_{t+1}}{P_{t+1}} + Z_{E,t+1}$, where $Z_{E,t}$ is the real price of home equity. Thus the gross real rate of return on the home equity is $r_{E,t+1} = \frac{\Pi_{t+1}/P_{t+1} + Z_{E,t+1}}{Z_{E,t}}$. In the Appendix, we show how to derive in this incomplete market setting for the optimal steady state asset allocation α_k.

2.2 Firms

There are two types of firms. A continuum of monopolistically competitive primary-goods producing firms indexed by $i \in [0,1]$, each of which produces a single differentiated intermediate good, Y_t. The final-goods producing firms combine intermediate goods using a CES function to produce the final goods.

2.2.1 Primary-goods firms

Each primary-good producing firm i produces its differentiated output using a linear production function in labour

$$Y_t(i) = A_t L_t \tag{5}$$

The corresponding marginal cost is denoted by

$$MC_t = \frac{W_t}{P_t A_t} \tag{6}$$

Firms optimize expected profits using:

$$E_t \left[\sum_{k=0}^{\infty} F_{t,t+1} \xi^k \, \Pi_{t+k}(i) \right],$$

Here, $F_{t,t+1}$ is the firm's discount rate while $\Pi_t(i) = P_t(i)\, Y_t(i) - MC_t\, Y_t(i)$ are period-t nominal dividends yielded. Note that the firm's discount rate depends in this set up also on the parameter γ. Hence, we obtain the following first-order condition characterizing the firm's optimal pricing decision for its output sold:

$$E_t \left[\sum_{k=0}^{\infty} F_{t,t+1} \xi^k \left(\tilde{P}_t(i) - \frac{\phi}{\phi - 1} MC_{t+k} \right) Y_{t+k}(i) \right] = 0.$$

This expression states that in those intermediate-good markets in which price contracts are re-optimised, these are set so as to equate the firms' discounted sum of expected revenues to the discounted sum of expected marginal cost. In the absence of price staggering ($\xi = 0$), the factor $\phi/(\phi - 1)$ represents the markup of the price charged in domestic markets over nominal marginal cost, reflecting the degree of monopoly power on the part of the intermediate-good firms.

2.2.2 Final-good firms

Final good Y_t is produced using the following CES technology:

$$Y_t = \left(\int_0^1 (Y_t(i))^{1-\frac{1}{\phi}} \, di \right)^{\frac{\phi}{\phi-1}},$$

As a result, the demand functions for individual goods, and the corresponding final good price aggregator have the following form:

$$Y_t(i) = \left(\frac{P_t(i)}{P_t} \right)^{-\phi} Y_t, \tag{7}$$

$$P_t = \left(\int_0^1 (P_t(i))^{1-\phi} \, di \right)^{\frac{1}{1-\phi}}, \tag{8}$$

2.3 Goods Market Clearing

Aggregating the production function across firms using (5)and using the individual demand function (7), we obtain the following condition for goods market equilibrium:

$$Y_t \int_0^1 \left(\frac{P_t(i)}{P_t} \right)^{-\phi} di = A_t N_t \tag{9}$$

Furthermore, domestic GDP is determined by demand from home and foreign consumers:

$$Y_t = \left(\frac{P_{H,t}}{P_t} \right)^{-\theta} (\mu C_t + G_t) + (1-\mu) \left(\frac{P_{H,t}}{S_t P_t^*} \right)^{-\theta} C_t^*$$

assuming that government expenditure is a stochastic fraction g_t of total output, i.e. $G_t = g_t Y_t$ that is entirely financed by lump sum taxes T_t, and C_t^* is the level of consumption in the foreign economy.

2.4 Monetary policy, the foreign economy and exogenous shocks

The monetary authority is assumed to follow a Taylor-type interest-rate rule specified in terms of annual consumer-price inflation and quarterly output growth,

$$R_t = \phi_R \, R_{t-1} + (1-\phi_R) \ \left[\phi_\Pi \left(\frac{P_t}{P_{t-1}} \right) + \phi_{gY} \left(\frac{Y_t}{Y_{t-1}} \right) \right] + \varepsilon_{R,t},$$

where the term $\varepsilon_{R,t}$ represents a serially uncorrelated monetary policy shock.

We introduce news shocks in the model in the same way as in Schmitt-Grohe and Uribe (2008) and Fukiwara et al. (2008). We write the shocks process for technology (in log-linear terms) as:

$$a_t = \rho^a a_{t-1} + \eta_t^a \tag{10}$$

where the innovation, η_t^a, is split into two components. An anticipated component, $\eta_t^{a,0}$, and an unanticipated component ,$\eta_t^{a,news}$,written as:

$$\eta_t^a = \eta_t^{a,0} + \eta_t^{a,news} \tag{11}$$

where $\eta_t^{a,news} = \sum_h^H \eta_{t-h}^{a,h}$and $\eta_{t-h}^{a,h}$ is the h-period ahead news about total factor productivity (TFP) anticipated by the agents at period t, and H the longest horizon over which shocks are anticipated by agents. The innovations are iid normal. In the following exercises, we will set $H = 4$, although taking e.g. longer horizons over which agents anticipate TFP changes does not alter qualitatively the response of the economy.

The model is subject to further exogenous AR(1) processes to government share of output defined in log-linear term as :

$$g_t = \rho^g g_{t-1} + \eta_t^g \tag{12}$$

The foreign economy has an analogous representation. Thus foreign consumers choose labour supply and portfolio holdings in a same manner, and the foreign firms adjust prices in the same way as defined above. The models equilibrium dynamics is solved following log-linearization around the non-stochastic zero inflation steady-state.

2.5 Deriving the sign restrictions

In this section we discuss the set of sign restrictions that we derive from the impulse response functions of the presented model. In what follows, we discuss the corresponding reactions of macro variables following shocks to productivity, news, monetary policy and government spending shocks.

First, we parameterize the model using values of the structural parameters generally utilized in the literature. We set the subjective discount rate β at 0.99. The Calvo parameters determining the degree of nominal price rigidities θ equals 0.75. In the monetary policy rule, we restrict the inflation response coefficient ϕ_Π at 2., the output growth response ϕ_{g_Y} is set at 0.5 and the degree of interest rate smoothing ϕ_R equals 0.8. Also, we set the parameter determining the degree of monopolistic competition in the goods market ϕ at 6, the degree of home bias equals μ is 0.8, while elasticity of substitution between domestic and foreign goods θ equals 1.5. As we will discuss in what follows, the later parameter plays a crucial role in the transmission of news shocks on inflation and the trade balance. The autoregressive coefficients in the model ρ^i are set at 0.9.

Table 1: Parameter values

Parameter	**Description**	Range
β	discount factor	$[0.985, 0.995]$
σ	risk aversion coefficient	$[1, 3]$
ϕ	degree of monopolistic competition in the goods market	$[3, 6]$
θ	elasticity of substitution between domestic and foreign goods	$[1, 3]$
μ	degree of home bias	$[0.5, 0.8]$
ξ	degree of nominal rigidities in the goods market	$[0.5, 0.8]$
ϕ_Π	coefficient on inflation in the monetary policy rule	$[1.5, 3]$
ϕ_{g_Y}	coefficient on output in the monetary policy rule	$[0.2, 1]$
ϕ_R	degree of interest rate smoothing	$[0.5, 0.9]$
ρ^i	persistence of shocks	$[0.5, 0.99]$

Recall that our goal is to find a set of sign restrictions that would allow us to differentiate the effects of news shocks from other shocks such as shocks to technology, government spending and monetary policy. Note that, in what follows, we normalize all shocks to have a positive impact on relative consumption, i.e. the log difference between home and foreign consumption. In what follows, we will discuss the response of relative variables, since this allows us later in the empirical exercise to differentiate between idiosyncratic and global shocks.

As shown in Figure 1, a positive technology shock at home induces a negative correlation between relative consumption and relative inflation, and a fall in relative interest rates. The rise in productivity leads also to an increase in output, but a decline in marginal costs in the home economy as indicated by equation (6). After a positive impact response, the relative interest rate declines, which in turn triggers the observed positive hump shaped response of consumption. As also shown in Figure 1, positive news shocks follow a similar pattern as technology shocks, but, by contrast, lead to a rise in relative inflation and a more persistent increase in relative interest rates. The positive wealth shock, driven by the expected rise in productivity, boosts consumption and inflation in the economy, resulting finally in increasing policy interest rates. On the other hand, we also observe a more persistent rise in relative equity prices. This is line with Beaudry and Portier (2006) that the joint behavior of stock prices and TFP is largely driven by a shock that does not effect productivity in the short run, and therefore does not look like a standard technology shock, but affects technology with some delay, and therefore can be differentiated by a demand side shock.[3]

In Figure 2, a positive monetary policy shock (a reduction in short-term interest rates) implies an increase in consumption and is also associated with a rise in inflation and asset prices. But the different direction of interest rate changes makes the monetary policy shock distinct from the news shock. Finally, in Figure 2 we also present the effect of an exogenous fall in government spending, which in our model induces a reaction of both the demand side and supply side, having a positive impact on household wealth - as it reduces the absorption of goods created by wasteful government spending. The negative effect of government spending on aggregate demand is dampened by the corresponding rise in private consumption. As a result, despite the fall in output the response of relative inflation is positive on impact, but falls persistently below zero afterwards. Under a standard policy rule, the interest rates will therefore decline following the exogenous fall in government spending.

In the next step, we test the sensitivity of the result to parameter uncertainty. We assume that the structural parameters are uniformly distributed over the selected parameter range, and draw a random value for each parameter from the intervals presented in Table 1 and calculate the corresponding impulse response functions of the model. This exercise is repeated for 500,000 simulations. The median, 84th and 16th percentiles of all the conditional responses are shown in Figures 3-6. The results show that the impulse response functions derived from the calibrated model are largely robust to variations in the structural parameters. The corresponding sign restrictions are shown in Table 2.

Table 2: Theoretical Impulse Response Functions

	consumption	output	inflation	interest rate	equity prices
Technology shock	↑	↑	↓		
News shock	↑	↑	↑	↑	↑
Government spending shock	↑	↓		↓	
Monetary policy shock	↑	↑	↑	↓	

The model presented above separates news shock from the standard macroeconomic shocks usually analyzed (technology, monetary policy and government spending), by highlighting the link to wealth effects generated by changes in future expected income partly through persistent rise in equity prices. Indeed, as discussed above, Beaudry and Portier (2006 and 2007) argue that equity prices adjustment are largely driven by changes in expectations about the future outcomes, such as to economic fundamentals. Alternatively, Engel and Rogers (2006) claim that wealth effect driven current account changes are consistent with changing expectations of relative output shares in the world economy. As a result, in the empirical exercise, we will label a news shock a shock that has a joint positive impact on

[3] The rise in relative inflation, the main difference of the impulse repsonse fucntion compared to a standard productivity shock, depends obviously on the paramertization of the model. Two key parameters are thereby the elasticity of substitution between domestic and foreign goods θ, and the risk aversion coefficient σ.Both parameters are determining the relative wealth effect of the anticipated news shock in the model influencing thereby the response of relative inflation.

consumption, output, inflation, interest rates and equity prices. Note that one important channel through which news about future productivity is increasing relative consumption is the persistent increase in equity prices in the model. Furthermore, empirical evidence, e.g. Beaudry and Portier (2006, 2007), points towards the close link between asset prices adjustments and expectations about the likelihood of future outcomes (or "news") e.g. about future productivity. As a result, we will use in the empirical exercise the terms news shock and asset price shocks interchangeably, and will assess the relative importance of the asset price channel in section 4. Keeping these points in mind, we turn now to our empirical exercise. now to our empirical exercise.

3 Empirical Model and Results

In this section we present the specification of our structural VAR and the empirical results.

3.1 Model specification and data

Consider the following specification for a vector of endogenous variables Y_t:

$$Y_t = a + \sum_{i=1}^{n} A_i Y_{t-i} + B\varepsilon_t \tag{13}$$

where a is an $(n \times 2)$ matrix of constants and linear trends, A_i is an $(n \times n)$ matrix of autoregressive coefficients and ε_t is a vector of structural disturbances. Identification of (13) requires imposing n(n-1)/2 restrictions on B, which we do by using the sign restrictions shown in Table 2. Our sign restriction approach is based on Canova and De Nicoló (2002), Uhlig (2005) and Peersman (2003). Note that the above derived sign restrictions of Table 2 are imposed on the initial 4 periods of the impulse response function. The Appendix explains in detail the implementation of the sign restriction approach.

Our VAR includes six variables: $Y_t = [EQ \quad c \quad i \quad \pi \quad TB \quad REER]$, and comprises the variables identified in the two-country setting of the DSGE model of section 2, i.e. private consumption (c), short-term interest rates (i), inflation (π), equity returns (EQ), as well as the trade balance (TB) and the real exchange rate ($REER$)[4].

We base our benchmark estimation on a core set of 16 industrialized countries for which we have data for an extended period reaching back to 1974. We use 1974 as the starting point of the analysis as it is the start of the floating exchange rate period after the collapse of the Bretton Woods system. In a second step, we then extend our sample to an additional 26, mostly emerging market countries. This, however, reduces the sample period to 1990-2007. All of the analysis uses quarterly data. Table 1 lists the countries included.

For our empirical estimation we use relative variables, i.e. we specify each variable in domestic versus rest-of-the-world terms. More precisely, consumption c is the difference in log private consumption in the domestic economy and log private consumption in the rest of the world, both expressed in US dollar (using end-of-period exchange rates). Interest rates i are the percentage difference of domestic short-term (money market) rates from those in the rest of the world, while inflation π is the corresponding percentage difference in CPI

[4] We experimented including by relative GDP into the VAR, as well as using alternative restriction to output and consumption-output ratio (see Table 2) for differentiating asset price shocks from government spending shocks, but the results did not change significantly. The results are available upon request.

inflation. The rest of the world for all three variables comprises the other 15 economies (in the benchmark sample) or other 41 countries (in the extended sample), with each country being weighted by its GDP share in the sample group.

Our preferred measure of asset prices EQ is the difference between domestic equity returns and foreign equity returns, both measured in local currency terms. We use local currencies to express returns, rather than US dollars, because we want to obtain a measure of asset price shocks that excludes exchange rate movements.[5] Moreover, we use shocks to equity prices, rather than changes to market capitalization, as our preferred measures because our primary interest is in the cross-country heterogeneity in the responses of the trade balance and the exchange rate. The rest-of-the-world group comprises the other countries in the sample, with each of these countries being weighted by their equity market capitalization. We use equity market capitalization weights, rather than GDP weights, because equity shocks are likely to affect the trade balance of countries partly through wealth effects, which in turn should be related to the size of financial wealth held by households, which is better proxied by market capitalization than GDP. In the section on the robustness analysis below we will discuss how alternative specifications of asset price shocks influence the empirical findings.

The trade balance TB is measured as a ratio to domestic GDP. We use the trade balance, rather than the current account, as we are interested in the effect of asset price shocks on net exports and want to exclude the effect on income. We use the total trade balance, rather than the trade balance only vis-a-vis the countries in the sample, though the results change little when using the extended country sample including EMEs; a point to which we return in the robustness analysis. As the final variable, the real effective exchange rate $REER$ uses trade weights for a broad set of partner countries, and is expressed in logs.

As to the data sources, the trade balance, GDP, consumption, inflation and short-term interest rates come from the IMF's International Financial Statistics (IFS). Equity returns and equity market capitalization are market indices and are sourced from Bloomberg while we took the real effective exchange rates from the IFS and the OECD. Table 2 lists the variables, their definitions and sources.

3.2 Empirical results

Figures 7-10 shows the impulse responses of the six variables to a 10% positive equity market shock based on our Bayesian VAR model, for four representative countries out of the 16 industrialized countries in the benchmark sample (the US, France, Australia and Japan). The shaded areas indicate the 16 and 84 percentiles of the posterior distribution, following the convention in the literature. Table 3 summarizes the point estimates of the peak impulse responses for all 42 countries in the sample.

As to the United States (Figure 7), a 10% increase in (relative) US equity prices leads to a substantial worsening in the US trade balance. The effect of the asset price shock increases gradually over time up to 16-20 quarters, when it reduces the US trade balance by more than 1.2 percentage points (p.p.) of US GDP. This effect of asset prices on the trade balance appears to stem from two channels, a first one through wealth effects and a second related to the exchange rate. The importance of wealth effects is evident by the strong and quite persistent increase in private consumption, which in turn leads to a higher demand for imports.

[5] Hau and Rey (2006) and Andersen et al. (2007), for instance, show that there tends to be a negative correlation between equity returns and exchange rate returns in the data for several industrialized countries.

The role of the exchange rate channel is underlined by the significant appreciation of the REER after a positive asset price shock. The real appreciation is likely to be influenced both by the increase in domestic inflation and in domestic interest rates, though both of these responses are more short-lived as inflation and nominal interest rates revert back within 10 quarters. The rise in interest rates and real appreciation of the exchange rate is consistent with the evidence of the presence of a significant forward discount bias found in the literature (e.g. Engel 1996), as well as the more recent evidence stressing the importance of monetary policy or 'Taylor-rule' fundamentals for exchange rate determination (Engel and West 2005, Mark 2005, Clarida and Waldman 2007).[6]

Figures 8-10 and Table 3 show the corresponding impulse responses for the other industrialized countries of the sample. More precisely, Figures 8-10 show the impulse responses for three additional industrialized countries in the benchmark sample (France, Australia and Japan), while Figures 11 and 12 provide those for two representative emerging market economies based on the shortened sample period 1990-2007. With a few exceptions, the patterns of the impulse responses are quite similar across countries: the trade balance of most countries deteriorates in response to a positive asset price shock, though the permanence of this response is mostly somewhat lower than that of the United States. Moreover, the real exchange rate and private consumption always increases over the medium-run after an increase in equity prices, though again the permanence of this effect differs markedly across countries. The strength of the reaction of private consumption for most countries suggests that wealth effects constitute an important channel through which asset price shocks affect the trade balance of countries. Nominal interest rates and inflation also rise in the short-run, though recall that we imposed this response for the first four quarters in order to identify asset price shocks. However, the magnitude and the persistence of the reaction of interest rates and inflation again differ substantially across countries.

How robust are these findings across alternative specifications, country samples and time periods? We conduct several robustness tests on the benchmark model.[7] First, we use the current account instead of the trade balance, taking into account the fact that the dynamics of both can be considerably different for some countries. Figure 13 shows the impulse responses of this specification for the United States and confirms the basic thrust of the benchmark results as the current account declines considerably after a positive asset price shock. In fact, the reaction of the current account is somewhat stronger, as one would indeed expect, likely due to the decline not only of the trade balance but also of the income part of the current account.

Second, we use relative equity market capitalization,[8] rather than equity prices, to define asset price shocks. Figure 14 shows that the pattern of the impulse responses is unchanged for the United States (as well as for other industrialized countries, which are not shown for brevity reasons).

As a third robustness check, we shorten the time sample to 1990-2007 in order to allow for the possibility that asset price shocks may have become more important over time as

[6] Moreover, this positive effect of asset prices on the exchange rate is not necessarily inconsistent with the literature that finds a negative correlation between equity returns and exchange rate movements (Hau and Rey 2006, Andersen et al. 2007) as those correlations are unconditional ones and may stem from other types of shocks.

[7] We show here only the corresponding results for the United States, though the conclusions on the robustness checks are qualitatively similar for other countries.

[8] Relative equity market capitalization is measured as the difference in the log domestic market capitalization and the log rest-of-the-world market capitalization, both measured in US dollars. Using market exchange rates or PPP exchange rates does not change the findings in a meaningful way.

countries have become more integrated financially and through trade. Figure 15 shows that the initial reaction of the trade balance is slightly larger and the response of private consumption significantly larger for the United States, lending some support to this conjecture. We will return to the discussion of various determinants and channels in the next section.

Finally, as a fourth robustness test we extend the sensitivity of the impulse response patterns to the extension of the country sample to include also emerging markets, which also implies a shorter estimation period for 1990-2007. Figure 16 again shows for the United States very similar impulse responses as for the benchmark specification.

In summary, asset price shocks appear to have a significant effect on the trade balance of countries, partly through wealth effects on domestic consumption and partly through an exchange rate channel that leads a real appreciation of the domestic currency. Moreover, there are substantial cross-country differences in the effect of asset price shocks, with the trade balance of the United States in particular exhibiting one of the largest reactions to asset price shocks.

4 Discussion

What explains the cross-country heterogeneity in the effects of exogenous asset price fluctuations? This section attempts to shed some light on this question by focusing on the role of financial openness and depth, trade openness as well as monetary policy and fiscal policy as potential determinants. In this respect, it also offers a discussion on the relative importance of asset market structure for the transmission of news shocks, as discussed in the theoretical exercise.

We stress at the outset that this analysis does not offer an empirical test of these different hypotheses, but its intention is rather to discuss how different factors may influence the transmission of asset price fluctuations to the trade balance, and whether or not these are consistent with the findings of our empirical analysis.

A starting point is the large literature on the role of financial openness and depth for consumption risk-sharing in international portfolios. The strand of the literature building on the seminal work by Lewis (1996) has emphasized the potential role of financial openness for consumption smoothing in response to various shocks; while other parts of this literature have focused on the role of various financial frictions (Alfaro et al. 2008, Fratzscher and Imbs 2009) and the role of a financial home bias (e.g. Kho et al. 2006). Applying the reasoning of this literature to our setting, differences in *financial market depth* are one potential explanation that may account for the heterogeneity in the effect of asset price shocks. The channel via wealth effects of an asset price shock should be more important in an economy in which the size of financial wealth is larger, in which financial markets are more liquid and in which fewer households are liquidity constrained. For instance, the comparably strong response of the US trade balance to an asset price shock through such a channel may potentially be accounted for by the fact that the United States has one of the deepest equity markets, not just in global size, but also as a share of domestic GDP.

However, what matters for the role of the wealth channel is not the size of the domestic equity market per se, but how much of it is owned by domestic investors (and how much by foreigners) - we refer to this as 'financial domestic size', measured as the ratio of domestic equity market capitalization owned by domestic investors to domestic GDP. Also for this proxy the United States is special, as with 90% this share is the highest among all countries in the sample. Although some small economies such as the Netherlands, Switzerland and

Finland have larger equity markets than the US in terms of domestic GDP, much less of the equity wealth of the domestic market is owned by domestic investors in those countries.[9]

This last point leads us to a second potential financial determinant of the strength of the wealth channel, which is the degree of *equity home bias*. Even if domestic equity markets are deep and liquid, consumption and thus the trade balance may be insensitive to an asset price shock if households have well diversified portfolios in which they hold a large share of their wealth in foreign assets. The larger the share of financial assets invested abroad - and thus the smaller the equity home bias and the higher risk sharing - the lower one would expect the response of the trade balance to be to a domestic asset price shock. Two, admittedly imperfect proxies of equity home bias that we construct are the 'financial home weight' for each country i - measured as the share of domestic investors' equity invested in domestic equity markets $(1 - w_i)$; and the 'financial home bias', $HB_i = 1 - w_i/w_i^*$ - with w_i the share of the equity wealth of country i that is invested abroad, and w_i^* as the share of the rest of the world market capitalization in the world - so that $HB_i = 0$ indicates no equity home bias and $HB_i = 1$ a perfect home bias.

Table 4 shows the correlation coefficients, for the extended sample of 42 countries, between the peak (absolute value) impulse responses of the 5 endogenous variables to a positive 10% relative equity price shock and the potential determinants (based on the estimation period 1990-2007). Figure 17 provides the graphical illustration of these correlations for three of the endogenous variables (the trade balance in Panel A, for private consumption in Panel B, and for the REER in Panel C).

The findings of both the table and the figure indeed provide support for the hypotheses that financial depth/size and the degree of home bias play a role for the sensitivity of the trade balance to asset price shocks. For instance, there is a sizeable negative correlation of -0.63 between the size of the domestic equity market (relative to domestic GDP, "financial depth") and the size of the trade balance response to equity shocks, suggesting that the trade balance is more sensitive to asset price shocks in economies in which domestic residents hold a lot of equity wealth (either as a share of the market or as a share of GDP). Similarly, the role of the home bias hypothesis is supported by the negative correlation of -0.23 between the home bias and the response of the trade balance to equity shocks, suggesting that the wealth channel of asset price shocks is more important in economies where households have poorly diversified financial portfolios.

Table 4 also underscores that both wealth effects and exchange rates are two key channels through which asset price shocks affect net exports of countries. The correlations between financial depth/domestic size and the private consumption response as well as the REER response to an asset price shock are substantial at around 0.66-0.72.

A third potential determinant is trade: ceteris paribus, an asset price shock should have a larger effect on net exports through the wealth channel in more open economies. However, Table 4 suggests that this may not be an important channel in practice as there is not a negative, but in fact a small positive correlation between the response of the trade balance to equity shocks and trade openness (measured as the sum exports and imports over GDP). A telling example is again the US, which is relatively closed in terms of trade but whose trade balance is highly sensitive to asset price shocks.

A fourth factor may be the size of the government in the economy. The larger the size of the government in an economy, the lower may be the response of private consumption

[9] Several other proxies may of course be relevant. For instance, it would be useful to know cross-country differences in equity market participation in order to understand how many households hold equity wealth. Such data is, to the best of our knowledge, not available for a cross-section of countries.

and thus the trade balance to an asset price shock.[10] There is mixed evidence for such a channel as the correlation between the response of net exports to asset price shocks and the size of the government (measured as the ratio of government consumption to GDP) is positive, but the correlation with consumption is negative.

A fifth candidate is monetary policy. An aggressive tightening of monetary policy in response to a positive asset price shock should dampen the effect of this shock on consumption and thus on net exports through the wealth channel, although, on the other hand, such a tightening may lead to an appreciation of the exchange rate and a worsening of the trade balance. Based on the impulse responses, however, Table 4 indicates that there seems to be no significant correlation between the response of interest rates and private consumption, or interest rates and the trade balance across countries. This of course is no more than suggestive, and does not necessarily imply that monetary policy is not relevant for influencing the impact of asset prices on the trade balance, as in fact there is a strong positive correlation between the inflation response and the interest rates response to asset price shocks across countries, as shown in Table 4.

5 Conclusions

The paper has analyzed the effect of asset price fluctuations on the current account. Its focus has been on the experience of a broad set of 42 industrialized and emerging market economies, employing a Bayesian VAR with sign restrictions. We have used a simple theoretical two-country DSGE model in order to derive the identifying restrictions exogenous asset price fluctuations, and to ensure that we can distinguish this type of shock from other shocks, such as to productivity, monetary policy and government spending. Importantly, we model asset price shocks as news shocks, along the line of work by Beaudry and Portier (2006, 2007), which argue that exogenous asset price fluctuations reflect changes to expectations about future fundamentals, and introduce such news shocks in a open economy DSGE model following Schmitt-Grohe and Uribe (2008) and Fukiwara et al. (2008).

The empirical evidence suggests that asset price shocks indeed exert a significant effect on the trade balance of countries, partly through a wealth channel of private consumption and partly via an exchange rate channel. An intriguing finding of the paper is the substantial cross-country heterogeneity that we detect in the sensitivity of the trade balance to asset price shocks. In particular the US trade balance seems to be among the most sensitive to relative asset price shocks, falling more than 1.2 percentage points in response to a 10% increase in US equity prices relative to the rest of the world. By contrast, other countries' trade balances appear to be less responsive to asset price shocks.

What explains this cross-country heterogeneity? While the paper does not offer a systematic empirical analysis, the stylized facts suggest that financial depth and the degree of equity home bias are related to the sensitivity of the current account to asset prices. For instance, a given asset price shock tends to have a larger effect on the trade balance in countries with deep financial markets and in which domestic investors have a large home bias, i.e. hold a large share of their financial assets domestically. By contrast, trade openness does not appear to be related in the expected way to the impact of asset price on net exports, and the picture is also much less clear-cut for the role of monetary policy and the size of government consumption.

[10] In a related vein, Corsetti and Mueller (2006, 2008) show for a set of OECD countries that the effect of fiscal policy shocks on net exports is smaller in a more closed economy due to terms of trade changes.

Many open questions remain and there are various future avenues for better understanding the importance of asset price shocks, both domestically and globally. In particular against the background of the financial crisis of 2007-09, the role of monetary policy for asset prices remains unclear. Similarly, the focus of the present paper has been only on equity markets. Extending the analysis to housing markets seems particularly relevant in the current financial market context. Another important avenue is to deepen further the analysis of emerging markets, which are rapidly becoming ever more important players in the global economy and international financial markets. We leave these avenues for future research.

Appendix I: Solving for steady-state portfolios

As discussed in Devereux and Sutherland (2006), we apply the following method for solving for the optimal portfolio in a 2 country, 4 assets economy. To apply the procedure, we first need to rewrite the equations governing the evolution of net wealth in terms of excess returns with respect to country 1 nominal bond, for example. As shown above, for country 1 this equation is as follows:

$$NFA_t = \frac{w_t}{P_t} L_t + \frac{\Pi_t}{P_t} + \sum_{k=1}^{N-1} \alpha_{k,t-1} \left(r_{k,t} - r_{B,t} \right) - C_t + r_{B,t} NFA_{t-1} \tag{14}$$

where NFA_t is the net foreign asset position of the country one in real terms, and the real return of the numeraire asset is denoted $r_{B,t}$. Under some general conditions, Devereux and Sutherland (2006) show that since expected excess returns are equal to zero up to first order, the term $\sum_{k=1}^{N-1} \alpha_{k,t-1} \left(r_{k,t} - r_{B,t} \right)$ will only be a function of the unexpected shocks in the approximate solution around the steady state — in the case of our model economy, the vector of innovations of exogenous processes ε. Moreover, they show that in the case of 2 countries the (near-stochastic) steady-state optimal portfolio, $\overline{\alpha}$, will be implicitly defined by the following moment conditions obtained by taking a second order approximation of the portfolio first order conditions around a nonstochastic steady state:

$$E_{t-1} \left[\left(\widehat{C}_t - \widehat{C}_t^{**} - \frac{1}{\rho} \widehat{RER}_t \right) \widehat{Rx}_{k,t} \right] = 0, \tag{15}$$

where $\widehat{Rx}_{k,t} = \widehat{r_{k,t}} - \widehat{r_{B,t}}$, $k = 1...N-1$, $\widehat{C}_t^{**}$ denotes consumption in country 2. Under the assumption of homoschedastic shocks, the above conditions will hold for any period.

The term $\sum_{k=1}^{N-1} \alpha_{k,t-1} \left(r_{k,t} - r_{B,t} \right)$ in the budget constraint depicting the wealth effect arising from realized excess returns on foreign assets and liabilities, can thus be replaced with the auxiliary, iid variable ξ_t. Therefore, a solution for the approximated equilibrium around the nonstochastic steady state will yield policy rules for the vector of excess returns $\widehat{R}_{x,t}$ and for $\Delta_t = \left(\widehat{C}_t - \widehat{C}_t^{**} - \frac{1}{\rho} \widehat{RER}_t \right)$ which will be functions of innovations ε_t, but also of the ξ_t.[11]

Since up to first order $\xi_t = \overline{\alpha}' \widehat{Rx}_t$, the auxiliary variable could be substituted out yielding expressions in terms of fundamentals innovations ε_t for Δ_t and $\widehat{R}_{x,t}$. Formally,

$$\begin{aligned} \widehat{R}_{x,t} &= R_1 \xi_t + R_2 \varepsilon_t \\ \Delta_t &= d_1 \xi_t + D_2' \varepsilon_t, \end{aligned}$$

so that substituting out ξ_t yields

$$\begin{aligned} \widehat{R}_{x,t} &= R_1 \overline{\alpha}' \widehat{R}_{x,t} + R_2 \varepsilon_t = \widetilde{R} \varepsilon_t \\ \Delta_t &= d_1 \overline{\alpha}' \widehat{R}_{x,t} + D_2' \varepsilon_t = \widetilde{D} \varepsilon_t, \end{aligned}$$

[11] The real marginal utility differential Δ will also be a function of state variables, like the wealth distribution.

where:

$$\begin{aligned}\widetilde{R} &= \left(I - R_1\overline{\alpha}'\right)^{-1} R_2 \\ \widetilde{D} &= d_1\overline{\alpha}'\left(I - R_1\overline{\alpha}'\right)^{-1} R_2 + D_2'\end{aligned}$$

In the case of two agents, k excess returns and e fundamentals shocks with variance-covariance matrix Σ, the time-invarying portfolio moment conditions (15) will amount to the following matrix equation:

$$\begin{aligned}\underbrace{0}_{kx1} &= \underbrace{\widetilde{R}\Sigma\widetilde{D}}_{(kxe)(exe)(ex1)}{}' \\ 0 &= \left(I - R_1\overline{\alpha}'\right)^{-1} R_2\Sigma\left[d_1\overline{\alpha}'\left(I - R_1\overline{\alpha}'\right)^{-1} R_2 + D_2'\right]',\end{aligned}$$

defining the steady-state unknown elements of the vector $\overline{\alpha}$, representing the gross holdings of foreign assets and liabilities for country 1, excluding the reference asset. The latter's position will be derived from the assumed level of steady state net foreign assets — we will assume throughout that this is zero for all countries.

The above formula yields the following closed form solution for $\overline{\alpha}$:

$$\overline{\alpha}' = -\frac{\left(D_2'\Sigma R_2'\right)\left(R_2\Sigma R_2'\right)^{-1}}{\left(d_1 - \left(D_2'\Sigma R_2'\right)\left(R_2\Sigma R_2'\right)^{-1} R_1\right)}, \tag{16}$$

which can be shown to be equal to the expression derived by Devereux and Sutherland (2006).[12] Note that we calibrate the variance-covariance matrix Σ in such a way to reproduce the home bias in equity documented in the empirical literature for the United States and euro area, respectively. See Dedola and Straub (2009) for details.

[12] The moment conditions can be written also as:

$$\begin{aligned}R_2\Sigma D_2 + R_2\Sigma R_2'\left(\left(I - R_1\overline{\alpha}'\right)^{-1}\right)'\overline{\alpha}d_1 &= 0 \\ \left(\left(I - R_1\overline{\alpha}'\right)'\right)^{-1}\overline{\alpha}d_1 &= -\left(R_2\Sigma R_2'\right)^{-1}\left(R_2\Sigma D_2\right);\end{aligned}$$

because of the following equality,

$$\left(\left(I - R_1\overline{\alpha}'\right)^{-1}\right)'\overline{\alpha} = \overline{\alpha}\left(\left(I - \overline{\alpha}'R_1\right)^{-1}\right)',$$

and noticing that $\overline{\alpha}'R_1$ is actually a scalar in this case, the above moment conditions simplifies to

$$\overline{\alpha}d_1 = -\left(R_2\Sigma R_2'\right)^{-1}\left(R_2\Sigma D_2\right)\left(1 - R_1'\overline{\alpha}\right),$$

from which it is easy to derive the solution for $\overline{\alpha}$ provided by Devereux and Sutherland (2006):

$$\overline{\alpha} = \left(R_2\Sigma D_2 R_1' - d_1 R_2\Sigma R_2'\right)^{-1}\left(R_2\Sigma D_2\right).$$

Appendix II: Implementation of the sign restrictions

In this appendix, we explain how we implement the sign restrictions in our VAR. For a detailed explanation, we refer to Peersman (2003). Consider equation (13) in section (3). Since the shocks are mutually orthogonal, $E(\varepsilon_t \varepsilon_t^{'}) = I$, the variance-covariance matrix of equation (13) is equal to: $\Omega = BB'$. For any possible orthogonal decomposition B, we can find an infinite number of admissible decompositions of Ω, $\Omega = BQQ'B'$, where Q is any orthonormal matrix, i.e. $QQ' = I$. Possible candidates for B are the Choleski factor of Ω or the eigenvalue-eigenvector decomposition, $\Omega = PDP' = BB'$, where P is a matrix of eigenvectors, D is a diagonal matrix with eigenvalues on the main diagonal and $B = PD^{\frac{1}{2}}$. Following Canova and De Nicoló (2002) and Peersman (2003), we start from the latter in our analysis. More specifically, $P = \prod_{m,n} Q_{m,n}(\theta)$ with $Q_{m,n}(\theta)$ being rotation matrices of the form:

$$Q_{m,n}(\theta) = \begin{bmatrix} 1 & \cdots & 0 & \cdots & 0 & \cdots & 0 \\ \cdots & \ddots & \cdots & \cdots & \cdots & \cdots & \cdots \\ 0 & \cdots & \cos(\theta) & ... & -\sin(\theta) & \cdots & 0 \\ \vdots & \vdots & \vdots & 1 & \vdots & \vdots & \vdots \\ 0 & \cdots & \sin(\theta) & \cdots & \cos(\theta) & \cdots & 0 \\ \cdots & \cdots & \cdots & \cdots & \cdots & \ddots & \cdots \\ 0 & \cdots & 0 & \cdots & 0 & \cdots & 1 \end{bmatrix} \tag{17}$$

Since we have six variables in our model, there are $n(n-1)/2 = 15$ bivariate rotations of different elements of the VAR: $\theta = \theta_1, \cdots, \theta_{15}$, and rows m and n are rotated by the angle θ_i in equation (17). All possible rotations can be produced by varying the 15 parameters θ_i in the range $[0, \pi]$. For the contemporaneous impact matrix determined by each point in the grid, B_j , we generate the corresponding impulse responses:

$$R_{j,t+k} = A(L)^{-1} B_j \varepsilon_t \tag{18}$$

A sign restriction on the impulse response of variable p at lag k to a shock in q at time t is of the form:

$$R_{j,t+k}^{pq} \gtrless 0 \tag{19}$$

We impose the sign restrictions for $k = 4$ lags; choosing a different length, however, does not alter the findings in a meaningful way. Following Uhlig (2005) and Peersman (2003), we use a Bayesian approach for estimation and inference. Our prior and posterior belong to the Normal-Wishart family for drawing error bands. Because there are an infinite number of admissible decompositions for each draw from the posterior when using sign restrictions, we use the following procedure. To draw the "candidate truths" from the posterior, we take a joint draw from the posterior for the usual unrestricted Normal-Wishart posterior for the VAR parameters as well as a uniform distribution for the rotation matrices, using 1000 draws. We then construct impulse response functions. If all the imposed conditions of the impulse responses of the four different shocks are satisfied, we keep the draw. Decompositions that match only the criteria of three or less shocks are rejected. This means that these draws receive zero prior weight. Based on the draws kept, we calculate statistics and report the median responses, together with 84th and 16th percentile error bands.

References

[1] Alfaro, L., Kalemli-Ozcan, S., Volosovych, V., 2008. Why doesn't capital flow from rich to poor countries? An empirical investigation. *Review of Economics and Statistics* 90, 347-368.

[2] Andersen, T., Bollerslev, T., Diebold, F. and C. Vega, 2007. Real-Time Price Discovery in Stock, Bond and Foreign Exchange Markets, *Journal of International Economics* 73, 251-277.

[3] Bernanke, B., 2005. The Global Saving Glut and the U.S. Current Account Deficit. Sandridge Lecture, Virginia Association of Economics, 10 March 2005.

[4] Bertaut, C., 2002. Equity Prices, Household Wealth, and Consumption Growth in Foreign Industrial Countries: Wealth Effects in the 1990s, Federal Reserve Board International Finance Discussion Paper No. 724.

[5] Beaudry, P. and F. Portier, 2006. News, Stock Prices and Economic Fluctuations, *American Economic Review* 96(4), September, 2006.

[6] Beaudry, P. and F. Portier, 2007. When can Changes in Expectations cause Business Cycle Fluctuations, *Journal of Economic Theory* 135(1), 2007.

[7] Blanchard, O., 1985. Debt, Deficits, and Finite Horizons, *Journal of Political Economy,* 93.

[8] Blanchard, O., F. Giavazzi and F. Sa, 2005. The U.S. Current Account and the Dollar, *Brookings Papers on Economic Activity* 1, 1-65.

[9] Blanchard, O., and R. Perotti, 2002, An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output, *Quarterly Journal of Economics*, Vol. 117, No.4, pp. 1329-68.

[10] Bussiere, M., M. Fratzscher and G. Müller, 2005. Productivity Shocks, Budget Deficits and the Current Account. ECB Working Paper No. 509, August 2005.

[11] Caballero, R., E. Farhi and P.-O. Gourinchas, 2006. An Equilibrium Model of 'Global Imbalances' and Low Interest Rates. MIT and University of California, Berkeley, mimeo.

[12] Canova, F. and G. de Niccolo, 2002. Monetary Disturbances Matter for Business Cycle Fluctuations in G-7, *Journal of Monetary Economics*, 49(6), 1131-1159.

[13] Chinn, M. and J. Frankel, 2008. The Euro May over the Next 15 Years Surpass the Dollar as Leading International Currency, forthcoming *International Finance.*

[14] Case, K.E., J.M. Quigley and R.J. Shiller, 2005. Comparing Wealth Effects: The Stock Market versus the Housing Market, *B.E. Advances in Macroeconomics* 5(1), Article 1.

[15] Chinn, M. and H. Ito, 2007. Current Account Balances, Financial Development and Institutions: Assaying the World 'Saving Glut', *Journal of International Money and Finance.*

[16] Clarida, Richard and Daniel Waldman, 2007. Is Bad News About Inflation Good News for the Exchange Rate? NBER Working Paper No. 13010.

[17] Corsetti, G., L. Dedola and S. Leduc, 2006. Productivity, External Balance and Exchange Rates: Evidence on the Transmission Mechanism Among G7 Countries, NBER Working Paper 12483.

[18] Corsetti, G. and G. Müller 2006. Twin Deficits: Squaring Theory, Evidence and Common Sense, *Economic Policy* 48, 597-638.

[19] Corsetti, G. and G. Müller 2008. Twin Deficits, Openness and the Business Cycle, *Journal of European Economic Association Papers and Proceedings.*

[20] Dedola, L. and S. Neri, 2007. What does a technology shock do? A VAR analysis with model-based sign restrictions, *Journal of Monetary Economics* 54(2), 512-549.

[21] Dedola, L. and R, Straub, 2009. Optimized Reserve Holdings and Country Portfolios, mimeo.

[22] Edelberg, W., M. Eichenbaum, and J. Fisher, 1999, Understanding the Effects of Shocks to Government Purchases, Review of Economic Dynamics, Vol. 2, pp.166-206.

[23] Engel, C., 1996. The Forward Discount Anomaly and the Risk Premium: A Survey of Recent Evidence. *Journal of Empirical Finance* 3, 123-192.

[24] Engel, C. and J. Rogers, 2006. The U.S. Current Account Deficit and the Expected Share of World Output, *Journal of Monetary Economics* 53(5), 1063-1093.

[25] Engel, C. and K. West, 2005. Taylor Rules and the Deutschmark-Dollar Real Exchange Rate, *Journal of Money, Credit and Banking* 38(5), 1175-94.

[26] Erceg C., L. Guerrieri and C. Gust, 2005. Expansionary Fiscal Shocks and the US Trade Deficit. *International Finance* 8, 363-397.

[27] Fatás, A., and I. Mihov, 2001, The Effects of Fiscal Policy on Consumption and Employment: Theory and Evidence, unpublished, INSEAD, Fontainebleau.

[28] Fogli, A. and F. Perri, 2006. The Great Moderation and the US External Imbalance, NBER Working Paper No. 12708.

[29] Forbes, K. and M. Chinn, 2004. A Decomposition of Global Linkages in Financial Markets Over Time, *Review of Economics and Statistics* 86(3), 705-722.

[30] Fratzscher, M., 2008. US shocks and global exchange rate configurations, *Economic Policy*, April 2008, 363–409.

[31] Fratzscher, M., and J. Imbs, 2009. Risk sharing, finance and institutions in international portfolios, *Journal of Financial Economics* 94: 428–447, December 2009.

[32] Fratzscher, M., L. Juvenal and L. Sarno, 2007. Asset prices, exchange rates and the current account, ECB Working Paper No. 790, forthcoming *European Economic Review.*

[33] Fratzscher, M. and R. Straub, 2009. Asset prices and current account fluctuations in G7 countries, *IMF Staff Papers* 56(3), 633-54.

[34] Fujiwara, I., Y. Hisero, and M. Shintani, 2008, Can News Be a Major Source of Aggregate Fluctuations? A Bayesian DSGE Approach, Bank of Japan.

[35] Galí, J. and J. López-Salido, and J. Vallés, 2007, Understanding the Effects of Government Spending on Consumption, *Journal of the European Economic Association*, March 2007, vol. 5 (1), 227-270

[36] Gourinchas, P.-O. and H. Rey, 2007. International Financial Adjustment, *Journal of Political Economy*, 115 (4): 665—703.

[37] Gruber, J. and S. Kamin, 2007. Explaining the Global Pattern of Current Account Imbalances, *Journal of International Money and Finance.*

[38] Hau, H. and H. Rey, 2006. Exchange Rates, Equity Prices and Capital Flows," *Review of Financial Studies* 19 (1), 273-317.

[39] Ju, J. and S.-J. Wei, 2006. A Solution to Two Paradoxes of International Capital Flows, mimeo, June 2006.

[40] Kho, B.-C., Stulz, R., Warnock, F., 2006. Financial globalization, governance, and the evolution of the home bias. NBER Working Paper No. 12389.

[41] Kraay, A. and J. Ventura, 2005. The Dot-Com Bubble the Bush Deficits, and the U.S. Current Account. NBER Working Paper No. 11543.

[42] Krugman, P., 2007. Will There Be a Dollar Crisis? *Economic Policy*, Vol. 22(51), 435-67.

[43] Lane, P. and G.M. Milesi-Ferretti, 2005, A Global Perspective on External Positions. In *G7 Current Account Imbalances: Sustainability and Adjustment,* edited by Clarida, R.H. Chicago: Chicago University Press.

[44] Lee, J. and M. Chinn, 2006. Current Account and Real Exchange Rate Dynamics in the G7 Countries, *Journal of International Money and Finance* 25, 257-274.

[45] Lettau and Ludvigson, 2004. Understanding Trend and Cycle in Asset Values: Reevaluating the Wealth Effect on Consumption, *American Economic Review* 94, 276 – 299.

[46] Lewis, K., 1996. What can explain the apparent lack of international consumption risk-sharing? *Journal of Political Economy* 104, 267-297.

[47] Mark, N., 2005. Changing Monetary Policy Rules, Learning and Real Exchange Rate Dynamics, NBER Working Paper No. 11061.

[48] Mendoza, Quadrini, and Rios-Rull, 2007. Financial Integration, "Financial Deepness and Global Imbalances, NBER Working Paper 12909.

[49] Nistico, Salvatore, 2006. Monetary Policy and Stock-Price Dynamics in a DSGE Framework, LLEE Working Document n.28, April 2005.

[50] Obstfeld, M. and K. Rogoff, 2005. Global Current Account Imbalances and Exchange Rate Adjustments, *Brookings Papers on Economic Activity* 1, 67-146.

[51] Palumbo, Rudd, and Whelan, 2006. On the Relationships between Real Consumption, Income, andWealth, *Journal of Business and Economic Statistics* 24, 1 – 11

[52] Peersman, G., 2003. What Caused the Early Millennium Slowdown? Evidence Based on Vector Autoregressions, CEPR Discussion Paper, 4087.

[53] Peersman, G., and R. Straub, 2006. Technology Shocks and Robust Sign Restrictions in a Euro Area SVAR, forthcoming *International Economic Review.*

[54] Perotti, R., 2002, Estimating the Effects of Fiscal Policy in OECD Countries, ECB Working Paper Series, No.168, Frankfurt.

[55] Sims, C., J.H. Stock and M. Watson, 1990, "Inference in Linear Time Series Models with Some Unit Roots", *Econometrica* 58

[56] Smets, F. and R. Wouters, 2003. An Estimated Dynamic Stochastic General Equilibrium Model of the Euro Area, *Journal of the European Economic Association*, 1(5), 1123-1175.

[57] Schmitt-Grohe S. and M. Uribe, 2008. What's News in Business Cycles?, NBER Working Paper14215.

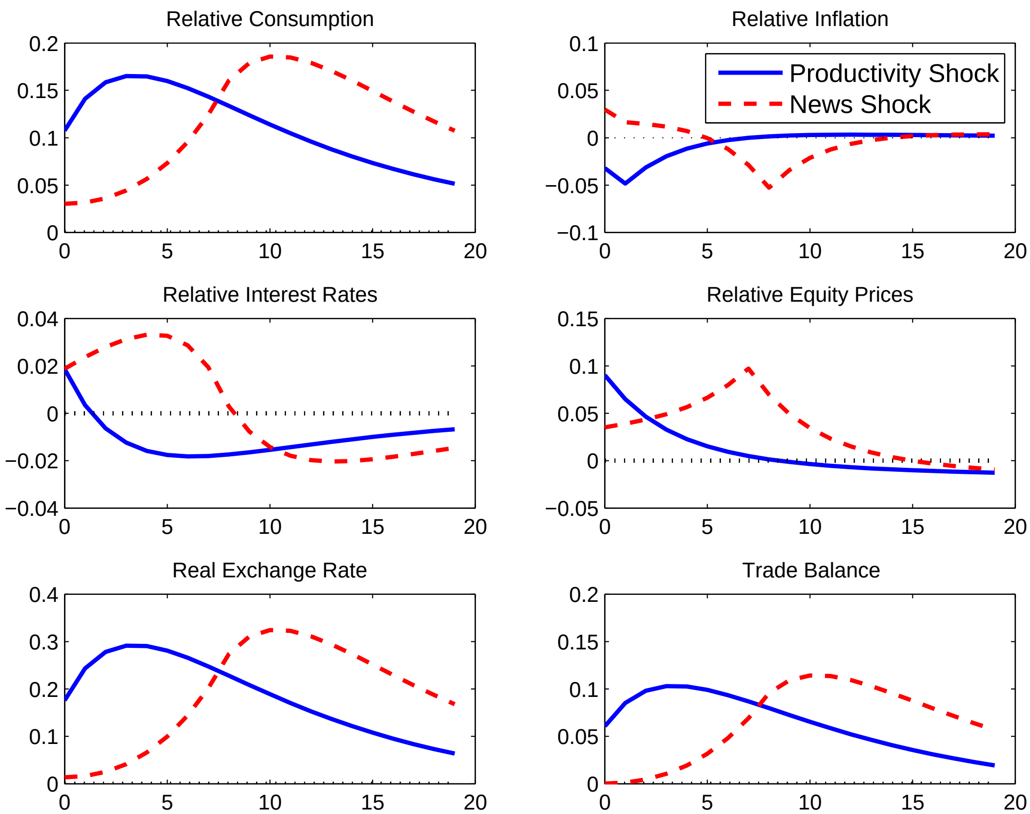
[58] Uhlig, H., 2005. What are the Effects of Monetary Policy on Output? Results from an Agnostic Identification Procedure. *Journal of Monetary Economics* 52, 381-419.

[59] Ventura, J., 2001. A Portfolio View of the US Current Account Deficit, *Brookings Papers on Economic Activity* 1, 241-253.

[60] Warnock, F. 2006. How Might a Disorderly Resolution of Global Imbalances Affect Global Wealth? IMF Working Paper 06/170.

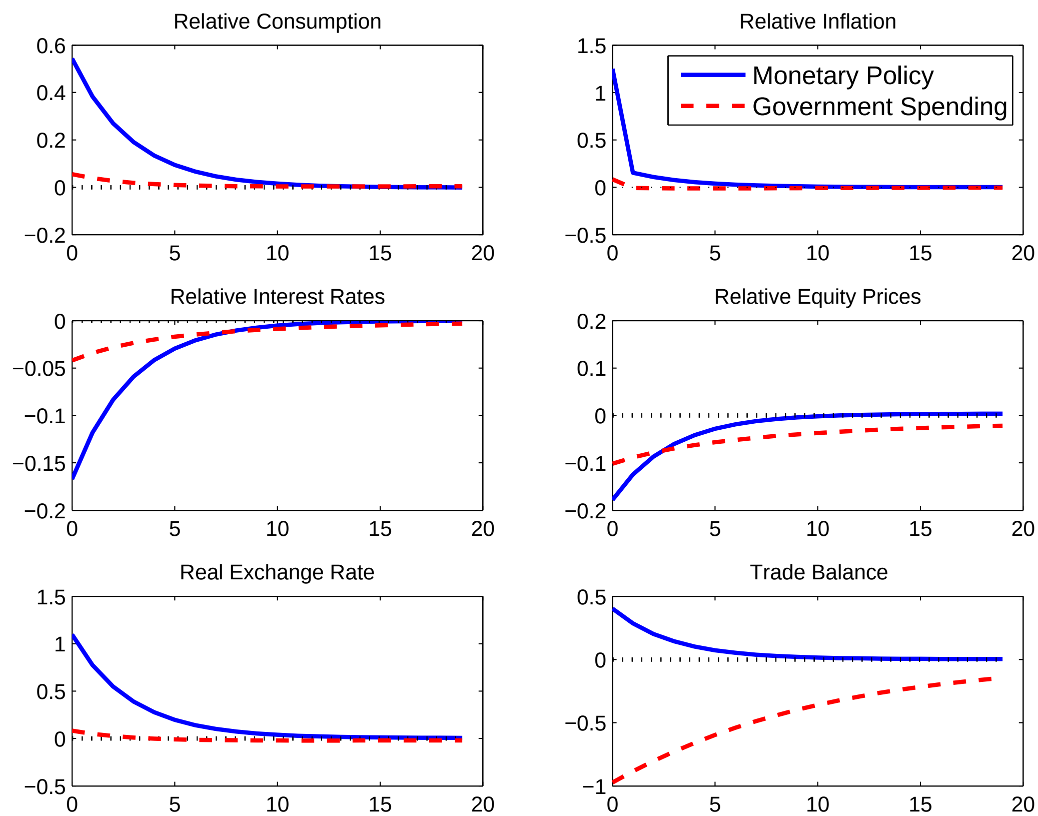
[61] Yaari, M.E., 1965. Uncertain Lifetime, Life Insurance, and the Theory of Consumers, *Review of Economic Studies*, 32.

Figure 1: Productivity and News Shocks in a Two-Country DSGE Model



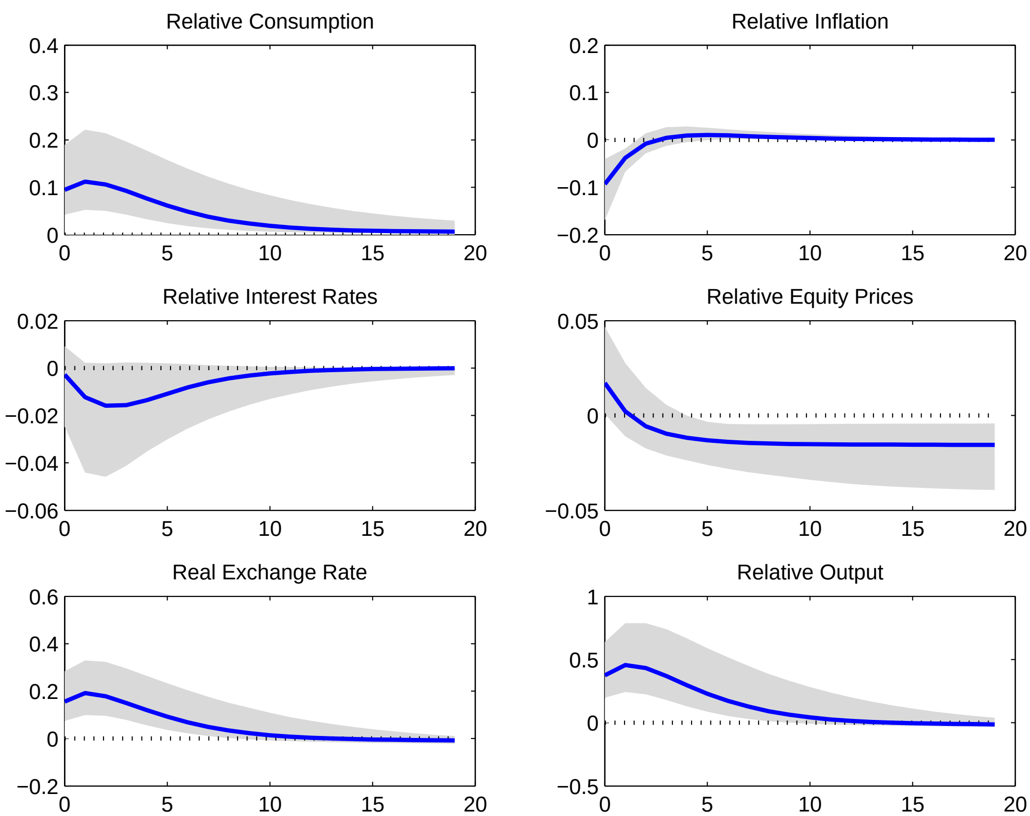
Notes: Figure shows the relative (domestic vs. foreign) impulse response function following a productivity and news shock in the domestic economy using the baseline calibration.

Figure 2: Monetary Policy and Government Spending Shocks in a Two-Country DSGE Model



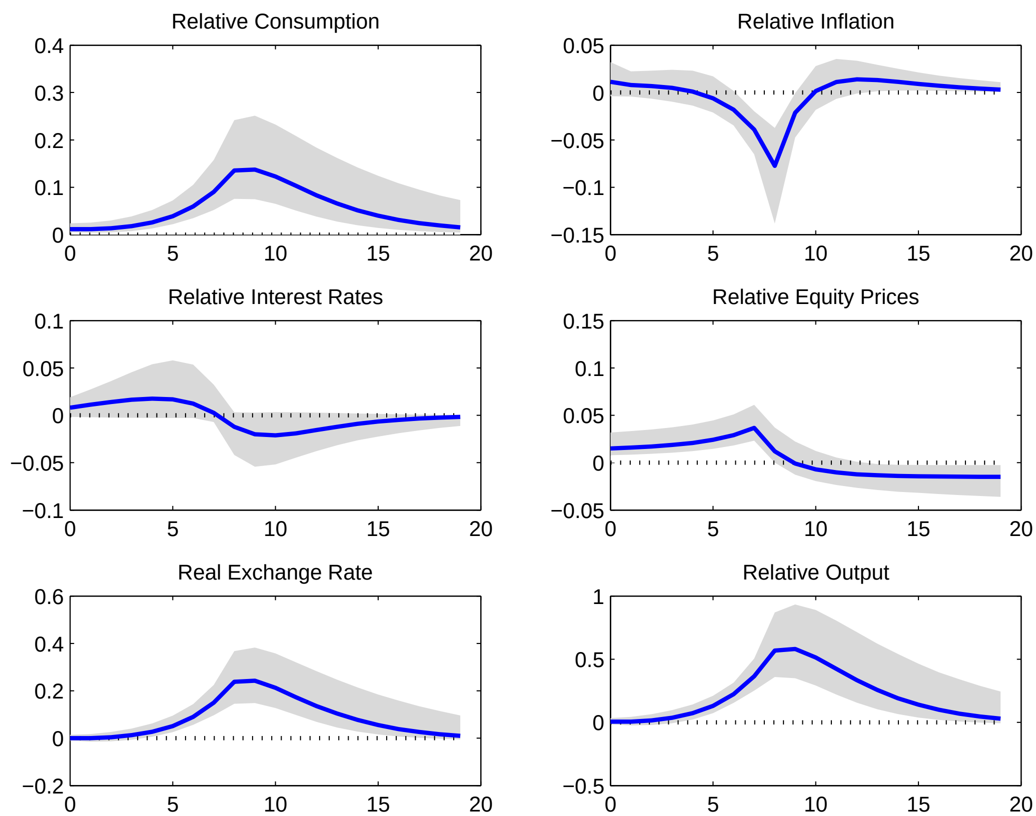
Notes: Figure shows the relative (domestic vs. foreign) impulse response function following a productivity and news shock in the domestic economy using the baseline calibration.

Figure 3: Distribution of Impulse Response Functions following a Technology Shock



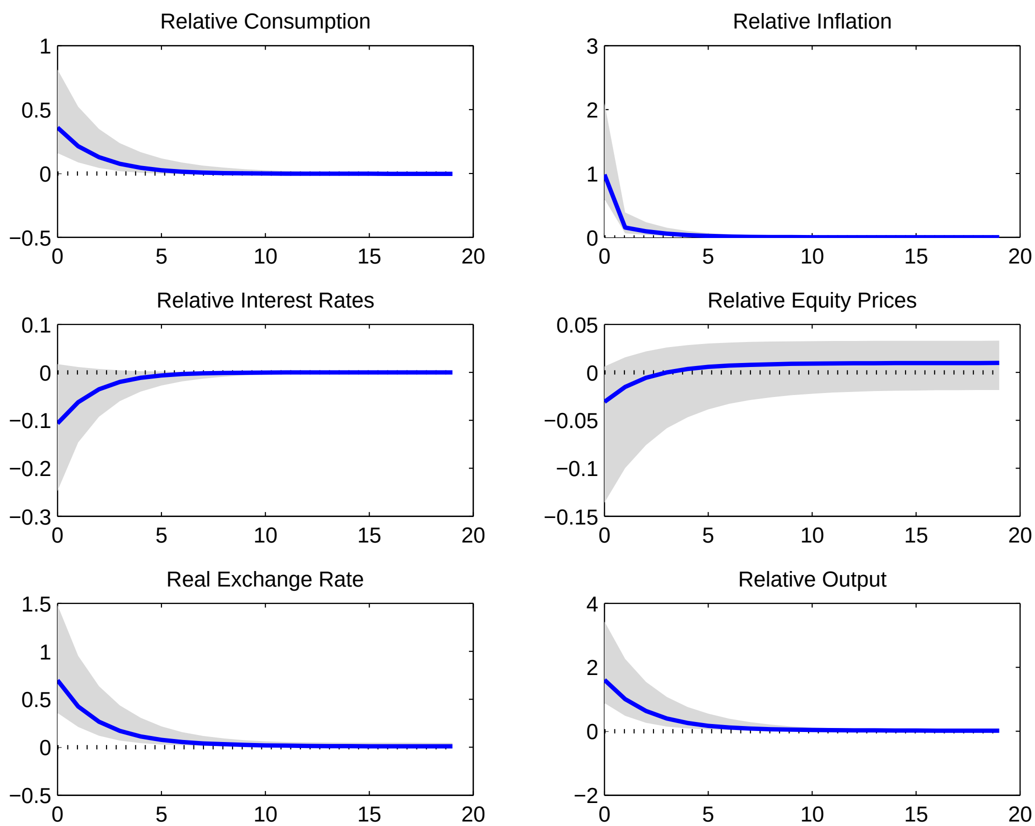
Notes: Figure shows the relative (domestic vs. foreign) impulse response functions following a productivity shock in the domestic economy using the parameter range presented in Table 1.

Figure 4: Distribution of Impulse Response Functions following a News Shock



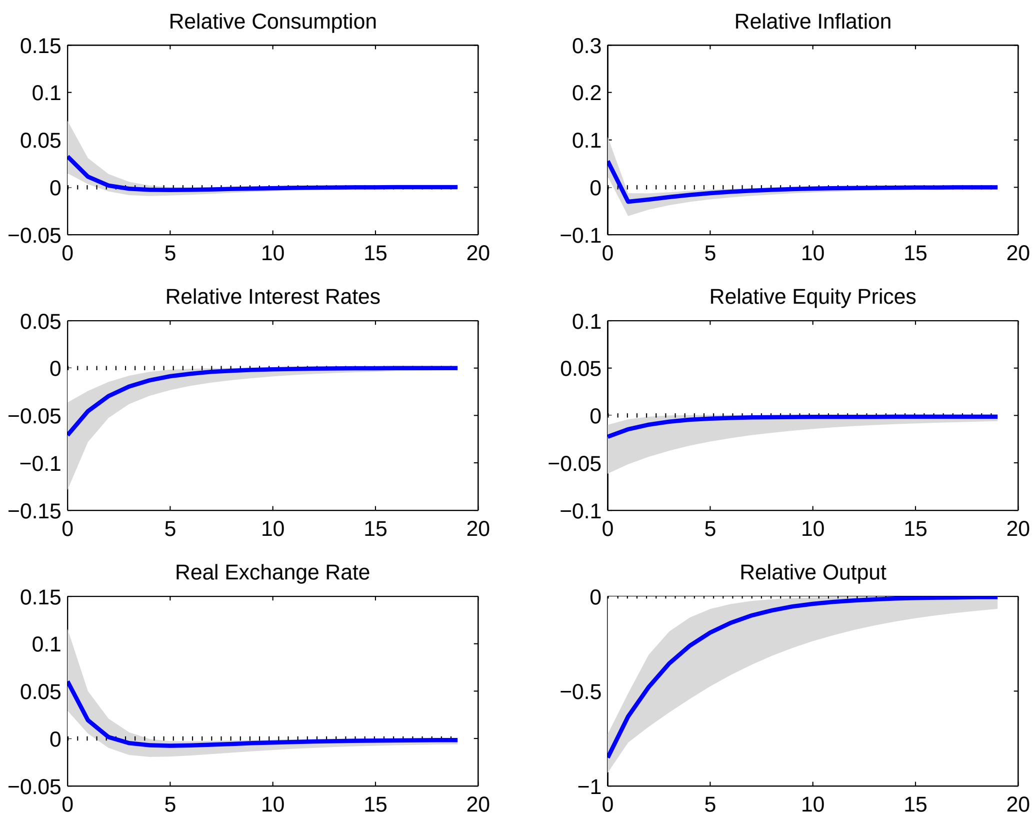
Notes: Figure shows the relative (domestic vs. foreign) impulse response functions following a news shock in the domestic economy using the parameter range presented in Table 1.

Figure 5: Distribution of Impulse Response Functions following a Monetary Policy Shock



Notes: Figure shows the relative (domestic vs. foreign) impulse response functions following a monetary policy shock in the domestic economy using the parameter range presented in Table 1.

Figure 6: Distribution of Impulse Response Functions following a Government Spending Shock



Notes: Figure shows the relative (domestic vs. foreign) impulse response functions following a government spending shock in the domestic economy using the parameter range presented in Table 1.

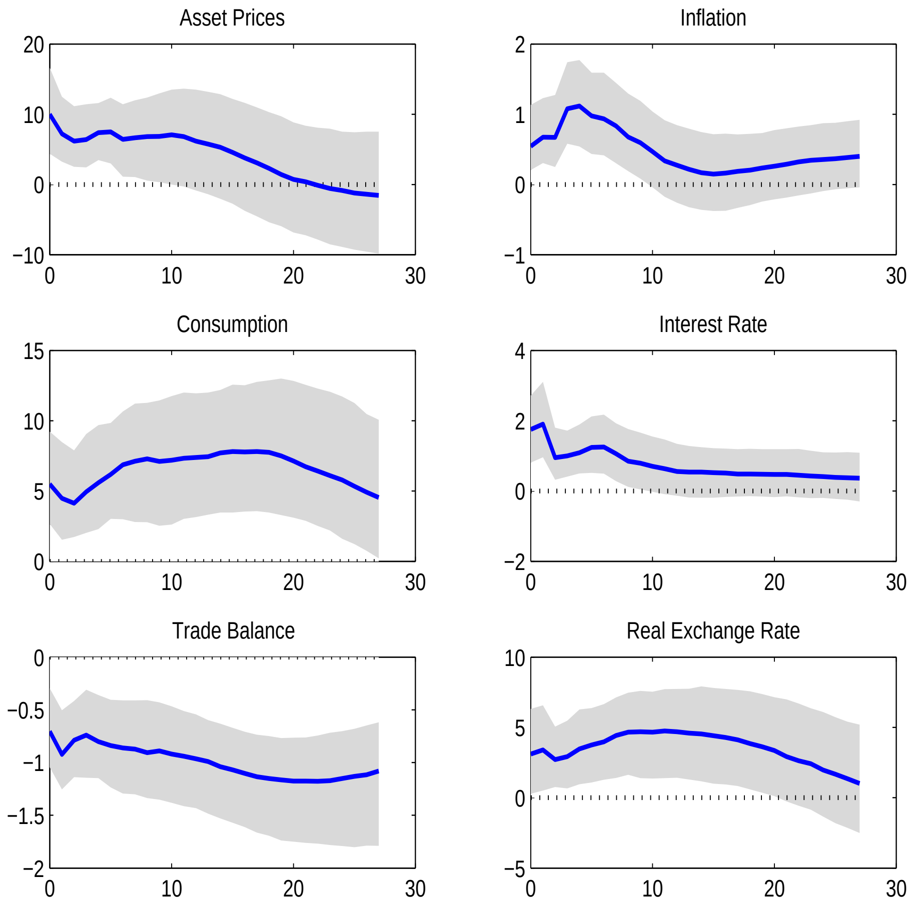


Figure 7: United States- Impulse Response following an Asset Price Shock

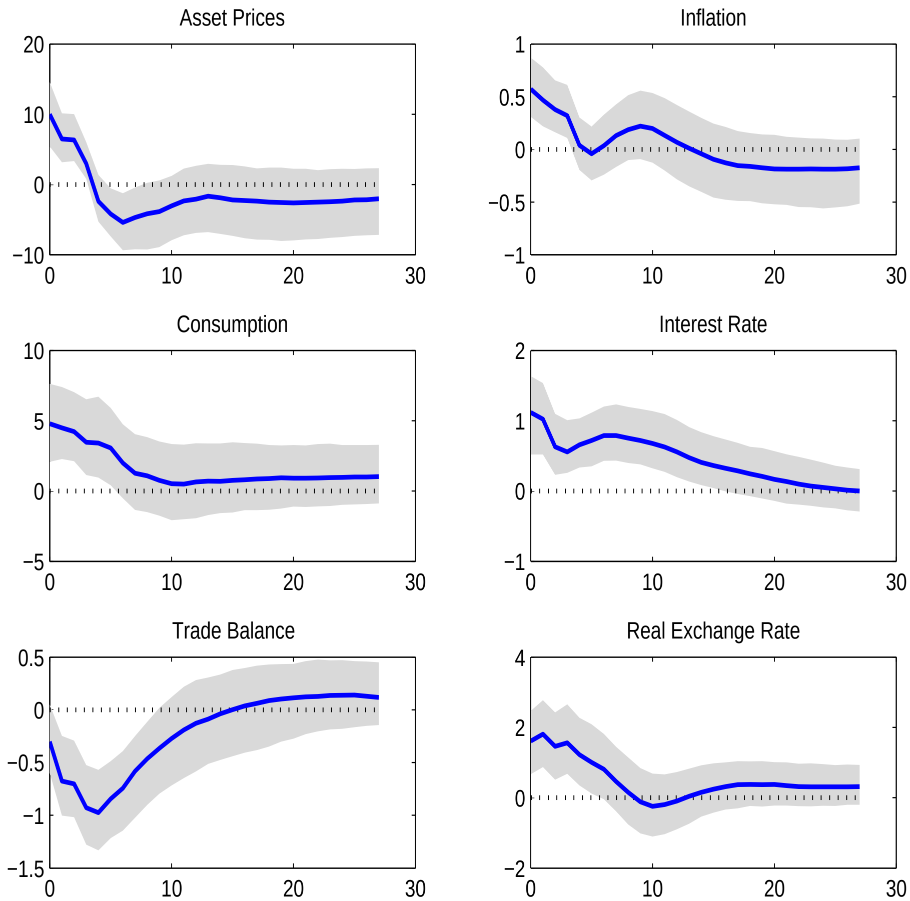


Figure 8: France- Impulse Response following an Asset Price Shock

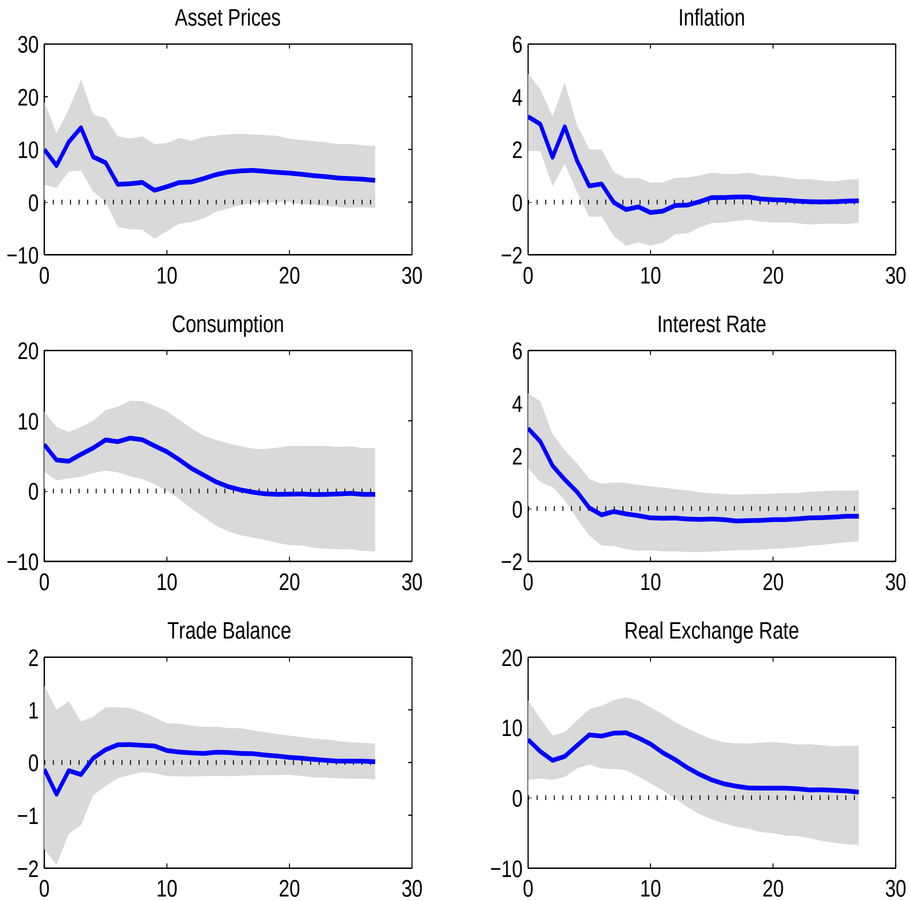


Figure 9: Australia- Impulse Response following an Asset Price Shock

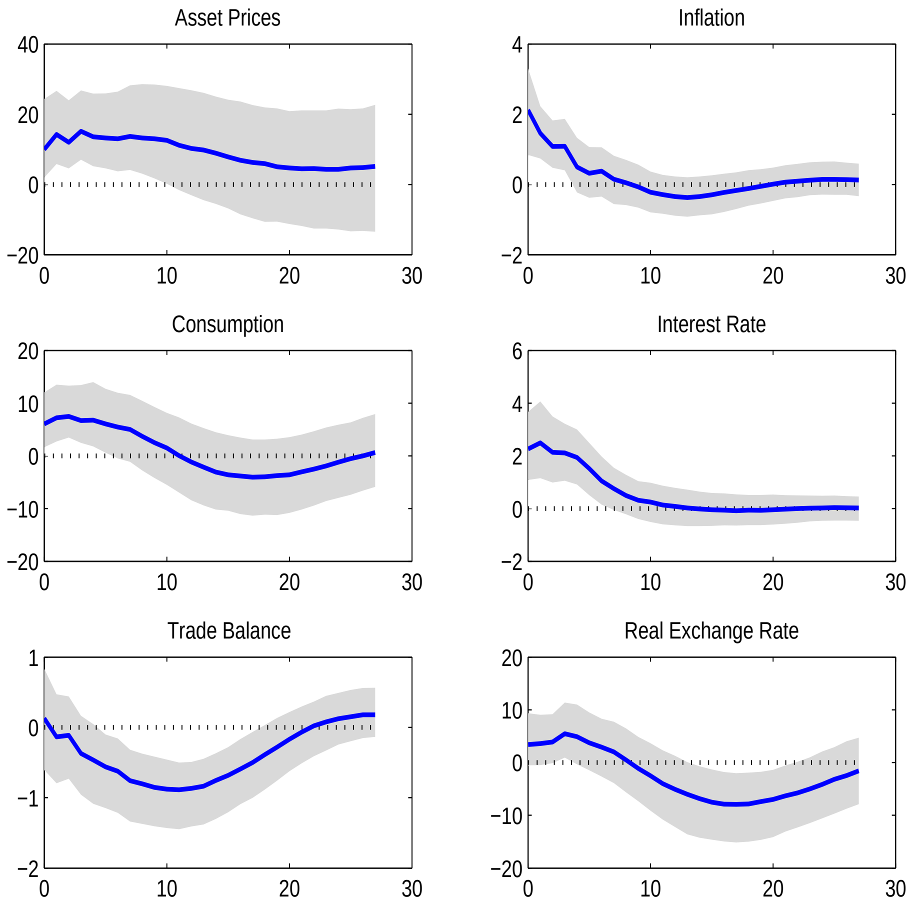


Figure 10: Japan - Impulse Response following an Asset Price Shock

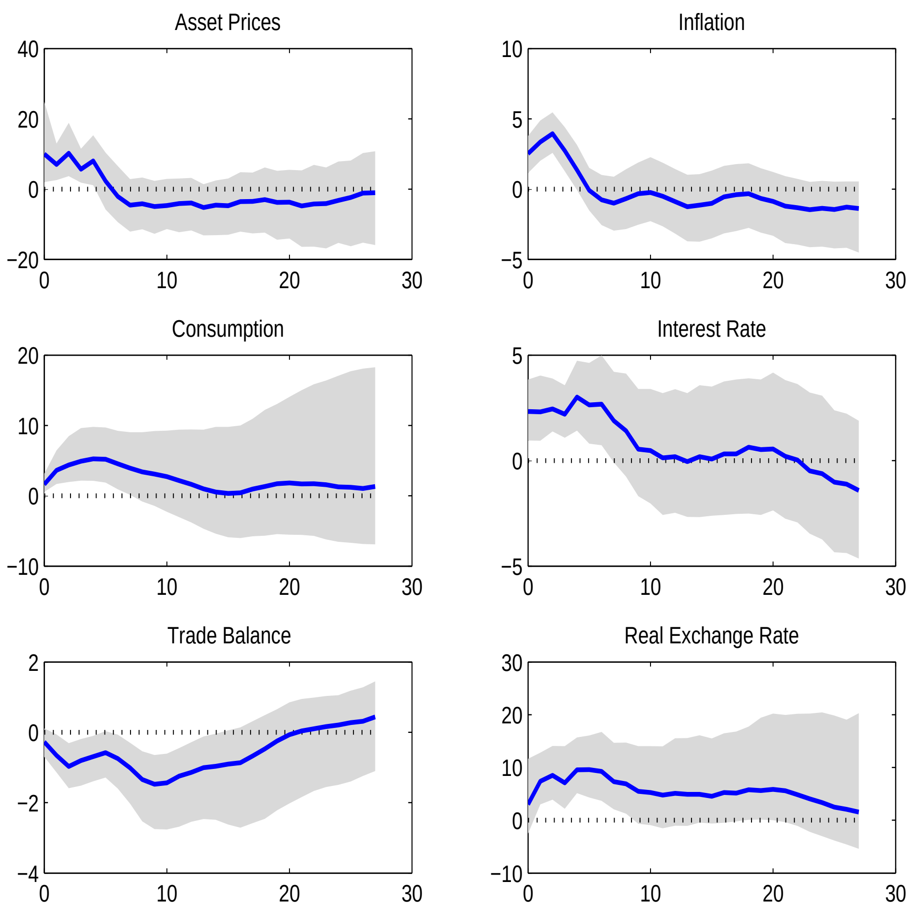


Figure 11: Korea- Impulse Response following an Asset Price Shock

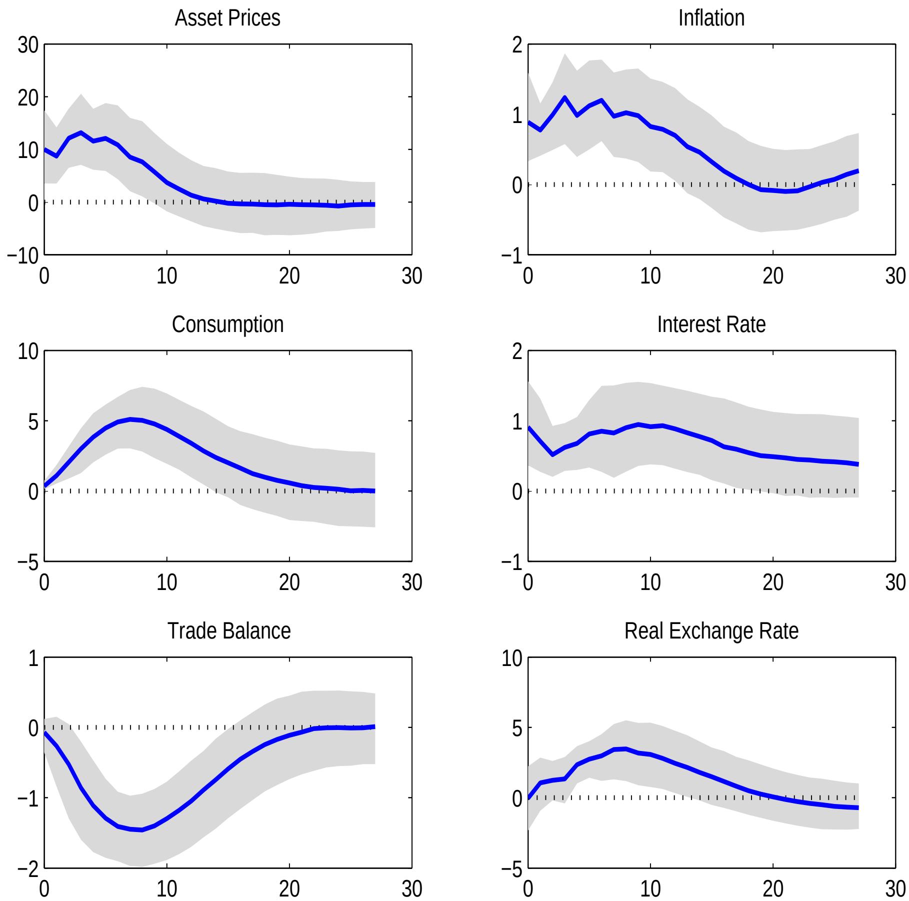


Figure 12: Poland- Impulse Response following an Asset Price Shock

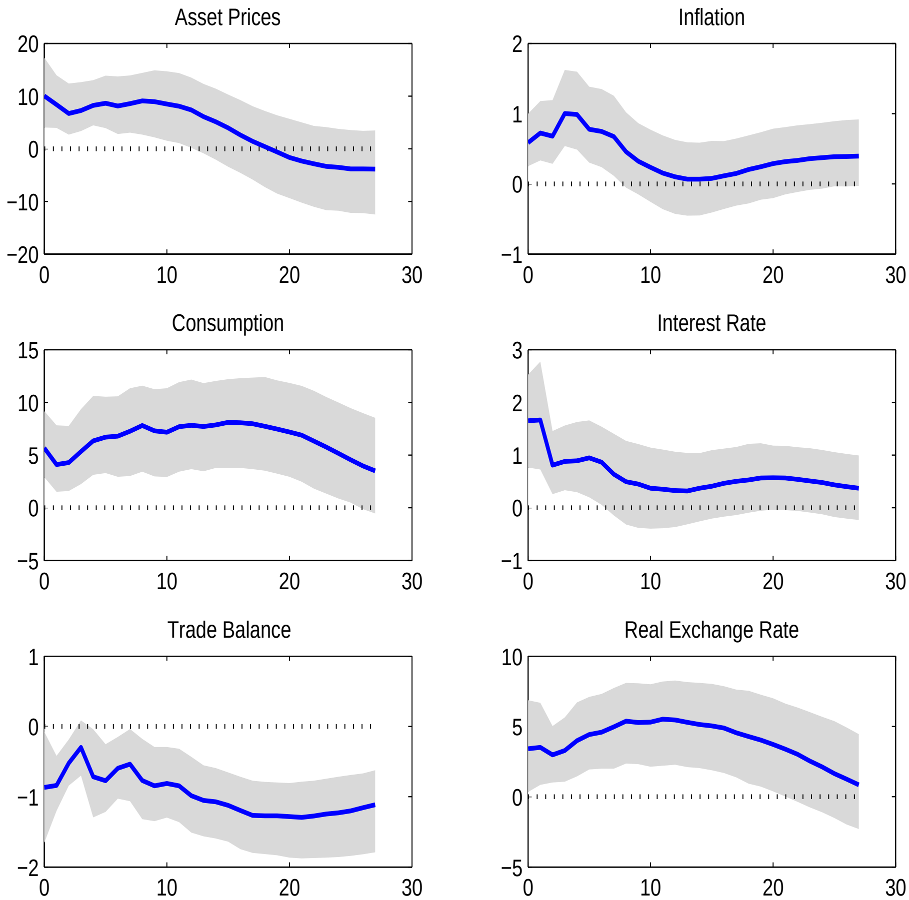


Figure 13: United States- Impulse Response following an Asset Price Shock with Current Account

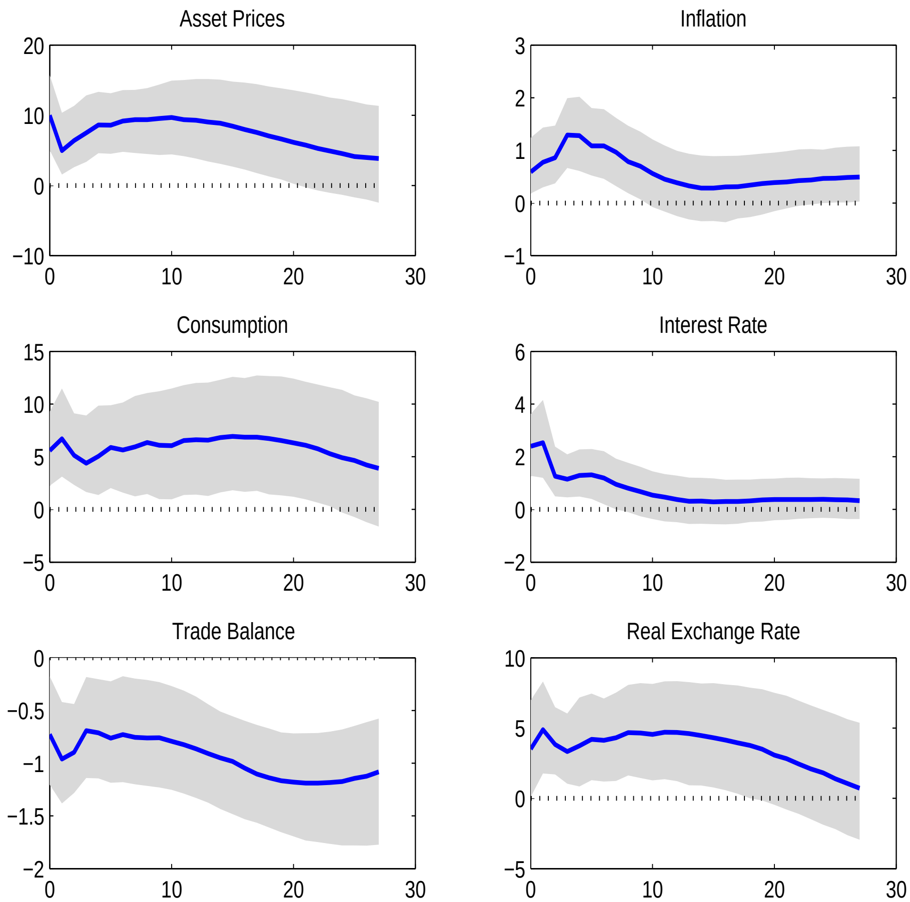


Figure 14: United States- Impulse Response following an Asset Price Shock with Equity Market Capitalization

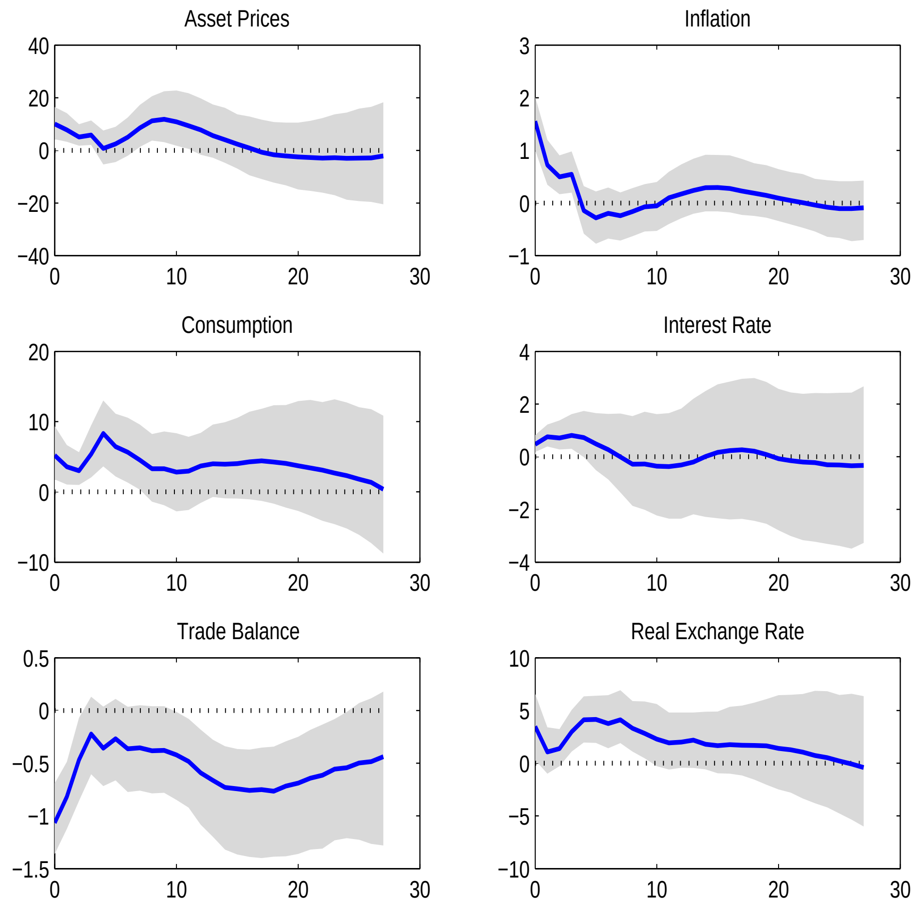


Figure 15: United States- Impulse Response following an Asset Price Shock with time sample 1990-2007

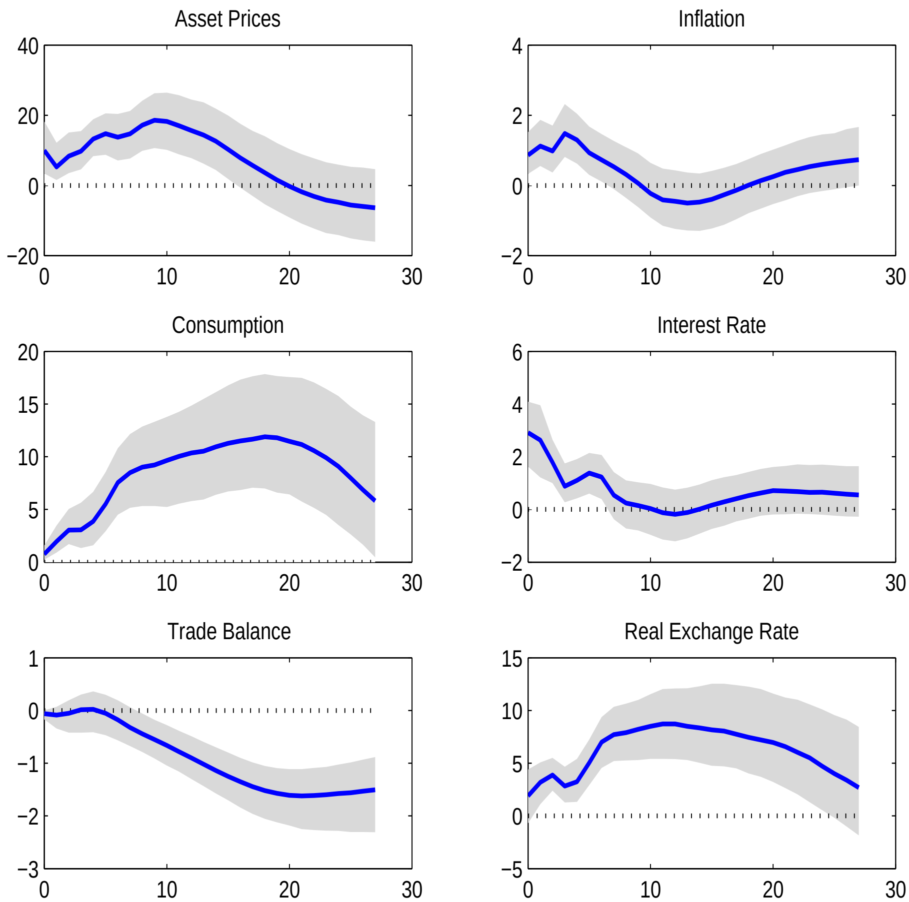
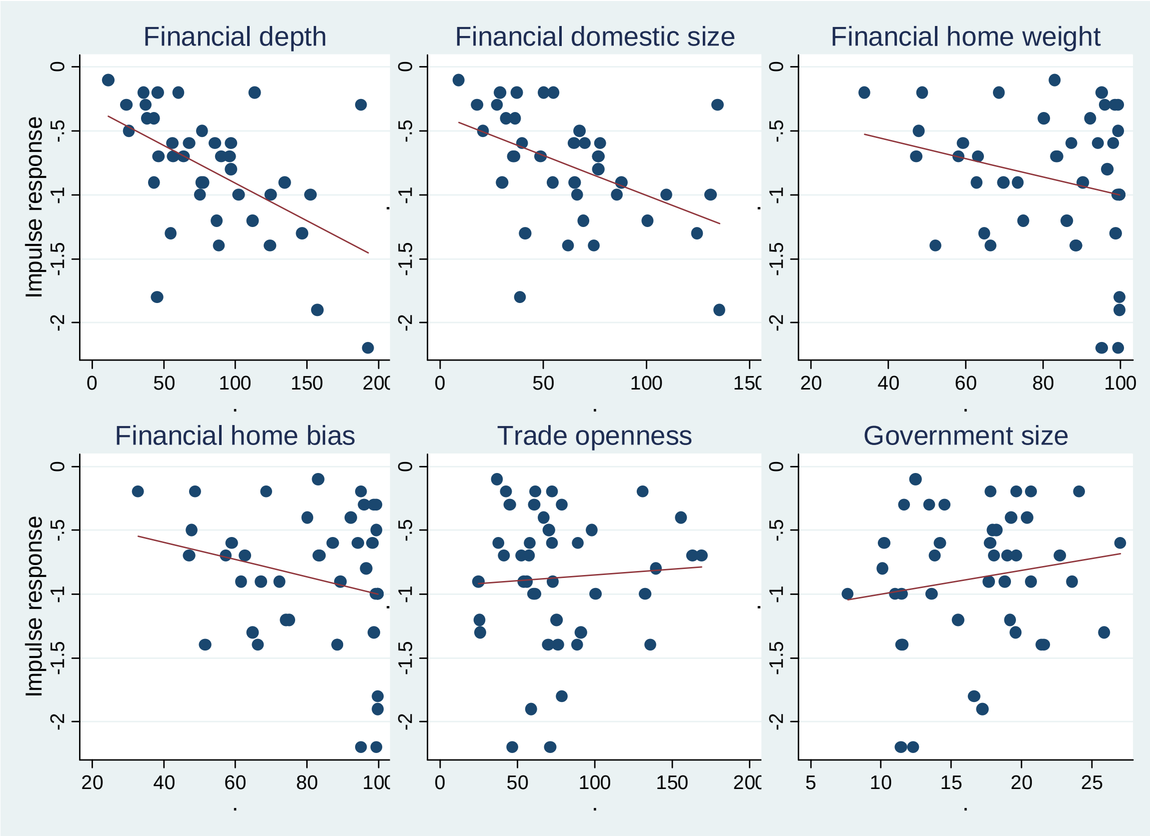


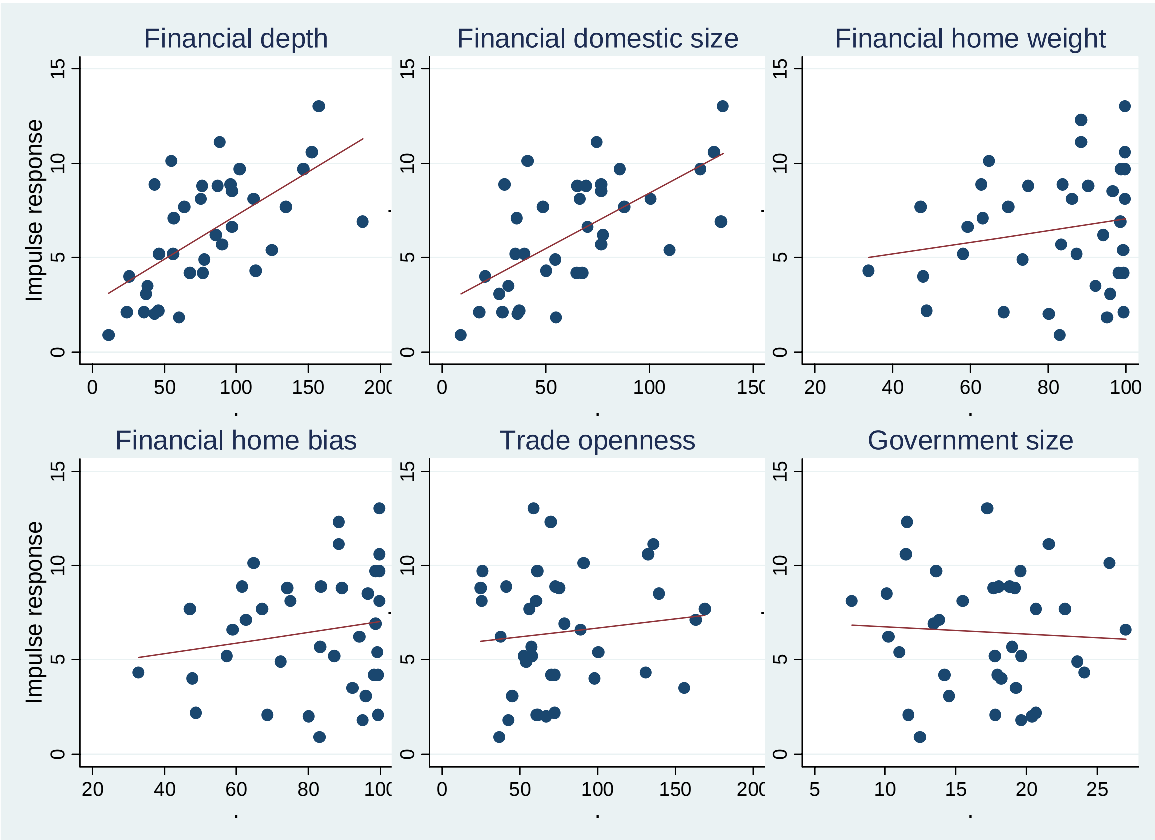
Figure 16: United States- Impulse Response following an Asset Price Shock with including emerging markets in the rest of the world sample

Figure 17: Correlation between impulse responses and potential determinants

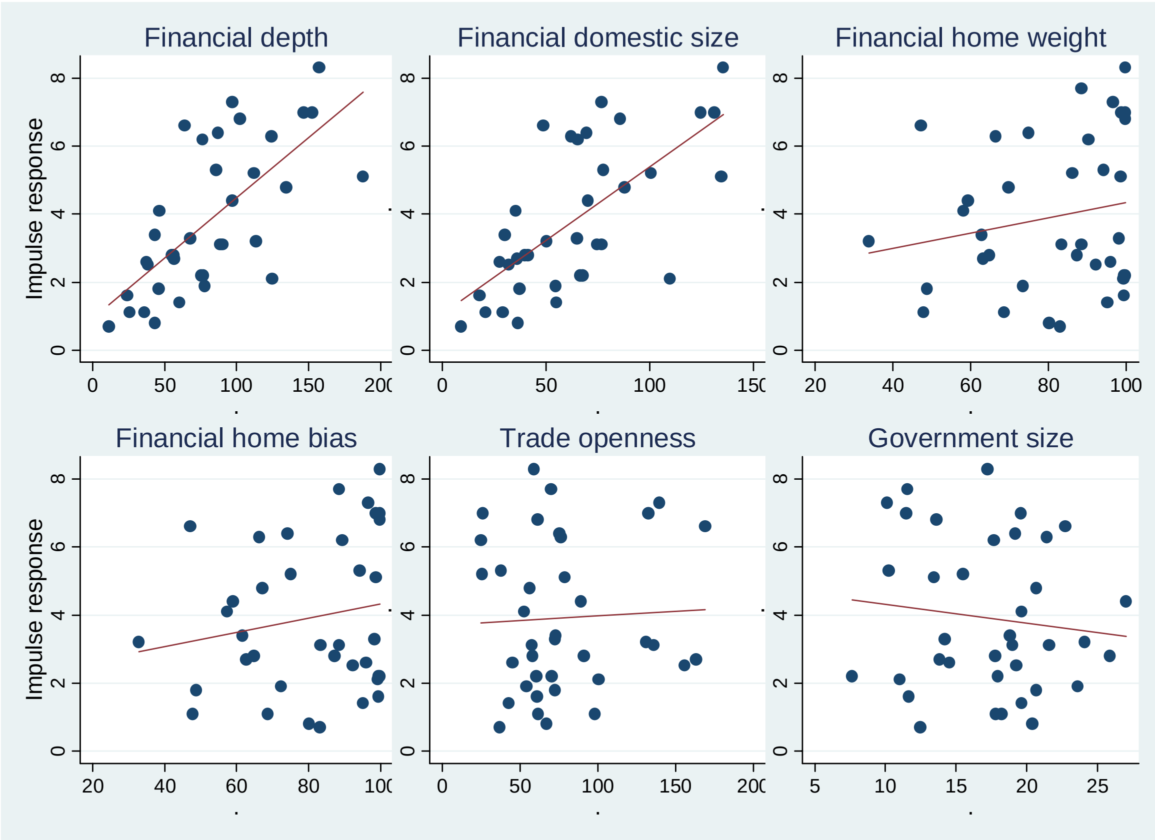
A. Peak impulse response of trade balance



B. Peak impulse response of private consumption



C. Peak impulse response of real effective exchange rate (REER)



Notes: The figure shows the relationship, for the extended sample of 42 countries, between the peak impulse responses of three of the endogenous variables (the trade balance in Panel A, for private consumption in Panel B, and for the REER in Panel C) to a positive 10% relative equity price shock and the potential determinants. The lines represent the linear fit between each pair of variables.

'*Financial depth'* is defined as the ratio of equity market capitalisation to GDP; '*financial domestic size*' as the ratio of domestic equity market capitalisation owned by domestic investors to domestic GDP; '*financial home weight*' as the share of domestic investors' equity invested in domestic equity markets (100-w_i); '*financial home bias*' as $HB_{i,t} = 1 - w_i / w_i^*$, with $HB_i=0$ indicating no equity home bias and $HB_i=1$ a perfect home bias; '*trade openness*' as the ratio of exports plus import to GDP; '*size of government*' as the ratio of government consumption to GDP. All numbers are in percent and are averages over the period 2000-2007.

Table 1: Country sample

Benchmark sample	Extended sample with EMEs	
Australia	Countries of benchmark	
Belgium	Argentina	Mexico
Canada	Austria	New Zealand
Denmark	Brazil	Peru
Finland	Chile	Philippines
France	China	Poland
Germany	Colombia	Portugal
Italy	Czech Republic	Romania
Japan	Greece	Russia
Netherlands	Hungary	South Africa
Norway	India	Slovakia
Spain	Indonesia	South Korea
Sweden	Ireland	Thailand
Switzerland	Malaysia	Turkey
UK		
USA		

Table 2: Data definitions and sources

Variable	Definition	Source
asset prices	difference between domestic equity returns and foreign equity returns, both measured in local currency terms	Bloomberg, mkt indices
trade balance	trade balance as a ratio to domestic GDP	IFS
current account	current account as a ratio to domestic GDP	IFS
REER	log real effective exchange rate using trade weights for a broad set of partner countries	IFS, OECD
consumption	difference in log private consumption in the domestic economy and log private consumption in the rest of the world, both expressed in US dollar (using end-of-period exchange rates)	IFS
inflation	percentage difference of domestic CPI inflation from that in the rest of the world	IFS
interest rate	percentage difference of domestic short-term (money market) rates from those in the rest of the world	IFS, OECD
Financial depth	ratio of market capit. to GDP	Bloomberg, CPIS
Financial size	ratio of dom. market capit. to world market capit. (1-w*)	Bloomberg, CPIS
Fin. dom. share	share of market capit. owned by dom. residents	Bloomberg, CPIS
Fin. dom. size	ratio of market capit. owned by dom. residents to GDP	Bloomberg, CPIS
Fin. home weight	domestic investors' share of equity invested in dom. equity market (1-w)	Bloomberg, CPIS
Fin. home bias	equity home bias: HB = 1- (w/w*)	Bloomberg, CPIS
Trade openness	ratio of exports plus imports to GDP	IFS
Size of governm.	ratio of government consumption to GDP	IFS, OECD
Real GDP growth	average growth rate p.a.	IFS
Productiv. growth	average growth rate p.a.	OECD
PPP weight	GDP weight in the world in PPP terms	OECD, WEO
PPP weight change	% change between 1990 and 2007	OECD, WEO

Table 3: Impulse responses to a 10% relative asset price shock

	IR trade balance	IR consumption	IR REER	IR inflation	IR interest rates
Benchmark sample					
Australia	-0.7	8.9	9.8	3.6	3.3
Belgium	-0.7	7.7	6.6	2.2	1.6
Canada	-1.2	8.8	6.4	1.2	1.8
Denmark	-1.3	10.1	2.8	0.9	1.2
Finland	-1.4	18.2	6.3	2.1	0.2
France	-0.9	4.9	1.9	0.6	0.8
Germany	-0.9	8.9	3.4	0.9	1.2
Italy	-0.7	5.2	4.1	1.7	1.4
Japan	-0.9	8.8	6.2	1.8	2.4
Netherlands	-0.2	4.3	3.2	1.7	7.7
Norway	-0.2	2.2	1.8	1.1	0.9
Spain	-0.6	5.2	2.8	0.5	0.1
Sweden	-0.6	6.6	4.4	1.2	1.4
Switzerland	-1.4	15.4	10.8	2.1	4.3
UK	-0.9	7.7	4.8	1.6	2.2
USA	-1.2	8.1	5.2	1.1	2.0
Extended sample with EMEs					
Argentina	-0.1	0.9	0.7	0.4	0.4
Austria	-0.5	4.0	1.1	0.4	0.5
Brazil	-1.3	9.7	7.0	1.3	2.0
Chile	-1.4	12.3	7.7	2.6	3.5
China	-0.6	4.2	3.3	1.4	1.1
Colombia	-0.2	1.8	1.4	0.9	0.7
Czech Republic	-1.4	11.1	3.1	1.0	1.3
Greece	-0.3	3.1	2.6	0.9	0.6
Hungary	-0.8	8.5	7.3	2.4	1.8
India	-2.2	29.1	10.1	3.4	0.3
Indonesia	-1.0	8.1	2.2	0.7	1.0
Ireland	-0.7	7.1	2.7	0.7	1.0
Korea	-0.3	6.9	5.1	2.7	12.3
Malaysia	-2.2	24.6	17.3	3.4	6.9
Mexico	-0.3	2.1	1.6	0.7	0.6
New Zealand	-0.2	2.1	1.1	0.2	0.0
Peru	-0.6	6.2	5.3	1.8	1.3
Philippines	-1.0	5.4	2.1	0.7	0.9
Poland	-0.5	4.2	2.2	0.4	0.1
Portugal	-0.4	2.0	0.8	0.2	0.3
Romania	-1.8	19.7	13.8	2.7	5.5
Russia	-1.9	13.0	8.3	1.8	3.2
South Africa	-0.7	5.7	3.1	0.6	0.1
Slovakia	-0.4	3.5	2.5	0.7	1.0
Thailand	-1.0	10.6	7.0	1.9	2.2
Turkey	-1.0	9.7	6.8	2.0	2.6

Notes: The table shows the peak impulse responses (IR), i.e. maximum responses of the various variables, in %, to a positive 10% shock to *relative* equity prices, i.e. of domestic asset prices relative to those in the rest of the world. Impulse responses for the benchmark sample are based on the estimation for the period 1974-2007, for the extended sample for the period 1990-2007.

Table 4: Correlation pattern between impulse responses and potential determinants

	IR trade balance	IR consump-tion	IR REER	IR inflation	IR interest rates	Trade openness	Government size	Financial depth	Fin. dom. size	Fin. home weight
IR trade balance	1									
IR consumption	-0.9116*	1								
IR REER	-0.7618*	0.8394*	1							
IR inflation	-0.5509*	0.7267*	0.8593*	1						
IR interest rates	-0.1724	0.2895	0.5046*	0.5875*	1					
Trade openness	0.0614	-0.0116	-0.0373	-0.0055	0.0995	1				
Government size	0.1631	-0.2085	-0.2529*	-0.2445*	-0.1112	0.1154	1			
Financial depth	-0.6333*	0.6642*	0.7119*	0.6433*	0.5370*	-0.0365	-0.3122*	1		
Fin. dom. size	-0.6667*	0.6771*	0.7245*	0.6254*	0.4662*	-0.0864	-0.3640*	0.9736*	1	
Fin. home weight	-0.2507*	0.1785	0.2173	0.1487	0.0337	-0.3159*	-0.5745*	0.1936	0.3151*	1
Fin. home bias	-0.2391*	0.1775	0.2143	0.1522	0.0318	-0.2906*	-0.5724*	0.1897	0.3097*	0.9958*

Notes: The table shows the correlation coefficients, for the extended sample of 42 countries, between the peak impulse responses of the 5 endogenous variables to a positive 10% relative equity price shock and the potential determinants. All correlations are based on the estimation period 1990-2007.
'*Financial depth'* is defined as the ratio of equity market capitalisation to GDP; '*financial domestic size*' as the ratio of domestic equity market capitalisation owned by domestic investors to domestic GDP; '*financial home weight*' as the share of domestic investors' equity invested in domestic equity markets (100-w_i); '*financial home bias*' as $HB_{i,t} = 1 - w_i / w_i^*$, with $HB_i=0$ indicating no equity home bias and $HB_i=1$ a perfect home bias; '*trade openness*' as the ratio of exports plus import to GDP; '*size of government*' as the ratio of government consumption to GDP. All numbers are in percent and are averages over the period 2000-2007.
"*"indicates statistical significance at the 10% level for pairwise correlation coefficients.