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Current Accounts and the Persistence of Global and Country-Specific Shocks: Is Investment Really too Volatile?

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Abstract

Using a small VAR of the current account and investment, we identify two categories of shocks: permanent vs. transitory and country-specific vs. global. Our approach involves only the most minimal identifying assumptions. Using data from the G7 countries, we find that the predictions of the intertemporal approach to the current account are confirmed by the data. We are also able to solve the puzzle encountered by Glick and Rogoff (1995) that the investment response to country-specific shocks is excessive vis-a-vis the current account response: the estimated response is an amalgam of responses to permanent and transitory shocks. In our specification the current account reacts as predicted to the permanent component of country-specific shocks and we find investment not to be excessively volatile.

Keywords: GLOBAL AND COUNTRY-SPECIFIC SHOCKS, CURRENT ACCOUNT, INVESTMENT, COINTEGRATION, VECTORAUTOREGRESSIONS, PRESENT-VALUE MODELS.

JEL classification: C32, F41, F47

1 Introduction

A better understanding of the empirical dynamics of the current account and investment in response to global and country-specific shocks is important as it puts to a test the modern 'intertemporal theory of the current account' (Obstfeld (1986, 1995), Sachs (1981), Obstfeld and Rogoff (1995)). Even though this theory is nowadays a theoretical workhorse in international macroeconomic analyses, empirical work in this area has so far been very sparse.

One exception is the important paper by Glick and Rogoff (1995). These authors empirically examined the role of global and country-specific productivity shocks for current account dynamics using a structural econometric model derived from the theory. Intertemporal optimization models predict that the current account reacts primarily to country-specific shocks, not to global shocks: global shocks hit all economies equally and change consumption possibilities world-wide. Hence, there is no role for international borrowing and lending with a view to smoothing consumption. In response to a, say, negative country-specific shock, however, a country can borrow from the rest of the world in order to smooth consumption.

Overall, Glick and Rogoff could confirm these predictions of the theory. They found, however, that the reaction of investment to country-specific shocks was excessive vis-a-vis the implied current account response.

The puzzle encountered by Glick and Rogoff illustrates an important property of rational expectations models: their predictions crucially depend on whether structural shocks have permanent or transitory effects and also on the speed of adjustment to the new steady state (persistence). This sensitivity constitutes a dilemma for the empirical researcher: using univariate methods, it is almost impossible to distinguish between very persistent but stationary processes on one hand and unit-root processes on the other.

In this paper we suggest measuring the permanent component of shocks by choosing an appropriate VAR specification of the model and by exploiting cointegration in the data. In so doing, we can give a coherent description of the permanent and transitory components of global and country specific shocks with respect to the information set implied by the theory. Using this approach, we offer an alternative solution to the Glick and Rogoff puzzle: the current account seems to react stronger than investment to the permanent component of country-specific shocks but country-specific shocks have important transitory components. To the degree that these transitory components are not taken care of in the estimation of the impact response of savings and investment, estimates will be an amalgam of the response to transitory and permanent shocks. The kind of excess sensitivity of the current account response to varying degrees of persistence suggested by Glick and Rogoff as a solution to the puzzle is generally not empirically warranted. Our findings rather suggest an open-economy analogue of the solution proposed by Quah (1990) for the excess-smoothness of consumption: if economic agents distinguish between transitory and permanent movements in their future income stream, low current-account investment correlations can be rationalized even if the current account is more sensitive to (the persistent component of) permanent shocks than is investment.

Our approach forces us to sacrifice some structure vis-a-vis the simultaneous equation model suggested by Glick and Rogoff. It is certainly a big advance of their study that the estimating equations are derived explicitly from an intertemporal model. The authors claim:

> 'The ability to derive closed-form solutions helps clarify some interesting issues that may easily be obscured in simulation analysis or vectorautoregression estimation' (Glick and Rogoff, pp.185-6)

In this study, we will argue that our understanding of current account and investment dynamics can be enhanced if both the economic theory as well as its reduced form are taken seriously. Employing a structural VAR, we use insights from the intertemporal model that are also confirmed by the results of Glick and Rogoff to identify country-specific and global shocks from the data directly. Using the same model framework, we also identify permanent and transitory shocks to investment and the current account. We are then able to describe the mapping between permanent and transitory shocks on the one hand and global and country-specific shocks on the other. Our reasoning will be based on geometric insights and will give rise to a measure of persistence of country-specific shocks. The quality of our identification of both country-specific shocks and their persistence is then assessed in two ways: first, cross-country-correlations of shocks are calculated for the panel of the seven largest economies in the world. Secondly, we use our models and the knowledge about country-specificity to forecast the current account based on a present value formula. Indeed, our models perform very well in forecasting current account behaviour.

The remainder of this paper is structured as follows: in section two we present the model of Glick and Rogoff (1995) and discuss how they derive the structural estimation equations. In section 3 we will introduce our own approach. We suggest how to estimate permanent and transitory shocks as well as global and country-specific shocks from the data and we present a measure of persistence of country-specific shocks that is based on a geometric reasoning. Section 4 presents data and estimation results and section 5 concludes.

2 Structural estimation equations

Glick and Rogoff (1995) use a simple intertemporal model with adjustment costs and quadratic utility. The representative agent maximizes

$$E_t \sum_{i=0}^{\infty} \left(\frac{1}{r}\right)^i U(C_{t+i}) \text{ where } U(C) = C - \frac{h}{2}C^2 \tag{1}$$

subject to the intertemporal budget constraint

$$B_{t+1} = RB_t + NO_t - C_t \tag{2}$$

where $[B, NO, C]$ denote the net foreign asset position, net output defined as the difference between GDP and Investment, $NO_t = Y_t - I_t$, and consumption respectively and $R = 1 + r$ where r is the world interest rate which here is assumed to equal the representative individual's rate of time preference. The current account is then given by the change in the net foreign asset position, $CA_t = \Delta B_t$. Equivalently, defining saving as $S = Y - C + rB$ we get the conventional definition of the current account, $CA = S - I$.

The production side of the economy is described by a Cobb-Douglas type production function given by

$$Y_t = A_t^c A_t^w K_t^\gamma \left[1 - \frac{g}{2}\left(\frac{I_t^2}{K_t}\right)\right]$$

Here, K_t denotes the time t capital stock, $I_t = \Delta K_{t+1}$ is gross investment , γ is the capital share of the economy, g is a positive constant and $\mathbf{A} = \left[\begin{array}{cc} A_t^c, & A_t^w \end{array}\right]'$ is a vector of country-specific and global total factor productivities which is supposed to follow an AR(1)-process:

$$\mathbf{A}_t = \begin{bmatrix} A_t^c \\ A_t^w \end{bmatrix} = \begin{bmatrix} \rho_{GR} & 0 \\ 0 & 1 \end{bmatrix} \mathbf{A}_{t-1} + \begin{bmatrix} \varepsilon_t^c \\ \varepsilon_t^w \end{bmatrix} \tag{3}$$

where ε_t^c and ε_t^w are supposed to be mutually uncorrelated at all leads and lags.

Glick and Rogoff (1995) linearize the first order conditions which yields a system of equations of the following form:

$$Y_t = a_I I_t + a_K K_t + \mathbf{a}_A' \mathbf{A}_t + \mu_{Yt} \tag{4}$$

$$I_t = b_1 I_{t-1} + \sum_{s=1}^{\infty} \boldsymbol{\lambda}_s' \left\{E_t \mathbf{A}_{t+s} - E_{t-1} \mathbf{A}_{t+s-1}\right\} + \mu_{It} \tag{5}$$

$$C_t = \frac{R-1}{R}\left(B_t + E_t \sum_{s=0}^{\infty} R^{-s} NO_{t+s}\right) + \mu_{Ct} \tag{6}$$

where $\boldsymbol{\lambda}_s' = \left[\begin{array}{cc} d_c\lambda_c^s, & d_w\lambda_w^s \end{array} \right]$ and ,λ_c and λ_w are positive and smaller than unity.

In the above, $\boldsymbol{\mu}' = \left[\begin{array}{ccc} \mu_{Yt} & \mu_{It} & \mu_{Ct} \end{array} \right]$ is a vector of mutually uncorrelated i.i.d. disturbances that is added *ad hoc* to provide the error structure for the estimation equations. From this linearization, it is then possible to derive the estimable equations

$$\Delta I_t = (b_1 - 1)I_{t-1} + b_2\Delta A_t^c + b_3\Delta A_t^w + v_{It} \tag{7}$$

and in the case of $\rho_{GR} = 1$:

$$\Delta CA_t = c_1 I_{t-1} + c_2\Delta A_t^c + c_3\Delta A_t^w + rCA_{t-1} + v_{CAt} \tag{8}$$

Again, $\mathbf{v}_t' = \left[\begin{array}{cc} v_{It} & v_{CAt} \end{array} \right]$ are error terms that are functions of $\boldsymbol{\mu}_t$. Glick and Rogoff also show that v_{CAt} is correlated with CA_{t-1} whereas I_{t-1} is predetermined in the equation for ΔCA_t. They solve this problem by imposing a value for r. Then the system of equations (7) and (8) can be estimated by two stage least squares as a seemingly unrelated regression model.

It is an important result of Glick and Rogoff that the coefficient on ΔA_t^w in the CA-equation is found to be insignificant for all seven countries, in accordance with the theory. However, their empirical implementation reveals a puzzle:

Under the assumption that country-specific shocks do have a permanent effect on net output, the theory also predicts that $|c_2| / b_2 > 1$, i.e. the reaction of the current account to country-specific shocks should be stronger than the response of investment. A positive, permanent country-specific TFP-shock increases today's gross output, Y_t. Future gross output will however even be higher than today's gross output because the productivity shock makes it profitable to invest. Hence the future capital stock and consequently also future output will be higher. Because consumption instantaneously adjusts to the permanently higher future output stream, this implies that savings will have to fall and hence the current account should change by more than investment (in the opposite direction, though).

From the data, Glick and Rogoff consistently find estimates of c_2 that are smaller in absolute value than those for b_2. This is puzzling but this result strongly depends on the persistence of country-specific shocks. Glick and Rogoff show that even for small deviations of ρ_{GR} from unity, the relative current-account / investment response can be substantially muted: as the shock is no longer permanent, people will save more instead of less. At the same time, the incentive to invest is weakened as productivity will only be temporarily high. Glick and Rogoff show that for reasonably chosen parameter values of the structural model the CA/I response will fall into the range of their estimates.

In the following section, we outline an alternative approach that relies on measuring the relative importance of transitory and permanent components in country-specific shocks rather than specifying it *a priori*, as in equation (3) which requires shocks to be fully permanent or fully transitory.. As we will show, our more data-driven approach leads to an alternative solution of the Glick-Rogoff puzzle: if shocks have both permanent and transitory components, the estimated response in the Glick-Rogoff model may be an amalgam of responses to permanent and transitory shocks.

Our method is based on a cointegrated VAR-model of investment and the current account: we first identify global and country-specific shocks from the data. Then we rerun the model with an alternative identification scheme that exploits the cointegrating information in the data to identify permanent and transitory shocks. We are then able to compare global and country-specific shocks with permanent and transitory disturbances and we can investigate how one class of shocks maps into the other. We can then suggest a measure of the persistence of global and country-specific shocks that is based on a geometric reasoning.

3 Identifying the shock matrix

In this section, we will present the structural VAR techniques that we will use to measure the persistence of country -specific and global shocks.

We will consider a simple bivariate VAR in investment and the current account:

$$\Pi(\mathbf{L})\mathbf{X}_t = \varepsilon_t \tag{9}$$

where $\mathbf{X}_t' = \left[\begin{array}{cc} CA_t, & I_t \end{array}\right]$.

Our aim is to identify two classes of shocks from this model: permanent vs. transitory shocks and global vs. country-specific shocks. Furthermore, we want to find out how one class of shocks maps into the other, i.e. we want to know how persistent country-specific shocks are or we want to know how much of the typical variation in permanent shocks is explained by global influences.

3.1 Permanent vs transitory

If investment and savings in the model-economy laid out in section 2 can be characterized by $I(1)$-processes, then the intertemporal approach imposes a cointegrating relationship on the data: the current account will have to be stationary as it can be represented as the discounted sum of changes in net output. As net output is itself assumed to be an $I(1)$-process, its differences will be $I(0)$ and so will be the current account. As investment and savings are $I(1)$, there is a cointegrating relationship between them.

Cointegration is a general property of present value models and the implications of this property for econometric modelling have first been explored by Campbell and Shiller (1987). In our model, the cointegrating restriction amounts to saying that CA_t is stationary while I_t is not. Let us rewrite the VAR in error correction form (VECM), neglecting constant terms:

$$\Gamma(\mathbf{L})\Delta\mathbf{X}_t = \boldsymbol{\alpha}\boldsymbol{\beta}'\mathbf{X}_{t-1} + \boldsymbol{\varepsilon}_t \tag{10}$$

Then the theory would predict that $\boldsymbol{\beta}' = \left[\begin{array}{cc} 1 & 0 \end{array}\right]$.

The VECM can be inverted to yield a Beveridge-Nelson-Stock-Watson (BNSW) representation in terms of reduced-form disturbances:

$$\mathbf{X}_t = \mathbf{C}(\mathbf{1}) \sum_{l=0}^{t} \boldsymbol{\varepsilon}_l + \mathbf{C}^*(\mathbf{L}) \boldsymbol{\varepsilon}_t \tag{11}$$

where $C^*(L)\varepsilon_t$ is a stationary moving average and the first term is the random walk component of the $I(1)$-process X_t. As Johansen (1995) has shown, $C(1)$ has a closed-form representation in terms of the parameters of the VECM:

$$\mathbf{C}(\mathbf{1}) = \boldsymbol{\beta}_\perp (\boldsymbol{\alpha}'_\perp \Gamma(\mathbf{1}) \boldsymbol{\beta}_\perp)^{-1} \boldsymbol{\alpha}'_\perp \tag{12}$$

where $\boldsymbol{\alpha}_\perp, \boldsymbol{\beta}_\perp$ are the orthogonal complements of $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$ respectively. As this representation shows, $\mathbf{C}(\mathbf{1})$ is of reduced rank: if there are h cointegrating relationships, then $\mathbf{C}(\mathbf{1})$ has rank $n - h$ where n is the dimension of the system. This reflects the fact that in a cointegrated system, there is a reduced number of common trends that drive the system in the long-run. This is what underlies the Stock-Watson representation of a cointegrated stochastic process. We can write the random walk component as

$$\mathbf{C}(\mathbf{1}) \sum_{l=0}^{t} \boldsymbol{\varepsilon}_l = \mathbf{A}_0 \boldsymbol{\alpha}'_\perp \sum_{l=0}^{t} \boldsymbol{\varepsilon}_l = \mathbf{A}_0 \boldsymbol{\tau}_t \tag{13}$$

where the common trends are given by $\boldsymbol{\tau}_t = \boldsymbol{\alpha}'_\perp \sum_{l=0}^{t} \boldsymbol{\varepsilon}_l$. Accordingly, the permanent shocks to the system are just given by $\boldsymbol{\eta}_t = \boldsymbol{\alpha}'_\perp \boldsymbol{\varepsilon}_t$. If we require that permanent and transitory shocks should be orthogonal to each other, the transitory shocks are given by

$$\xi_t = \boldsymbol{\alpha}' \Omega^{-1} \boldsymbol{\varepsilon}_t \tag{14}$$

where Ω is the variance-covariance matrix of the reduced form residuals $\boldsymbol{\varepsilon}_t$.

Hence, the matrix $\mathbf{P}$ that maps $\boldsymbol{\varepsilon}_t$ on the vector of permanent and transitory disturbances, $\boldsymbol{\theta}'_t = \begin{bmatrix} \eta_t, & \xi_t \end{bmatrix}$ is given by

$$\mathbf{P} = \begin{bmatrix} (\alpha'_\perp \Omega \alpha_\perp)^{-1/2} \boldsymbol{\alpha}'_\perp \\ (\alpha' \Omega^{-1} \alpha)^{-1/2} \boldsymbol{\alpha}' \Omega^{-1} \end{bmatrix} \tag{15}$$

where the factors $(\alpha'_{\perp}\Omega\alpha_{\perp})^{-1/2}$ and $(\alpha'\Omega^{-1}\alpha)^{-1/2}$ normalize η_t and ξ_t to have unit variance.

3.2 Global vs. country-specific

We are now in a position to identify permanent and transitory disturbances. In a next step, we need to identify global and country-specific shocks from the data. The solution in this case will not come from a correct interpretation of the parameters of the econometric model but rather from outside, i.e. from economic theory. Theory predicts that the current account should not react to global shocks. Our tests will be flawed if we wrongly build our analysis on this presumption. But this is exactly the main finding by Glick and Rogoff: in their estimates, the global shock almost never has a significant effect on the current account in the same period. We can therefore base our analysis on theirs, assuming that we can validly identify global from country-specific shocks by imposing that the former do not have a contemporaneous effect on the current account.

In the framework of our VAR, this amounts to a very simple and convenient identifying restriction: identification is achieved by means of a Choleski decomposition of the variance-covariance matrix of the reduced form residuals, Ω. To see this, consider the BNSW-representation

$$\mathbf{X}_t = \mathbf{C(1)}\sum_{l=1}^{t}\boldsymbol{\varepsilon}_l + \mathbf{C}^*(\mathbf{L})\boldsymbol{\varepsilon}_t \tag{16}$$

we have referred to this as the 'reduced' form. We can rewrite in difference form:

$$\Delta\mathbf{X}_t = \mathbf{C}(\mathbf{L})\boldsymbol{\varepsilon}_t \tag{17}$$

where the coefficients of the matrix polynomial $\mathbf{C}(\mathbf{L})$ are given by $\mathbf{C}_i = \mathbf{C}_i^* - \mathbf{C}_{i-1}^*$.

Then, we hypothesize the existence of a structural form

$$\Delta\mathbf{X}_t = \mathbf{D}(\mathbf{L})\mathbf{e}_t$$

where $\mathbf{e}_t' = \begin{bmatrix} e_t^c, & e_t^w \end{bmatrix}$ is the vector of country-specific and global shocks. It is assumed that the reduced form residuals are a linear function of the structural disturbances e_t:

$$\boldsymbol{\varepsilon}_t = \mathbf{S}\mathbf{e}_t \tag{18}$$

Furthermore, the structural disturbances are orthonormal, i.e. $\mathbf{var}(\mathbf{e}_t) = \mathbf{I}_n$. It is then clear that

$$\Omega = \mathbf{S}\mathbf{S}' \tag{19}$$

and

$$\mathbf{D}(\mathbf{L}) = \mathbf{C}(\mathbf{L})\mathbf{S} \tag{20}$$

In a bivariate system, the first of these conditions gives three restrictions for the four elements of $\mathbf{S}$. To achieve identification, one additional restriction is needed and we get it from the theory: global shocks do not have a contemporaneous impact on the current account. Recalling that $\mathbf{X}_t' = \begin{bmatrix} CA_t & I_t \end{bmatrix}$ and

$$\mathbf{C}(\mathbf{0})\mathbf{S} = \mathbf{S} = \mathbf{D}(\mathbf{0}) \tag{21}$$

this amounts to assuming that S is lower triangular:

$$\mathbf{S} = \begin{bmatrix} s_{11} & 0 \\ s_{12} & s_{22} \end{bmatrix}$$

We now have classified disturbances to our bivariate system according to two categories: their persistence and their country-specificity. The question that we set out to answer is: how persistent are country-specific and global shocks? We are now in the position to answer this question. The matrix that maps global and country-specific shocks into the permanent and transitory domain is given by

$$\boldsymbol{\theta}_t = \mathbf{P}\mathbf{S}\mathbf{e}_t = \mathbf{Q}\mathbf{e}_t \tag{22}$$

Note that $\mathbf{Q} = \mathbf{P}\mathbf{S}$ is a orthonormal matrix, i.e. $\mathbf{Q}\mathbf{Q}' = \mathbf{I}_n$.

The matrix $\mathbf{Q}$ contains all the information we are interested in. In fact, $\mathbf{Q}$ is nothing else than the covariance of $\boldsymbol{\theta}_t$ and $\mathbf{e}_t$:

$$E(\boldsymbol{\theta}_t \mathbf{e}_t') = \mathbf{Q} E(\mathbf{e}_t \mathbf{e}_t') = \mathbf{Q} \tag{23}$$

Note that due to the unit variance of the components of $\mathbf{e}_t$ and $\boldsymbol{\theta}_t$, $\mathbf{Q}$ also defines the cross-correlation of $\mathbf{e}_t$ and $\boldsymbol{\theta}_t$ But beyond being covariance and correlation matrix at the same time, the orthonormality of $\mathbf{Q}$ provides a particular structure. It tells us, that if we choose the orthogonal basis of permanent and transitory shocks as our coordinate system, global and country-specific shocks are just a pair of orthogonal vectors in this coordinate system and the coordinates are given by the rows of $\mathbf{Q}$. Also, the squares of this coordinates are just the share of the variance of $\mathbf{e}_t$ that is given by permanent and transitory shocks. Figure (1) in the appendix, illustrates this geometric intuition: the upper left entry of $\mathbf{Q}$ which we will henceforth denote by ρ, is nothing else than the cosine of the angle λ between the typical country-specific shock and the permanent axis, the span of $[0, \eta]'$.

In fact, $\mathbf{Q}$ is nothing else than a rotation of the orthogonal basis of the country-specific and global shocks onto the basis of permanent and transitory shocks. Hence, the parameter ρ or, alternatively, the angle λ uniquely determine $\mathbf{Q}$. In other words: the space of orthonormal (2×2) matrices is one-dimensional. This becomes immediately apparent from recalling that $\mathbf{Q}\mathbf{Q}' = \mathbf{I}$, which imposes 3 non-redundant restrictions on $\mathbf{Q}$. We can then parametrize $\mathbf{Q}$ as a function of the permanent component of country-specific shocks as follows:

$$\mathbf{Q}(\rho) = \begin{bmatrix} \rho & -\sqrt{1-\rho^2} \\ \sqrt{1-\rho^2} & \rho \end{bmatrix} = \begin{bmatrix} \cos\lambda & -\sin\lambda \\ \sin\lambda & \cos\lambda \end{bmatrix} \tag{24}$$

We deliberately choose ρ to denote the permanent components of country-specific shocks, in analogy to ρ_{GR} in section 2. Certainly, these are not the same parameters but in the context of different models they formalize the same notion: ρ measures the correlation between the country-specific and the permanent shock in the VAR, whereas ρ_{GR} roughly measures the conditional correlation between A_t^c and A_{t-1}^c. In this sense, both ρ and ρ_{GR} are persistence measures.

3.3 Current account response and persistence

Glick and Rogoff (1995) show theoretically, how the period zero current account and investment responses depend on the persistence of country-specific shocks. In this subsection, we will discuss how our framework can be used to assess whether excess sensitivity can account for their results. Recall that Glick and Rogoff found that, empirically, investment reacts much stronger than the current account in response to a country-specific shock. In terms of our model, that corresponds to estimates of the matrix $\mathbf{S} = \{s_{ij}\}$ such that $|s_{11}| < s_{12}$. However, as long as country-specific shocks have some permanent impact, the prediction of the theory is just the inverse: the current account should react much stronger than investment.

Note that our measure of persistence, ρ and hence the matrix $\mathbf{Q}$ is a function of the period zero impulse response of current account and investment. Taking an 'inverse engineering' approach, we can therefore ask a question that is the reduced-form analogue to Glick and Rogoff: how does persistence depend on changes in the relative impulse responses and vice versa?

For this purpose, recall that

$$\mathbf{Q} = \mathbf{PS} \tag{25}$$

Now let $\boldsymbol{\alpha}' = \begin{bmatrix} \alpha_1 & \alpha_2 \end{bmatrix}$. Then $\boldsymbol{\alpha}'_\perp = \begin{bmatrix} -\alpha_2 & \alpha_1 \end{bmatrix}$. Furthermore, let $\Omega = \{\omega_{ij}\}$. Note also that $\mathbf{S}$ is just the lower Choleski-factor of Ω which is given by

$$\mathbf{S} = \begin{bmatrix} \sqrt{\omega_{11}} & 0 \\ \omega_{21}/\sqrt{\omega_{11}} & \sqrt{\omega_{22} - \omega_{21}^2/\omega_{11}} \end{bmatrix} \tag{26}$$

Then plugging in for $\mathbf{Q}$ we can write the upper left entry, ρ, as follows:

$$\rho = \frac{-\alpha_2\sqrt{\omega_{11}} + \alpha_1\omega_{21}/\sqrt{\omega_{11}}}{\sqrt{\alpha_2^2\omega_{11} + a_1^2\omega_{22} - 2\alpha_1\alpha_2\omega_{21}}} \tag{27}$$

Let us also consider the relative impulse response of current account and investment which from the above is just given by the ratio of the current account variance to the covariance with investment:

$$\chi = \frac{s_{11}}{s_{21}} = \frac{\omega_{11}}{\omega_{21}}$$

We now have expressed the persistence of country-specific shocks as an involved function of the adjustment coefficients $\boldsymbol{\alpha}$, the variance-covariance-structure of investment and the current account. However, we should rather think of ρ as the natural parameter and the impulse response and hence the covariance structure as an outcome of the economic structure. What we are particularly interested in is the change of the impulse response with respect to a change in persistence around $\rho = 1$.

The strategy we are going to pursue is as follows: we are going to reparameterize ρ and χ as functions of the correlation of current account and investment which is defined by

$$\phi = \frac{\omega_{21}}{\sqrt{\omega_{11}\omega_{22}}}$$

I.e., we are going to treat the adjustment parameters, $\boldsymbol{\alpha}$, and the conditional variances of investment and the current account, ω_{22} and ω_{11} respectively, as fixed. The correlation ϕ therefore contains the same information as ω_{21}. Using the implicit function theorem, we can then express $\partial\phi/\partial\rho$ at $\rho = 1$ and therefore also get a notion of the sensitivity of χ in a neighbourhood of $\rho = 1$. This is done in the mathematical appendix. Before we provide the results, however, let us briefly sharpen our intuition by considering what happens if $\rho = 1$. We can then solve (27) to find that

$$\phi = \pm 1 \tag{28}$$

This is an important first result: if and only if country-specific shocks are completely persistent, we should expect changes in the current account and investment to be perfectly correlated. This explains why Glick and Rogoff - like many other authors - find a robust negative correlation that is, however, significantly different from one. Complete persistence of country-specific shocks leads to singularity of the matrix Ω, which is another way of stating that investment and the current account have a 'common cycle'[1].

In the appendix, we derive the following expression for $\partial\phi/\partial\rho$ at $\rho = 1$:

$$\partial\phi/\partial\rho_{|\rho=1} = \left[1 - \frac{\alpha_2}{\alpha_1}\sqrt{\frac{\omega_{11}}{\omega_{22}}}\right]^2 \tag{29}$$

Plugging into $\chi = \frac{\sqrt{\omega_{11}}}{\phi\sqrt{\omega_{22}}}$and doing a Taylor expansion around $\phi = 1$, we find that

$$\chi(1 - \Delta\rho) = \sqrt{\frac{\omega_{11}}{\omega_{22}}} + \sqrt{\frac{\omega_{11}}{\omega_{22}}}\left[1 - \frac{\alpha_2}{\alpha_1}\sqrt{\frac{\omega_{11}}{\omega_{22}}}\right]^2 \Delta\rho \tag{30}$$

and obviously, we can approximate

$$\partial\chi/\partial\rho = \sqrt{\frac{\omega_{11}}{\omega_{22}}}\left[1 - \frac{\alpha_2}{\alpha_1}\sqrt{\frac{\omega_{11}}{\omega_{22}}}\right]^2$$

This is the second important result of this section: using the parameters of the reduced form, we can estimate, how sensitive the current-account and investment response would be to small changes in the persistence of country-specific shocks around $\rho = 1$ - keeping $(\boldsymbol{\alpha}, \Omega)$ fixed. This puts us in the position to empirically assess whether small departures from the assumption that country-specific TFP follows a random-walk can rationalize the findings of Glick and Rogoff.

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[1] This is just a dual way of phrasing the Feldstein-Horioka puzzle: if changes in the current account actually represent changes in investment then the covariance between savings and investment changes will be zero. In earlier work (Hoffmann (1998)), we have argued that correlations of appropriately detrended savings and investment data can take any value without assumptions on the structure of underlying shocks but that they are *per se* uninformative about capital mobility. The present paper can be interpreted as extending this argument to *changes* of savings and investment: if country-specific shocks are not permanent but persistent, investment-current account relations can be low without any implications for capital mobility. In theoretical terms, this insight has first been put forward by Obstfeld (1986, 1995).

3.4 Forecast performance and country-specificity

The essential message of the previous section was that small changes in persistence can have dramatic effects on the dynamic responses of investment and the current account.

In this section, we will argue that the forecast performance of VARs can be used to assess the validity of the intertemporal approach. This idea is not new. There is a developing but still small literature that tests the present value formula of the current account that is implied by the intertemporal approach (Sheffrin and Woo (1990), Gosh (1995)). The general flavour of the results is that VAR-forecasts based on a present value formula do a good job in tracking ups and downs in the current account (i.e. are highly correlated with observed current accounts). Yet. the volatility of the implied current account forecasts often differs markedly from the actually observed current account (for an illustration, see also the graphs in Obstfeld and Rogoff (1996), pp.93-95).

Let us now illustrate the procedure that is generally employed for current-account forecasts: first, a bivariate VAR is estimated, consisting of the real current account and a proxy of net output, NO_t:

$$\mathbf{B}(\mathbf{L})\mathbf{Z}_t = \varepsilon_t \text{ where } \mathbf{Z}_t = \begin{bmatrix} \Delta NO_t, & CA_t \end{bmatrix}'$$

Then, the VAR is used to forecast ΔNO_t. The current account, in a simple model with quadratic utility like the one laid out above, can be expressed as the present discounted value of expected changes in net output:

$$CA_t = -\sum_{l=1}^{\infty} R^{-l} E_t(\Delta NO_{t+l}) \tag{31}$$

The VAR forecasts of ΔNO_{t+l} can be used to approximate agent's expectations and an implied current account can be calculated from the VAR, once a plausible value for the interest rate is imposed.

In some cases this procedure works well, while in others, it does a very bad job. The theory, however, makes much stronger statements about which changes in net output should drive the current account: it tells us that if capital markets are sufficiently integrated, then global shocks should not impinge on the current account at all. Based on our reasoning in the previous section, it may be possible to improve forecasts of the current account by taking into consideration only those predictable changes in net-output that are driven by country-specific shocks. Hence, we can restrict our forecast of changes in net output to the component that is driven by country-specific shocks. If we have identified country-specific shocks well and if our theory is compatible with the data, we should be able to forecast the current account at least as well as if we chose the traditional approach.

Even though we have considered a model that contains investment instead of net output, we are going to use investment as proxy of net output: if agents expect higher net output, they will invest more and hence changes in investment should be highly correlated with changes in net output. As we will see, this notion is also empirically justified and in some cases, we are able to substantially improve over the naive (traditional) way of forecasting the current account.

4 Empirical results

4.1 Data and model specification

In the estimation of our model, we used the data given in the appendix of Taylor (1996): annual savings and investment rates for the G7-countries (Unites States, Japan, Germany, France, Italy, the United Kingdom and Canada) from 1960 to 1991. We then used the real GDP data in Gordon (1993) to convert the rates into levels.

In a first step, we estimated an unrestricted VAR in levels to determine the correct lag length of the VAR model. Hannan-Quinn-, Schwarz- and Akaike information criteria all suggested that one to two lags yielded an adequate representation for all of the countries. To allow for richer dynamics, we chose two lags for all models. We then performed tests for cointegration based on Johansen's (1988) procedure. In three cases we did not find cointegration: for the US, Canada and the UK, no cointegration could be detected, whereas for Japan cointegration was detected at the 90-percent significance level in the maximum eigenvalue test. However, our sample is quite short (31 observations) and the low power of unit-root tests in particular in small samples, is well known. Also, we have strong theoretical priors: a nation's intertemporal budget constraint will restrict its current account dynamics in the long run. We therefore decided to impose one cointegrating restriction in the estimation of all seven models.

For the United States, Germany and Japan we had difficulties in establishing that the current account is indeed stationary, rather, it seems that for those countries we have a non-trivial cointegrating relationship. However, it is difficult to conceive of a theoretically meaningful cointegrating relationship between the current account and investment. Rather, these results seem to suggest that there is an important variable missing. Figure 2 plots the cointegrating residuals for these three countries vis-a-vis the long-term interest rate differential with the United States. Upon visual inspection, the correlation is striking and it seems to suggest that the dynamics of the current account for these countries cannot be adequately modelled without taking account of the common factor represented by the interest rate differential.

For Japan, the US and Germany, we therefore set up a trivariate VAR with the interest rate differential vis-a-vis the US (vis-a-vis Germany for the US). We detected one cointegrating relationship in all three cases. We then tested for weak exogeneity of the interest rate differential. This also was accepted in all three cases. We can therefore return to our bivariate VAR of current account and investment as a conditional model, treating the interest rate differential as an exogenous variable. Indeed, now the hypothesis that $\boldsymbol{\beta}' = [1, 0]$ was accepted for both Japan and the United States. For Germany, the hypothesis still could not be accepted but a cointegrating vector of $[1, 1/2]$ seemed compatible with the data and we decided to model the German economy with this cointegrating vector imposed.

Also for Canada and the UK we decided to introduce conditioning variables: the oil price in the UK model and the Can\$/US\$ nominal exchange rate for the Candian model. This was done for reasons of forecast performance which will be discussed later in this section.

In tables 1 and 2 we report test results on our final model specifications, i.e. with the exogenous regressors included. For Japan and Germany, we now find cointegration at high significance levels and also the theoretical value of $\beta' = [1, 0]$ is not rejected in tests on the cointegrating space, except in the German case.

Recent work by Harbo et al. (1998) has established that the distributions of tests for cointegrating rank in partial systems can be substantially altered vis-a-vis the standard distributions that arise when the partial system is treated as if it was a full system. Hence, our systems should be regarded as two-dimensional subsystems of three-dimensional systems where one variable does not react to the equilibrium error. Using the results from table 3 in Harbo et al. (1998) in our table 1 we now also accept cointegration for both the UK and Canada.

4.2 Persistence and country-specificity

In Table 3 we give the estimates of the matrix $\mathbf{Q}$ for all countries. Note that there is nothing to prevent empirical estimates of ρ from becoming negative. The sign of ρ is without importance in our context, however and that is why we report values of ρ^2. This gives us the added benefit that ρ^2 can be interpreted as the share of permanent shocks in the variability of the country-specific shocks.

On average, global shocks seem to be primarily permanent whereas country-specific shocks are not very persistent. There are however, a few exceptions: For Japan, 38 percent of the variability in the country-specific shock seems to be explained by permanent influences. For Germany, the country-specific shock seems highly persistent as well, 86 percent of its variance are explained by permanent influences.

One clear result stands out, however: country-specific shocks are neither fully permanent nor completely transitory. On average, 23 percent of the variance of country-specific shocks is explained by permanent influences. Theoretical models, in which country-specific TFP follows either a random walk or is just a mean-reverting process are therefore likely to give misleading results.

We showed earlier that the persistence of country-specific shocks is also going to influence the immediate response of investment and the current account. In table 4 we give our estimates of the Choleski-factor $\mathbf{S}$ of the reduced form covariance matrix Ω. The result is striking; by and large, the Glick-Rogoff puzzle disappears: for most countries, the current account response is $1-2$ times stronger than the investment response. Also, in all cases, their signs are opposite. There, are two exceptions: the United States, where the puzzle persists and investment still reacts twice as strong as the current account and Italy where the ratio is slightly smaller than unity. For the UK, it is roughly equal to one. The results all share a common feature of SVAR impulse responses: the standard errors are very large. Nonetheless, it is an encouraging result that the point estimates are in the range predicted by the theory. Also, calculating the average of the ratio s_{11}/s_{21} across all countries is we get a value of -1.23, clearly in the range predicted by the theory.

On the other hand, we can also take a counterfactual look at the implied response if country-specific shocks were completely permanent. This is given by $\chi(1) = -\omega_{11}/\omega_{22}$. Table 5 compares the Glick and Rogoff responses with the responses implied by our model at $\rho = 1$. Conversely, it also provides the implied persistence of the Glick and Rogoff response in terms of our model, which is given by $1 - \Delta\rho$, where $\Delta\rho$ can be calculated from the Taylor-approximation in (30). At first sight it seems that small departures from the random-walk assumption can account for the impulse responses found by Glick and Rogoff: on average our estimate of the implied ρ equals 0.95, very close to the 0.97 average autocorrelation coefficient in the original study. However, the estimated sensitivities are generally fairly low, so even though $\chi(1)$ is generally bigger in absolute value than the GR-estimate, assuming $\rho = 1$ only goes a small way towards bringing the impulse response into the range predicted by the theory. The average $\chi(1)$ - not including Canada - is -0.63. For Germany we find a rather high sensitivity and here the Glick-Rogoff approach goes furthest towards explaining the puzzle. Also for France, half of the difference between the GR-impulse response and unity can be bridged by letting ρ go to unity. For Canada we find a sensitivity close to zero which suggests that $\alpha_2/\alpha_1 \approx \sqrt{\omega_{22}/\omega_{11}}$, an unusual parameter constellation for which we do not have an interpretation, yielding nonsensical results for the implied persistence. Overall, the results suggest that excess sensitivity cannot account for the observed impulse responses.

Conversely, does the apparent resolution of the GR-puzzle showing up in table 4 have anything to do with the permanence of shocks at all? Note that the theory restricts the current account to be more sensitive to country-specific shocks only to the degree that they do have permanent effects. If the current account 'overshoots' investment even if shocks do not have a permanent effect, then table 4 would be meaningless. Also this issue can be addressed, now be letting ρ go to zero. Then, from (27) above we get

$$\frac{s_{11}}{s_{12}} = \frac{\alpha_1}{\alpha_2}$$

This ratio of the adjustment coefficients gives us the 'shadow' impulse response of the current account and investment if country-specific shocks are completely transitory. Our estimates of α_1/α_2 are given in table (6): the results are encouraging - with the exception of the United States, the implied response is now still negative but smaller than unity in absolute value, in the case of Canada even positive. This verifies that it is indeed the fact that country-specific shocks have permanent components that leads the current account to react more sensitively than investment.

Putting things together, we find that near random-walk behaviour of country-specific shocks cannot account for the Glick and Rogoff puzzle when a model is used that restricts the data less strongly than the Glick and Rogoff model. Rather, by focussing on a reduced-form cointegrated VAR, we could show that the current account is actually more sensitive to country-specific shocks than is investment and that this result is in fact due to permanent components in country-specific shocks - as is predicted by the theory. We conclude, in the spirit of Quah (1990), that the GR-puzzle is likely to come about because estimated responses are an amalgam of responses to transitory and permanent shocks. We draw a conclusion similar to Quah's: univariate time series properties (i.e. the fact that TFP seems well described by a random-walk in a univariate context) should not be used as a basis for economic theorizing if the economic theory of interest involves several variables. We have proposed to focus on a few reduced-form implications of the theory and then to assess time-series properties in a dynamic system-framework. In the next subsection we will deal with the dynamic implications of the theory: impulse responses and the forecast performance of our models.

4.3 Dynamic Responses

The dynamic responses of the model are in line with what one would expect from the theory: Figures 3 to 8 provide plots of the dynamic response of the model for the G3 countries. The current account and investment react in different directions with respect to a country-specific shock. Both investment and the current account reach their permanent value after roughly five years. In the case of the U.S. and Japan, this means that the current account reverts to zero, which is an outcome of the cointegrating relationship in the model. As, in the estimation of the model for Germany, we have imposed a non-trivial cointegrating relationship between investment and the current account, there is no need in this model for the current account to revert to zero. Indeed, in the German case, country-specific shocks do have a pronounced permanent effect on the current account.

The response of the current account to global shocks is much less pronounced than to country-specific shocks. In the US case, the point estimate of the response is on average smaller than the response to the country-specific disturbance by a factor of ten. Similar results, even though with somewhat smaller factors, ensue for the other countries. It seems, that the imposition that the current account's period zero response to a global shock is zero is compatible with the data. In all three countries, however, the global shock has a noticeable impact on the permanent value of investment.

For Japan and the U.S. the responses to permanent and transitory shocks are largely unspectacular. The permanent shock has a sizeable impact on investment whereas the long-run response is zero for the current account. Only in the German case, the long-run response of the current account is roughly half of the investment response. To the degree that we believe that the cointegrating relationship between current account and investment reflects economic structure, this result tells us that permanent shocks in Germany (which over the sample period proved to be largely idiosyncratic), have huge leakage effects: the shock triggers increased investment but it also increases capital exports and hence leads to accelerated accumulation of foreign assets. Another notion is the one of export-led growth that is often referred to in the discussion about Germany's postwar economic development (see e.g. Marin (1992)). We checked whether we could accept that the current account is weakly exogenous with respect to the parameters of investment. Indeed, this hypothesis could not be rejected. In effect this means that for Germany, innovations to the current account seem to represent permanent, country-specific shocks.

4.4 Forecast performance

Figures 7-12 display the results of a forecasting exercise. It is based on the following present value formula:

$$CA_t^p = -\sum_{l=1}^{\infty} R^{-l} \Delta I_{t+i|t}^c \tag{32}$$

where $\Delta I_{t+i|t}^c$ represents the time t forecast of those changes in investment in time $t+i$ that are explained by country-specific shocks. Usually, in intertemporal optimization models, the current account is represented as the discounted sum of changes in net output, $NO_t = Y_t - C_t - G_t$ where G_t is government consumption. We deviate from this representation in this case and use investment as a proxy of net output. This allows us to stay in the framework of the econometric model we have used from the outset. As we will see, it seems a valid approach. The forecast performance of our model is very good and there is also a good rationale of why investment should be a good proxy of net output: models of balanced growth suggest that the great ratios, i.e. investment over output and consumption over output are stationary. Hence, changes in investment should be highly correlated with changes in output and we should not be too surprised to see the former predict the latter well.

In our VAR model, the predicted country-specific component of investment is given by

$$\Delta I^{c}_{t+i|t} = \left[\begin{array}{cc} 1, & 0 \end{array}\right] \sum\nolimits_{l=i}^{\infty} C_l S \left[\begin{array}{c} e^{c}_{t-(l-i)} \\ 0 \end{array}\right] \tag{33}$$

The values of $\Delta I^{c}_{t+i|t}$ are gained from this formula and then plugged into the above present-value relation in order to get CA^{p}_{t}. In figures 9-15, CA^{p}_{t} is then plotted together with the actual current account.

Overall, our models do a good job in tracking the current account dynamics. But also the order of magnitude of the swings in the current account is captured well in most cases. Even notoriously 'difficult' cases like Germany and the United States can be explained well by our models. The fit for France and Italy and also for Canada is very good. For Japan - based on a visual inspection of the plots - we get the ups and downs right but the variance is not quite precisely estimated. The UK remains the difficult case it usually is in the current account literature, the current account that is predicted by country-specific shocks alone is essentially flat. However,we calculated a correlation between the forecast and the observed current account of roughly 0.82, quite high vis-a-vis other studies (Gosh (1995) finds a correlation of 0.7 for the period 1960-88). Note that this result has been obtained by conditioning on the price of oil which does not figure in the models in the literature. As the country is a big oil exporter, its current account is likely to reflect the swings in the price of oil. To the degree that we consider oil price changes as global shocks, one would expect the British current account indeed to be better explained by global shocks rather than country-specific ones. Figure 16 shows the forecast of the current account, this time based on global rather than country-specific changes in investment. The forecast is certainly not good, but it is probably closer to the observed current account in terms of volatility than the forecast based on country-specific shocks.

Overall, the forecast performance of our models compares very well with that of earlier 'naive' approaches that do not take into account the distinction between country-specific and global shocks. In some difficult cases like Germany and the US, our forecast is even much better. Even though it should be noted however, that we also obtained these improvements through conditioning on a set of exogenous variables, the models seem to fulfill the restriction imposed by economic theory, namely that only country-specific shocks drive the current account.

4.5 How country-specific are country-specific shocks?

Our discussion in the previous subsections documents a very good match between the theory and the data. However, we should recall that our identification procedure for country-specific shocks relied on the theory itself. We assumed that global shocks do not affect the current account in period zero. Certainly, this theoretical presumption is also backed by the results of Glick and Rogoff. Nonetheless, it would be nice to have an evaluation to know if we have really identified the right shocks. There is clearly no way in which we can evaluate a just-identifying assumption within each individual model. However, we have valuable information in the cross-section of countries we are investigating. The G7 countries account for two thirds of world output and they represent a fairly closed bloc in the world economy. It therefore seems reasonable to take these countries as a proxy of the 'rest of the world'. Country-specific shocks should then be uncorrelated across countries whereas we should find some correlation between the global shocks identified at the country level.

Table 7 gives the average correlation of each country's specific and global shocks with all other 6 countries. It also provides the standard errors of these correlations. The result is very encouraging: not only are global shocks much more highly correlated across countries than country-specific shocks, their correlation is also highly significant. On the other hand, country-specific shocks are on average not significantly correlated. The only exception is Canada, where both country-specific shocks and global shocks are on average significantly correlated with shocks in the rest of the world. Still, these results should provide some confidence that by and large we have indeed identified the right shocks.

5 Conclusion

The intertemporal approach to the current account is becoming increasingly standard in international macroeconomics. This theory makes very strong predictions about shocks that can be classified according to two criteria: persistence and country-specificity. The current account is supposed to respond only to the persistent but transitory component of shocks and this only to the degree that they are country-specific.

Little work has been done so far on classifying shocks along these lines and testing the predictions of the theory. The seminal paper by Glick and Rogoff (1995) is an exception. Whereas the structural estimation approach adopted by Glick and Rogoff allows us to understand in detail in which way the implied responses of investment and the current account depend on the persistence of country-specific shocks, the estimation itself relies on univariate evidence about the time-series properties of shocks, leading to estimates in which the relative sensitivity of the current-account and investment are at odds with the theory.

In this paper, we reverted to the more black-box approach of a structural VAR. Whereas this forces us to sacrifice some model structure, it puts us in a position to classify shocks to the current account and investment according to their persistence by exploiting cointegration information in the data. We identified country-specific shocks using the suggestions of the theory and the empirical results of Glick and Rogoff: global shocks do not have an effect on the current account. It then becomes possible to measure the persistence of country-specific shocks. We also derived a reduced-form analogue to the Glick-Rogoff result that the relative response of current account and investment is highly sensitive with respect to the persistence of country-specific shocks. In our estimates the puzzle encountered by Glick and Rogoff, i.e. that the relative response of investment vis-a-vis the current account is 2-4 times too strong, vanishes. As our results show the GR-puzzle is likely to have arisen because country-specific shocks have both important permanent and transitory components and therefore the impulse responses by Glick and Rogoff are likely to reflect an amalgam of responses to permanent and transitory shocks. Our conclusion is that it is not possible to disentangle these permanent and transitory components unless the data are allowed to speak loudly and only some key restrictions are imposed from economic theory on the reduced form. In a more theoretical context, Quah (1990) has proposed the mechanism put forward in this paper as an explanation of the apparently excessively smooth behaviour of consumption vis-a-vis other macroeconomic aggregates, in particular output. Only if all shocks are permanent should consumption move one to one with permanent income. However, if economic agents distinguish between permanent and transitory shocks, consumption will on average be much smoother than output.

In this paper, we empirically explore the open-economy analogue of the excess-smoothness puzzle: if country-specific shocks have permanent and transitory components then the current account can be extremely sensitive to permanent shocks while at the same time being imperfectly correlated with investment.

Finally, we have exploited our approach to forecast the current account based only on the country-specific shocks. The forecast performance compares very well with models that are less restricted than ours. This provides evidence that the current account is indeed driven mainly by country-specific shocks. Even in the case of the United Kingdom we can gain some ground. Using investment as a proxy of net output and conditioning on oil prices, we can not only achieve a high correlation between the actual and the forecasted current account but also emulate the actual current account variance.

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6 Mathematical Appendix

We can rearrange (27) to yield

$$\rho^2\left(\alpha_2^2\omega_{11}+\alpha_1^2\omega_{22}\right)-\alpha_2^2\omega_{11}=\left(\rho^2-1\right)2\alpha_1\alpha_2\phi\sqrt{\omega_{11}\omega_{22}}+\alpha_1^2\phi\omega_{22} \quad (34)$$

For simplicity, we redefine

$$A=\left(\alpha_2^2\omega_{11}+\alpha_1^2\omega_{22}\right) \quad (35)$$

$$B=2\alpha_1\alpha_2\sqrt{\omega_{11}\omega_{22}} \quad (36)$$

$$C_1=\alpha_2^2\omega_{11} \quad (37)$$

$$C_2=\alpha_1^2\omega_{22} \quad (38)$$

Substituting and rearranging, we get

$$G(\rho)=\rho^2 \text{ and } F(\phi)=\frac{C_1-\phi B+C_2\phi^2}{A-\phi B}$$

and

$$G(\rho)-F(\phi)=0 \quad (39)$$

By the implicit function theorem

$$\frac{\partial \phi}{\partial \rho}=\frac{2\rho(A-\phi B)^2}{(2C_2\phi-B)(A-\phi B)+B(C_1-\phi B+C_2\phi^2)} \tag{40}$$

Letting $\rho = 1$ implies $\phi = \pm 1$ and hence, exploiting $A - B = (C_1 - B + C_2)$, we get the result

$$\frac{\partial \phi}{\partial \rho}_{|\rho=1}=\pm\frac{(A\mp B)}{C_2}=\left[1\mp\frac{\alpha_2}{\alpha_1}\sqrt{\frac{\omega_{11}}{\omega_{22}}}\right]^2$$

The economically relevant case is $\phi = -1$, (investment and the current account are negatively correlated). So we get

$$\frac{\partial \phi}{\partial \rho}_{|\rho=1}=\frac{-(A+B)}{C_2}=\left[1+\frac{\alpha_2}{\alpha_1}\sqrt{\frac{\omega_{11}}{\omega_{22}}}\right]^2$$

7 Tables and Figures

Table 1: Tests for cointegration

a) Johansen Trace statistic

	US	Japan	Germany	France	Italy	UK	Canada	90%	95%
$h = 0$	25.4	25.06	20.78	19.58	19.57	14.29	13.82	15.58	17.84
$h = 1$	4.85	0.02	0.12	2.84	1.137	2.13	3.07	6.69	8.08

b) Johansen Maximum Eigenvalue statistic

	US	Japan	Germany	France	Italy	UK	Canada	90%	95%
$h = 0$	20.55	25.04	20.66	16.73	18.43	12.16	10.74	12.78	14.6
$h = 1$	4.85	0.02	0.12	2.84	1.137	2.13	3.07	6.69	8.08

The tests were performed on VAR(2)-models with an unrestricted constant.
The models for the US, Japan, Germany, the UK and Canada.
included one weakly exogenous regressor. Critical values for the trace test,
following table 3 in Harbo et. al. in this case are 10.4 (12.3) at 90 (95)%.

Table 2: Estimates of the cointegrating vector

Estimate of $\beta = \left[\begin{array}{cc} 1 & \beta_2 \end{array}\right]$ and test of $H_0 : \beta_2 = 0$

	US	Japan	Germany	France	Italy	UK	Canada
β_2	-0.2535	0.0174	**-0.619**	-0.002278	-0.005234	0.1728	0.0883
LR-test	1.91	0.2482	12.8	0.005503	0.0113	1.04	2.27
P-value	0.17	0.62	0.0003	0.94	0.92	0.6922	0.13

Table 3: persistence of country-specific shocks

	US	Japan	Germany	France	Italy	UK	Canada	Average
ρ^2	0.1702	0.3827	0.8656	0.1025	0.0474	0.0454	0.0329	0.2352

Table 4: Estimates of the Choleski factors

Coefficients	US	Japan	Germany	France	Italy	UK	Canada	Averag
s_{11}	15.4	1.66	12.18	27.06	7.716	3.64	3.50	-
s_{21}	-30.15	-1.01	-6.65	-21.03	-8.906	-3.55	-2.36	-
s_{22}	42.25	2.86	14.19	38.95	6.318	3.81	4.53	-
s_{11}/s_{21}	-0.51	-1.64	-1.83	-1.29	-0.87	-1.03	-1.48	-1.23

Table 5: GR-responses and their implied persistence

	US	Japan	Germany	France	Italy	UK	Canada	Avg.
G&R	-0.27	-0.30	-0.42	-0.27	-0.5	-1.02	-0.48	-0.46
$\chi(1)$	-0.30	-0.54	-0.77	-0.61	-0.70	-0.69	-0.76	-0.62
implied ρ	0.95	0.89	0.96	0.82	0.92	1.13	2392	0.95$^{*)}$
$\partial\chi(1)/\partial\rho$	0.44	2.35	10.77	1.92	2.67	2.36	0.0001	3.42$^{*)}$

$^{*)}$ not including Canada

Table 6: Implied response at $\rho = 0$.

	US	Japan	Germany	France	Italy	UK	Canada	Average
α_1/α_2	-1.4	-0.50	-0.28	-0.79	-0.74	-0.83	0.75	-0.54

Table 7: Cross-country correlations of structural shocks

a) country-specific shocks (e^c)

	US	Japan	Germany	France	Italy	UK	Canada
avg. correlation	0.00	0.11	-0.04	0.08	0.13	0.02	**-0.16**
standard dev.	0.02	0.07	0.04	0.09	0.07	0.02	0.03

b) global shocks (e^w)

	US	Japan	Germany	France	Italy	UK	Canada
avg. correlation	**0.21**	**0.28**	**0.21**	**0.35**	**0.20**	**0.28**	**0.16**
standard dev.	0.03	0.04	0.03	0.01	0.04	0.009	0.06

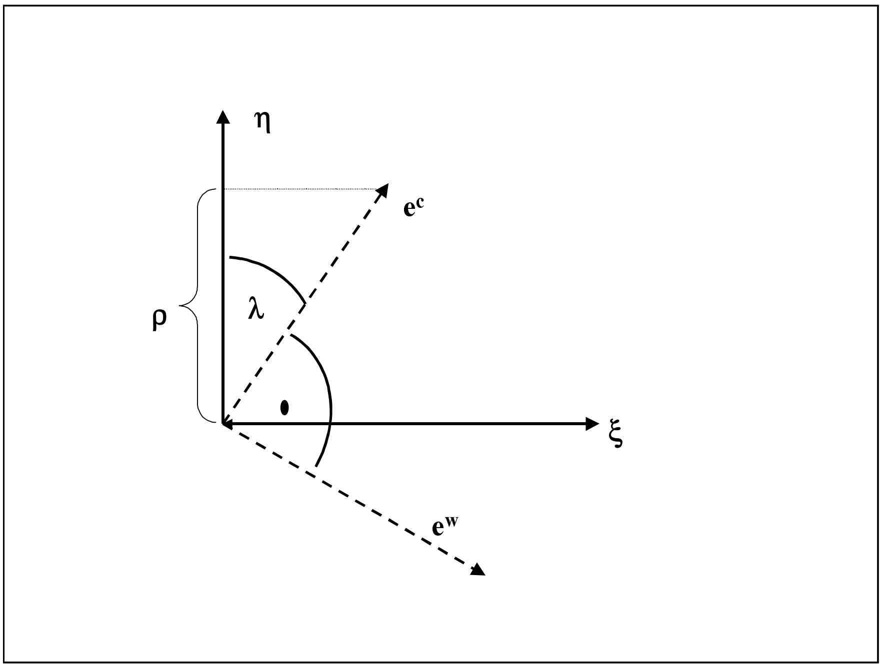

Figure 1: The geometry of global and country-specific shocks

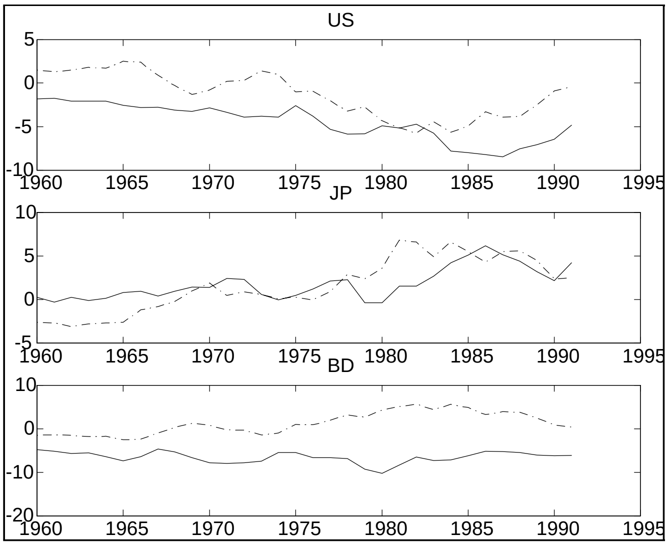

Figure 2: G 3 - interest rate differential (dashed) vs. cointegrating residuals.

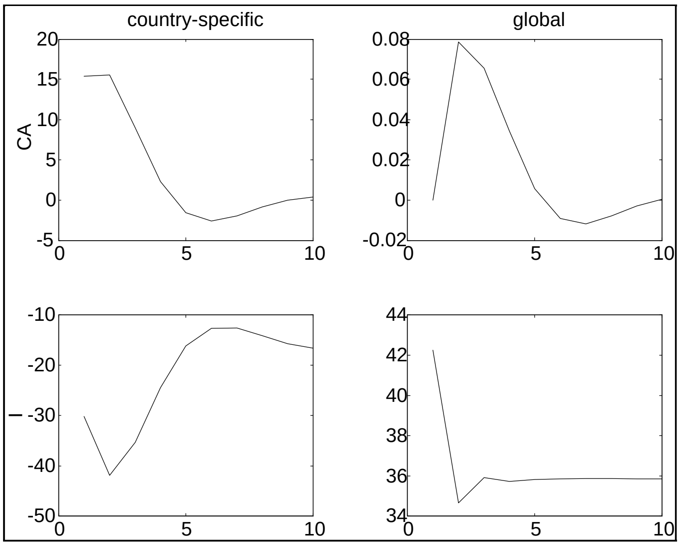

Figure 3: US - impulse responses by country_specificity

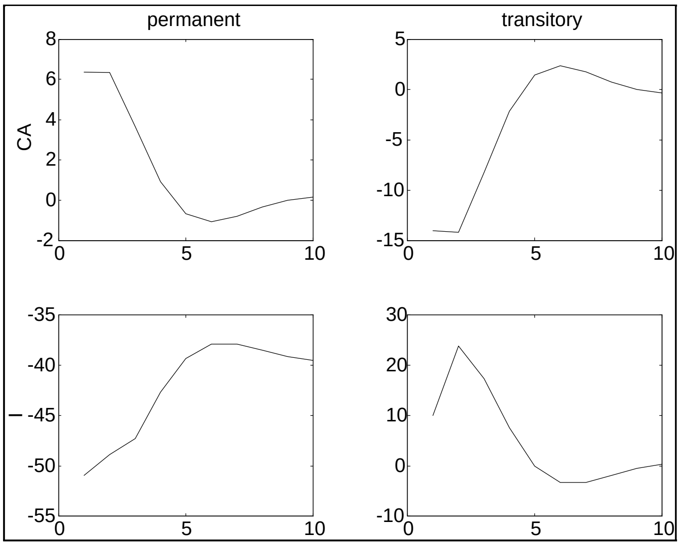

Figure 4: US - impulse responses by persistence

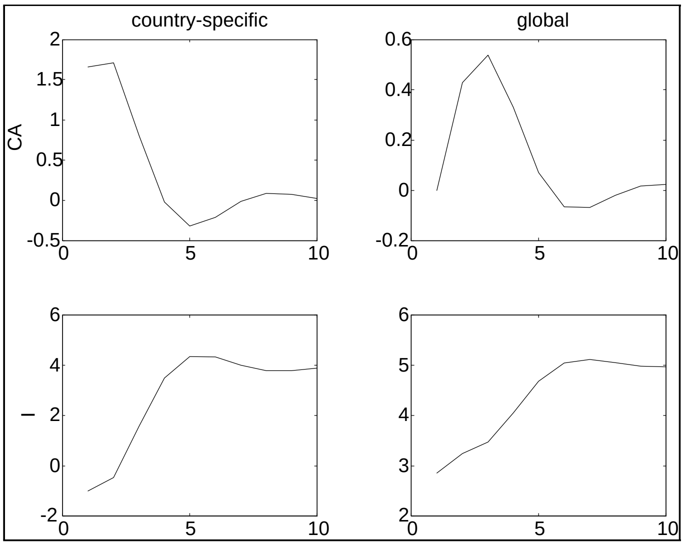

Figure 5: Japan - impulse responses by country -specificity

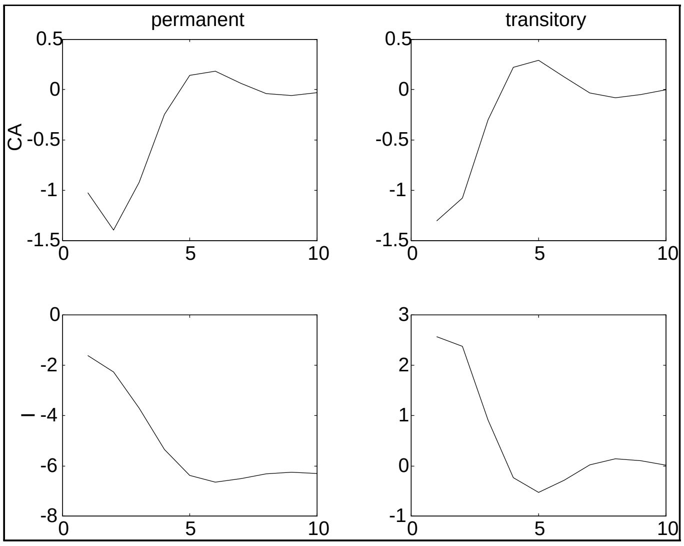

Figure 6: Japan - impulse responses by persistence

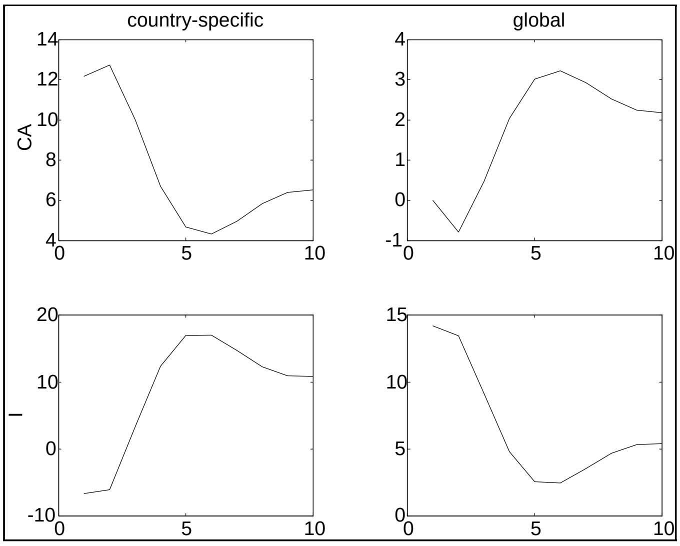

Figure 7: Germany - impulse responses by country-specificity

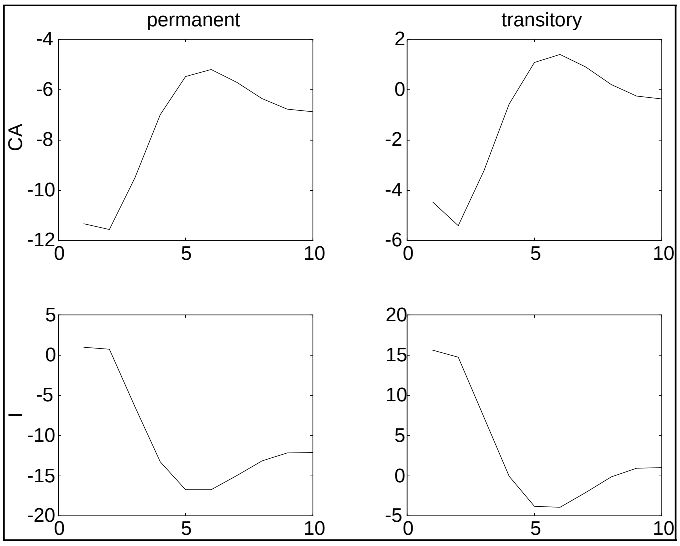

Figure 8: Germany - impulse response by persistence

Figure 9: Actual and forecasted (dashed line) US current account

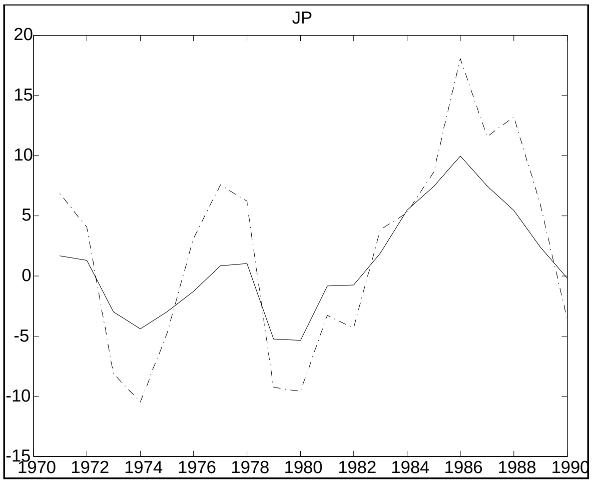

Figure 10: Actual and forecasted (dashed line) Japanese current account

Figure 11: Actual and forecasted (dashed line) German current account

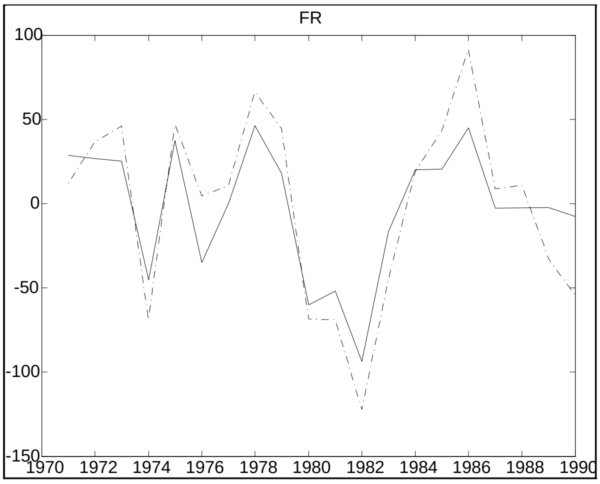

Figure 12: Actual and forecasted (dashed line) French current account

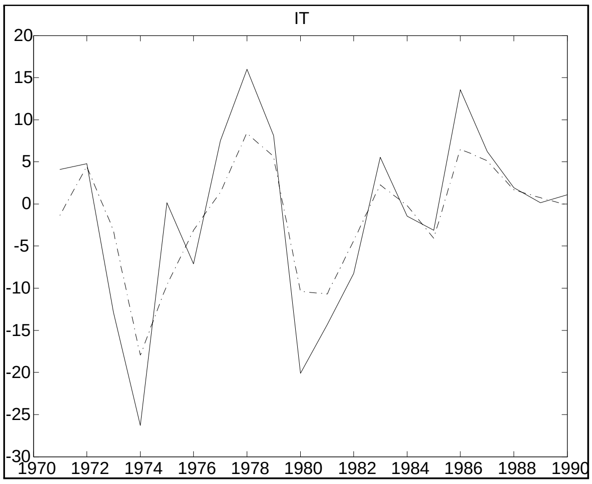

Figure 13: Actual and forecasted (dashed line) Italian current account

Figure 14: Actual and forecasted (dashed line) UK current account

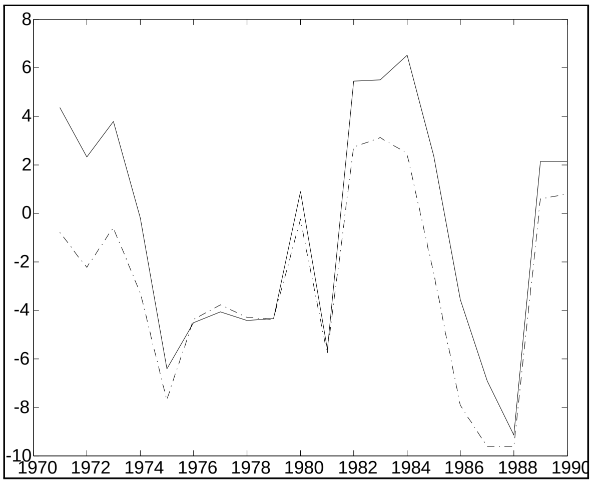

Figure 15: Actual and forecasted (dashed line) Canadian current account

Figure 16: forecast of the UK current account based on both country-specific and global shocks