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Consumption smoothing channels in open economies ☆

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ABSTRACT

Many intertemporal open economy macro models imply a theory of consumption smoothing channels; thus we build an empirical model to analyze the intertemporal smoothing role of saving components (fixed investments, inventories and trade balance) through the use of VAR impulse responses to different types of shocks. We find that for the OECD countries the bulk of intertemporal smoothing has been carried out domestically, via gross fixed investments and inventories, but the trade balance has also played a relevant – albeit volatile – smoothing role. We also characterize the dynamic behavior of each component: the trade balance and inventories are mostly used as short-run smoothing tools while fixed investment provides more and more smoothing over time. We can also address some empirical puzzles, such as the "excess sensitivity of investment" anomaly (Glick, R., Rogoff, K., 1995. Global versus country-specific productivity shocks and the current account. Journal of Monetary Economics, 35, 159–192) and the "saving-investment correlation puzzle" (Feldstein, M., Horioka, C., 1980. Domestic saving and international capital flows. Economic Journal, 90, 314–329).

1. Introduction

Modern open economy macroeconomics is based on intertemporal optimization, and in particular on the consumption smoothing condition imposed by the Euler equation. Yet not many empirical models in the field focus on the properties of consumption smoothing. This paper aims to set up a framework that analyzes the empirical implications of the open economy literature from the viewpoint of consumption smoothing channels. We impose minimal identifying restrictions on a vector auto-regression (VAR) model, and analyze smoothing channels in open economies jointly, through its estimated impulse responses.

The econometric model we set up, and particularly the VAR specification of income and saving components, buffeted with various structural shocks, generalizes and deepens previous models, both in the smoothing channels and in the intertemporal current account literature.

As for the former, our framework draws inspiration from such papers as Asdrubali et al. (1996) and Asdrubali and Kim (2008a,b), who assess the overall degree of intertemporal smoothing among US states and OECD countries. These studies do not consider the role of investments and net exports, and use an unconditional static formulation of smoothing channels, where all lagged coefficients are set to zero and interactions among smoothing channels and endogeneity of income from channels are not allowed (as in Sørensen and Yosha, 1998). We explicitly consider the role of investment and net exports; in addition, following Asdrubali and Kim (2004), we set up a dynamic model that incorporates interactions among income and smoothing channels. We improve upon the existing consumption smoothing channels literature also by using quarterly data. This allows us to assess finer dynamic properties of smoothing channels at the business cycle frequency, providing a better connection with business cycle studies; but it also allows us to explore the evolution of intertemporal smoothing channels in various sub-periods without incurring in the efficiency loss inherent in a yearly estimation.

As for our contribution to the intertemporal approach to the current account, Glick and Rogoff (1995) can be regarded as a special case of our model with fewer lags and fewer variables, which does not consider the interactions among various components of saving and income, while Sheffrin and Woo (1990) and Ghosh (1995) concentrate only on the unconditional current account behavior, in the sense that they do not separate various structural shocks.

We find that our "smoothing approach" is quite fruitful, in the sense that all the saving channels we consider play a relevant stabilizing role in response to income shocks: the bulk of intertemporal smoothing is carried out domestically – through gross fixed investments, inventories, and government expenses – but the trade

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balance also plays a relevant smoothing role. In addition, we find that the dynamic behavior of each component is quite diverse; the trade balance and inventories are mostly used as short-run smoothing tools, while fixed investments (and possibly government expenditures) provide more and more smoothing over time. In addition, long run smoothing in the 90s is higher than in the 80s, due to the trade balance effect. Finally, since our framework can accommodate various models of the current account, we document empirically relevant mechanisms underlying the "excess sensitivity of investment" anomaly (Glick and Rogoff, 1995) – which turns out to be linked primarily to saving behavior – and the "saving-investment puzzle" (Feldstein and Horioka, 1980) – which seems to emerge after a productivity shock, and to disappear when the investment change is exogenous.

The analysis proceeds as follows. Section 2 presents the econometric method for the consumption smoothing channels' decomposition. Section 3 documents the empirical results based on the impulse responses of various smoothing channels to various sources of shocks. Section 4 presents results from extended exercises. Section 5 concludes with the summary of results.

2. Econometric model

Considering country-specific variables – that is, variables expressed in deviation from their aggregate – and defining private income $Z \doteqdot Y - G$, gross domestic saving can be defined as follows:

$$S \equiv Z - C, \tag{1}$$

where Y is Gross Domestic Product, C is Private Consumption and G Government Consumption Expenditures; S is Gross Domestic Saving, composed of Household Saving (S^H), Firms Saving (S^F) and Government Saving (S^G). Then, the national accounts identity for an open economy implies:

$$S \equiv I^f + I^s + TB, \tag{2}$$

where I^f are Gross Fixed Investments, I^s stands for the change in Stock Investment, and TB, the trade balance, is defined as the difference between Exports (EX) and Imports (IM).

Given that consumption is smoother than private income Z, the responses of saving components will smooth consumption following changes in private income. In order to gauge such responses, we can plug (2) into (1) at time t, and manipulate it by taking first differences and dividing through by ΔZ_t, to obtain:

$$\frac{\Delta I_t^f}{\Delta Z_t} + \frac{\Delta I_t^s}{\Delta Z_t} + \frac{\Delta TB_t}{\Delta Z_t} + \frac{\Delta C_t}{\Delta Z_t} = 1 \tag{3}$$

or, with obvious definitions:

$$\beta_F^l + \beta_S^l + \beta_{TB}^l + \beta_C^l = 1 \tag{4}$$

for each time horizon l. The marginal propensities on the LHS can be interpreted as the (country-specific) responses of fixed and inventory investments, net exports and consumption to a change in (country-specific) private output. The interest of (3) lies in the exact decomposition of responses to private income changes: the change in Z_t that is not reflected in consumption must be absorbed by the saving components.

Recalling that we measure variables in deviation from the aggregate, the fractions could be estimated as the slope coefficients in the regressions

$$\Delta I_t^f = \beta_F \Delta Z_t + \varepsilon_t^i, \tag{5}$$

$$\Delta I_t^s = \beta_S \Delta Z_t + u_t^i, \tag{6}$$

$$\Delta TB_t = \beta_{TB} \Delta Z_t + v_t^i, \tag{7}$$

$$\Delta C_t = \beta_C \Delta Z_t + \eta_t^i. \tag{8}$$

A specification like (5)–(8), even when estimated through a SUR system (as in Sørensen and Yosha, 1998) suffers from at least three shortcomings: (a) it does not control for the endogeneity of private income; (b) it cannot distinguish between different kinds of shocks; and (c) it completely ignores dynamics. To implement a metric for intertemporal smoothing, we devise a method of estimating the β coefficients more precisely than with unrelated static simple regressions. To that purpose, we adopt the following VAR model.

$$\begin{bmatrix} a_{11}^0 & 0 & 0 & 0 \\ a_{21}^0 & a_{22}^0 & 0 & 0 \\ a_{31}^0 & a_{32}^0 & a_{33}^0 & 0 \\ a_{41}^0 & a_{42}^0 & a_{43}^0 & a_{44}^0 \end{bmatrix} \begin{bmatrix} \Delta Z_t \\ \Delta I_t^f \\ \Delta I_t^s \\ \Delta TB_t \end{bmatrix} = \sum_{l=1}^{p} A^l \begin{bmatrix} \Delta Z_{t-1} \\ \Delta I_{t-1}^f \\ \Delta I_{t-1}^s \\ \Delta TB_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{Z,t}^i \\ \varepsilon_{F,t}^i \\ \varepsilon_{S,t}^i \\ \varepsilon_{TB,t}^i \end{bmatrix}, \tag{9}$$

where A^l is a 4×4 matrix, $\varepsilon_{Z,t}^i$ is a shock to private GDP, $\varepsilon_{F,t}^i$ is a shock to gross fixed investment, $\varepsilon_{S,t}^i$ is a shock to inventories, and $\varepsilon_{TB,t}^i$ is a shock to the trade balance. Note that the consumption dynamics can be obtained by using the national income identity, that is, $\Delta C_t = \Delta Z_t - \Delta I_t^f - \Delta I_t^s - \Delta TB_t$. This VAR model has a recursive structure: ΔZ_t is assumed to be contemporaneously exogenous to the other three variables, ΔI_t^f is contemporaneously exogenous to ΔI_t^s and ΔTB_t, ΔI_t^s is contemporaneously exogenous to ΔTB_t. This follows the accounting logic of national accounts which has been adopted in the literature on channels of risksharing, for example Sørensen and Yosha (1998) and Asdrubali and Kim (2004). ΔZ_t is assumed to be contemporaneously exogenous to all other variables since value added is a primary measure of income before borrowing and lending decisions take place; in fact, investment decisions can be modeled as depending on income via the productivity channel (Glick and Rogoff, 1995; Gregory and Head, 1999; Backus et al., 1992). Then, investment is assumed to be contemporaneously exogenous to the trade balance, since investment decisions typically do not depend on consumption or lending and borrowing decisions in the small open economy modelization, whether along the lines of the intertemporal approach to the current account (Glick and Rogoff, 1995; Nason and Rogers, 2002) or along the lines of DSGE models (i.e., the small open economy model with fixed labor input in Baxter and Crucini, 1993 and Baxter, 1995). Also note that as long as private income is assumed to be contemporaneously exogenous to the other variables, the ordering does not affect the responses to private income shocks, which are the main focus of our paper.

By expressing the system (9) in a moving average form, we obtain:

$$\begin{bmatrix} \Delta Z_t \\ \Delta I_t^f \\ \Delta I_t^s \\ \Delta TB_t \end{bmatrix} = \sum_{l=0}^{\infty} B^l \begin{bmatrix} \varepsilon_{Z,t}^i \\ \varepsilon_{F,t}^i \\ \varepsilon_{S,t}^i \\ \varepsilon_{TB,t}^i \end{bmatrix}, \tag{10}$$

where B^l is a 4×4 matrix and B^0 is a lower triangular matrix. The moving average representation (or impulse responses) shows how each variable responds to a shock over time; for example, B_{jk}^l (which is the jth row and the kth column of B^l) shows the effect of the kth shock in the system on the jth variable in the lth period after the shock. From the impulse responses to shocks to private income, $\varepsilon_{Z,t}^i$, we can infer the intertemporal smoothing role of savings components. Note that we can apply the decomposition in (3) to the responses to shocks to private income since such shocks would generate exogenous changes in private income in our VAR model. The relative responses of $\Delta I_t^f, \Delta I_t^s, \Delta TB_t$ and ΔC_t to ΔZ_t would show how saving components stabilize consumption in response to shocks to private income. For each time horizon l, we apply the decomposition in the following way:

$$1 = \beta_F^l + \beta_S^l + \beta_{TB}^l + \beta_C^l, \tag{11}$$