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THE CURRENT ACCOUNT AND THE NEW RULE IN A NOT-SO-SMALL OPEN ECONOMY

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This paper provides an extension of the new rule for the current account [Kraay and Ventura (2000)], abandoning the small open economy assumption: the response of transitory income shocks on the current account is equal to the new rule (savings generated by the shock multiplied by the domestic holdings of foreign assets over total domestic assets) plus the saving generated by the shock in the foreign economy multiplied by the foreign country's share of domestic capital in foreign total assets. The extended new rule provides a good description for the behavior of current accounts, and is even better than the new rule, which would be rejected by recent evidence.

Keywords: Current account, intertemporal approach, traditional rule, new rule.

(*JEL* F41, F43)

1. Introduction

International financial integration has accelerated enormously in recent years, which has implied a tremendous change in the magnitude of cross-border holdings of assets and liabilities. For example, while in the period 1970-1995 only 3.4% of the domestic capital in the USA

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was owned, on average, by foreign investors, in the recent period 1996-2004 this had reached 16.1%. Similar numbers apply to many countries around the world: in Germany, for instance, the percentage of domestic capital in the hands of foreign investors increased from 2.3% during 1970-1995 to 9.7% in the period 1996-2004; in Spain the increase was from 4.8% to 17.1%.[1] As Lane and Milesi-Ferretti (2007, p. 224) put it, "In particular, the size of countries' external position is now such that fluctuations in exchange rates and asset prices cause very significant reallocations of wealth across countries". This has important implications for the behavior of current accounts.

According to the standard version of the intertemporal approach to the current account (or *the traditional rule*), the impact of transitory income shocks (fluctuations in output, for example) on the current account is equal to the amount of saving generated by the shock in all countries since countries invest the marginal unit of wealth in foreign assets. This occurs when investment risk is weak and diminishing returns are strong[2]. As is widely known, the empirical evidence is at odds with the traditional rule: "there are some patterns in the current accounts of industrial countries that are inconsistent with the basic theory that international economists have been using for more than two decades" (Ventura, 2003, p. 510). Recent studies have challenged the traditional rule [Kraay and Ventura (2000), Ventura (2001), Kraay and Ventura (2003), and Ventura (2003); K&V hereafter]. According to *the new rule,* the impact of transitory income shocks on the current account is equal to the saving generated by the shock multiplied by the country's share of foreign assets in total assets, since "the country invests the marginal unit of wealth as the average one" when investment risk is strong and diminishing returns are weak (K&V, 2000, p. 1138). The new rule seems to be well supported in the long run, as well as in the short run (once costs of adjustment to investment are introduced) [K&V (2003); and Ventura (2003)]. However, an important implicit assumption both in the traditional rule and in the new rule is that the country is a small open economy. Thus foreign holdings of domestic capital are assumed to be constant, which is clearly restrictive, especially when financial markets are becoming increasingly integrated.

[1] See Section 3 for more details of the database upon which these numbers are based.
[2] See Obstfeld and Rogoff (1995, 1996), Razin (1995), and Frenkel, Razin and Yuen (1996), for example, for excellent surveys on the intertemporal approach to the current account.

This paper suggests a straightforward extension of the new rule, abandoning the small open economy assumption. It analyzes the impact of transitory income shocks on the current account in a two-country stochastic growth model. According to the extended new rule, the impact of transitory income shocks on the current account is equal to the new rule plus an additional term. This term captures the saving generated by the income shock in the foreign economy multiplied by the foreign country's share of domestic capital in foreign total assets. The extended new rule provides a good description for the empirical evidence on current accounts for 19 OECD countries in the period 1970-2004, both in the short run and the long run, and is even better than the new rule. Additionally, we have found that the new rule would be rejected by recent evidence.

2. Theory

2.1 Basic structure

The world economy is composed of two countries, each of them producing only one homogeneous good. Each country has a representative agent with an infinite time horizon. The homogeneous good produced by both countries can be either consumed or invested in capital without having to incur in any kind of adjustment costs. There are three assets: domestic capital, foreign capital and bonds. Unstarred variables refer to the domestic economy, whereas the starred variables refer to the foreign economy. Both domestic capital, K, and foreign capital, K^*, can be owned by the domestic representative agent or the foreign representative agent. The subscript d denotes the holdings of assets of the domestic representative agent and the subscript f denotes the holdings of assets of the foreign representative agent. It must be satisfied, therefore, that

$$\begin{aligned} K &= K_d + K_f \\ K^* &= K_d^* + K_f^*. \end{aligned}$$

Domestic production is obtained using only domestic capital, K, through an AK function, and it is expressed through a first order stochastic differential equation, so that production flow dY is subject to a stochastic disturbance

$$dY = \alpha K dt + K dy,$$

where $\alpha > 0$ is the marginal physical product of domestic capital. The term dy represents a proportional domestic productivity shock: dy is the increment of a stochastic process y. Those increments are temporally independent and are normally distributed. They satisfy that $E(dy) = 0$ and $E(dy^2) = \sigma_y^2 dt$.[3] We omit, for convenience, formal references to time, although those variables depend on time. Note that dY indicates the flow of production, instead of Y, as is ordinarily done in stochastic calculus.

The foreign economy is structured symmetrically to the domestic economy. Thus, foreign production is carried out using capital domiciled abroad, K^*, with a production function very similar to the one in the domestic economy

$$dY^* = \alpha^* K^* dt + K^* dy^*,$$

where $\alpha^* > 0$ is the marginal physical product of foreign capital. The term dy^* represents a proportional foreign productivity shock and it is the increment of a stochastic process y^*. Those increments are temporally independent and are distributed normally, satisfying that $E(dy^*) = 0$ and that $E(dy^{*^2}) = \sigma_{y^*}^2 dt$. Furthermore, shocks are correlated across countries: $E(dydy^*) = \sigma_{yy^*} dt$.

In addition, bonds pay an instantaneous risk-free interest rate η. The domestic economy can be lending to (and thus $B > 0$) or borrowing from (and thus $B < 0$) the foreign economy. Thus B denotes the net position of risk-free loans. The wealth of the domestic representative agent, W, and the wealth of the foreign representative agent, W^*, therefore will be

$$W = K_d + K_d^* + B \quad [1]$$
$$W^* = K_f + K_f^* - B. \quad [2]$$

[3] That is, the production flow follows a Brownian motion with drift αK and with variance $K^2 \sigma_y^2$.

The net foreign asset position for the domestic economy, P, is defined as

$$P = K_d^* - K_f + B, \tag{3}$$

where changes in any of those variables lead to changes in the net foreign asset position.

The current account of the domestic economy, CA, is defined as the variation in its net foreign asset position given by [3], dP. Thus we have that

$$CA = dP = dK_d^* - dK_f + dB. \tag{4}$$

This means that, for instance, the current account is positive if and only if the variation in K_d^* and B is higher than the variation in K_f.

We can convert equation [4] into

$$CA = dW - dK = dW - dW\frac{\partial K_d}{\partial W} - dW^*\frac{\partial K_f}{\partial W^*}. \tag{5}$$

Thus equation [5] is the national account identity, where the current account balance is equal to the variation in domestic wealth minus the variation in domestic capital. Please note that the variation in domestic wealth, dW, is equal to the national savings for the period, S, that is, national income minus (private and public) consumption. Additionally, the variation in domestic capital, dK, is equal to the domestic net investment for the period.

2.2 The domestic economy

The preferences of the domestic representative agent are represented by an isoelastic intertemporal utility function where utility is obtained from consumption, C

$$E_0 \int_0^\infty \frac{C^\gamma - 1}{\gamma} e^{-\beta t} dt \tag{6}$$
$$-\infty < \gamma < 1.$$

The welfare of the domestic representative agent in period 0 is the expected value of the discounted sum of instantaneous utilities, conditioned on the set of disposable information in period 0. The parameter

β is a positive subjective discount rate (or rate of time preference). For the isoelastic utility function the Arrow-Pratt coefficient of relative risk aversion is given by the expression $1-\gamma$. When $\gamma = 0$ this function corresponds to the logarithmic utility function. The restrictions on the utility function are necessary to ensure concavity with respect to consumption.

The domestic representative agent consumes at a deterministic rate $C(t)dt$ in the instant dt and thus the dynamic budget restriction can be expressed in the following way

$$dW = [\alpha K_d + \alpha^* K_d^* + \eta B]\, dt + [K_d dy + K_d^* dy^*] - Cdt. \qquad [7]$$

If we define the following variables for the domestic representative agent

$$\begin{aligned} n_d &\equiv \frac{K_d}{W} = \text{ share of the domestic portfolio materialized} \\ &\quad \text{in domestic capital} \\ n_d^* &\equiv \frac{K_d^*}{W} = \text{ share of the domestic portfolio materialized} \\ &\quad \text{in foreign capital,} \\ n_b &\equiv \frac{B}{W} = \text{ share of the domestic portfolio materialized} \\ &\quad \text{in bonds,} \end{aligned}$$

equation [1] can be expressed more conveniently as

$$1 = n_d + n_d^* + n_b, \qquad [8]$$

and plugging [8] into the budget constraint [7] we obtain the following dynamic restriction for the resources of the domestic economy

$$\frac{dW}{W} = \psi dt + dw, \qquad [9]$$

where the deterministic and stochastic parts of the rate of growth of assets, dW/W, can be expressed in the following way

$$\psi \equiv (\alpha - \eta)\, n_d + (\alpha^* - \eta)\, n_d^* + \eta - \frac{C}{W} \equiv \rho - \frac{C}{W} \qquad [10]$$

$$dw \equiv n_d dy + n_d^* dy^*, \qquad [11]$$

where $\rho \equiv \alpha n_d + \alpha^* n_d^* + \eta n_b \equiv (\alpha - \eta) n_d + (\alpha^* - \eta) n_d^* + \eta$ denotes the gross rate of return of the asset portfolio.

The objective of the domestic representative agent is to choose the path of consumption and portfolio shares that maximizes the expected value of the intertemporal utility function [6], subject to $W(0) = W_0$, [9], [10], and [11]. This optimization is a stochastic optimum control problem.[4] The macroeconomic equilibrium is derived in Appendix A1. The equilibrium (implicit) portfolio shares and the consumption-wealth ratio in the domestic open economy are given by equations [A1.9], [A1.10], [A1.11] and [A1.12] in Appendix A1,

$$\begin{aligned} \alpha - \eta &= (1-\gamma)\left[n_d \sigma_y^2 + n_d^* \sigma_{yy^*}\right] && [12] \\ \alpha^* - \eta &= (1-\gamma)\left[n_d^* \sigma_{y^*}^2 + n_d \sigma_{yy^*}\right] && [13] \\ n_b &= 1 - n_d - n_d^* && [14] \\ \frac{C}{W} &= \frac{1}{1-\gamma}\left[\beta - \gamma\rho + 0.5\gamma(1-\gamma)\sigma_w^2\right], && [15] \end{aligned}$$

where

$$\sigma_w^2 = n_d^2 \sigma_y^2 + 2 n_d n_d^* \sigma_{yy^*} + n_d^{*^2} \sigma_{y^*}^2.$$

Appendix A2 shows that second order conditions are satisfied.

2.3 The foreign economy

The equilibrium facing the foreign representative agent can be formulated in an analogous way as

$$\begin{aligned} \alpha - \eta &= (1-\gamma^*)\left[n_f \sigma_y^2 + n_f^* \sigma_{yy^*}\right] && [16] \\ \alpha^* - \eta &= (1-\gamma^*)\left[n_f^* \sigma_{y^*}^2 + n_f \sigma_{yy^*}\right] && [17] \\ n_b^* &= 1 - n_f - n_f^* && [18] \\ \frac{C^*}{W^*} &= \frac{1}{1-\gamma^*}\left[\beta^* - \gamma^*\rho^* + 0.5\gamma^*(1-\gamma^*)\sigma_{w^*}^2\right], && [19] \end{aligned}$$

where

[4]To solve problems of stochastic optimum control see, for example, Kamien and Schwartz (1991, section 22), Malliaris and Brock (1982, ch. 2), Obstfeld (1992), or Turnovsky (1997, ch. 9; 2000, ch. 15).

$$
\begin{aligned}
n_b^* &= -\frac{B}{W^*} \\
\sigma_{w^*}^2 &= n_f^2 \sigma_y^2 + 2 n_f n_f^* \sigma_{yy^*} + n_f^{*^2} \sigma_{y^*}^2 .
\end{aligned}
$$

2.4 The equilibrium interest rates

In a closed domestic economy there is no trade in any inside asset, such as a risk-free bond. In autarky the equilibrium risk-free interest rate in the domestic economy, η_a, becomes, from equation [12],

$$
\eta_a = \alpha - (1-\gamma)\,\sigma_y^2 .
$$

Similarly, in autarky the equilibrium risk-free interest rate in the foreign economy, η_a^*, is given by equation [16]

$$
\eta_a^* = \alpha^* - (1-\gamma^*)\,\sigma_{y^*}^2 .
$$

The equilibrium world risk-free interest rate in an open economy where the representative agent holds domestic capital, foreign capital, and bonds is derived by equations [12], [13], [14], [16], [17], and [18], and by the requirement that the world bond market clears, that is,

$$
W n_b + W^* n_b^* = 0.
$$

Combining those equations, the world risk-free interest rate is expressed as

$$
\begin{aligned}
\eta \;=\; & \frac{\eta_a\left(\sigma_{y^*}^2 - \sigma_{yy^*}\right) + \eta_a'\left(\sigma_y^2 - \sigma_{yy^*}\right)}{\sigma_y^2 + \sigma_{y^*}^2 - 2\sigma_{yy^*}} \\
& + \frac{(1-\gamma)(1-\gamma^*)\left(\sigma_y^2 - \sigma_{yy^*}\right)\left(\sigma_{y^*}^2 - \sigma_{yy^*}\right)(W+W^*)}{\left[\sigma_y^2 + \sigma_{y^*}^2 - 2\sigma_{yy^*}\right]\left[W(1-\gamma^*) + W^*(1-\gamma)\right]} \\
& + \frac{(\gamma-\gamma^*)\left[W(1-\gamma^*)\left(\sigma_y^2 - \sigma_{yy^*}\right)\sigma_{y^*}^2 - W^*(1-\gamma)\left(\sigma_{y^*}^2 - \sigma_{yy^*}\right)\sigma_y^2\right]}{\left[\sigma_y^2 + \sigma_{y^*}^2 - 2\sigma_{yy^*}\right]\left[W(1-\gamma^*) + W^*(1-\gamma)\right]},
\end{aligned}
$$

where

$$
\eta_a' = \alpha^* - (1-\gamma)\,\sigma_{y^*}^2 .
$$

The world risk-free interest rate η is time-varying. It depends on the autarky risk free rates, on the world distribution of wealth, on the value of the parameters related to risk aversion, and so on. Since world risk-free interest rate is time-varying, portfolio shares and growth rates are also time-varying[5].

2.5 The rules

Once world equilibrium has been derived the impact of transitory income shocks on current accounts can be discussed. For simplicity and without loss of generalization, the impact of changes in foreign holdings of domestic capital on domestic productivity is assumed to be negligible, $\frac{\partial \alpha}{\partial K_f} = 0$. Additionally, the impact of changes in domestic and foreign holdings of foreign capital on foreign productivity is also assumed to be negligible, $\frac{\partial \alpha^*}{\partial K_d^*} = \frac{\partial \alpha^*}{\partial K_f^*} = 0$.

A small open economy implies that foreign holdings of domestic capital are constant[6]: $dK_f = 0$ (See equation [4] or [5]).

Now, in case domestic capital and foreign capital are subject to diminishing returns to capital in equations [12] and [16],[7] then, combining equations [12] and [13], and totally differentiating, we get that,

$$\frac{\partial K_d}{\partial W} = -\frac{K_d}{W}\frac{\lambda}{W+\lambda}, \qquad [20]$$

where

$$\lambda = \left[(1-\gamma)\,\sigma_y^2 - \frac{\sigma_{yy^*}^2}{(1-\gamma)\,\sigma_{y^*}^2}\right] \times \left(\frac{\partial \alpha}{\partial K_d}\right)^{-1}.$$

Therefore, in a small open economy, if risk associated with investment is low compared to the diminishing returns effect, that is, $\lambda \to 0$, we get in equation [20] that $\partial K_d/\partial W = 0$, or expressed in another way, "in existing intertemporal models of the current account countries invest the marginal unit of wealth in foreign assets" (K&V, 2000, p.

[5] See Devereux and Saito (1997). In addition to the closed economy, two scenarios are considered for the open economy and logarithmic utility in their paper: countries invest in domestic and foreign capital (and there is no bond trade in equilibrium), on the one hand, and countries invest in their own capital and bonds (but not in the capital of the other country), on the other hand.
[6] See K&V (2000, p. 1145, footnote 7).
[7] Corsetti (1997), for example, develops a stochastic version of the Arrow-Romer model where aggregate capital stock has an external effect on labor productivity, but the representative firm faces decreasing returns to capital.

1138): the traditional rule. On the one hand, since diminishing returns are strong, investing abroad becomes more attractive. On the other hand, low risk associated with investment makes the investor willing to change portfolio composition. Then the impact of transitory income shocks on the current account, via equation [5], becomes

$$CA = dW. \tag{21}$$

The impact of transitory income shocks on the current account is equal to the saving generated by the shock: positive shocks generate surpluses in all countries.

However, in a small open economy, if investment risk is high compared to the diminishing returns effect, that is, $\lambda \to \infty$, then equation [20] leads to

$$\frac{\partial K_d}{\partial W} = \frac{K_d}{W}, \tag{22}$$

and "the country invests the marginal unit of wealth as the average one" (K&V, 2000, p. 1138): the new rule. On the one hand, since diminishing returns are low, purchasing new capital is as attractive as existing capital. On the other hand, high risk associated with investment makes portfolio composition more difficult to change. Then the current account, via equation [5], becomes

$$CA = dW\left(\frac{K_d^* + B}{W}\right). \tag{23}$$

The response of current accounts to transitory income shocks is equal to the saving generated by the shock multiplied by the share of foreign assets over total domestic wealth. This implies that a positive shock generates surpluses in creditor countries and deficits in debtor countries in a small open economy.

In case risk associated with investment is neither low nor high compared to the diminishing returns effect, that is, $0 < \lambda < \infty$, then equation [20] gives us

$$0 < \frac{\partial K_d}{\partial W} < \frac{K_d}{W}.$$

This means that the reaction of investors will be somewhere between the traditional rule and the new rule: while the diminishing returns effect makes investing abroad more attractive, investment risk makes investor unwilling to change portfolio composition.

Now the assumption of a small open economy is relaxed: the third term on the right hand side of equation [5] becomes crucial since dK_f need not equal 0. Additionally, combining equations [16] and [17] for the foreign economy, we find that,

$$\frac{\partial K_f}{\partial W^*} = \frac{K_f}{W^*} \qquad [24]$$

This means that the impact of transitory income shocks on the current account (see equation [5]) is given by

$$CA = dW\left(\frac{K_d^* + B}{W}\right) - dW^* \frac{K_f}{W^*}, \qquad [25]$$

if both the new rule (equation [22]) and the additional term implied by abandoning the small open economy assumption (equation [24]) apply. Therefore, the response of the current account, when a transitory income shock occurs, is equal to the new rule plus an additional term[8]. This term would capture the change in savings generated by the income shock in the foreign economy multiplied by foreign holdings of domestic capital over total foreign wealth. Please note that the change in domestic wealth is equal to national savings, $dW = S$, as shown in Section 2.1 above.

In summary, the extended new rule nests the new rule as a special case where a small open economy is assumed, that is, when the impact of the foreign economy on the domestic economy (via foreign holdings of domestic capital) is negligible. In both cases, the country invests the marginal unit as the average one, since the risk associated with investment is high compared to the diminishing returns effect. In contrast, according to the traditional rule, countries invest the marginal unit of wealth in foreign assets when investment risk is low compared to the diminishing returns effect.

[8] Please note that the impact on current account is similar to that shown in Turnovsky (1997, p. 436), except for the existence of risk-free loans now.

3. Data sources

The sample to test all the rules is composed of 19 OECD countries for the period 1970-2004[9]: Austria, Australia, Belgium, Canada, Denmark, France, Germany, Greece, Iceland, Italy, Japan, The Netherlands, Norway, New Zealand, Spain, Portugal, Sweden, United Kingdom, and the United States[10]. Additionally some series for the world as a whole are estimated, as we shall show below. The data on GDP and gross national savings for those countries (world included) are provided directly by World Bank's World Development Indicators (WBWDI). The data on current accounts and international investment positions have been obtained from the International Monetary Fund's International Financial Statistics (IMFIFS). Additionally, as data on international investment positions are incomplete or missing for many countries before 1980-1986, Lane and Milesi-Ferretti (2007) provide an excellent source of data for those years[11]. Domestic holdings on foreign capital, K_d^*, is measured as direct plus portfolio equity investment by domestic agents abroad, while foreign holdings of domestic capital, K_f, refers to direct plus portfolio equity investment by foreign agents in the domestic economy. The net lending position abroad, B, is the sum of the net position in portfolio debt investment, the net position in other investment assets (general government, banks, and others), reserve assets (minus gold) and the net position in financial derivatives.

The gross domestic capital stock in current US dollars for the countries in the sample (and also for the world as a whole) is constructed using the procedure suggested by K&V (2000) in Appendix A2: gross domestic investment in current US dollars (from WBWDI) is cumulated assuming a depreciation rate of 4% per year, and adjusting the value of previous year's stock using the US gross domestic investment deflator. The initial capital stock in 1970 is estimated using the average

[9] K&V (2003) and Ventura (2003) employ a similar sample, except for Finland, Ireland, Switzerland, and Turkey, which are not included. Constructing the data for Finland, Ireland and Switzerland produces inconsistent results to estimate foreign holdings of domestic capital due to the enormous and rapid increase of foreign investment in those countries.

[10] Countries could be aggregated into larger blocks in order to test the behavior of current accounts for not-so-small open economies. However, the availability of data on international investment positions does not allow us to do so.

[11] Please note that most of the data from IMFIFS, and Lane and Milesi-Ferretti (2007) coincide for recent years.

capital-output ratio over the period 1965-1975[12] [based on Nehru and Dareshwar (1993)[13]] multiplied by GDP in current US dollars (WB-WDI). The series for the foreign economy are estimated as follows: we take the values for the whole world and then the values for the domestic economy are substracted from it.

4. Empirical evidence

4.1 The traditional rule

We test the traditional rule following regression equation [21]

$$CA_{ct} = a_0 + a_1 S_{ct} + u_{ct}, \qquad [26]$$

where CA_{ct} and S_{ct} denote current account balance and the amount of savings, respectively, both expressed as a share of GDP[14], for country c in period t, and u_{ct} is the error term for country c in period t. Under the null hypothesis that the traditional rule is true, then the parameter a_1 should be equal to one: an increase in savings leads to a one-to-one increase in the current account.

In their pioneer work Feldstein and Horioka (1980, p. 317) wanted to "[...] measure the extent to which a higher domestic saving rate in a country is associated with a higher rate of domestic investment.", so that "with perfect world capital mobility, there should be no relation between domestic saving and domestic investment: saving in each country responds to the worldwide opportunities for investment while

[12] The initial value for capital-output ratio for the world is the weighted mean of capital-output ratios in the sample of 19 countries for the period 1965-1975.

[13] Please note that the EU KLEMS Productivity Report, first released in March 2007, provides data on economic growth, productivity, employment creation, and capital formation at the industry level for EU member states, Japan and the US from 1970 onwards (Timmer *et. al.,* 2007). However, we have not employed that database for two main reasons. First, testing the extended new rule requires estimating capital stock for the world, which is not available in the EUKLEMS database. Second, the database has been constructed in a similar manner to that in KV (2000), so that the results of this paper can be easily compared with those of previous literature.

[14] Two differences arise between the testing pursued by Feldstein and Horioka (1980) and by K&V(2000). First, Feldstein and Horioka regressed investment on savings. Instead, K&V regressed the current account on savings, making it easier to compare the new rule with the traditional rule. However, both approaches are equivalent. Second, Feldstein and Horioka used data related to Gross Domestic Product, whereas K&V used data related to Gross National Product. Here we are inclined to use GDP for the testing.

investment in that country is financed by the worldwide pool of capital." They find that the empirical evidence runs in favor of a strong relationship between both variables, thus attributing it to the lack of perfect world capital mobility. According to Frankel (1992, p. 41), "Feldstein and Horioka upset conventional wisdom in 1980 when they concluded that changes in countries' rate of national saving had very large effects on their rates of investment and interpreted this finding as evidence of low capital mobility". However, many economists do not share Feldstein and Horioka's conclusion. The paradox of having perfect capital mobility alongside a strong association between savings and investment has been termed the *Feldstein-Horioka puzzle.* Many studies followed suit and analyzed the reasons to explain the evidence, while assuming perfect world capital mobility. However, "it seems likely that of many potential explanations of the Feldstein-Horioka results, no single one fully explains the behavior of all countries", according to Obstfeld and Rogoff (1995, p. 1779). We should note that Feldstein and Horioka (1980, p. 319) were aware that a high association "could reflect other common causes of the variation in both saving and investment", but they argued that a high association "would however be strong evidence against the hypothesis of perfect capital mobility and would place on the defenders of that hypothesis the burden of identifying such common causal factors." Recent empirical studies suggest that the Feldstein-Horioka finding is losing some support in the euro area (Blanchard and Giavazzi, 2002)[15].

TABLE 1
The traditional rule

	Pooled regression	Between regression	Within regression
Gross national saving/GDP	0.3421 (0.0368)	0.3559 (0.1231)	0.3405 (0.1061)
R^2	0.1796	0.3297	0.0929
No. of observations	608	19	608

Standard errors are in parenthesis.
Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and Dhareshwar (1993), and own elaboration.

Table 1 shows the results of fitting equation [26] by ordinary least squares (OLS). The estimate falls very far from 1, thus rejecting the traditional rule, as expected. That is, of course, another piece of evidence in favor of the Feldstein-Horioka puzzle. Additionally, we show the between-group estimates (that is, based on the mean values of

[15] See Giannone and Lenza (2008) for a recent paper on the Feldstein-Horioka result.

the variables of the group) and the within-group estimates (that is, in terms of deviations from the mean values of the variables of the group). In any case the null hypothesis that the traditional rule is true is rejected. Similar results are found in K&V (2000, 2003), and Ventura (2003).

Since other variables may influence the behavior of current accounts some control variables have been included in the regression equation. They include population and output per capita (both in levels and growth rates), so that the size and development of the economy are considered; and a time trend that can capture possible upward or downward movements in economic variables. Now the period analyzed is restricted to 1975-2004 for the same set of countries owing to data availability. When control variables are added to the regression, these variables have some effect on the different estimates of the coefficient a_1, as shown in Table 2. Nonetheless, the traditional rule is again rejected by the data.

TABLE 2
The traditional rule (with control variables)

	Pooled regression	Between regression	Within regression
Gross national saving/GDP	0.3481	0.2711	0.4507
	(0.0325)	(0.1045)	(0.0809)
Time trend	0.0001		0.0008
	(0.0002)		(0.0015)
Population	5.64E-11	5.45E-11	-7.79E-10
	(2.02E-11)	(6.67E-11)	(4.60E-10)
Population growth	-0.0254	-0.0385	-0.0119
	(0.0029)	(0.0096)	(0.0046)
GDP per capita	1.83E-06	2.17E-06	9.29E-07
	(4.71E-07)	(1.25E-06)	(4.64E-06)
GDP per capita growth	-0.0025	-0.0006	-0.0025
	(0.0007)	(0.0100)	(0.0008)
R^2	0.3951	0.7518	0.2279
No. of observations	563	19	563

Standard errors are in parenthesis.
Sources: IFS (IMF), WDI (WB), Lane and Milesi-Ferretti (2007), Nehru and Dhareshwar (1993), and own elaboration.

4.2 The new rule

We test the new rule with the equation [23]

$$CA_{ct} = a_0 + a_1 \left(\frac{K^*_{d,ct} + B_{ct}}{W_{ct}} \right) S_{ct} + u_{ct}. \qquad [27]$$

Under the null hypothesis that the new rule is true, then the parameter a_1 should be equal to one: increases in savings lead to variations in the current account that are equal to the fraction of the net foreign asset position for country c in period t with respect to the level of domestic wealth for country c in period t. Current account balance and the amount of savings are expressed as a share of GDP.

TABLE 3
The new rule

	Pooled regression	Between regression	Within regression
Gross national saving/GDP × Net foreign assets over wealth	0.7470	0.8454	0.6315
	(0.0518)	(0.1562)	(0.1827)
R^2	0.3900	0.6327	0.2201
No. of observations	608	19	608

Standard errors are in parenthesis.
Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and Dhareshwar (1993), and own elaboration.

TABLE 4
The new rule (with control variables)

	Pooled regression	Between regression	Within regression
Gross national saving/GDP × Net foreign assets over wealth	0.6340	0.5999	0.7009
	(0.0495)	(0.1330)	(0.1400)
Time trend	-0.0011		0.0005
	(0.0002)		(0.0014)
Population	-5.03E-11	-5.05E-11	-6.05E-10
	(2.24E-11)	(4.82E-11)	(3.96E-10)
Population growth	-0.0152	-0.0198	-0.0086
	(0.0021)	(0.0086)	(0.0048)
GDP per capita	2.54E-06	2.79E-06	-1.38E-06
	(4.87E-07)	(8.73E-06)	(3.99E-06)
GDP per capita growth	-0.0007	0.0087	-0.0008
	(0.0006)	(0.0076)	(0.0006)
R^2	0.4793	0.8532	0.2674
No. of observations	563	19	563

Standard errors are in parenthesis.
Sources: IFS (IMF), WDI (WB), Lane and Milesi-Ferretti (2007), Nehru and Dhareshwar (1993), and own elaboration.

Table 3 reports the results of fitting equation [27] by OLS. The pooled regression generates an estimate of a_1 equal to 0.75. The between estimate is closer to 1 and provides a better fit to the evidence on current accounts. However, the within estimate is slightly above 0.60 and the goodness-of-fit of the regression falls drastically. Including control variables in the estimation of the new rule offers estimates in the range of 0.60 and 0.70, as shown in Table 4. These results suggest that the new rule is losing support for the whole period 1970-2004. In fact, the null hypothesis that the new rule is true is rejected by the empirical evidence in all cases, except for the within estimate in the first regression (without control variables). Additionally, we find that the new rule explains the dynamics of current accounts in the long run much better than in the short run, as already pointed out by K&V (2003) and Ventura (2003): the new rule fits the data reasonably well in the pooled and in the between-group estimations, but "explains essentially none of the year-to-year within-country differences in current accounts." (K&V, 2003, p. 69). Let us now turn to each of these two issues.

Why has the new rule received less support in the whole period 1970-2004 than in previous estimations? Can the addition of recent data explain the difference between more recent estimates and older estimates? It seems so. If we restrict testing the new rule to the period 1970-1997 (1997 is the final period in K&V), the empirical evidence runs again in favor of the new rule, as shown in Table 5: the estimates are very close to 1 (and the null hypothesis cannot be rejected, except strictly for the pooled), while some divergence between long run and short run behavior arises again.[16]

TABLE 5
The new rule for the period 1970-1997

	Pooled regression	Between regression	Within regression
Gross national saving/GDP × Net foreign assets over wealth	0.8780 (0.0593)	0.8476 (0.1591)	0.9197 (0.1810)
R^2	0.3666	0.6253	0.1786
No. of observations	476	19	476

Standard errors are in parenthesis.
Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and Dhareshwar (1993), and own elaboration.

K&V (2003) argue that the differences arising in the between and within estimations of the new rule have to do with the differences in the short run and long run behavior of the current account: the new rule provides a good explanation of the long run behavior, but not so in the short run. Adjustment costs of investment are a key element explaining this divergence. Countries facing a transitory income shock modify their portfolio composition in the short run, investing most of their savings in foreign assets, when investment adjustment costs are important: portfolio rebalancing occurs. However, portfolio

[16] The results for the period 1970-1997 do change somewhat when control variables are added (not shown): the pooled and the between estimates seem to reject the new rule.

composition goes back to its initial distribution in a few years[17]: portfolio growth takes place. K&V (2003) estimate the dynamic behavior of the current account constructing the portfolio rebalancing component, PR. If $PR = CA - [(K_d^* + B)/W] \cdot S$, then the dynamic linear regression can be estimated as[18]

$$PR_{ct} = a_0 + \sum_{n=1}^{j} a_n \cdot PR_{c,t-n} + \sum_{n=0}^{k} b_n \cdot S_{c,t-n} + u_{ct}. \qquad [28]$$

The coefficients estimated can be used to generate the impulse response functions of portfolio rebalancing, which captures the impact of saving on portfolio composition. Table 6 shows the results for the simple case where only 5 lags of savings are considered. The impulse response function has also been estimated: it is equal to the estimated coefficients on current and lagged saving in this case. The results imply that, when the impact occurs, the fraction of an increase in saving that countries invest into foreign assets is 0.35 (when initial foreign assets are zero). However, they gradually rebalance their portfolio composition toward the initial distribution: the coefficients of lags of saving in the next 5 years are negative and decreasing (in absolute terms). Those coefficients denote the fraction of the initial increase in saving that is allocated in domestic assets again in each of the next 5 years. In fact, the sum of all the coefficients is -0.01. This would mean that the initial response toward foreign assets is reversed back to the initial composition. Results do change when lagged values of the portfolio rebalancing term are introduced, as Table 7 shows. Nonetheless, the impulse response function is qualitatively broadly similar to that reported in Table 6. To summarize, even though the new rule would be rejected by the recent evidence, we still find strong support for it both in the short run and the long run.

[17] See K&V (2003) for a formal model of current account when adjustment costs of investment are important.

[18] Please note that current account balance and savings are expressed as a share of GDP. Standard control variables can also be included in the regression.

TABLE 6
The new rule: The short run and the long run

	Regression		Impulse resp. funct.	
Coeff. estimates	Coeff.	S.E.	Year	Impulse resp.
$S_{c,t}$	0.3484	0.0876	*t*	0.3484
$S_{c,t-1}$	-0.0614	0.1193	*t-1*	-0.0614
$S_{c,t-2}$	-0.1537	0.1177	*t-2*	-0.1537
$S_{c,t-3}$	-0.1456	0.1121	*t-3*	-0.1456
$S_{c,t-4}$	-0.0527	0.1107	*t-4*	-0.0527
$S_{c,t-5}$	0.0091	0.0794	*t-5*	0.0091

Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and Dhareshwar (1993), and own elaboration.

TABLE 7
The new rule, with portfolio rebalancing lags:
The short run and the long run

	Regression		Impulse resp. funct.	
Coeff. estimates	Coeff.	S.E.	Year	Impulse resp.
$S_{c,t}$	0.4058	0.0574	*t*	0.4058
$S_{c,t-1}$	-0.4632	0.0827	*t-1*	-0.3051
$S_{c,t-2}$	-0.0334	0.0837	*t-2*	-0.1643
$S_{c,t-3}$	0.0088	0.0764	*t-3*	-0.1447
$S_{c,t-4}$	0.0707	0.0693	*t-4*	-0.1119
$S_{c,t-5}$	0.0152	0.0499	*t-5*	-0.0428
$PR_{c,t-1}$	0.9342	0.0432	*t-6*	-0.0150
$PR_{c,t-2}$	-0.1707	0.0568	*t-7*	-0.0030
$PR_{c,t-3}$	0.0466	0.0431	*t-8*	0.0008

Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and Dhareshwar (1993), and own elaboration.

4.3 The extended new rule

Now the implications of abandoning the small open economy assumption on current accounts can be empirically estimated. The extended new rule, shown in equation [25], can be tested with the regression equation[19]

$$CA_{ct} = a_0 + a_1 \left(\frac{K^*_{d,ct} + B_{ct}}{W_{ct}} \right) S_{ct} + a_2 \left(\frac{K_{f,ct}}{W^*_{ct}} \right) S^*_{ct} + u_{ct}. \qquad [29]$$

Under the null hypothesis that the extended new rule is true, then a_1 should be equal to 1, and a_2 should be equal to -1: the impact of transitory income shocks on current accounts is equal to the saving generated by the income shock in the domestic economy multiplied by the share of domestic holdings of foreign assets over domestic wealth

[19] All the variables are expressed as a share of GDP, as usual.

plus the saving generated by the income shock in the foreign economy multiplied by the share of domestic capital in the foreign economy over foreign wealth.

TABLE 8
The extended new rule

	Pooled regression	Between-group regression	Within-group regression
Estimate of a_1	1.0450	1.1121	1.0156
	(0.0612)	(0.1699)	(0.2907)
Estimate of a_2	-0.8657	-1.3476	-0.7397
	(0.0957)	(0.5202)	(0.4050)
R^2	0.4734	0.7412	0.2841
No of observations	608	19	608

Standard errors are in parenthesis.
Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and Dhareshwar (1993), and own elaboration.

TABLE 9
The extended new rule (with control variables)

	Pooled regression	Between regression	Within regression
Estimate of a_1	0.9856	1.0718	1.2300
	(0.0726)	(0.2192)	(0.2152)
Estimate of a_2	-1.1324	-1.6177	-1.3135
	(0.1595)	(0.6456)	(0.4231)
Time trend	4.15E-05		0.0027
	(0.0002)		(0.0009)
Population	-1.03E-10	-1.32E-10	-4.05E-10
	(2.07E-11)	(5.21E-11)	(2.70E-10)
Population growth	-0.0072	-0.0056	-0.0031
	(0.0021)	(0.0092)	(0.0039)
GDP per capita	2.08E-06	3.03E-06	-4.48E-06
	(4.36E-07)	(7.42E-07)	(2.67E-06)
GDP per capita growth	-0.0003	-0.0073	-1.36E-06
	(0.0005)	(0.0090)	(0.0005)
R^2	0.5498	0.9036	0.3627
No. of observations	563	19	563

Standard errors are in parenthesis.
Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and Dhareshwar (1993), and own elaboration.

Table 8 shows the results. The pooling estimates have the expected signs and are close to their expected values: a_1 is equal to 1.05 and a_2 is equal to -0.87. The within estimates follow similar patterns (1.02 for a_1 and -0.74 for a_2), except for the second parameter, which moves away from its expected value, even though it cannot rejected by the data. The between estimate for a_1 is equal to 1.11, and that for a_2 is equal to -1.35: the distance from expected values widens. Nonetheless the null cannot be rejected. The evidence suggests that the extended new rule explains the evidence on current accounts better than other rules. Similar evidence was found by Erauskin-Iurrita (2004) for the period 1973-1995. Since the goodness-of-fit for the within regression is considerably lower than that of the between regression, it seems that the extended new rule explains long run behavior more satisfactorily than short run dynamics, as in the new rule. We turn to this issue below. Once the regression equation is controlled by some variables, the results for the parameter a_1 remain more or less intact, as Table 9 shows. However, the estimates for a_2 become more negative and they move away from their expected values. The null cannot be rejected though.

As we mentioned before, differences in the goodness of fit for the within and between estimates suggest that the extended new rule provides a better account of long run behavior than that in the short run. Thus we are inclined to reformulate the portfolio rebalancing behavior, as above with the new rule, to take into account the extended new rule. The new portfolio rebalancing component, is denoted by PR'. If $PR' = CA - [(K_d^* + B)/W] \cdot S + (K_f/W^*) \cdot S^*$, then the new dynamic linear regression (see equation [28]) can be estimated as[20]

$$PR'_{ct} = a_0 + \sum_{n=1}^{j} a_n \cdot PR'_{c,t-n} + \sum_{n=0}^{k} b_n \cdot S_{c,t-n} + u_{ct}.$$

Table 10 shows the results for the simple case where only 5 lags of savings are introduced. Countries, on impact, invest 0.48 of an increase in saving into foreign assets (for zero initial foreign assets), but then portfolio composition rebalances toward the initial composition. The coefficients of lags of saving in the next 5 years are negative and decreasing (in absolute terms) and the sum of all the coefficients is equal to 0.003. When lagged values of the portfolio rebalancing component are included (see Table 11) then we find that, even though the results change, they are similar, in qualitative terms, to the simple case. Therefore, the results for the extended new rule provide a good portrayal of the evidence of current accounts, even better than the new rule, both in the short run and the long run.

[20] Please note that current account balance and savings are expressed in terms of GDP. Control variables can also be included in the regression equation.

TABLE 10
The extended new rule: The short run and the long run

	Regression		Impulse resp. funct.	
Coeff. estimates	Coeff.	S.E.	Year	Impulse resp.
$b_0(S_{c,t})$	0.4754	0.0735	*t*	0.4754
$b_1(S_{c,t-1})$	-0.0684	0.0999	*t-1*	-0.0684
$b_2(S_{c,t-2})$	-0.1061	0.0986	*t-2*	-0.1061
$b_3(S_{c,t-3})$	-0.1499	0.0939	*t-3*	-0.1499
$b_4(S_{c,t-4})$	-0.0391	0.0927	*t-4*	-0.0391
$b_5(S_{c,t-5})$	-0.1091	0.0665	*t-5*	-0.1091

Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and Dhareshwar (1993), and own elaboration.

TABLE 11
The extended new rule, with portfolio rebalancing lags:
The short run and the long run

	Regression		Impulse resp. funct.	
Coeff. estimates	Coeff.	S.E.	Year	Impulse resp.
$b_0(S_{c,t})$	0.4629	0.0541	*t*	0.4629
$b_1(S_{c,t-1})$	-0.4541	0.0779	*t-1*	-0.2619
$b_2(S_{c,t-2})$	-0.0327	0.0789	*t-2*	-0.1383
$b_3(S_{c,t-3})$	0.0013	0.0721	*t-3*	-0.1318
$b_4(S_{c,t-4})$	0.0598	0.0651	*t-4*	-0.1065
$b_5(S_{c,t-5})$	0.0349	0.0474	*t-5*	-0.0410
$a_1(PR'_{c,t-1})$	0.8371	0.0428	*t-6*	-0.0147
$a_2(PR'_{c,t-2})$	-0.1323	0.0541	*t-7*	-0.0031
$a_3(PR'_{c,t-3})$	0.0004	0.0419	*t-8*	0.0006

Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and Dhareshwar (1993), and own elaboration.

5. Conclusions

International financial integration has increased tremendously in recent years. The subsequent dramatic growth of cross-border holdings of assets and liabilities has important implications for the behavior of current accounts since a crucial implicit assumption in models of current accounts is that the country is a small open economy. This assumption implies that foreign holdings of domestic capital are constant, which is very restrictive, especially when financial markets are increasingly integrated.

According to the standard intertemporal approach to the current account, or the traditional rule, the impact of a transitory income shock on the current account is equal to the savings generated by the shock one-to-one in all countries since risk associated with investment is low compared to the diminishing returns effect. The empirical evidence rejects the traditional rule. Recent research by K&V has proposed the new rule: the impact of a transitory income shock on the current account is equal to the savings generated by the shock multiplied by the domestic holdings of foreign assets over total domestic assets when investment risk is high compared to the diminishing returns effect. The empirical evidence supports the new rule in the long run as well as in the short run (once adjustment costs of investment are included).

This paper has suggested an extension of the new rule abandoning the small open economy assumption. According to the extended new rule, the impact of a transitory income shock on the current account is equal to the response suggested by the new rule plus an additional term. This term would capture the saving generated by the shock in the foreign economy multiplied by the foreign country's share of domestic capital in foreign total assets. We find in this paper that the traditional rule has been unsurprisingly rejected by the empirical evidence. Nonetheless, in contrast to recent favorable evidence, the new rule appears to be losing support: it has even been rejected by the data. However, the empirical evidence provides strong support for the extended new rule, both in the long run and the short run. Further research extending the number of countries and years involved will probably show how robust the extended new rule remains in comparison with other alternatives.

Appendixes

A1. Optimization

The first step in order to solve the optimization problem in the domestic economy is to introduce a value function, $V(W)$, which is defined as

$$V(W) = \underset{\{C,n_d,n_d^*\}}{Max} E_0 \int_0^\infty \frac{C^\gamma - 1}{\gamma} e^{-\beta t} dt, \qquad [A1.1]$$

subject to the restrictions [9], [10], and [11] and given initial wealth. The value function in period 0 is the expected value of the discounted sum of instantaneous utilities, evaluated along the optimal path, starting in period 0 in the state $W(0) = W_0$.

Starting from equation [A1.1] the value function must satisfy the following equation, known as the Hamilton-Jacobi-Bellman equation of stochastic control theory or, for short, the Bellman equation

$$\beta V(W) = \underset{\{C,n_d,n_d^*\}}{Max} \left[\frac{C^\gamma - 1}{\gamma} + V'(W)W\psi + 0.5V''(W)W^2\sigma_w^2 \right]. \qquad [A1.2]$$

The right hand side of equation [A1.2] is partially differentiated with respect to C, n_d and n_d^* in order to get the first order optimality conditions of this problem

$$\begin{aligned} C^{\gamma-1} - V'(W) &= 0 & [A1.3] \\ V'(W)W\left(\alpha - \eta\right)dt + V''(W)W^2 cov\left(dw, dy\right) &= 0 & [A1.4] \\ V'(W)W\left(\alpha^* - \eta\right)dt + V''(W)W^2 cov\left(dw, dy^*\right) &= 0. & [A1.5] \end{aligned}$$

The solution to this problem is obtained through trial and error. We seek a value function $V(W)$ that satisfies, on the one hand, the first order optimality conditions and, on the other, the Bellman equation. In the case of isoelastic utility functions the value function has the same form of the utility function [Merton (1969), then generalized in Merton (1971)]. Thus, we postulate that the value function is of the form

$$V(W) = AW^\gamma,$$

where the coefficient A has to be determined. This function implies that

$$\begin{aligned} V'(W) &= A\gamma W^{\gamma-1} \\ V''(W) &= A\gamma\left(\gamma - 1\right)W^{\gamma-2}. \end{aligned}$$

Substituting these expressions in the first order optimality conditions [A1.3], [A1.4] and [A1.5] we derive

$$\begin{aligned} C^{\gamma-1} &= A\gamma W^{\gamma-1} & [A1.6] \\ \left(\alpha - \eta\right)dt &= \left(1 - \gamma\right) cov\left(dw, dy\right) & [A1.7] \\ \left(\alpha^* - \eta\right)dt &= \left(1 - \gamma\right) cov\left(dw, dy^*\right). & [A1.8] \end{aligned}$$

These are typical equations in stochastic models in continuous time. Equation [A1.6] indicates that at the optimum, the marginal utility derived from consumption must be equal to the marginal change in the value function or the marginal utility of wealth. Equations [A1.7] and [A1.8] show that the optimal choice of portfolio shares of the domestic representative agent must be such that the risk-adjusted rates of return of assets are equalized.

Combining equations [8], [A1.6], [A1.7], and [A1.8] and inserting them in the equation [A1.2], we can calculate the equilibrium portfolio shares (implicitly) and the consumption-wealth ratio in the domestic open economy

$$\begin{aligned}
\alpha - \eta &= (1-\gamma)\left[n_d \sigma_y^2 + n_d^* \sigma_{yy^*}\right] && \text{[A1.9]}\\
\alpha^* - \eta &= (1-\gamma)\left[n_d^* \sigma_{y^*}^2 + n_d \sigma_{yy^*}\right] && \text{[A1.10]}\\
n_b &= 1 - n_d - n_d^* && \text{[A1.11]}\\
\frac{C}{W} &= \frac{1}{1-\gamma}\left[\beta - \gamma\rho + 0.5\gamma(1-\gamma)\sigma_w^2\right], && \text{[A1.12]}
\end{aligned}$$

where

$$\sigma_w^2 = n_d^2 \sigma_y^2 + 2 n_d n_d^* \sigma_{yy^*} + n_d^{*^2} \sigma_{y^*}^2.$$

A2. Second order conditions

In this appendix we check the second order condition and the transversality condition.

To guarantee that consumption is positive in the domestic open economy we impose the feasibility condition that the marginal propensity to consume out of wealth must be positive since wealth does not become negative

$$\frac{1}{1-\gamma}\left[\beta - \gamma\rho + 0.5\gamma(1-\gamma)\sigma_w^2\right] > 0.$$

For the first order optimality conditions to characterize a maximum, the corresponding second order condition must be satisfied, that is, the Hessian matrix associated to the maximization problem and evaluated at the optimal values of the choice variables

$$\begin{bmatrix} (\gamma-1)(V'(W))^{\frac{\gamma-2}{\gamma-1}} & 0 \\ 0 & V''(W)W^2\Delta \end{bmatrix}$$

must be negative definite,[21] which implies that

$$\begin{aligned}(\gamma-1)\left(V'(W)\right)^{\frac{\gamma-2}{\gamma-1}} &< 0\\ V''(W)W^2\Delta &< 0,\end{aligned}$$

where $\Delta=\sigma_y^2+2\sigma_{yy^*}+\sigma_{y^*}^2>0$. To evaluate those conditions first we obtain the value of the coefficient A in equation [A1.6]

$$A=\frac{1}{\gamma}\left(\frac{C}{W}\right)^{\gamma-1}, \qquad \text{[A2.1]}$$

where C/W is the optimal value obtained in equation [A1.12]. Then substituting expression [A2.1] into the value function [A1.1], we get that the value function is given by

$$V(W)=\frac{1}{\gamma}\left(\frac{C}{W}\right)^{\gamma-1}W^{\gamma}, \qquad \text{[A2.2]}$$

where we can observe that, given the restrictions on the utility function, $V'(W)>0$ and $V''(W)<0$ provided that $C/W>0$.

In addition, we impose that the macroeconomic equilibrium must satisfy the transversality condition so as to guarantee the convergence of the value function

$$\lim_{t\to\infty}E\left[V\left(W\right)e^{-\beta t}\right]=0. \qquad \text{[A2.3]}$$

Now it can be shown that should the feasibility condition be satisfied then that is equivalent to satisfying the transversality condition.[22] To evaluate [A2.3], we start expressing the dynamics of the accumulation of wealth

$$dW=\psi W dt+W dw. \qquad \text{[A2.4]}$$

The solution to equation [A2.4], starting from the initial wealth $W(0)$, is[23]

$$W(t)=W(0)e^{(\psi-0.5\sigma_w^2)t+w(t)-w(0)}.$$

[21] See Chiang (1984, pp. 320-323), for example.
[22] See Merton (1969). Turnovsky (2000) provides, for example, the proof of the transversality condition as well.
[23] See Malliaris and Brock (1982, pp. 135-136), for example.

Since the increments of w are temporally independent and are normally distributed then[24]

$$
\begin{aligned}
E[AW^{\gamma}e^{-\beta t}] &= E[AW(0)^{\gamma}e^{\gamma(\psi-0.5\sigma_w^2)t+\gamma[w(t)-w(0)]-\beta t}] \\
&= AW(0)^{\gamma(1+\eta)}e^{\left[\gamma(\psi-0.5\sigma_w^2)+0.5\gamma^2\sigma_w^2-\beta\right]t}.
\end{aligned}
$$

The transversality condition [A2.3] will be satisfied if and only if

$$\gamma\left[\psi - 0.5\gamma\left(1-\gamma\right)\sigma_w^2\right] - \beta < 0.$$

Now substituting equations [10] and [A1.12], it can be shown that this condition is equivalent to

$$\frac{C}{W} > 0, \tag{A2.5}$$

and thus feasibility guarantees convergence as well.

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Resumen

Este artículo ofrece una extensión de la regla nueva para la cuenta corriente [Kraay y Ventura (2000)] abandonando el supuesto de una pequeña economía abierta: la respuesta de los shocks de renta transitorios sobre la cuenta corriente es igual a la regla nueva (ahorro originado por el shock multiplicado por las tenencias de activos extranjeros sobre el total de los activos internos) más el ahorro originado por el shock en la economía extranjera multiplicado por la participación que supone el capital doméstico en el país extranjero respecto al total de activos extranjeros. La regla nueva ampliada proporciona una descripción satisfactoria del comportamiento de las cuentas corrientes, incluso mejor que la regla nueva, que sería rechazada por la evidencia reciente.

Palabras clave: Cuenta corriente, enfoque intertemporal, regla tradicional, nueva regla.

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