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THE ROLE OF TWO INTEREST RATES IN THE INTERTEMPORAL CURRENT ACCOUNT MODEL

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We analyze the role of the lending-deposit interest rate spread in the dynamics of the current account in developing countries. For that purpose, we extend the standard perfect-foresight intertemporal model of the current account for the existence of the interest rate spread and simulate the convergence path of developing economies. This model helps explain why in many cases it is optimal for a fast-growing, low-income country to run a balanced current account.

Keywords: Intertemporal Current Account, Financial Market Imperfections, Economic Convergence

1. INTRODUCTION

The literature on current account dynamics has evolved over time. Starting from the seminal articles by Buiter (1981) and Sachs (1981), the focus changed from intratemporal factors, such as relative prices and demand, to intertemporal factors, where expectations of the future influence savings and investment decisions. According to the latter perspective, the current account reflects the optimal transfer of consumption opportunities across time rather than indicating any economic disequilibrium implicit in intratemporal models.

As extensively discussed by Singh (2007), the early literature on the intertemporal approach to the current account (ICA) relied on perfect-foresight optimizing models to conduct calibrated simulations examining the direction and magnitude of the current account response to structural monetary, fiscal, or terms-of-trade shocks. The early literature, however, rarely tested the empirical fit of the ICA model to the data. Attempts to do so started in the early 1990s and proceeded along three main directions.

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The first strand of the literature applied the "present value test," as developed by Campbell (1987), to examine whether the current account balance was equal to the present value of expected future declines in net output [Sheffrin and Woo (1990)]. The framework was extended subsequently by emphasizing the role of interest and exchange rates variability [Bergin and Sheffrin (2000)]; incorporating consumption habits [Gruber (2004)]; or adding an exogenous world real interest rate shock [Nason and Rogers (2006)]. This literature typically concluded that the ICA model is rejected by the data on account of higher volatility of the observed current account figures in comparison to the model-predicted series. As summarized by Bergin (2006), the current account dynamics of many countries has proven quite difficult to explain in terms of macroeconomic models using present value tests.

The second strand of the literature applied standard econometric techniques to establish if there is a long-term relationship between the current account and standard macroeconomic fundamentals affecting savings and investment, such as relative GDP per capita, the demographic structure, or fiscal policy. The most relevant examples of this analytical approach are the studies by Faruqee and Debelle (1996) and by Chinn and Prasad (2003). The associated panel-data regressions generally confirm some of the ICA model implications, in particular, that there is a positive relationship between the current account and per capita GDP across countries. However, the estimated coefficients of the relationship between the relative income and the current account tend to be substantially lower than values implied by the permanent income hypothesis.

The third strand of the literature applied full-fledged general equilibrium ICA models to explain the observed current account patterns in selected countries. Most notably, Blanchard and Giavazzi (2002) show that increased product and financial markets integration helps understand the widening current account deficit in Greece and Portugal. Fagan and Gaspar (2007), within the ICA framework, explain why a group of converging economies, having seen a sizable fall in their domestic interest rates after joining the euro area, experienced a rise in their current account deficit. In the same vein, Ca' Zorzi and Rubaszek (2008) show that current account patterns observed in the euro area can be explained by intertemporal optimization considering the set of initial conditions (defined in terms of productivity, capital stock, and net foreign assets) and expectations of a gradual process of convergence. Even though these articles constitute some evidence in favor of the ICA model, forecasting tests are less encouraging. For example, Bergin (2003, 2006) shows that a dynamic stochastic ICA model is not able to beat a random walk or vector autoregressions in predicting future movements of the current account.

The preceding discussion shows that, despite their appeal, ICA models need to be refined to better characterize the reality. This appears especially true for low-income converging economies, for which the standard ICA models predict high and persistent current account deficits, an order of magnitude greater than what is observed in practice.[1] In this article we put forward the hypothesis that the limited empirical performance of the standard ICA models is related to the fact that they assume that there exists only one domestic interest rate, which is the same for deposits and loans. In the real world, however, these rates tend to be substantially different.[2]

The problem of optimal consumption under a differential in the interest rates on deposits and loans was first introduced by Fisher (1930) in a two-period setup. He showed that for some income paths, households would like to make deposits at the borrowing rate and loans when confronted with the deposit rate. As these rates are different, however, their consumption is equal to their current income. These results, which were subsequently extended to the multiperiod case by Watkins (1969) and Hassin and Lieber (1982), indicate that households might consume their entire income because prevailing market conditions discourage them from both making deposits and taking loans. At the country level, the existence of the interest rate spread can explain why low-income converging economies are typically not running high current account deficits, leading to a sizeable build-up of foreign debt, as is implied by the standard ICA model. Even though households would like to smooth their consumption on account of expected growth in income, the high intertemporal price of future consumption, which is given by the lending rate, constraints them from doing so. As a result, their consumption follows their income closely.

So far, these considerations have been ignored in the ICA literature. One reason might be of a technical nature: in an environment with different rates on assets and debt, the relation between the net financial position of households and the interest rate is not continuous around the steady state. Consequently, the standard perturbation techniques of solving dynamic general equilibrium models cannot be applied in this setting. In this article we tackle this problem by using numerical direct optimization methods. However, because perturbation techniques cannot be applied in our framework, we limit our analysis to the perfect-foresight framework, leaving it for further research to relax the one-interest assumption in a stochastic ICA model.

The main contribution of this paper is that we show that because of the existence of the interest rate spread, it might be optimal for low-income, converging economies to run balanced current accounts. Moreover, we indicate that for small values of the spread, further narrowing can have very substantial effects on savings and investment decisions, and hence on the level of the current account.

The article is structured as follows. Sections 2 describes the ICA model, whereas Section 3 discusses the method of solving it. Section 4 presents simulation results, which show that in the environment of two interest rates the model implies current account deficits of low-income converging economies substantially lower than the standard ICA model would imply. The last section concludes.

2. THE MODEL

The model economy is populated by representative households that are both consumers and producers. The economy is small, open, and subject to a convergence

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process. There is a banking sector, which differentiates between lending and deposit rates. Finally, capital is subject to installation costs. In the exposition of the model, we use lower-case letters for individual variables, whereas capital letters stand for country aggregates.

2.1. Households

The model economy is populated by a continuum of identical household producers maximizing their utility from consumption c_t,

$$\max U_0 = \sum_{t=0}^{T} \beta^t u(c_t), \tag{1}$$

and producing output y_t according to the Cobb–Douglas technology,

$$y_t = k_t^\alpha Z_t^{1-\alpha}. \tag{2}$$

Here k_t is per-household level of capital available at the beginning of period t and Z_t stands for aggregate productivity. Produced output can be invested in capital, deposited in a bank, or consumed. The capital stock evolves in line with the equation [Hayashi (1982)]

$$k_{t+1} = (1-\delta)k_t + i_t(1-\psi\kappa_t), \tag{3}$$

where i_t is investment expenditures, δ the depreciation rate, and ψ the capital adjustment cost parameter. The variable κ_t is the individual investment–capital ratio relative to its steady-state value IK^*, $\kappa_t = (i_t/k_t)/IK^*$.

Households can participate in financial markets through banks, which offer loans and deposits at gross rates R_t^L and R_t^A. Finally, consumption is taxed at rate τ. As a result, the representative household faces the budget constraint

$$a_{t+1} - l_{t+1} = R_t^A a_t - R_t^L l_t + y_t - i_t - (1+\tau)c_t, \tag{4}$$

where $a_t \geq 0$ and $l_t \geq 0$ are deposits and loans at the beginning of period t.

2.2. Banks

The banking sector is perfectly competitive. Banks are maximizing profits from loans l_t^b and deposits a_t^b, for which rates are equal to r_t^L and r_t^A, respectively. The difference between collected deposits and granted loans is covered by participation in the interbank market, where funds can be raised or deposited at a rate R_t. Profits of a representative bank are equal to

$$\pi_t = \left(r_t^L - R_t\right) l_t^b + \left(R_t - r_t^A\right) a_t^b - \Phi(l_t^b, a_t^b), \tag{5}$$

where Φ is an increasing and differentiable cost function, with the first derivatives Φ_1 and Φ_2. Expression (5) is maximized for

$$r_t^L = R_t + \Phi_1\left(l_t^b, a_t^b\right),$$
$$r_t^D = R_t - \Phi_2\left(l_t^b, a_t^b\right). \quad \textbf{(6)}$$

As all banks are assumed to be identical, the countrywide level of the rates is $R_t^L = r_t^L$ and $R_t^A = r_t^A$.

Two things should be noted. First, we justify the existence of the interest rate spread solely by fixed costs, whereas in reality other factors are also significant [Ho and Saunders (1981); Saunders and Schumacher (2000)]. Second, the specification implies null profits of the banking sector.

2.3. Closing the Model and the Current Account

To close the model, we make the following assumptions. First, the government runs a balanced budget; i.e., tax revenues are spent in the form of public expenditures (G_t):

$$G_t = \tau C_t. \quad \textbf{(7)}$$

Second, the country's productivity is converging to its steady-state path Z_t^*, which is growing at a deterministic rate γ:

$$Z_t = \rho Z_{t-1} + (1-\rho) Z_t^*,$$
$$Z_t^* = \gamma Z_{t-1}^*. \quad \textbf{(8)}$$

Third, the interbank interest rate is constant and equal to the world interest rate, at which domestic banks can borrow from abroad:

$$R_t = R^*. \quad \textbf{(9)}$$

The current account is calculated as the increment in the stock of net foreign assets, i.e.,

$$CA_t = (A_{t+1} - L_{t+1}) - (A_t - L_t), \quad \textbf{(10)}$$

where changes in aggregate assets and liabilities are given by

$$A_{t+1} - L_{t+1} = R_t^A A_t - R_t^L L_t + Y_t - C_t - I_t - G_t. \quad \textbf{(11)}$$

3. SOLVING THE MODEL

As indicated in the Introduction, the standard perturbation techniques of solving dynamic general equilibrium cannot be applied to a framework with two interest rates.[3] For that reason, we use direct optimization techniques, which can be applied only to problems with a finite number of control variables. As a result, we write the optimization problem faced by households in a finite-horizon setting. We set the

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horizon T at 100, so that the solution will be a good approximation of household decisions in the infinite-horizon setting.[4]

The optimization problem is as follows. Households maximize their utility, given by (1), by choosing the sequences of c_t, i_t, a_{t+1}, l_{t+1}, and implicitly k_{t+1} that satisfy equality constraints (2), (3) and (4), nonnegativity conditions $a_t \geq 0$ and $l_t \geq 0$, terminal conditions $a_{T+1} = 0$, $l_{T+1} = 0$ and $k_{T+1} = K^*_{T+1}$, given the initial values a_0, l_0 and k_0. The Lagrangian takes the form

$$\begin{aligned}\mathcal{L} = \sum_{t=0}^{T} \{ & \beta^t u(c_t) + \lambda_t \left[R^A_t a_t - R^L_t l_t + k^\alpha_t Z^{1-\alpha}_t - i_t - (1+\tau)c_t - a_{t+1} + l_{t+1} \right] \\ & + q_t \left[(1-\delta)k_t + i_t(1-\psi\kappa_t) - k_{t+1} \right] + \mu^A_t a_{t+1} + \mu^L_t l_{t+1} \} \\ & + \nu^A a_{T+1} + \nu^L l_{T+1} + \nu^K (k_{T+1} - K^*_{T+1}) + \omega^A a_0 + \omega^L l_0 + \omega^K k_0. \end{aligned} \tag{12}$$

The respective Karush–Kuhn–Tucker (KKT) first-order conditions are

$$c_t : \lambda_t = \frac{\beta^t}{1-\tau} u'(c_t), \tag{13}$$

$$a_{t+1} : \lambda_t = R^A_{t+1}\lambda_{t+1} + \mu^A_t, \tag{14}$$

$$l_{t+1} : \lambda_t = R^L_{t+1}\lambda_{t+1} - \mu^L_t, \tag{15}$$

$$i_t : \lambda_t = q_t(1 - 2\psi\kappa_t), \tag{16}$$

$$k_{t+1} : q_t = \lambda_{t+1}\alpha \left(k_{t+1} Z^{-1}_{t+1} \right)^{\alpha-1} + q_{t+1} \left[(1-\delta) + \psi\kappa^2_{t+1} I K^* \right]. \tag{17}$$

Equation (13) defines the present value of the marginal utility from consumption, which according to equations (14) and (15) is decreasing at a gross rate lying in the interval $[R^A_t; R^L_t]$. It can be noticed that if $a_{t+1} > 0$ then the decrease rate is equal to R^A_t and if $l_{t+1} > 0$ then it amounts to R^L_t. Equation (16) relates the market value of capital q_t to the marginal utility of consumption, whereas equation (17) determines the dynamics of q_t.

4. THE RESULTS

This section presents the results of a number of simulations showing the convergence path of the model economy, focusing on the role of the initial conditions and the interest rate spread. We start by discussing the parameterization of the model and the resulting steady state. Then we elaborate on the relationship between GDP per capita, the initial stock of capital, the interest rate spread, and the current account. Finally, we perform sensitivity analysis with respect to model parameterization.

4.1. Parameterization

The model economy is calibrated at an annual frequency. The utility function is chosen to be logarithmic, $u(c_t) = \ln c_t$, but the general findings presented here would still hold for a general class of concave and differentiable functions. The steady-state growth rate of productivity γ is set to 1.5% per year and the discount factor β to 0.975, which implies that the steady-state real interest rate R^* is around 1.04. The coefficient ψ is fixed at 0.10, so that in the steady state 10% of investments covers installation costs [see Roeger and in 't Veld (2004)]. The depreciation rate δ is chosen to be 0.08 and the share of capital α is 0.30, which implies steady-state investment and capital–output ratios of 0.23 and 2.19, respectively. The tax rate τ is fixed at 0.33, so that private consumption and government spending constitute 58% and 19% percent of GDP. These values do not deviate from the standard parameterization of general equilibrium models. More detailed discussion can be found, e.g. in Ca' Zorzi and Rubaszek (2008) or Smets and Wouters (2007).

For the remaining parameters, we fixed the convergence pace ρ at 0.95, so that the half-life of the productivity gap amounts to around 13 years. This assumption is clearly more optimistic than the literature consensus of around 0.98, but we decided to use this value to show that even a high speed of convergence might not be sufficient to generate a current account deficit in the environment of high interest rate spread. Finally, we set both interest rate spreads $R^L - R^*$ and $R^* - R^A$ at 2%, a value based on the World Bank WDI data.

4.2. Simulating Convergence Path

The first simulation investigates the convergence path of the model economy for different assumptions concerning the initial level of GDP per capita. We assume that the starting value of the capital–output ratio is equal to its steady-state value, $KY_0 = KY^*$, and that net foreign assets are null, $B_0 = 0$. These additional assumptions are helpful in isolating the impact of the interest rate spread on the current account dynamics in converging economies. However, we will relax them later, considering that developing countries are generally characterized by lower capital–output ratios [Nehru and Dhareshwar (1993)] than industrial countries and run positive net foreign debt [Lane and Milesi-Ferretti (2001)].

Let us focus first on the results for a country that starts its convergence from low GDP per capita, equal to one-fourth or one-third of its steady-state value ($*$ and $\diamond$ markers on Figure 1). In the initial years the country is running a substantial current account deficit and accumulates foreign debt. New investment is delayed until the moment at which the rate of return on new projects reflects the borrowing rate R^L. As a result, in the initial years the capital–output ratio is falling to around 80% of its steady-state value, where it fluctuates for another 20 years. As regards the growth rate of consumption, at the beginning it is equal to βR^L_t. Subsequently, starting from period 15, the current account turns into surplus. The foreign debt

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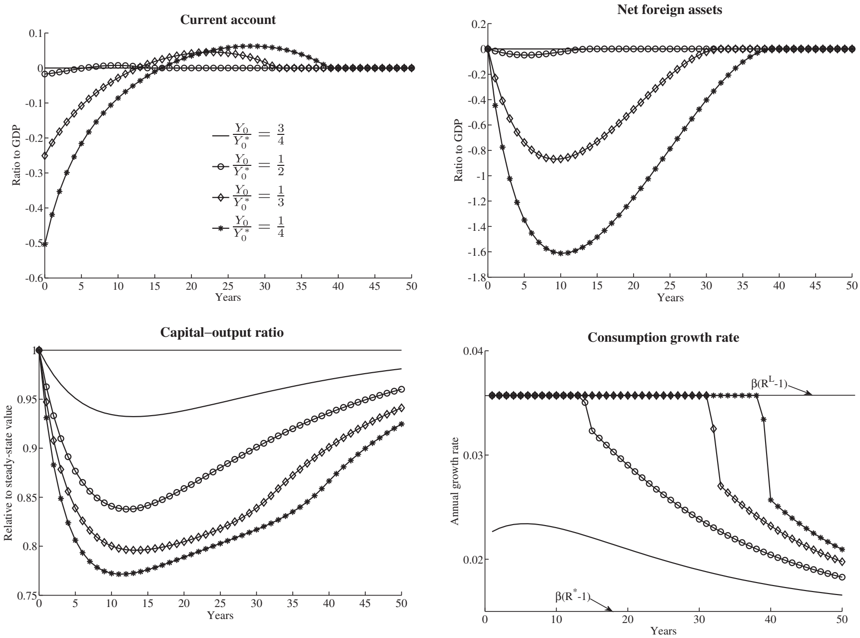

FIGURE 1. Convergence path and the initial value of GDP per capita. Simulations are performed for the basic parameterization of the model, assuming that $KY_0 = KY^*$ and $B_0 = 0$.

is declining, to be paid back around period 35–40. The capital stock is rebuilt steadily, so that the return on new investment reflects the dynamics of marginal utility from consumption λ_t, which converges to βR_t.

The result for a country that starts its convergence story from a relatively higher GDP per capita, equal to half or two-thirds of its steady-state value (*o* marker and straight line in Figure 1), is different. The current account is closed or its deficit never exceeds 3% of GDP. The process of consumption smoothing is reflected mainly in a decline of the capital–output ratio, which is falling because the intertemporal price of consumption in the initial periods is higher than its steady-state value R_*. This, in turn, requires an augmented rate of return on new investment projects.

4.3. Comparison to the Standard ICA Model

The preceding results constitute a significant change from the standard ICA model with one interest rate. To illustrate this, we solve the model in which equations (5) and (6), describing the banking sector, and equation (9), for the domestic interbank rate, are replaced by the standard equation of new open economy models with

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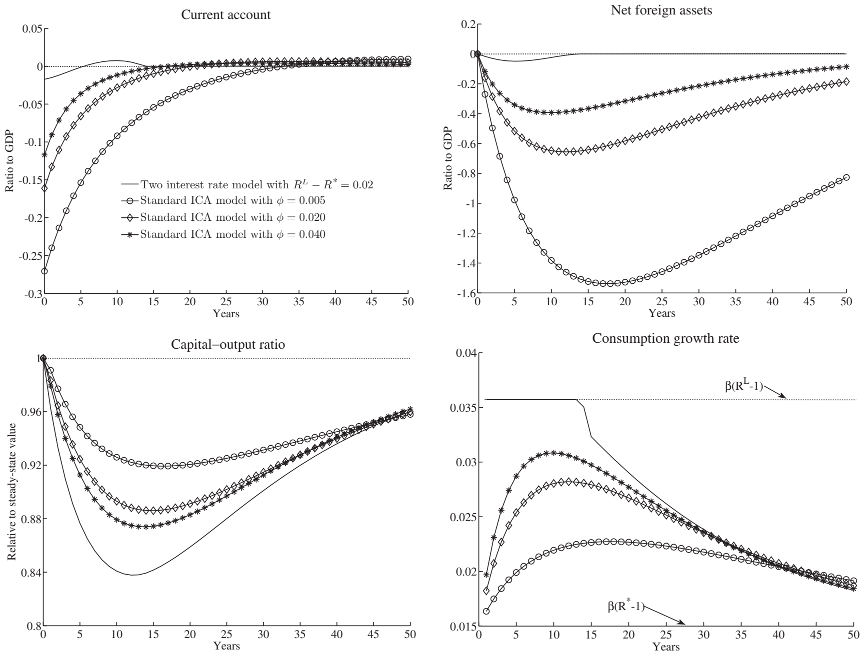

FIGURE 2. Comparison of convergence paths in two interest rate and standard ICA models. Simulations are performed for the basic parameterization of the model, assuming that $Y_0 = 0.5 \times Y_0^*$, $KY_0 = KY^*$, and $B_0 = 0$.

market imperfections [Benigno (2009)],

$$R_t^L = R_t^A = R_t = R^* \exp\left(-\phi \frac{B_t}{Y_{t-1}}\right). \quad \textbf{(18)}$$

We compare the solution of the models for a country that starts its convergence with GDP per capita equal to half of its steady-state value, the capital–output ratio at the steady-state level, and null net foreign assets. We investigate convergence paths for three values of the parameter ϕ, equal to 0.005, 0.02, and 0.04, which imply that a decrease in net foreign assets by 10% of GDP increases the domestic interest rate by 5, 20, and 40 basis points, respectively.

The results, which are presented in Figure 2, show that the current account deficit in the standard ICA model is substantially higher than that in the two–interest rate model. This is because in the initial periods, before net foreign debt is accumulated, the difference between domestic and foreign interest rates is not distant from zero. As a result, the consumption growth rate is lower, which translates into a higher level of consumption in the first 40 years of the convergence process. Better opportunities to smooth consumption through financial markets participation in

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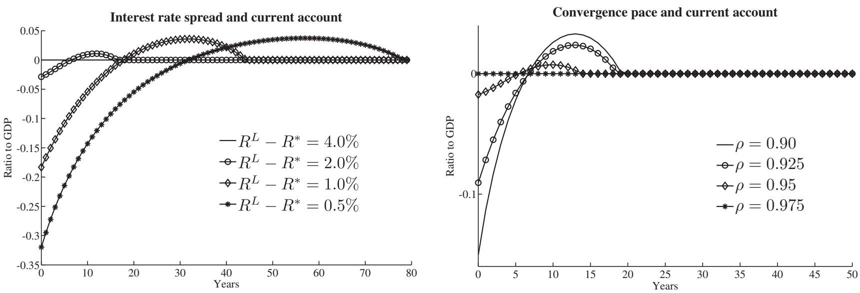

FIGURE 3. The current account paths for different structural parameters. Simulations are performed for the basic parameterization of the model, assuming that $Y_0 = 0.5Y_0^*$, $KY_0 = KY^*$, and $B_0 = 0$.

the standard ICA model are also reflected in a shallower decline in the capital–output ratio than in the two–interest rate model.

4.4. Convergence Path and Model Parameterization

We continue our analysis by simulating the convergence path of the model economy for different values of the parameters interest rate spread $R_t^L - R^*$ and convergence pace ρ. The existence of the interest rate spread is dampening the process of consumption smoothing as, in the case of developing economies, the present value of future consumption is relatively high. This is illustrated by the left side of Figure 3, which presents the relationship between the interest rate spread and the current account deficit for the model economy with initial GDP per capita equal to half of its steady-state value. We simulated the convergence path for four values of the lending–interbank interest rate spread. The results point out that even small changes in the spread have large effects on the theoretical value of the current account deficit. For a relatively small interest rate spread, amounting to 0.5 percentage point, the current account deficit in the initial period amounts to over 32% of GDP, whereas for spreads equal to 1.0 and 2.0 percentage points, the deficit falls to about 18% of GDP and 3% of GDP, respectively. When the spread is relatively large, equal to 4.0 percentage points, the current account is closed.

In our model, the pace of convergence is also an important factor influencing the current account dynamics, which is in line with the panel data results of Chinn and Prasad (2003) or Bussiere et al. (2004). This is illustrated by the right-side panel of Figure 3, which shows that fast-growing economies, with convergence pace $\rho = 0.90$, should run relatively high current account deficits, amounting to around 15% of GDP in the initial period of the simulation. In the case of a country with identical initial conditions, but for which the convergence pace is four times lower, $\rho = 0.975$, the current account is null. These results show that countries with a substantial income gap might not report a current account deficit, especially if the interest rate spread is high or the convergence pace is low.

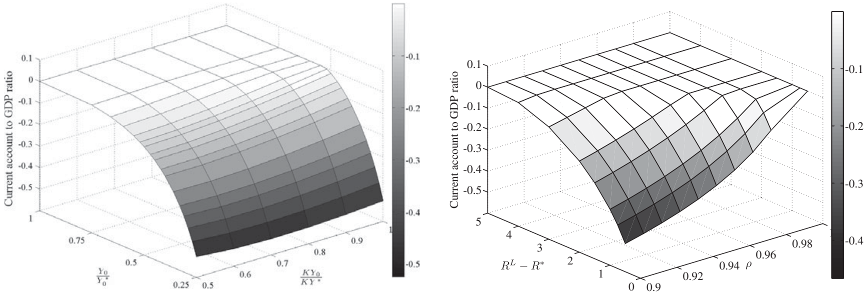

FIGURE 4. The current account and initial conditions. Simulations are performed for the basic parameterization of the model, assuming that $B_0 = 0$. The current account values refer to the first period of simulations.

4.5. When Current Account Deficits Are Null

In the proposed model, the existence of the interest rate spread has significant effects on consumption and investment decisions of households. For many combinations of initial conditions, the current account balance is closed, which means that consumption and investment are constrained by the current income. The question might arise, for which starting values of relative GDP per capita and capital stock-to-output ratios is the current account closed? We investigate this problem by simulating the convergence path for the grid of Y_0, ranging from $0.25Y_0^*$ to Y_0^*, and KY_0, ranging from $0.5KY^*$ to KY^*. The results of these simulations, which are presented in the left panel of Figure 4, show that the current account deficit in countries with $KY_0 = KY^*$ exists if the initial GDP per capita is below 0.52 of its steady-state value. At the other extreme, for countries with low initial capital stock, $KY_0 = 0.5KY^*$, current account deficit prevails if the initial GDP per capita is below 0.75 of its steady-state value. The results also show that a double-digit current account deficit should be observed for low per capita income countries, with the initial output lower by 60% than its steady-state value. It should be noted that this finding is relevant for a productivity convergence pace amounting to 5% per year and the spread between the borrowing and interbank rates of about 2 percentage points. In practice, financial conditions in poor countries tend to be much tougher and the convergence pace lower, which has a dampening effect on the current account deficit.

We address this issue in the next simulation, where we investigate for which values of ρ and $R^L - R^*$ a country with an initial GDP per capita $Y_0 = 0.5Y_0^*$ and capital–output ratio $KY_0 = KY^*$ would run a current account deficit. In this case, the convergence path is simulated for ρ ranging from 0.9 to 1.0, and $R^L - R^*$ ranging from 0.5% to 5.0%. The results, which are given by the right panel of Figure 4, show that for a country converging at 2% per year, i.e., in line with the literature consensus, it runs a current account deficit if the lending–interbank rate spread is relatively narrow and amounts to less than 1.0%. For an interest rate

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spread equal to 4%, which is a more realistic description of emerging markets, a current account deficit would be the outcome of an extremely rapid pace of convergence, amounting to 10% per year. Finally, it can be noted that the model implied current account deficit for a fast-converging economy ($\rho = 0.90$) in the environment of low interest rate spread ($R^L - R^* = 0.5\%$) amounts to almost 50% of GDP, a value that is close to the implications of the standard ICA model.

5. CONCLUSIONS

The standard intertemporal model of the current account assumes that the rates on deposits and loans are the same. One of the implications of this assumption is that fast-converging economies with initially low per capita output should run substantial current account deficits, which are hardly observed in reality. In this paper we have argued that the poor performance of the standard ICA model might be explained to some degree by the existence of the lending–deposit interest rate spread. For that purpose, we have developed a perfect-foresight general equilibrium model with two interest rates and performed a series of simulations to show that even a small change in the interest rate spread might have a tremendous effect on the current account balance, especially if the interest rate spread is close to zero. Moreover, we believe that our results provide an intuition as to why emerging markets may not choose to have a current account deficit, even when decisions are taken with an intertemporal perspective. If the interest rate spread is high, investment in low-income, converging economies is equal to savings, in line with Feldstein and Horioka (1980).

Further research related to the proposed framework can evolve in three main directions. First, the specification of the model could be developed to embody other features that may be appropriate in explaining current account fluctuations. Second, it might be reasonable to introduce the two–interest rate setup into models other than those aimed at analyzing current account developments. Taking into account the empirical evidence that the development of the financial sector has a positive impact on growth [Rajan and Zingales (1998)], economic growth models could be a good candidate. Finally, and most importantly, it would be very interesting to introduce two interest rates into a DSGE setup to analyze the implications of the lending–deposit interest rate spread for the shape of impulse responses to structural shocks. However, to do this, new methods of solving DSGE models need to be developed.

To summarize, it is evident that the role of two interest rates is a relatively unexplored field in microfunded optimizing models, which currently dominate modern macroeconomics. These models assume that rates on deposits and loans are the same, which is strongly in opposition to what we observe in reality. In this paper, we have shown that the existence of the interest rate spread can significantly change the implications of the standard ICA model for the current account dynamics. We put forward the hypothesis that the existence of the spread has an important impact on the dynamics of other macroeconomic variables, the verification of which we leave for further research.

NOTES

1. Obstfeld and Rogoff (1996) provide a more extended discussion of this issue.

2. For example, the World Bank WDI data show that for developed countries the median interest rate spread in the last three decades amounted to over 4% (http://data.worldbank.org/indicator/FR).

3. Some authors have recently proposed DSGE models with two interest rates that are solved by perturbation techniques. This is possible, however, only if it is assumed that there are two group of agents that are heterogenous in terms of utility function [Cúrdia and Woodford (2009)] or discount factor [Gerali et al. (2010)].

4. Lau et al. (2002) provide a detailed discussion of how and why infinite-horizon models can be approximated by finite-horizon ones.

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