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Current Account Norms in Natural Resource Rich and Capital Scarce Economies

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Abstract

The permanent income hypothesis implies that frictionless open economies with exhaustible natural resources should save abroad most of their resource windfalls and, therefore, feature current account surpluses. Resource-rich developing countries (RRDCs), on the other hand, face substantial development needs and tight external borrowing constraints. By relaxing these constraints and providing a key financing source for public investment in RRDCs, temporary resource revenues might then be associated with current account deficits, or at least low surpluses. This paper develops a neoclassical model with private and public investment and several frictions that capture pervasive features in RRDCs, including absorptive capacity constraints, inefficiencies in investment, and borrowing constraints that can be relaxed when natural resources lower the country risk premium. The model is used to study the role of investment and these frictions in shaping the current account dynamics under windfalls. Since consumption and investment decisions are optimal, the model also serves to provide current account benchmarks (norms). We apply the model to the Economic and Monetary Community of Central Africa and discuss how our results can be used to inform the current account norm analysis pursued at the International Monetary Fund.

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I. Introduction

A. Motivation

Resource-rich developing countries (RRDCs) with exhaustible natural resources have to manage windfalls that may induce significant macroeconomic effects in their economies, including on external stability.[1] During a windfall, they must decide how much to consume or save out of this transitory and sizeable resource income, as well as how much to invest. By doing so, they implicitly determine the macroeconomic impact of the windfall, including on the current account balance and, therefore, on external stability. With the significant rise of resource prices in the last ten years, the issue of how to manage resource windfalls has become more prominent in policy discussions, especially when history has showed that many countries failed to manage past booms causing abrupt external adjustments. At the same time, this coincides with a period when external sector assessments have received renewed attention in the work of the International Monetary Fund (IMF).[2]

At the IMF, external sector assessments rely on the Consultative Group on Exchange Rate Issues (CGER) and External Balance Assessment (EBA) methodologies and, more recently for resource-rich countries, on the model-based approach developed by Bems and Carvalho (2009).[3] At the core of this model-based approach lies Friedman's (1957) permanent income hypothesis (PIH), which implies that frictionless open economies with exhaustible natural resources should save most of their resource windfalls abroad and face *current account surpluses*. By saving abroad the resource windfall—in a sovereign wealth fund, for instance—countries can smooth consumption, preserve resource wealth, ensure intergenerational equity, and maintain macroeconomic stability.[4] However, since Bems and Carvalho's frictionless model abstracts from investment dynamics, the existence of large development investment needs and pervasive frictions in RRDCs questions the use of such PIH-based frameworks to assess external stability in these countries. This calls for efforts to further understand the role that, during boom periods, optimal saving and investing decisions may play for the current account dynamics—external stability—in RRDCs.

Development considerations suggest that in RRDCs windfalls should finance investment and, as a result, can be associated with lower current account surpluses or even deficits. Collier et al. (2010) and van der Ploeg and Venables (2011a) argue that since these countries are capital scarce and face external borrowing constraints, they should use windfalls to speed up development by financing the accumulation of physical and human capital. Because of capital scarcity, the return to capital in these countries is likely to be higher than world interest rates, so investing domestically ensures

[1] In this paper resource-rich developing countries refers to low- and lower-middle income countries with exhaustible natural resources (e.g., oil and minerals).

[2] A comprehensive review of the Fund's surveillance activities supported the need for renewed emphasis on external stability (See IMF, 2011a).

[3] For the CGER methodology, see Lee et al. (2008) and for EBA see IMF (2012b). Bems and Carvalho (2009) extend the CGER external sustainability approach—which determines the external sector balance that would bring the net foreign asset position (NFA) of a country to a desired level—allowing for a long-term trend in NFA in order to accommodate the temporary nature of exhaustible resources.

[4] See, for instance, Davis et al. (2001) and Barnett and and Ossowski (2003).

a much higher return than that of the PIH recommendation of saving abroad. In addition, since resource revenues may help relax borrowing constraints, RRDCs can expand the financing sources for investment projects necessary to fill the development gap and for consumption front-loading. With more external borrowing, higher investment and consumption, it is then possible that resource revenue windfalls can lead to current account deficits in RRDCs.

The data at first glance suggest that, on average, RRDCs have faced lower current account balances than higher income countries, during the period 1960-2011 (Chart A in Figure 1). However, a closer inspection reveals that during periods of windfalls, the current account balances in RRDCs have not been particularly different from those of higher income countries (Chart B in Figure 1).[5,6] This evidence does not generally conform with the previously discussed development considerations and raises several questions.

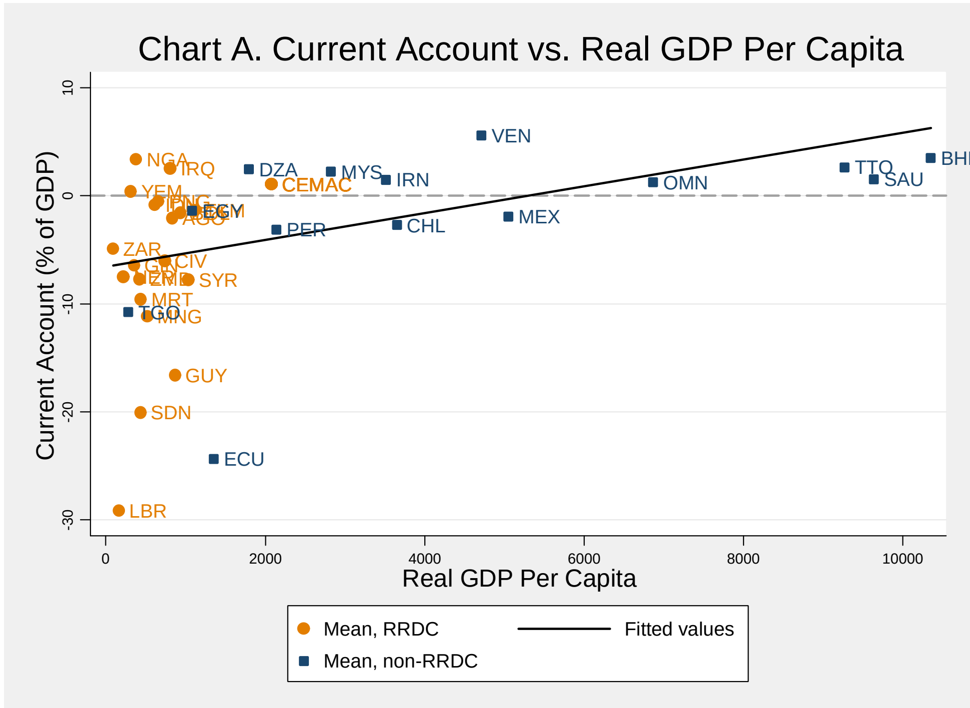
How important are these development considerations—investment needs and frictions such as external credit constraints—in shaping the current account dynamics and external sustainability in RRDCs during windfalls? What is the *optimal* external balance in response to windfalls for RDDCs? In this paper, we take a model-based approach to address these questions. We develop a neoclassical small open economy model with capital accumulation and frictions that capture pervasive features in RRDCs, including absorptive capacity constraints, inefficiencies in investment, and external borrowing constraints that can be relaxed when resources lower the country risk premium. Relative to models that only consider consumption and satisfy the PIH, we show the extent to which these features matter quantitatively and qualitatively in driving the current account dynamics. Moreover, since we solve the social planner's problem, consumption and investment decisions are *optimal,* as is the implied current account balance.

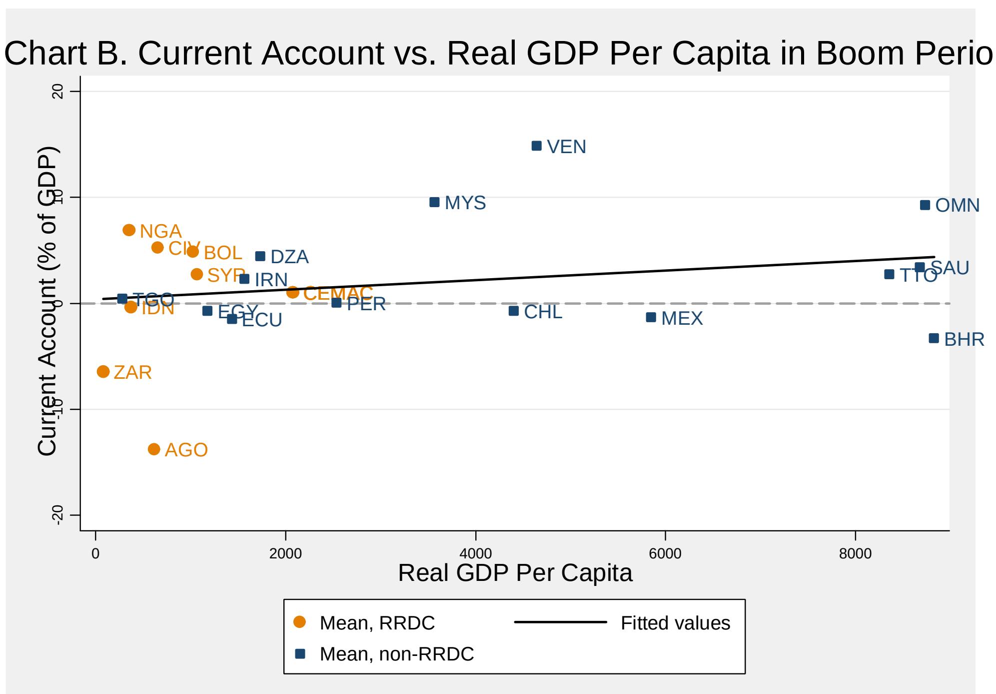
In terms of frictions, we model investment inefficiencies as impediments in translating a dollar of investment into a dollar of effectively productive capital, and absorptive capacity constraints as investment adjustment costs. Hulten (1996) and Pritchett (2000) argue, for instance, that often high productivity of infrastructure can coexist with very low returns on public investment in developing countries, because of inefficiencies in investing. As a result, public investment spending does not necessarily commensurately increase the stock of productive capital and growth, as suggested by Esfahani and Ramirez (2003).[7] Additionally, absorptive capacity constraints relate to the pace of

[5] In Chart B, boom periods are indentified in two stages. First, we find periods of expansions and recessions (cycles) using the Bry and Boscham (1971) algorithm (see also Harding and Pagan, 2002). Such a methodology searches for local maxima (peaks) and minima (droughts) in the data for each country. The algorithm is calibrated to identify cycles in resource exports of a country that last at least 4 years, with a phase of at least 2 years, and a grid (window) to find local peaks and troughs of 5 years. Once the cycles are obtained, the booms are finally identified for those expansion periods in which the cumulative change in resource exports is above the 90th percentile of the entire period of expansion for a particular country.

[6] See also the econometric evidence provided by Beidas-Strom and Cashin (2011), who find no link between relative income levels and current account balances for a group of emerging market and developing countries.

[7] Even if a resource abundant LIC gets enough resources to invest, these frictions can hamper the process from translating investment into growth-inducing capital accumulation, becoming a potential explanation for the natural resource "curse" discussed by Sachs and Warner (1995)—a negative relationship between resource abundance and growth. Another explanation, which we do not explore in this paper, relies on strong Dutch disease effects—the atrophy of traded economic sectors which have positive spillovers to growth. For a detailed investigation of these issues in the context





Source: World Development Indicators, IMF World Economic Outlook, and authors' calculations.

Figure 1: Current Account versus Real GDP per Capita.[1/]

1/ Chart A presents the average current account balances and real GDP per capita for a sample of natural-resource exporting countries during the period 1960-2011. Chart B presents the same variables but focuses on natural resource boom periods. Countries are divided in RRDCs and non-RRDCs following the classification in IMF (2012a).

scaling up. In this case, additional costs can arise whenever the speed of investment negatively impact project selection, management, and implementation. The presence of these frictions is key for our analysis since they determine the appropriate speed of investment and potential widening of a current account deficit. If they are pervasive, it may be preferable to gradually invest the windfall or even postpone investment until these inefficiencies and absorptive capacity constraints become less prominent.[8]

Another important friction in the model is imperfect international capital mobility due to borrowing constraints, which is captured by introducing a country risk premium that depends on the country's external debt, as in Schmitt-Grohe and Uribe (2003). A very high premium reflects tight constraints and hence the inability of RRDCs to access external capital markets. In addition, the premium depends on the value of natural resources, capturing the fact that resource endowments can relax the borrowing constraints and, therefore, lower the premium. This is in line with the view that whenever developing economies experience new discoveries or resource prices rise in international markets, credit constraints can be relaxed, allowing for new—and sometimes excessive—borrowing, as discussed by Mansoorian (1991).[9]

We calibrate the model to the Economic and Monetary Community of Central Africa (CEMAC). Countries in this region are a good example of the challenges faced by RRDCs, since they have been credit constrained, while being endowed with exhaustible natural resources. In addition, they still face daunting developing needs that require sizeable public investments, which are not exempt from inefficiencies and absorptive capacity constraints (Tabova and Baker, 2012).

We rely on numerical simulations to derive the following results, which we believe transcend the specific CEMAC calibration.

First, absent investment frictions, imperfect capital mobility implies that oil windfalls will be mostly turned into private and public physical capital, and not fully saved in foreign assets as recommended by PIH. This tends to lower the current account balance. When the economy faces borrowing constraints, the oil revenue is used to repay debt, lowering the debt premium and interest rates. A lower interest rate contributes to consumption frontloading and allows for public and private capital accumulation and convergence of the marginal productivity of capital towards that of developed economies. The increase in investment combined with borrowing restrictions imply that RRDCs should register lower current account balances than those of a developed economy that is fully integrated to international

oil windfalls and aid surges see also Berg et al. (2010) and van der Ploeg and Venables (2010). Despite many studies supporting the existence of this "curse", overall the empirical literature points to mixed results, suggesting also the possibility of a natural resource "blessing" (see van der Ploeg, 2011b).

[8] Berg et al. (2013) show, for example, that *gradually* investing a windfall and making non-resource revenues available to cover recurrent costs of public capital can alleviate absorptive capacity constraints, help preserve resource wealth, and address concerns about growth sustainability, macroeconomic stability, and Dutch disease. Baunsgaard et al. (2012), van der Ploeg and Venables (2011b) and van der Ploeg (2011a) advocate for the so called parking strategy of postponing domestic spending until the economy is ready to implement efficient spending choices.

[9] Interestingly, Manzano and Rigobon (2007) argue that during the 1970s, when commodities' prices were high, natural resource abundant countries used them as collateral for debt. As the 1980's witnessed an important fall in the prices, these countries faced debt crises. In this regard, the previously mentioned natural resource curse might be related to a debt overhang.

capital markets. Furthermore, if oil wealth reduces the country risk premium, credit constraints are relaxed and borrowing helps further increase public and private investment, inducing lower current account balances and even deficits.

Second, with credit constraints, high investment inefficiencies or absorptive capacity constraints decelerate private and public capital accumulation, implying higher current account balances than in economies where these frictions are absent. As before, falling interest rates still lead to some tilting of consumption towards the present—moving away from standard PIH consumption behavior—as well as some increase in private and public investment. But as there are substantial inefficiencies and absorptive capacity constraints, it turns out to be optimal to reduce the speed of investment. As a result, part of the windfall is accumulated in foreign assets leading to an increased current account balance.

Third, we show that adverse resource shocks may call for buffer-stock savings and, therefore, current account surpluses. Although our analysis assumes perfect foresight and is silent on precautionary saving issues, we investigate the consequences of having an expected sudden drop in the price of the natural resource some years after the windfall starts.[10] As agents foresee this drop in prices and income, they tend to save more of the windfall before the price drop occurs. This contributes to a higher current account balance in the short term relative to that when prices are not expected to decline.

Finally, we show how, for RRDCs, our model can be used to inform the current account *norm* analysis pursued at the IMF.[11] In our model, consumption and investment decisions are *optimal* and derived from solving the social planner's problem. From this perspective, its results have normative content and can be used to provide benchmarks for the current account. We apply our model to CEMAC and show that our benchmark falls in between the underlying current account deficits for this region and the relatively high surpluses obtained under the Bems and Carvalho (2009) PIH-based approach, which abstracts from investment. Much of these results depend, of course, on making explicit investment and its frictions. For example, as we assume higher absorptive capacity constraints, then our benchmark becomes closer to the results by Bems and Carvalho, since it becomes optimal to reduce the speed of investment and save some of the windfall in NFAs.

B. Related Literature

Our focus is on external sustainability, but our work is related to the literature on the optimal behavior of consumption and investment in resource rich economies that are credit constrained and face investment inefficiencies. The relevant work by van der Ploeg and Venables (2011a) is a good example of this literature. It is then worth pointing out a couple of differences in our work. We assume that both public and private capitals are domestically owned and that their returns are driven

[10] For current account and precautionary savings issues in exporters of exhaustible resources, see Bems and Carvalho (2011) and Cherif and Hasanov (2012a, 2012b).

[11] The one-sector model is suitable to analyze current account adjustments due to non-optimal private and public sector behavior. However, the framework does not directly imply the economy's equilibrium real exchange rate.

by domestic conditions. This differs from van der Ploeg and Venables (2011a), who assume that private capital is owned by foreigners (FDI-related). This is not an innocuous assumption. As developing economies are capital scarce, in their model it is optimal to run very large FDI-financed current account deficits. In addition, this means that the economy will not build any *domestically owned private* capital over time, defeating part of the purpose of the capital-accumulation development strategy. van der Ploeg and Venables (2011a) also tie the private sector investment return to the low world interest rates implying that, in response to a windfall, private sector investment cannot rise as much as in our setup, where the return is driven in part by domestic conditions.

Our results can be also framed in the context of the literature on the link between the terms of trade (*tot*) and the current account. According to the Harberger-Laursen-Metzler (HLM) effect, a temporary rise of the *tot* improves the current account through consumption-smoothing behavior.[12] The strength of this effect diminishes with the duration of the *tot* shock, in open economy endowment setups, as shown by Obstfeld (1982) and Svensson and Razin (1983). For instance, a permanent deterioration of the *tot*, which lowers permanent income, leaves the current account unchanged, as it leads to permanently lower consumption without disrupting savings. The inclusion of investment in intertemporal models also affects these results.[13] If the effect on investment dominates the consumption-smoothing effect, the current account can move in the opposite direction of the *tot* shock. Another strand of the literature has evaluated optimal current account deficits for emerging and advanced economies, in the context of productivity shocks, using a model-based approach—e.g., Blanchard (1983) and Blanchard and Giavazzi (2002). Our work differs from these literatures in its emphasis on development specific considerations.[14]

Our paper is also related to the large and most recent literature on the medium-term determinants of current accounts. Work by Chinn and Prasad (2003), Beidas-Strom and Cashin (2011), IMF(2012a), Lee et al. (2008), and Prati et al. (2011), among others, are *empirical* and do not focus exclusively on the external sustainability issues in resource abundant and capital scarce countries. An important exception is Bems and Carvalho (2011) who followed a model-based approach. However, they concentrate on precautionary saving issues in a model where, as mentioned in the motivation, investment and its associated frictions do not play a role.[15] Cherif and Hasanov (2012a, 2012b) also discuss precautionary savings but in a model that takes into account investment decisions with constant "golden

[12] See also Ostry and Reinhart (1992), Ogaki et al. (1996), Kent and Cashin (2003), and Spatafora and Warner (1999), among others.

[13] See, for example, Sen and Turnovsky (1989) and Serven (1999).

[14] Some of our results have the flavor of the conclusions of Blanchard and Giavazzi (2002), who show that when a poor and faster-growing country achieves greater integration with a richer country, larger current account deficits are somewhat appropriate. They consider a reduction in the interest rate wedge facing the poorer country as a measure of capital account integration, which is analogous along some dimensions to an increase in natural resource rents. In addition, we have built several extra features into our framework that can be used to substantiate and manifest the caution of running persistent current account deficits for some countries. Most notably, the absorptive capacity and inefficiency considerations greatly mitigate the implications of a pure opening. Moreover, we consider finite increases in resource rents, rather than the permanent and in effect infinite scope for capital inflows implied by greater financial integration in their framework.

[15] Bems and Carvalho (2011) find that external savings are dominated by consumption smoothing motive. The results suggest that the precautionary motive in the stochastic version of the model contributes only marginally in improving the mean squared error statistics relatively to the deterministic setting.

rules". Our work differs from theirs by considering endogeneous optimal investment decisions and other features such as absorptive capacity constraints and imperfect international capital mobility.

The remainder of this paper is organized as follows. In Section II, we present the model with its main assumptions and define the open economy equilibrium. In Section III, we pursue some simulations to shed light on how introducing investment and the aforementioned frictions can affect the current account dynamics. In Section IV, we apply the model to CEMAC and discuss how our results can complement the current account norm analysis at the IMF. Finally, we provide some concluding remarks in Section V.

II. The Model

We use a flexible-price model of a small open economy, but enrich it with investment inefficiencies, absorptive capacity constraints and a country risk premium that captures foreign credit constraints. There is exogenous productivity growth at the rate $\mathfrak{g}_a$ and population growth at the rate $\mathfrak{g}_n$, so in the long-run all the variables grow at the rate $\mathfrak{g}$, where $(1+\mathfrak{g}) = (1+\mathfrak{g}_a)(1+\mathfrak{g}_n)$. To facilitate the description of the model, we present its structure in stationary terms. This involves, when required, rescaling variables by the effective units of labor A_tL_t, where A_t is the productivity level and and L_t denotes labor. That is, $x_t \equiv \frac{X_t}{A_tL_t}$ for all the variables X_t. In this way all the transformed variables are constant in the long run (steady state).

The economy is populated by a large number of identical and infinitely lived households, who are endowed with perfect foresight. The representative agent derives utility from private consumption (c_t) and public consumption (g_t), but not leisure, according to:

$$\sum_{t=0}^{\infty} \beta^t \left[\frac{(c_t - \varkappa c_{t-1})^{1-\gamma}}{1-\gamma} + \kappa \frac{(g_t - \varkappa g_{t-1})^{1-\gamma}}{1-\gamma} \right]. \tag{1}$$

The parameter β equals $\mathcal{B}(1+\mathfrak{g}_a)^{1-\gamma}(1+\mathfrak{g}_n)^{1-\gamma} A_0^{1-\gamma} L_0^{1-\gamma}$ where $\mathcal{B}$ is the discount factor and satisfies $\mathcal{B} \in (0,1)$. The coefficient of relative risk aversion is given by γ. The parameter κ controls the preference share for private and public consumption and $\varkappa \in (0,1)$ denotes the intensity of internal habit formation. We introduce habit formation to allow for a smooth path of private consumption, as discussed by Christiano et al. (2005), and to avoid unrealistically drastic adjustments in public consumption in the simulations.

The economy has two sectors: the non-oil sector (n) and the oil sector (o), whose outputs are denoted by y_t^n and y_t^o, respectively.[16] The production function in the non-oil sector is given by

$$y_t^n = a k_{t-1}^{\theta_k} s_{t-1}^{\theta_s}, \qquad \text{with} \qquad \theta_k + \theta_s < 1, \tag{2}$$

[16] The oil sector here represents any exhautible resource sector.

where k_t and s_t are private and public capital, respectively; while oil production is exogenous.

We incorporate two types of investment frictions that capture inefficiencies in investing and absorptive capacity constraints. As in Agenor (2010) and Berg et al. (2013), among others, we assume that all public investment i_t^s does not necessarily translate into productive public capital s_t. The public capital accumulation equation is

$$(1+\mathfrak{g})s_{t+1} = e_s i_t^s + (1-\delta_s)s_t, \qquad \text{with} \qquad e_s \in [0,1] \tag{3}$$

where δ_s is the depreciation of public capital and the efficiency parameter e_s captures the idea that one dollar spent on public investment may translate into less than one dollar of productive public capital. The traditional "perpetual inventory method" usually imposes $e_s = 1$ and then uses this equation to infer the stock of public capital from information on public investment and assumptions about depreciation rates. However, assuming full efficiency is problematic, particularly in developing economies. Whether because of waste and corruption, an absence of market pressures to ensure that all projects have the highest possible rate of return, or simply misclassification of current spending (e.g. salary payments to civil servants) as investment, a dollar of public investment spending may not always yields a full dollar of public capital, as argued by Pritchett (2000). Similar inefficiencies exist in the creation of private capital, when investing the amount i_t^k. Therefore

$$(1+\mathfrak{g})k_{t+1} = e_k i_t^k + (1-\delta_k)k_t. \tag{4}$$

We model absorptive capacity constraints as investment adjustment costs that only play a role off steady state. These costs take the form of

$$AC_t^s = \frac{\phi_s}{2}\left(\frac{s_t}{s_{t-1}} - 1\right)^2 s_{t-1} \quad \text{and} \quad AC_t^k = \frac{\phi_k}{2}\left(\frac{k_t}{k_{t-1}} - 1\right)^2 k_{t-1}. \tag{5}$$

As in Buffie et al. (2012), these reflect the fact that skilled administrators are in scarce supply in RRDCs and, therefore, ambitious public and private investment programs are often plagued by poor planning, weak oversight, and a myriad of coordination problems, all of which contribute to costs which can increase with the pace of scaling up.[17] The parameters ϕ_k and ϕ_s determine the severity of these absorptive capacity constraints.

Developing economies are also characterized by their inability to fully access international capital market, because of borrowing constraints. One might think that at each period t, foreign lenders impose an aggregate borrowing limit on the domestic economy. This can stipulate that the level of external liabilities d_t must satisfy $d_t \leq \bar{d} + \psi V_t$, where $\bar{d}$ is an exogenous limit on debt, $V_t = \sum_{i=t}^{T}\left(\frac{1}{1+r^*}\right)^{i-t} y_i^o$ is the net present value (NPV) of the oil output flows from time t until the depletion time T, r^* is the risk-free world interest rate, and $\psi \in [0,1]$. Note that this means that resource revenues

[17] Development agencies report that cost overruns of 35% and more are common for new projects in Africa. The most important factor by far is inadequate competitive bidding for tendered contracts. See Foster and Briceno-Garmendia (2010) and Lledo and Poplawski-Ribeiro (2013), among others.

(ψV_t) can help relax borrowing constraints enabling the country to contract debt beyond the limit $\bar{d}$ at a lower cost, as argued by Mansoorian (1991).

To capture these borrowing constraints, we assume the country faces an interest rate with a country risk premium that depends on the stock of its external liabilities. In particular, we assume that the premium ($r_t - r^*$) can be represented by

$$\Pi(d_t) = r_t - r^* = \frac{\pi}{\rho_1^2}\left[e^{\rho_1(d_t-\bar{d}-\psi V_t)} - \rho_2(d_t - \overline{d} - \psi V_t) - \rho_3\right], \tag{6}$$

where $\pi, \rho_1, \rho_2 > 0$, $\rho_3 = e^{-\rho_1 \overline{d}} + \rho_2 \overline{d}$ and $\overline{d}$ is the steady-state level of debt.[18] This representation combines an exponential with a linear function. For low values of ρ_2, as in the calibration below, the exponential form drives the premium for highly indebted countries; while the linear form becomes the main driver of the premium for creditor countries—i.e., creditors will actually face almost no premium as the supply curve of funds becomes flatter.

The country risk premium specification, which depends on debt, serves several purposes. First, although our motivation is to capture occasionally binding credit constraints, this specification helps us get around the highly complex and technical issues related to having inequality constraints in dynamic optimization.[19] Second, it ensures stationarity of foreign debt holdings, as explained by Schmitt-Grohe and Uribe (2003). Third, it allows us to model different degrees of international capital mobility. The degree of the capital account openness depends to a great extent on the composite parameter $\frac{\pi}{\rho_1^2}$. For very small values of this ratio, the capital account is in effect fully open reflecting perfect international capital markets. For very high values, on the other hand, the capital account is almost fully closed. Last, including the value of oil wealth V_t in the specification helps reduce the risk premium and the interest rate paid on debt. This in turn creates incentives to borrow more, which is in line with some of the empirical facts discussed by Manzano and Rigobon (2007).

The current account can be expressed as

$$ca_t = d_{t-1} - (1 + \mathfrak{g})d_t, \tag{7}$$

while the resource constraint of the economy corresponds to

$$(1 + \mathfrak{g})d_t = (1 + r_{t-1})d_{t-1} + c_t + i_t^k + AC_t^k + g_t + i_t^s + AC_t^s - y_t^n - y_t^o - T_t, \tag{8}$$

where T_t denotes exogenous transfers to the economy not related to natural resources.

[18] This specification is borrowed from Kim and Ruge-Murcia (2009), who use this functional form to model asymmetric nominal wage adjusment costs.

[19] This is in the same spirit of the recent literature on incomplete markets and heterogenous agents models. In this literature, the problem of maximizing an objective function subject to an inequality constraint is replaced with an unconstrained maximization problem, whose objective function or budget constraint include a penalty function that tries to capture the effects of the inequality constraint. This approach allows the use of perturbation methods to simulate these models. See Preston and Roca (2007) and Algan et al. (2010), among others.

We assume that there is a social planner who chooses the sequences for consumption, private and public capital stock, private and public investment, and borrowing $\{c_t, g_t, i_t^s, i_t^k, s_t, k_t, d_t\}_{t=0}^{\infty}$ to maximize (1) subject to (2)-(8), given k_0, s_0, d_0 and the exogenous path for $\{y_t^o\}_{t=0}^{\infty}$ and $\{T_t\}_{t=0}^{\infty}$.[20] The first order conditions of this problem presented in the Appendix can be reduced to[21]

$$\hat{c}_t^{-\gamma} - \varkappa(1+\mathfrak{g})\beta\hat{c}_{t+1}^{-\gamma} = \beta\left[1 + r^* + \Pi(d_t) + \Pi'(d_t)d_t\right]\left[\hat{c}_{t+1}^{-\gamma} - \varkappa(1+\mathfrak{g})\beta\hat{c}_{t+2}^{-\gamma}\right] \tag{9}$$

$$\hat{c}_t^{-\gamma} - \varkappa(1+\mathfrak{g})\beta\hat{c}_{t+1}^{-\gamma} = \kappa[\hat{g}_t^{-\gamma} - \varkappa(1+\mathfrak{g})\beta\hat{g}_{t+1}^{-\gamma}] \tag{10}$$

$$\frac{\hat{c}_t^{-\gamma} - \varkappa(1+\mathfrak{g})\beta\hat{c}_{t+1}^{-\gamma}}{\hat{c}_{t+1}^{-\gamma} - \varkappa(1+\mathfrak{g})\beta\hat{c}_{t+2}^{-\gamma}} = \beta(1+\mathfrak{g})\frac{\left[e_k\theta_k\frac{y_{t+1}^n}{k_t} + (1-\delta_k) - e_k\frac{\phi_k}{2}\left(\frac{k_{t+1}}{k_t} - 1\right)^2 + e_k\phi_k\left(\frac{k_{t+1}}{k_t} - 1\right)\frac{k_{t+1}}{k_t}\right]}{\left[(1+\mathfrak{g}) + e_k\phi_k\left(\frac{k_t}{k_{t-1}} - 1\right)\right]}, \tag{11}$$

$$\frac{\hat{c}_t^{-\gamma} - \varkappa(1+\mathfrak{g})\beta\hat{c}_{t+1}^{-\gamma}}{\hat{c}_{t+1}^{-\gamma} - \varkappa(1+\mathfrak{g})\beta\hat{c}_{t+2}^{-\gamma}} = \beta(1+\mathfrak{g})\frac{\left[e_s\theta_s\frac{y_{t+1}^n}{s_t} + (1-\delta_s) - e_s\frac{\phi_s}{2}\left(\frac{s_{t+1}}{s_t} - 1\right)^2 + e_s\phi_s\left(\frac{s_{t+1}}{s_t} - 1\right)\frac{s_{t+1}}{s_t}\right]}{\left[(1+\mathfrak{g}) + e_s\phi_s\left(\frac{s_t}{s_{t-1}} - 1\right)\right]}. \tag{12}$$

The interpretation of these conditions is straightforward. Condition (9) is the Euler equation for private consumption c_t including the effects of internal habits, since $\hat{c}_t = c_t - \varkappa c_{t-1}$. Equation (10) equates the marginal utility of private and public consumption, where $\hat{g}_t = g_t - \varkappa g_{t-1}$. Conditions (11) and (12) set optimal private and public investment by equating the marginal cost and benefit of postponing consumption one period ahead. Note that we have assumed that the social planner internalizes the effect of more borrowing on the country risk premium and, therefore, on the cost of debt $1 + r_t$—this explains the term $\Pi'(d_t)d_t$. This is consistent with the view that the social planner will use *marginal* borrowing decisions to affect the marginal increase of the cost of debt. Moreover, as is common in the literature of capital adjustment costs, the planner internalizes the effect of more investment on the absorptive capacity constraints.

We provide now a definition of equilibrium in this open economy model.

[20] Since we want to derive current account benchmarks with optimality content, we focus on the social planner problem, where the government takes optimally both private and public decisions. By doing this, the government internalizes and, therefore, mitigates the negative effect that fiscal policies may have on the private sector. To some extent, this explains why domestic borrowing is ruled out: although domestic borrowing can be a financing source for public investment, it can substantially crowd out the private sector and, as a result, is dominated by external borrowing (see Buffie et al. 2012).

[21] Transversality conditions on s_t, k_t, and d_t are also imposed.

Definition 1 *Given k_0, s_0, and d_0, and the sequences $\{y^o_t\}_{t=0}^{\infty}$ and $\{T_t\}_{t=0}^{\infty}$, an equilibrium is a set of sequences $\{c_t, g_t, i^s_t, i^k_t, s_t, k_t, d_t, y^n_t, AC^s_t, AC^k_t, r_t, ca_t\}_{t=0}^{\infty}$ satisfying equations (2)-(8) and the first order conditions (9)-(12).*

III. The Role of Investment and Frictions in Shaping the Current Account Dynamics

A. Calibration

Our analysis will rely on numerical simulations.[22] To impose discipline, we calibrate the parameters of the model to the CEMAC region, where possible. Otherwise we rely on econometric estimates or frequently used parameter values in the literature for developing countries. The time frequency is annual.

Using CEMAC data we calibrate the following parameters. The steady-state level of debt $\bar{d}$ is set to match the 2010 debt level of 13 percent of GDP. The population and technological growth rates in the region correspond to $\mathfrak{g}_n = 0.024$ and $\mathfrak{g}_a = 0.014$, respectively. And the parameter κ in the utility is chosen to match the 2010 ratio of public consumption to private consumption ($\kappa = 0.15$). The productivity parameter a is chosen so that total output is normalized to one, initially. Moreover, it is possible to use the oil production forecasts of the region to define natural resource shocks in the simulations. We will do so below, when we use the model to generate a current account benchmark. For the moment, in the analytical experiments we will impose an stylized windfall that follows an AR(2) process, giving a hump-shaped path.

Regarding parameter values found in the literature, we set the relative risk aversion coefficient γ—or inverse of the intertemporal elasticity of substitution—equal to $\frac{1}{0.34}$, which is in line with the average estimate for low-income countries in Ogaki et al. (1996). Following van der Ploeg and Venables (2011a), the production parameters for private and public capital are $\theta_k = 0.4$ and $\theta_s = 0.25$, respectively.[23] The depreciation rates of private and public capital δ_k and δ_s correspond to 5.5 percent, which are close to values estimated by Bu (2004). We are somewhat optimistic about the investment frictions: the public and private efficiency parameters e_k and e_s are both set to 0.5, which are slightly above the estimates by Pritchett (2000) for sub-Saharan Africa;[24] while the capital adjustment cost parameters ϕ_k and ϕ_s are picked to match costs overruns of 25% for both private and public capital accumulation (i.e., $\phi_k = 522$ and $\phi_s = 50$), which Foster and Briceno-Garmendia (2010) argue to be 35% or higher

[22] The model was simulated with the software Dynare. See http://www.cepremap.cnrs.fr/dynare.

[23] This implies a return on public capital of 23 percent. Foster and Briceño-Garmendia (2010) estimate returns for electricity, water and sanitation, irrigation, and roads range from 17% to 24% in low-income countries. Similarly, the macro-based estimates in Dalgaard and Hansen (2005) cluster between 15% and 30% for a wide array of different estimators.

[24] Pritchett (2000) estimates range from 0.08 to 0.49 for the sub-Saharan Africa.

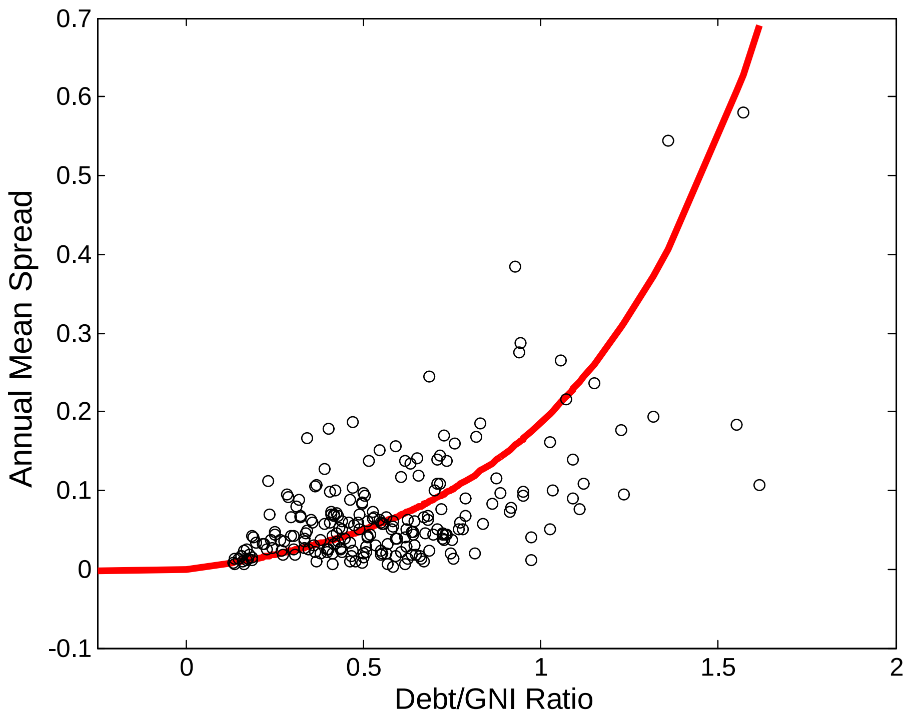


Figure 2: Interest Rate Country Risk Premium Function.

for new projects in Africa.[25] Nevertheless there is a lot of uncertainty about these parameters.[26] The world interest rate corresponds to $r^* = 0.055$, as in van der Ploeg and Venables (2011a), and the habit persistence parameter $\varkappa$ is set to 0.7, which is in line with estimates of the macroeconomic literature such as those in Kano and Nason (2012).

We apply a non-linear curve fitting method to estimate the parameters of the risk premium function (6) using the cross-country dataset from Akitoby and Stratmann (2008), which includes the debt stock levels and annual spreads data for 33 countries from 1993 to 2004.[27] The bond spreads are measured as the differences between the annual average domestic interest rates and the world risk-free rates—U.S.

[25] Since in the model, adjustment costs are only present off steady state, then ϕ_k and ϕ_s are picked to match a specific ratio—in this case 25%—of average adjustment costs to total investment outlays. To do so, we also need values of private and public capital stocks, in percentage of GDP. As we explain below in our application to CEMAC, we use the average estimates for Cameroon and Congo by Cubas (2011) of 100 and 36 percent of GDP, respectively.

[26] For further discussion on public investment and a proposed index for efficiency see Dabla-Norris et al. (2011).

[27] By running linear regressions, Akitoby and Stratmann (2008) and Van der Ploeg and Venables (2011a) find empirical evidence of a positive link between interest rate spreads and the debt to gross national income ratios for a subset of developing economies. From a theoretical perspective, Bardhan (1967) was the first one to postulate an upward-sloping supply schedule, where the cost of debt increases with the absolute level of foreign debt. More recently, this assumption has been used by Agenor (1997), Schmitt-Grohe and Uribe (2003), and Turnovsky (1997), among others. By expressing the supply curve in terms of debt-to-gdp ratios, in our model a country that adopts growth-oriented policies can shift the supply curve downward, so that at each level of debt the country faces a lower risk premium, as proposed by Sachs (1984).

10-year government bond rates, using the Emerging Markets Bond Index Global dataset. The debt, which is expressed as a ratio of gross national income (GNI), is the country's *total* debt from the World Development Indicators. Although domestic debt is becoming more prominent in RRDCs, most of the debt is still external. We then apply a non-linear least squares method to fit the non-symmetric risk premium function and estimate the parameters constraining them to be greater or equal to zero, yielding $\pi = 0.13$, $\rho_1 = 0.93$, and $\rho_2 = 0$, which are significant at the 1 percent level (see Figure 2 for the fit). However, an important caveat is in order. Despite the interesting economic implications of having the value of oil wealth V_t in the risk premium function, it is challenging to come up with sensible estimates for V_t to estimate the parameter ψ. This is due in part to the fact that this variable is forward-looking. So in the estimation, we impose $\psi = 0$. Nevertheless below we explore analytically the consequences of raising this parameter.

B. Analytical Experiments

To illustrate the role of investment and frictions in shaping the current account dynamics, we consider five different scenarios in which we vary some of the previously calibrated parameters.[28] For simplicity we start the simulations at the steady state.[29]

- Scenario 1 reflects almost perfect international capital mobility ($\pi/\rho_1^2 \simeq 0$). In addition, there are no absorptive capacity constraints ($\phi_k = \phi_s = 0$), and no resource wealth in the risk premium function ($\psi = 0$).
- Scenario 2 differs from Scenario 1 in that there is imperfect international capital mobility—the capital account is somewhat closed. In this case, we use the estimates for the interest rate country risk premium function from the calibration.
- Scenario 3 differs from Scenario 2 by introducing absorptive capacity constraints according to our calibration.
- Scenario 4 is like Scenario 2, except that oil lowers the country risk premium and relaxes the borrowing constraints ($\psi = 0.1$).

When there are no borrowing constraints, the PIH holds, implying significant current account surpluses from natural resource windfalls. In Scenario 1—almost perfect international capital mobility—the windfall has negligible effects on non-resource output, and it is optimal to save the windfall by accumulating foreign assets to smooth consumption over time (Figure 3).[30] These assets earn the

[28] In the analytical experiments that follow, we assume that there is full private and public investment efficiency, i.e., ek=es=1. Of course, one could also vary these parameters over time, but as discussed below, the effect would be very similar to that of varying the degree of absorptive capacity constraints.

[29] Development considerations can suggest starting simulations off steady state. Our results, which are available from the authors upon request, do not change to a great extent. When we apply the model to derive a current account benchmark for CEMAC, we start simulations off steady state.

[30] Negative values of debt denote accumulation of foreign assets.

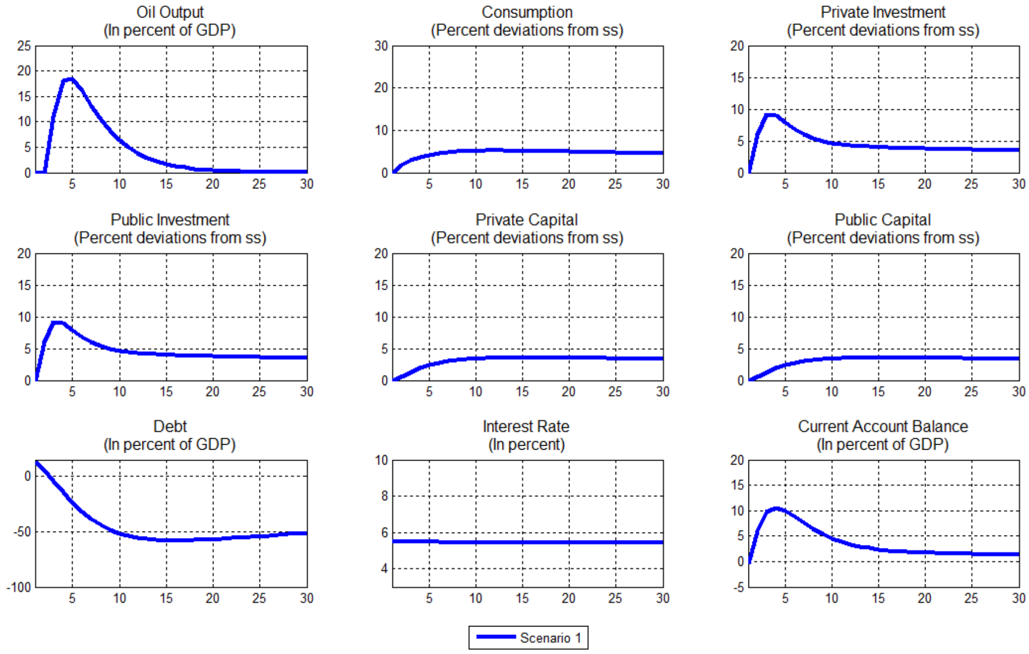


Figure 3: An Almost Frictionless Economy that Mimics PIH1/

1/ Scenario 1: High Degree of International Capital Mobility, No Absorptive Capacity Constraints, and No Resource Wealth in the Risk Premium Function.

risk-free international interest rate. The behavior of this economy mimics the endowment economy model analyzed in Bems and Carvalho (2009), as output and capital variations are relatively small and consumption is smoothed over time. This scenario is a useful benchmark for PIH behavior, in which a windfall generates large current account surpluses and external savings for future consumption.

However, saving most of the resource wealth abroad, as in the PIH, might no longer be appropriate if there are borrowing constraints, which tends to lower the current account balance (Figure 4). When borrowing constraints are prominent—very low international capital mobility—profitable investment opportunities are forgone as the premium on borrowing is too high (or credit is unavailable). In this case, the oil windfall helps drive down interest rates as oil revenue is used to repay debt, raising private and public investment and non-oil production. The lower interest rates also contribute to decisions to frontload consumption. As a result, the natural resource wealth is mostly converted into productive capital leading to very small savings abroad, and a lower current account balance. Although the comparison between this scenario and Scenario 1 is somewhat loose since they have different steady states, the differences between the current account balances are still striking.[31]

[31] These two scenarios have different steady states and represent different economies. In the imperfect capital mobility case, the high country risk premium implies a lower discount factor reflecting very impatient agents. This explains in part the consumption tilting. In contrast, in the case of almost perfect international mobility, the country risk premium is significantly lower and therefore the discount factor much higher. Hence agents in this economy are more patient. The steady-state value of debt, which is given exogenously to the model, has also implications for the discount factor. At the steady state, a lower debt value would imply a higher discount factor and more patient agents, leading to higher current account balances in the dynamics.

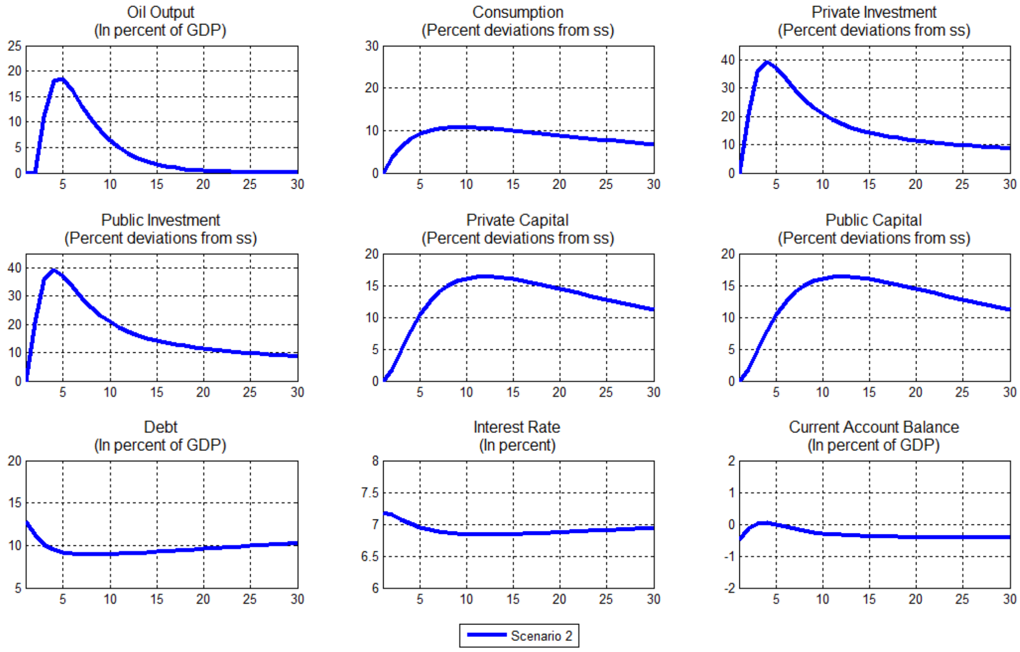


Figure 4: The Effects of Imperfect Capital Mobility1/

1/ Scenario 2: Low Degree of International Capital Mobility, No Absorptive Capacity Constraints, No Investment Inefficiencies, and No Resource Wealth in the Risk Premium Function.

Absorptive capacity constraints also play a key role in shaping the current account dynamics. Figure 5 shows that during resource booms, these constraints induce a larger current account balance than that under no constraints. Scenario 3 shows that with higher costs for accumulating capital, due to these constraints, the interest rate will undershoot until capital can fully adjust, making it optimal to tilt consumption somewhat further relative to Scenario 2, where these constraints are absent. In addition, the presence of these frictions implies that despite the fall in interest rates, it becomes optimal to reduce the speed of public and private investment, leading to less accumulation of capital. As a result, the current account balance tends to be higher under absorptive capacity constraints than without them. Similar results are obtained with higher inefficiencies—lowering e_k and e_s—in translating investment into effective capital.[32]

On the other hand, natural resource wealth, can help relax borrowing constraints in developing countries and induce current account deficits. If a country's risk premium depends not only on external debt but also on natural resource assets underground, new discoveries or an increase in resource prices can relax the borrowing constraints and therefore lower the country risk premium (Figure 6). As shown by Scenario 4, when resource value lowers the risk premium (setting $\psi = 0.11$ in (6)), countries may decide to boost current private and public investment by acquiring foreign debt and take advantage of lower borrowing rates, relative to Scenario 2, where natural resources do not contribute to relaxing borrowing constraints. As consumption behavior remains almost unchanged, more investment associated with higher borrowing translates into a current account deficit in the short to medium term.

[32] For instance, lower efficiencies will call for higher current account balances.

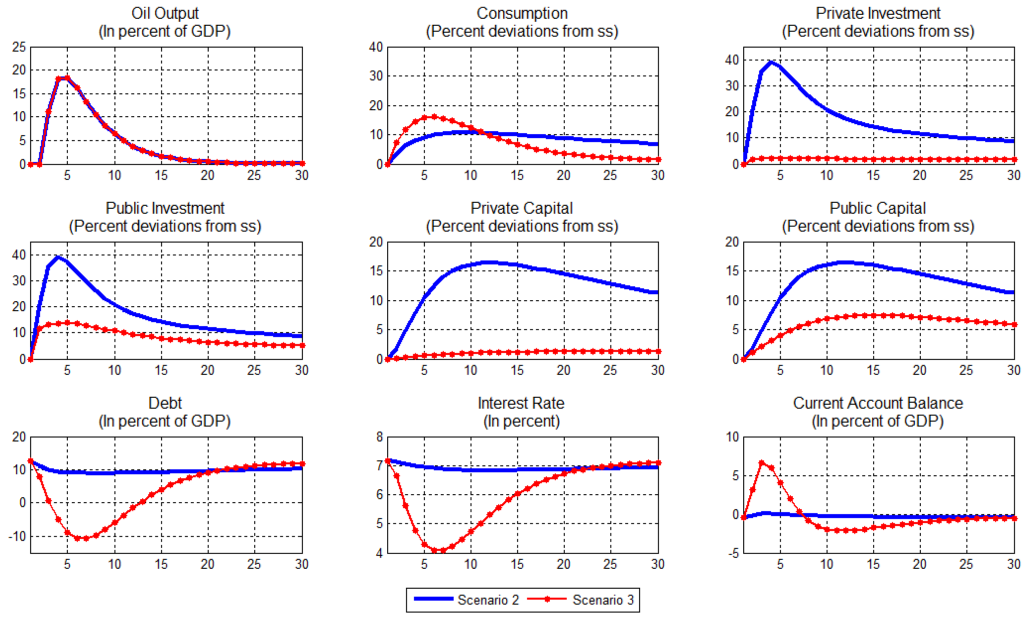


Figure 5: The Effects of Absorptive Capacity Constraints1/

1/ Scenario 2: Low Degree of International Capital Mobility, No Absorptive Capacity Constraints, and No Resource Wealth in Risk Premium Function; Scenario 3: Like Scenario 2 Except for Having Absorptive Capacity Constraints.

This starkly differs from the results in Scenarios 1-3, where a windfall always leads to accumulation of financial assets (foreign bonds) or reduction of financial liabilities (foreign debt) and, therefore, to current account surpluses.

In the last analytical experiment, we explore the implications of adverse resource shocks for the current account dynamics. We find that adverse resource shocks may induce buffer-stock savings, raising the current account balance. Figure 7 simulates a sudden drop in resource income at year 5, reflecting, for instance, a decline in resource prices in Scenario 3. To grasp the buffer-stock savings effect, the analysis focuses on the macroeconomic adjustment in the first five years before resource income collapses. If the price decline is expected then consumption is still smoothed over time but does not increase as much as in the case of Scenario 3, where prices do not fall. This reflects the buffer-stock savings effect, since agents save for bad times. This buffer, though, is not related to uncertainty or volatility of resource revenues—which can induce precautionary savings effects—since in the simulation, the negative shock is fully expected. The additional savings translate into both lowering external debt (reducing the interest rate) and further increasing private and public investment. The overall impact on external sustainability is then an increase in the current account surplus in the first five years relative to that of the scenario without the decline in prices.

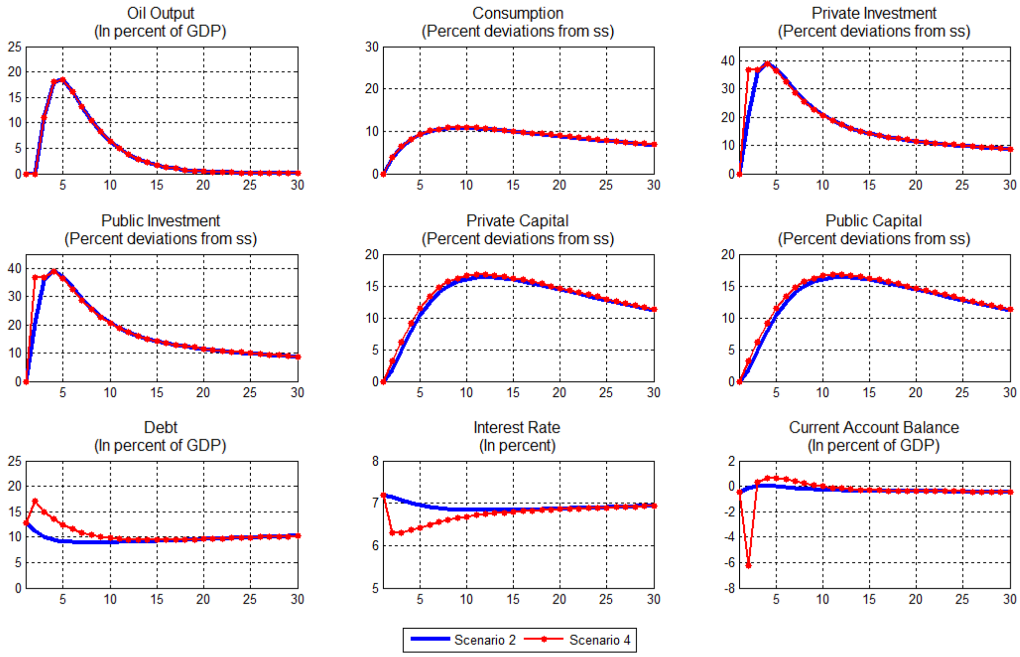


Figure 6: The Effects of Resource Wealth in the Risk Premium Function[1/]

1/ Scenario 2: Low Degree of International Capital Mobility, No Absorptive Capacity Constraints, and No Resource Wealth in Risk Premium Function; Scenario 4: Like Scenario 2 Except for Resource Wealth in the Risk Premium Function.

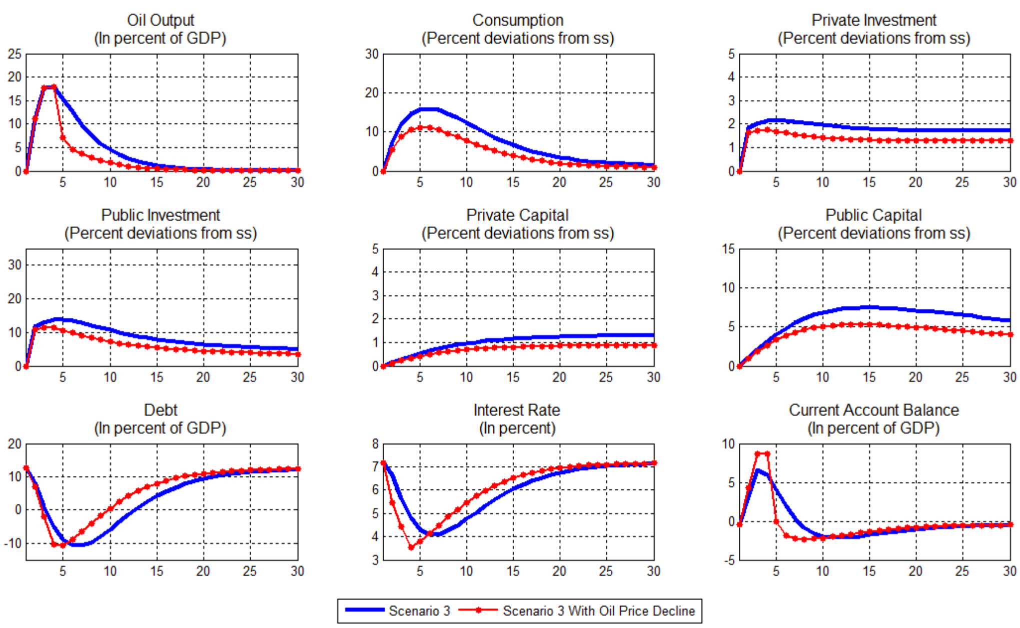


Figure 7: The Effects of an Expected Oil Price Decline[1/]

1/ Scenario 3: Low Degree of International Capital Mobility, With Absorptive Capacity Constraints, and No Resource Wealth in Risk Premium Function. Scenario 3 With Oil Price Decline: Like Scenario 3 but with Expected Drop of Oil Price in year 5.

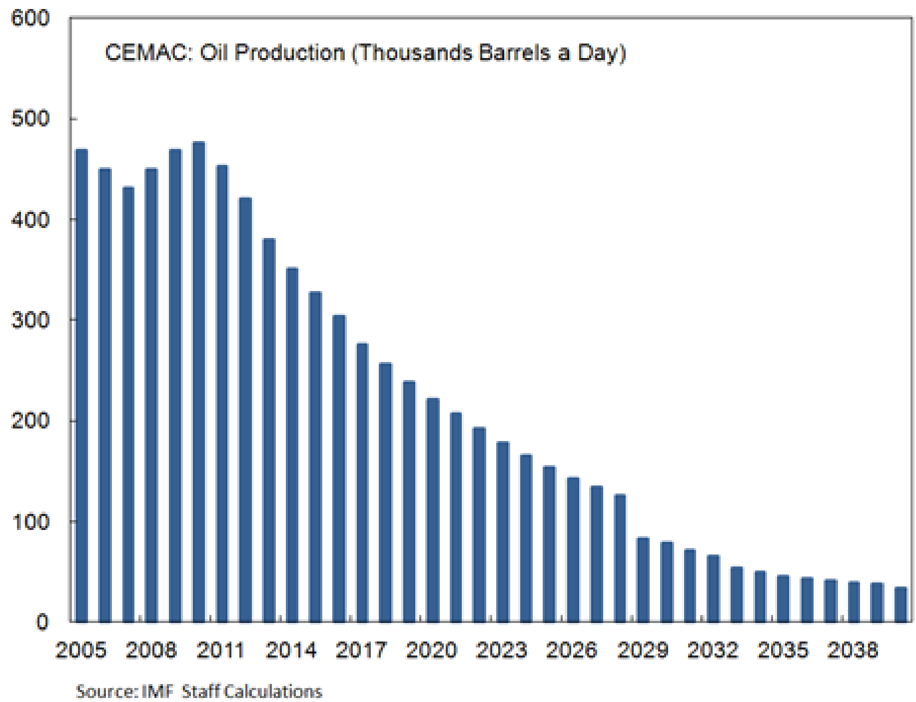


Figure 8: CEMAC: Oil Production

IV. Applying the Model to CEMAC

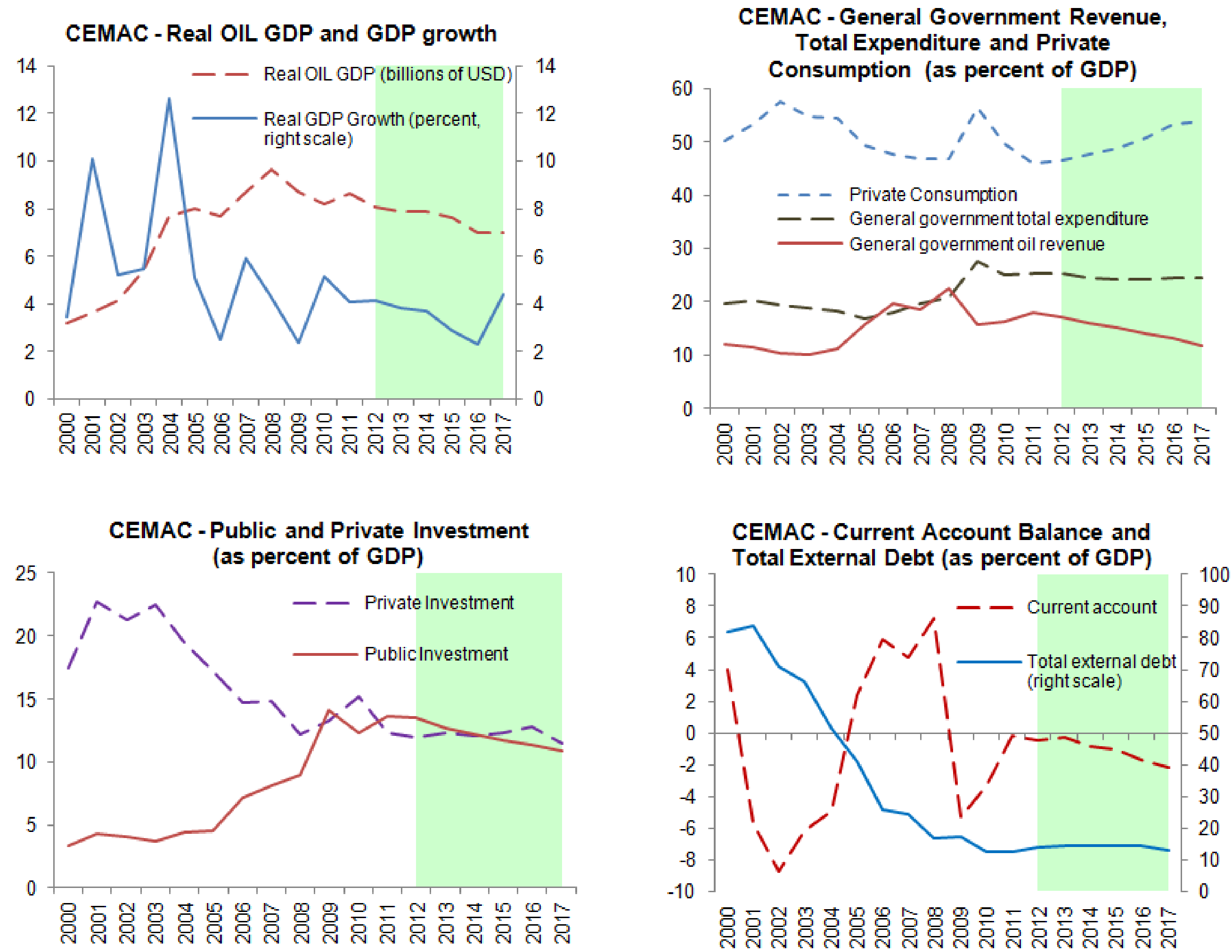
A. Background and Economic Outlook

We apply our model to the Economic and Monetary Community of Central Africa (CEMAC), which faces the challenge of managing exhaustible natural resources while simultaneously addressing development needs.[33] Oil dominance is prominent in the CEMAC countries: on average, oil accounts for about 40 percent of regional GDP, 70 percent of total exports, and 75 percent of revenue. However, after having peaked in 2010, oil production is projected to decline fairly rapidly over the next decades (see Figure 8).[34] Exhaustion of this important source of revenues is a matter of concern, since the governments in these countries still have little access to international credit markets and face daunting development needs such as large infrastructure gaps and low levels of human capital—which in turn may take time to overcome, given investment inefficiencies and absorptive capacity concerns.

Access to external financing is still limited in the CEMAC region. While national treasuries are allowed to issue Treasury bills and bonds through weekly and monthly auctions, the government securities markets have yet to take off in the region. As of mid-2010, there was no significant track

[33] In the analysis we include the oil-producing CEMAC countries: Republic of Congo, Chad, Cameroon, Gabon, and Equatorial Guinea.

[34] Though the focus here is on oil production, other natural resources (e.g. natural gas) could also be taken into account.



Source: IMF WEO and authors' calculations

Figure 9: CEMAC: Macroeconomic Indicators, 2000-2017

record of bond issuance: there was no recent issuance of treasury instruments, and only one outstanding government bond on the market was issued by the Republic of Gabon—the only lower-middle income country of the region . In 2007, Gabon successfully issued a 10-year USD 1 billion Eurobond, registering strong investor interest. As of April 2011, Gabon received long-term sovereign debt ratings of BB- for both local and foreign currency by Fitch and Standard and Poor's. The fairly low rating was reflected in interest spreads.

The region is also plagued with dire infrastructure gaps. Ranganathan et al. (2012) find, for instance, that mobile and mainline telephone subscriptions and access to sanitation, though marginally better than in other RRDCs, are lower than in resource-rich peers. The installed generation capacity is low and access to power is limited, while prices for infrastructure services are very high relative to global and African standards. For example, power prices and road freight tariffs cost three times as much in the CEMAC region as in other developing regions.

Furthermore, entrenched public investment inefficiencies and absorptive capacity constraints need to be addressed in the region. Ranganathan et al. (2012) estimate that roughly 1.2 percent of the region's GDP per year can be recovered through addressing these inefficiencies. The power sector, with inefficiencies valued at 0.8 percent of GDP annually, represents by far the largest drain, due to under-pricing and operational deficiencies. Similarly, the transport and water sectors inefficiencies amount to some 0.2 percent of GDP of resources annually, as a result of low capital budget execution and under-pricing.

Against this structural background, what has been the macroeconomic outlook in the region, including external balances in recent years? Before and after the global crisis, the oil price and production booms improved current account balances and pushed up public investment in the CEMAC region. Since 2003, increases in oil prices and production caused a boom in government revenues, which boosted government spending, particularly capital spending (Figure 9). Nevertheless, despite considerable additional public investment, GDP growth (in particular, non-oil GDP) fell below the 2000–04 average, in part due to constraints such as inadequate infrastructure services, inefficiencies in investment, a poor business environment, and low-quality health and education services. Yet, from 2003 to 2008, the current account for the region registered larger balances. As a consequence, net foreign assets increased steadily during the same period.[35] The deterioration of the current account in 2009 was associated with the global financial crisis, but soon after a new oil price boom induced an improvement in the current account as well as in government revenues and public investment.

B. Current Account Benchmarks for CEMAC

We apply our model to study the current account dynamics for CEMAC from 2011 to 2016. This allows us to come up with a benchmark for external balances in the region and compare it with existing benchmarks. The current account benchmark provided by our model refers to the equilibrium current account obtained by taking into account the projected natural resource windfall and associated optimal consumption and investment responses.

The 2012 CEMAC external sustainability assessments, as part of CGER, estimate a larger current account surplus than that of the underlying current account.[36] The assessments are based on two methodologies proposed by Bems and Carvalho (2009) that are modified versions of the CGER macroeconomic balance (MB) and external sustainability (ES) approaches. The MB approach estimates a norm as a function of fundamentals (including the oil fiscal balance and a dummy for oil-exporting countries),[37] whereas the ES approach determines the external sector balance consistent with a long-

[35] External positions have been further strengthened by HIPC and MDRI debt relief in Cameroon, Central African Republic and Republic of Congo.

[36] The underlying current account is defined here as the projected current account balance by the IMF desks taking into account the countries macroeconomic frameworks and authorities plans. Alternatively, the underlying current account could also be defined as the current account balance that would emerge at a zero output gap.

[37] The "current account norm" is defined as the equilibrium current account that is in line with macroeconomic fundamentals.

term trend in net foreign assets in order to incorporate the impact of the natural resource windfall in a model-based approach. For the CEMAC as a whole, the current account norm using the MB approach is a surplus of 2.1 percent of GDP in 2011, while the norm is estimated to be a 3.5 percent surplus using the ES approach. On the other hand, in 2011 the underlying current account for CEMAC was almost in balance.

To calculate a current account benchmark with our model, we use the previously discussed calibration for the structural parameters. However, following the development view that claims that developing economies are far from their steady state, we start the simulations off steady state, as in van der Ploeg and Venables (2011a) and Takizawa et al. (2004). The initial off-steady-state point corresponds to 2010, and we use this year's data of some macroeconomic variables for the region to start the simulations. To be specific, by construction, the first point matches the 2010 values of the following variables: (i) the current account balance (3.3 percent of GDP), (ii) private and public consumption (52.3 and 12.7 percent of GDP, respectively), (iii) private and public investment (27.6 and 12.3 percent of GDP, respectively), (iv) aid and remittances (1.8 percent of GDP), and (v) non-oil GDP (77 percent of GDP). We also set initial values for the three state endogenous variables of the model—i.e., we set the external debt level at the 2010 value of 13 percent of GDP, and the private and public capital stocks at 100 and 36 percent of GDP, respectively.[38] The value of private and public capital are based on the average estimates by Cubas (2011) for Cameroon and Congo. Then we subject the model to the 2011-2041 projected oil income path, which combines the IMF staff projected oil production (quantity) in CEMAC (see Figure 8) and the 2011 WEO oil price forecasts.

The simulated current account is shown in Figure 10 (blue line).[39] This provides a benchmark (norm) of about 2.7 percent of GDP in 2012, which is roughly within the norms derived using the MB and ES approaches of Bems and Carvalho (2009). In the medium term, however, the benchmark points to a deficit of -0.6 percent of GDP. Moreover, for the projection period our model delivers a current account benchmark that is below the ES estimates, since the return on both private and public capital is calibrated to be higher than the interest rate paid on foreign assets, making it optimal to invest domestically in public and private capital instead of saving abroad.

However, investment inefficiencies and absorptive capacity constraints can also influence the return on private and public investment and the estimated current account benchmark. Given the lack of information in developing economies, the simulations assume that absorptive capacity constraints reflect investment cost overruns of 25 percent. However, investment cost overruns of about 50 percent—i.e., higher absorptive capacity constraints—would be associated with higher current account benchmarks (see Figure 11, left chart), as its would be optimal to reduce the pace of investment. On the other had, raising the efficiencies of public and private investment would induce much lower current account bal-

[38] In this application, we have chosen the same values for the initial and the steady-state debt to GDP ratios. Of course, it is possible to pick a different steady-state value depending on the user's view of the state to which the economy is converging.

[39] The dynamics of the macroeconomic variables, including the current account, are driven by both the projected oil path and the inherent dynamics associated with starting the economy off steady state. This also reveals the need of having a stand about the steady state to which the economy is converging. For simplicity in the analysis, in these simulations the steady state is still determined by the structural parameter values described in the calibration subsection.

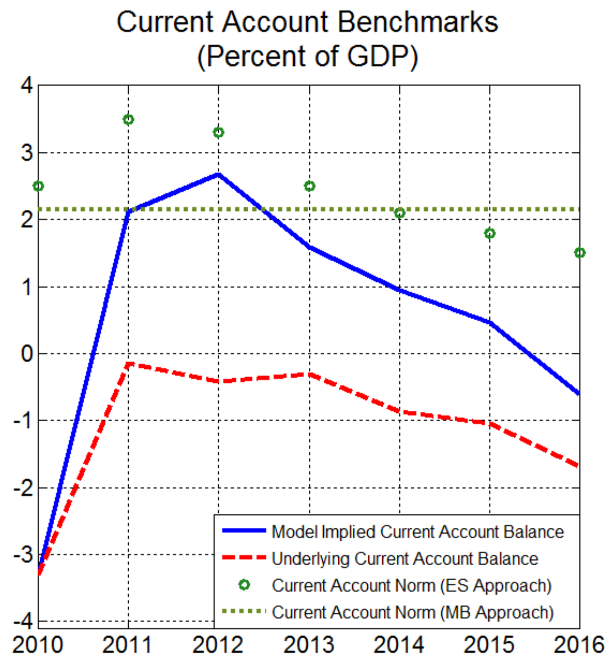


Figure 10: Comparison of Benchmarks and Underlying Current Account1/
1/Comparison of the Model-Implied Current Account (CA) Benchmark with the Underlying CA, the CA Norm Based on the External Sustainability (ES) Approach, and the CA Norm Based on the Macroeconomic Balance (MB) Approach.

ances (see Figure 11, right chart).[40] This underscores the need to quantify these frictions in developing economies and to apply judgment in estimating current account benchmarks.

V. Concluding Remarks

The empirical literature has found that many oil exporting countries seem to follow the permanent income hypothesis—their private spending decisions are made based on permanent rather than current income—and tend to run larger external surpluses compared to their non-oil exporting peers.[41] But should resource-rich developing countries (RRDCs) be saving as much as resource-abundant developed countries and, therefore, run large current account surpluses? While in advanced and some emerging economies transforming natural resource assets into higher external savings could be the appropriate response to windfalls, RRDCs could potentially use these windfalls to speed up development by accumulating physical capital (increasing investment), which in turn may imply lower external savings.

[40] By the same token, this also means that lowering the efficiencies of public and private investment would induce higher current account balances.

[41] See Bayoumi and Thomas (2009) and Bems and Carvalho (2009). Bayoumi and Thomas find, for instance, that for non-African oil-exporting countries, about half of the fluctuations in the private sector non-oil balance are driven by changes in permanent wealth rather than current income.

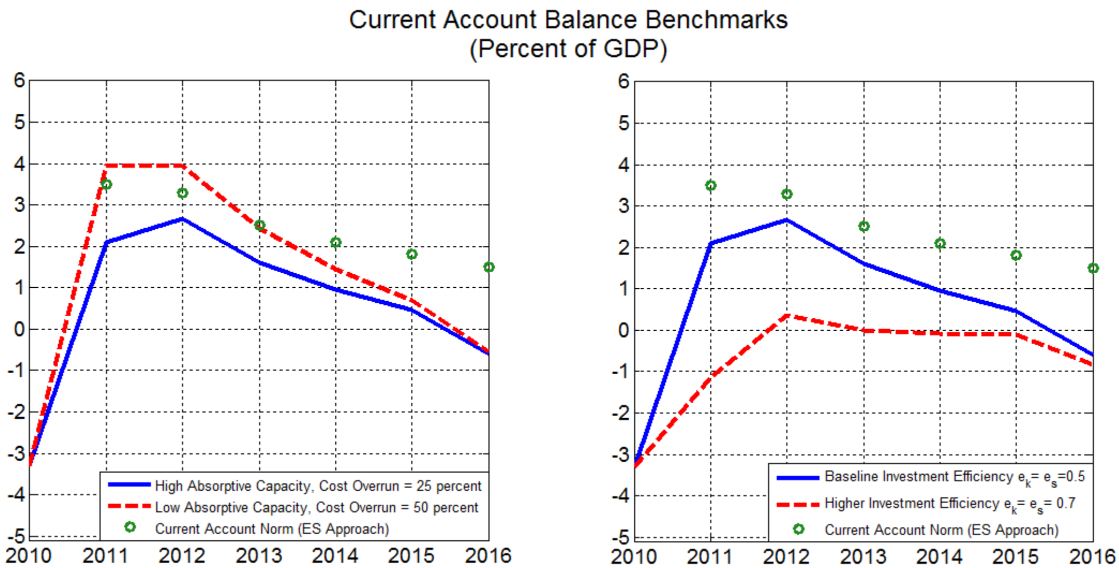


Figure 11: The Impact of Absorptive Capacity Constraints and Investment Efficiency[1/]
1/Effects of Varying the Degree of Absorptive Capacity Constraints (Left Chart) and Private and Public Investment Efficiencies (Right Chart) on the Model-Based Current Account Benchmark.

In this paper we develop a model that can be used for external sustainability analysis in RRDCs, as it takes into account development considerations as well as pervasive frictions in these countries, such as limited international financial market access and absorptive capacity constraints. Our results indicate that external sustainability prescriptions depend on the presence and degree of these frictions. Our simulations show that with borrowing constraints, and absent absorptive capacity issues, oil wealth should be mostly turned into physical private and public capital instead of saving it in the form of foreign assets. This would then tend to lead to lower the current account balances. However, absorptive capacity constraints make it optimal to decelerate private and public capital accumulation and therefore call for higher current account balances that those obtained absent these frictions. Similarly expected natural resource price drops induce higher current account balances in the short term, as a result of buffer-stock savings. Since in our model consumption and investment decisions are *optimal*—derived from solving the social planner's problem—results from our model have normative content and can be used to provide current account benchmarks in RRDCs and, in this way, complement the current account norm analysis pursued at the IMF.

Our model could be extended in different dimensions. First, we could introduce commodity price volatility, which may call for precautionary savings that improve the current account balance. In the absence of such prudence, countries might borrow excessively in boom years and run into difficulties in bust years. Second, RRDCs that accumulate capital that is mostly foreign owned may be more likely to run current account deficits. We could then incorporate FDI related to non-oil activities as an important financing source for current account deficits, while the economy develops. Although in this paper we analyzed the impact of several relevant frictions for RRDCs, future work could further investigate the role of introducing a saving wedge and capital wedge (e.g., a gap between the social and private return to capital) into the model. These wedges have been proved to be useful to understand the "allocation puzzle" of capital flows to developing countries (see Gourinchas and Jeanne, 2011) and may be key to analyze external sustainability. Finally, the paper did not explicitly discuss the role of investment in human capital. However, an extension of the model could incorporate both physical and human capital investment, two important pillars of economic development.

VI. Appendix

Letting η_t^s , η_t^k and λ_t be the Lagrangian multipliers on equations (3), (4) and (8) respectively, the first order conditions are given by:

$$c_t : [c_t - \varkappa c_{t-1}]^{-\gamma} - \varkappa\beta(1+\mathfrak{g})[c_{t+1} - \varkappa c_t]^{-\gamma} = \lambda_t, \tag{13}$$

$$g_t : [g_t - \varkappa g_{t-1}]^{-\gamma} - \varkappa\beta(1+\mathfrak{g})[g_{t+1} - \varkappa g_t]^{-\gamma} = \lambda_t, \tag{14}$$

$$i_t^k : e_k\eta_t^k = \lambda_t, \tag{15}$$

$$i_t^s : e_s\eta_t^s = \lambda_t, \tag{16}$$

$$d_t : \lambda_t = \beta\lambda_{t+1}\left[1 + r^* + \frac{\pi}{\rho_1^2}\left[e^{\rho_1(d_t - \bar{d} - \psi V_t)} - \rho_2(d_t - \overline{d} - \psi V_t) - \rho_3\right] + \frac{\pi}{\rho_1^2}\left[\rho_1 e^{\rho_1(d_t - \bar{d} - \psi V_t)} - \rho_2\right] d_t\right], \tag{17}$$

$$k_t : \lambda_t = \beta(1+\mathfrak{g})\lambda_{t+1}\frac{\left[e_k\theta_k\frac{y_{t+1}^n}{k_t} + (1-\delta_k) - e_k\frac{\phi_k}{2}\left(\frac{k_{t+1}}{k_t} - 1\right)^2 + e_k\phi_k\left(\frac{k_{t+1}}{k_t} - 1\right)\frac{k_{t+1}}{k_t}\right]}{\left[(1+\mathfrak{g}) + e_k\phi_k\left(\frac{k_t}{k_{t-1}} - 1\right)\right]}, \tag{18}$$

$$s_t : \lambda_t = \beta(1+\mathfrak{g})\lambda_{t+1}\frac{\left[e_s\theta_s\frac{y_{t+1}^n}{s_t} + (1-\delta_s) - e_s\frac{\phi_s}{2}\left(\frac{s_{t+1}}{s_t} - 1\right)^2 + e_s\phi_s\left(\frac{s_{t+1}}{s_t} - 1\right)\frac{s_{t+1}}{s_t}\right]}{\left[(1+\mathfrak{g}) + e_s\phi_s\left(\frac{s_t}{s_{t-1}} - 1\right)\right]}, \tag{19}$$

$$\eta_t^s : (1+\mathfrak{g})s_{t+1} = e_s i_t^s + (1-\delta_s)s_t, \tag{20}$$

$$\eta_t^k : (1+\mathfrak{g})k_{t+1} = e_k i_t^k + (1-\delta_k)k_t, \tag{21}$$

$$\lambda_t : (1+\mathfrak{g})d_t = (1+r_{t-1})d_{t-1} + c_t + i_t^k + AC_t^k + g_t + i_t^s + AC_t^s - y_t^n - y_t^o - T_t. \tag{22}$$

At steady-state, we find that:

$$[c(1-\varkappa)]^{-\gamma}[1-\varkappa\beta(1+\mathfrak{g})] = \lambda, \tag{23}$$

$$\kappa[g(1-\varkappa)]^{-\gamma}[1-\varkappa\beta(1+\mathfrak{g})] = \lambda, \tag{24}$$

$$e_k\eta^k = \lambda, \tag{25}$$

$$e_s\eta^s = \lambda, \tag{26}$$

$$1 = \beta\left[1 + r^* + \frac{\pi}{\rho_1^2}[1-\rho_3+(\rho_1-\rho_2)d]\right], \tag{27}$$

$$1 = \beta\left[e_k\theta_k\frac{y^n}{k} + (1-\delta_k)\right], \tag{28}$$

$$1 = \beta\left[e_s\theta_s\frac{y^n}{s} + (1-\delta_s)\right], \tag{29}$$

$$s(\mathfrak{g}+\delta_s) = e_s i^s, \tag{30}$$

$$k(\mathfrak{g}+\delta_k) = e_k i^k, \tag{31}$$

$$(\mathfrak{g}-r)d + y^n + y^o + T = c + i^k + g + i^s. \tag{32}$$

Combining (23) and (24):

$$\kappa = \left(\frac{g}{c}\right)^{\gamma} \tag{33}$$

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