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Equilibrium Non-Oil Current Account Assessments for Oil Producing Countries

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Equilibrium Non-Oil Current Account Assessments for Oil Producing Countries

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Abstract

This paper introduces a methodology for assessing external balance in countries with large stocks of non-renewable resources based on oil stock data, and applies it to selected oil producing countries. The methodology uses a stock approach (instead of the more traditional flow approach) to estimate the equilibrium non-oil current account consistent with optimal consumption smoothing. One of the benefits of the stock approach is that geological data for oil reserves can be used to estimate oil wealth; however, the methodology makes the estimated non-oil current account norm very sensitive to oil price projections. Based on an oil price about US$70 per barrel prevailing in the summer of 2007, the baseline estimates indicate that the non-oil current accounts for most of the countries in the sample are broadly in equilibrium. By the same token, using oil price projections as of the summer of 2008 implies large disparities between the equilibrium non-oil current account position and the medium term forecast for all countries in the sample except for Malaysia.

JEL Classification Numbers: E21, F32, F41

Keywords: exchange rate assessment, oil-exporting countries, consumption smoothing

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Contents

I. Introduction

The IMF is charged by its Articles of Agreement to exercise surveillance over the international monetary system and members' exchange rate policies. Recently, the 1977 Executive Board decision outlining the modalities of this surveillance was revised in order to reflect the momentous changes in the world economic and financial system since the adoption of the 1977 Surveillance Decision. The new surveillance Decision updates guidance to Fund staff regarding the obligations of members under Article IV of the Articles of Agreement.

One of the main features of the updated guidance is to assess whether the level of the exchange rate in a member country is in equilibrium. This of course requires a metric Although there exist large uncertainties in assessing whether an exchange rate is in equilibrium, in recent years, various methodologies have been developed that provide a range of estimates for the equilibrium real exchange rate.

The purpose of this paper is to discuss an alternative methodology for providing an assessment for whether the real exchange rates of countries with large stocks of non-renewable resources are in equilibrium. This alternative methodology is based on the notion of consumption smoothing and uses a simple intertemporal model of the current account as its theoretical construct. Intertemporal saving decisions are of particular importance for oil-exporting countries where national income derives largely from nonrenewable oil resources and is thus expected to fall in the future. Given the expected fall in future income, consumption smoothing suggests that the current account may need to register large surpluses for an extended period of time, in order to finance the accumulation of net foreign assets needed for future consumption.

Because of the forward-looking nature of the equilibrium current account under consumption smoothing, the alternative approach requires an estimation of the present value of future income from oil production or, simply put, oil wealth. As typical in many empirical analyses, one may extrapolate future oil income by using the estimated stochastic process of oil income in the past. However, this could be misleading particularly if oil income has been on an increasing trend or if the extrapolation is carried out over an infinite horizon. Since future oil production is bounded by the existing oil reserves (ignoring new discoveries) and expected to fall, simple extrapolation from the past trend into an infinite horizon would grossly overstate oil wealth. For this reason, the estimation of oil wealth under the proposed alternative approach utilizes information on the subterranean oil reserves obtained from geological survey data to proxy the duration over which oil-exporting countries will be able to maintain oil related current account surpluses.

This methodology captures the past behavior of the non-oil current account for Republica Bolivariana de Venezuela, Saudi Arabia, United Arab Emirates, and Malaysia since the Asian crisis, but is unable to replace the historical pattern of the non-oil current account for the other two countries in the sample, Kuwait and Russia. The paper can be used to provide a benchmark for the appropriate real exchange rate level in these countries based on a comparison of the consumption smoothing non-oil current account and its medium term prediction. At oil prices prevailing in the summer of 2007 (US$67 per barrel), the two current account estimates are comparable for Republica Bolivariana de Venezuela, Malaysia and Russia but for Kuwait, the consumption smoothing non-oil current account deficit is far larger than the medium term prediction while for Saudi Arabia and United Arab Emirates the opposite is the case. At oil prices prevailing in the summer of 2008 (US$124 per barrel), all consumption smoothing non-oil current account deficits are far larger than the corresponding medium term predictions except for Malaysia.

The paper is structured as follows: section II provides a description of the alternative methodology used in this paper; section III provides a simple intertemporal model of the current account; section IV presents estimates of the equilibrium non-oil current account based on the return on oil wealth, the present discounted value of non-oil cash flow, and consumption tilting behavior for a sample of oil-producing countries; section V provides an assessment of the equilibrium non-oil current account position for the sample of countries based on the methodology developed in this paper. Section VI concludes.

II. Basic Structure of Alternative Methodology

Existing analysis

Currently, in its analysis of the long-run equilibrium level of the real exchange rate, staff distinguish oil-exporting countries by an estimate of the sensitivity of the current account to movements in the oil balance. Current account norms are established based on a set of fundamental variables that include the fiscal balance, demographic variables, net foreign assets and economic growth and oil exporters are distinguished by the size of their current account surplus. These norms are then used to establish the target current account level. However, one problem with distinguishing oil exporters on the basis of the current oil balance is that, by definition, it is a flow approach and therefore does not provide an indication of the duration over which an oil exporter will be able to maintain a surplus. To take an extreme example, if a country is on the verge of depleting its oil reserves it may have a large oil surplus today but this surplus cannot be maintained indefinitely. Therefore adjusting the current account norm for these economies on the basis of the current account balance would be inappropriate.

Alternative approach

An alternative approach to establishing an estimate of the long-run equilibrium external balance position is couched in the framework of the intertemporal model of the current account tailored to oil-producing countries. Under this framework, oil-exporting countries are assumed to consume the return on total wealth—which is comprised of oil and non-oil wealth (or the present discounted value of future non-oil cash flow)—with a correction for consumption tilting, thus allowing the real value of total wealth to be maintained for future generations. If the non-oil current account implied by the consumption smoothing profile is comparable to the underlying non-oil current account balance (i.e. adjusted for temporary and cyclical factors), countries are assumed to be in long-run equilibrium with no need for exchange rate adjustments to influence the level of the non-oil current account balance.

Given the dynamic nature of the framework, the basic building blocks of the analysis contain the following:

- an assessment of the stock of oil reserves and the appropriate valuation of these stocks
- measures of the present discounted value of non-oil cash flow
- a reasonable estimate for the return on investment and the discount rate
- a measure of consumption tilting
- a long-run estimate of the non-oil current account

A few research papers have used some elements of this analysis. In particular, Akram (2004) has estimated a fundamental equilibrium exchange rate for Norway using this methodology and Segura (2006) has discussed the management of oil wealth in São Tomé and Principe based on the permanent income hypothesis. Recently, Bems and de Carvalho Filho (2008) have incorporated precautionary saving into the standard dynamic consumption smoothing model and they find that countries with larger uncertainty about future production will save more today to insure against negative production surprises.

III. Model

A. General Model

The representative household's optimization problem is given by:

(1)
$$\max_{C_t} E_t \sum_{t=0}^{\infty} \beta^t L_t u\left(C_t\right)$$
$$\text{subject to } \; B_t = (1+n)^{-1}\left(1+r\right)B_{t-1} + Y_t - C_t - I_t - G_t - T_t$$

where $L_t = L_0(1+n)^t$ is population per household which grows at the constant rate *n*. C_t is private consumption, B_t is net foreign assets at the end of period, Y_t is real GDP, I_t is investment, G_t is government consumption, and T_t is net external transfers. All variables except for population *L* are expressed in *per capita* terms.

Utility takes on a constant relative risk aversion (CRRA) form:

$$u(C) = \frac{C^{1-1/\theta} - 1}{1-1/\theta}$$

It is well known that dynamic optimization models with CRRA preference are generally intractable under stochastic uncertainty about future income.[2] For this reason, we proceed in what follows as if the model is deterministic with no stochastic uncertainty about future income. As a result, the optimal current account solution discussed below abstracts from precautionary saving and thus corresponds to a lower bound of the optimal current account under uncertainty.

We drop hereafter the expectation operator as the model is considered as deterministic. The utility maximization yields the familiar Euler equation:

$$C_{t+1}/C_t \;=\; \lambda \;=\; [\beta(1+r)]^{\theta} \tag{2}$$

If $\beta(1+r)=1$ or, equivalently, $\lambda=1$, the time profile of optimal consumption is flat (with no consumption tilting) irrespective of the risk aversion parameter θ.

For brevity of notation, we define $1+\overline{r}=(1+r)(1+n)^{-1}$ for the (gross) real interest rate adjusted for population growth, and $\tilde{Y}_t = Y_t - I_t - G_t - T_t$ for the national cash flow in per capita terms. Substituting (2) into the budget constraint yields the expression for optimal per capita consumption given by

$$\begin{aligned} C_t^* \;&=\; (1+\overline{r}-\lambda)\left[B_{t-1}+(1+\overline{r})^{-1}\sum_{j=0}^{\infty}(1+\overline{r})^{-j}\tilde{Y}_{t+j}\right] \\ &=\; (\overline{r}/\omega)W_t \end{aligned} \tag{3}$$

where $W_t = B_{t-1}+(1+\overline{r})^{-1}\sum_{j=0}^{\infty}(1+\overline{r})^{-j}\tilde{Y}_{t+j}$ is per capita wealth and $\omega=\overline{r}/(1+\overline{r}-\lambda)$ is the consumption tilting factor. Note that optimal consumption falls short of the annuity value of wealth $\overline{r}\,W_t$ if $\omega>1$ or, equivalently, $\lambda>1$.

The optimal current account (in per capita terms) is accordingly expressed as:

---

[2] A closed form solution for optimal consumption would be available for quadratic utility (whose marginal utility is linear) or a certain CARA (constant absolute risk aversion) class utility such as exponential utility. Under stochastic uncertainty, CRRA (and CARA as well) preference implies positive precautionary saving as the third derivative of the utility function is not zero. See Ghosh and Ostry (1997) for the derivation of the optimal current account under precautionary saving for CARA preference. Also see Bems and de Carvalho Filho (2008) for simulation results using CRRA preference.

$$
\begin{aligned}
CA_t^* &= \bar{r}B_{t-1} + \tilde{Y}_t - C_t^* \\
&= \bar{r}B_{t-1} + \tilde{Y}_t - \omega C_t^* - (1-\omega)\, C_t^* \\
&= \bar{r}B_{t-1} + \tilde{Y}_t - \bar{r}\, W_t - (1-\omega)\, C_t^* \\
&= CA_t^{*S} - (1-\omega)\, C_t^*
\end{aligned} \tag{4}
$$

where $CA_t^{*S} = \bar{r}B_{t-1} + \tilde{Y}_t - \bar{r}\, W_t$ is the optimal *consumption-smoothing* current account which would arise if there is no consumption tilting. As expected, the optimal current account is the sum of the optimal consumption-smoothing current account and the consumption tilting component. Substituting (3) into the budget constraint and rearranging terms yield the expression for the optimal current account as follows:

$$
CA_t^* = CA_t^{*S} - (1-\omega)\, C_t^* = -\sum_{j=1}^{\infty} (1+\bar{r})^{-j} \Delta\tilde{Y}_{t+j} - (1-\omega)\, C_t^* \tag{5}
$$

B. Model Application to Oil Based Economy

Typically oil-producing countries split their current accounts into oil and non-oil components for statistical purposes. In particular exports are divided between oil and non-oil exports. There are a number of ways to try and modify the model to take account of the oil sector. First, we partition output into oil and non-oil components:

$$
Y_t = Y_t^O + Y_t^N
$$

so that the budget constraint is

$$
B_t = (1+\bar{r})B_{t-1} + Y_t^O + Y_t^N - G_t - I_t - C_t - T_t
$$

Given this partition, the optimal current account is similarly expressed as:

$$
CA_t^* = -\sum_{j=1}^{\infty} (1+\bar{r})^{-j} \Delta Y_{t+j}^O - \sum_{j=1}^{\infty} (1+\bar{r})^{-j} \Delta\tilde{Y}_{t+j}^N - (1-\omega) C_t^* \tag{6}
$$

where $\tilde{Y}_{t+j}^N = Y_{t+j}^N - I_{t+j} - G_{t+j} - T_{t+j}$ is the *non-oil* national cash flow. Note that permanent changes in non-oil cash flow and/or oil output have no effect on the optimal current account as in standard models.

Without loss of generality, the oil current account (or net oil exports) is expressed as a fraction of oil output: $CA_t^O = (1-\alpha)Y_t^O$ where $\alpha \in [0, 1)$ represents the (time varying) share of current domestic consumption of oil in total oil production. Given this specification, the optimal non-oil current account is given by

$$
\begin{aligned}
CA_t^{*N} &\equiv CA_t^{*} - CA_t^{O} \\
&= -\bar{r}\ (1+r)^{-1}\sum_{j=0}^{\infty}(1+\bar{r})^{-j}Y_{t+j}^{O} - \sum_{j=1}^{\infty}(1+\bar{r})^{-j}\Delta\tilde{Y}_{t+j}^{N} + \alpha Y_t^{O} - (1-\omega)\,C_t^{*} \qquad (7)\\
&= -\bar{r}W_t^{O} - PDV_t^{N} + \alpha Y_t^{O} - (1-\omega)\,C_t^{*}
\end{aligned}
$$

where $W_t^O = (1+\bar{r})^{-1}\sum_{j=0}^{\infty}(1+\bar{r})^{-j}Y_{t+j}^O$ is the present value of current and future per capita oil production or, simply, per capita oil wealth, and PDV_t^N is the present value of future changes in per capita non-oil cash flow. According to (7), the optimal non-oil current account consists of four components: the return on oil wealth, the present value of future changes in non-oil cash flow, current domestic consumption of oil, and the consumption tilting component.

If the non-oil cash flow is independent of oil output, it is straightforward to show that

$$
\frac{\partial CA_t^{*N}}{\partial\{Y_{t+j}^O\}_{j=0}^{\infty}} = -(1-\lambda)/\bar{r} - (1-\alpha), \qquad \frac{\partial CA_t^{*N}}{\partial Y_t^O} = \lambda/(1+\bar{r}) - (1-\alpha)
$$

where $\partial Z_t / \partial\{X_{t+j}\}_{j=0}^{\infty}$ denotes the partial derivative of Z with respect to a permanent change in X. The impact on the non-oil current account of changes in oil output can go in either direction depending on the values of λ and α. In a simple case with $\lambda = 1$ (no consumption tilting), the non-oil current account worsens by $1-\alpha$ units for a permanent unit increase in oil output while it could either improve or decline (but by less than $1-\alpha$ units if declines) for a transitory increase.[3]

Equations (6) and (7) together form the basis of the equilibrium current account to be estimated for oil exporting countries in the next section. As such, the estimation of the model would require estimates of future oil production and non-oil cash flow.

We assume that future oil production in *aggregate* level equals a constant fraction δ of the initial oil reserve R_0^O at the end of the base year $t = 0$. Thus, the entire oil reserve is exhausted by the time $T = 1/\delta$ after which oil production is simply zero. Since population *L* is assumed to grow at the constant rate of *n*, $L_t = L_0(1+n)^t$ for all $t \geq 0$. Given these assumptions, per capita oil production and total oil reserves at time $t > 0$ can be expressed as follows:

[3] Under no consumption tilting and the assumed independence of non-oil cash flow with respect to oil production, the total current account as shown in (7) remains unaffected for a permanent increase in oil output while improves for a transitory increase. Since the oil current account always improves with an increase in oil output, the non-oil current account must decline for a permanent increase in oil output. The impact of a transitory increase in oil output depends on the relative size of improvements in the total and oil current accounts.

$$Y_t^O \equiv \Delta R_t^O / L_t = \begin{cases} \delta R_0^O / L_t & \text{for } 1 \le t \le T \\ 0 & \text{for } t \ge T+1 \end{cases}$$

(8)

$$R_t^O = \text{Max}\left[(1-\delta t) R_0^O,\ 0\right] \qquad \text{for all } t \ge 1$$

Per capita oil production declines over time before it reaches zero if population growth is positive. Total oil reserve also declines monotonically to zero regardless of whether population growth is positive or not.

Equation (8) can be used to estimate the oil wealth term W_t^O on the right hand side of (7). Clearly, W_t^O is zero for $t \ge T+1$ since per capita oil production is zero beyond time *T*. After some algebra, W_t^O for $t = 1, 2, ..., T$ can be expressed as

(9)
$$W_t^O = \left(\frac{\delta R_0^O}{L_0 (1+n)^{t-1}}\right)\left[\frac{(1+r)^{T+1-t} - 1}{r(1+r)^{T+1-t}}\right]$$

Note that the expression in square bracket involves the real interest rate *r* instead of $\bar{r}$. Finally, W_t^O at time $t = 0$ can be expressed as

(10)
$$W_0^O = (Y_0^O + W_1^O)/(1+\bar{r})$$

For the per capita non-oil cash flow, we assume the following simple autoregressive model:

(11)
$$\Delta \tilde{Y}_{it}^N = \phi_i + \sum_{j=1}^{J} \gamma_j \Delta \tilde{Y}_{it-j}^N + \sum_{k=1}^{K} \rho_k (\Delta R_{it-k}^O / L_{it-k})$$

Per capita changes in the real value of oil reserve ($\Delta R^O / L$) are included as control variables for the spillover effect of oil price changes on the non-oil sector. Note that country-specific constant terms are allowed to vary but all other coefficients are restricted to be the same across countries to preserve degrees of freedom. Once future values of $\Delta R^O / L$ are obtained from (8), the estimate of the term PDV_t^N in (7) can be easily obtained by iterating (11) forward.

Finally, the consumption tilting factor ω can be estimated by invoking the stationarity of the optimal consumption-smoothing current account, $CA_t^{*S} = \bar{r}B_{t-1} + \tilde{Y}_t - \omega C_t^*$ which, as can be seen from equation (5), equals the negative of the present value of future changes in the national cash flow. Since both the national cash flow and consumption are nonstationary, an estimate of ω can be directly obtained from the cointegrating regression of the national cash flow on consumption.

IV. Estimation

The sample used in this paper to evaluate the consumption smoothing approach to real exchange rate assessments includes countries with the largest amounts of proven oil reserves (Kuwait, Saudi Arabia, United Arab Emirates, Russia and Republica Bolivariana de Venezuela) except for Iran and Iraq and adds Malaysia as a benchmark for countries with limited reserves. The reserves data come from the 2006 edition of the British Petroleum Statistical Review.

Recall that the equilibrium non-oil current account has four terms: the return on oil wealth (or the present discounted value of future oil production), the present discounted value of the change in non-oil cash flow, the consumption tilting factor, and a correction for domestic oil consumption. Each of these components will be taken in turn.

The return on oil wealth

In the consumption smoothing model presented in section III, the oil wealth term involves the present discounted value of future per capita oil production (equation (9)). The baseline estimate for the valuation of oil wealth for each country uses a five year average of future oil prices for Brent and West Texas oil. The estimate used in this paper is taken from the summer 2007 WEO forecast in order to maintain comparability with IMF staff estimates of the equilibrium exchange rate for the various countries. At that time the five year average of future oil prices was $67.4 dollars per barrel. Of course, country wealth is not only determined by the value of assets in the ground but also by other asset stocks that the countries have built up over time. However, since the return on existing assets is a component of national income and consumption, it is netted out in the non-oil current account.

The present discounted value of oil wealth is dependent on the assumption made about the discount rate and population growth as well as the oil price. The current real return on an inflation indexed bond in the United States is 2 percent while the Office of Management and Budget estimates that private companies in the US use a 7 percent real discount rate when making judgments about the viability of investment projects. As a baseline estimate a real discount rate of 4 percent is used. Population growth estimates are taken from World Bank 20-year forecasts issued in its World Development Report. The projections indicate that populations in the Middle Eastern countries are projected to grow the fastest at between 2.2 and 2.5 percent per annum, with Malaysian and Republica Bolivariana de Venezuelan populations projected to grow at 1 ½ percent per annum and Russia's population is projected to decline slightly.

Another assumption required to obtain the net present value of oil wealth is the extraction rate. To obtain the current extraction rate, average production estimates over the period of 2004-06 were expressed in terms of the stock of oil reserves in 2006. The highest extraction rate is for the two countries with the smallest estimated stock of reserves (Malaysia and Russia) at about 5 percent of the total stock per annum while the median extraction rate for the sample is slight below 1 ½ percent per annum (Table 1). For our estimate of the net present value of oil wealth we assume an extraction rate of 1 percent per annum for Republica Bolivariana de Venezuela, Kuwait, Saudi Arabia, and United Arab Emirates which implies that the oil reserves are fully extracted within 100 years. For Malaysia and Russia, the reserves are assumed to be fully extracted within twenty years.

Table 1. Oil Reserves, Production, and Extraction

Country	Oil reserve stock 2006	Oil production average (2004-2006)	Extraction rate 1/
	(In billions of barrels)		(In percent)
Venezuela	80.01	1.05	1.32
Kuwait	101.50	0.95	0.94
Malaysia	4.20	0.28	6.68
Russia	79.54	3.48	4.38
Saudi Arabia	264.25	3.97	1.50
United Arab Emirates	97.80	1.02	1.04
Median			1.41

Notes: 1/ The extraction rate is the ratio of oil production to the oil reserves stock
Sources: International Monetary Fund; *WEO* database, and IMF staff estimates.

The present value of future oil production based on a 4 percent real discount rate ($r = 0.04$), country-specific population growth estimates, oil prices at US$67 per barrel, and extraction periods between 20 and 100 years are shown in Table 2. At US$67 per barrel, oil wealth varies between US$212 billion for Malaysia to over US$4300 billion in Saudi Arabia.[4] The annual return (assumed at 4 percent with corrections for population growth differences) is smallest in terms of output for Malaysia at 2 ½ percent of GDP and rises to almost 20 percent of GDP for Kuwait.

[4] This paper has focused on oil wealth but the same type of analysis can be conducted for other types of non-renewable resources such as natural gas, copper etc.

Table 2. Oil Wealth, and Annual Return

Country	Oil Wealth (Present discounted value, in US$ billions)	Annual Return (In percent of 2012 GDP)
Venezuela	1317.6	15.9
Kuwait	1671.5	19.5
Malaysia	212.2	2.5
Russia	3125.0	9.3
Saudi Arabia	4351.7	16.4
United Arab Emirates	1610.6	11.5

Sources: British Petroleum Statistical Review; *WEO* and *WDI* databases, and IMF staff estimat

The present discounted value of non-oil cash flow

To proxy the present discounted value of future non-oil national cash flow, an estimate of the long-run growth in non-oil cash flow is necessary. Since the real oil price is assumed to remain constant in future it is necessary to net out the effects on non-oil cash flow of historical movements in the real oil price. To accomplish this, a second order autoregressive process for the change in real non-oil cash flow per capita (in relation to the average level of real output per capita) was estimated for the sample of countries with country dummies and the change in real oil wealth used as regressors (Table 3). The time period for the estimation runs from 1980 to 2006 except for Kuwait which is estimated over the 1993-2006 period and Russia which has available data from 1991. In addition, a dummy variable for 1998 is included for Malaysia to net out the sharp decline in non-oil output for this year.

The analysis indicates that movements in national cash flow are quite volatile since the only significant time varying variable is the second lag on non-oil cash flow. Moreover, the only significant country dummies are for Malaysia and Russia and the coefficient estimates indicate that the growth rate for the real national cash flow in Malaysia is 2.7 percent per annum while it is slightly higher at 3.2 percent per annum for Russia. Since both country estimates are less than 4 percent, this provides support for the assumption of a 4 percent real discount rate since convergence in the wealth estimate requires that the growth rate is below the discount rate.

Although some of the country specific constant terms are insignificant in Table 3, for expositional purposes they are all used in the calculation of the present discounted value of non-oil cash flow.[5] The estimates are discussed in Table 5 (see below).

[5] For the present value calculation, the regression equation in Table 3 is reformulated into a first-order VAR:

$$\Delta Z_{it} = B_{i0} + B_1 \Delta W_{it-1} + B_2 \Delta Z_{it-1}$$

(continued…)

Table 3. Determinants of the Change in Real Non-oil Cash Flow: 1980-2006

	coefficient	standard error	
Change in real non-oil cash flow (t-1)	-0.15	0.15	
Change in real non-oil cash flow (t-2)	-0.150	0.07	**
Change in real oil wealth (t-1)	0.001	0.00	
Change in real oil wealth (t-2)	0.001	0.00	
Venezuela	-0.010	0.01	
Kuwait	0.028	0.04	
Malaysia	0.028	0.01	***
Russian Federation	0.032	0.01	**
Saudi Arabia	-0.01	0.01	
United Arab Emirates	0.001	0.01	
Number of observations	118		
R squared	0.16		

Notes:*** signifies significance at the 99 percent level; * *signifies signficance at the 95 percent level

The consumption tilting factor

As demonstrated by Ghosh (1995), an estimate of the consumption tilting component can be obtained from the cointegrating vector between real consumption and real cash flow as in equation (4) above. Since, on average, the consumption smoothing term should equal cash flow, a regression of one variable on the other should yield stationary residuals. To limit the influence of the oil price on the deflator for cash flow, both consumption and cash flow are deflated by the consumption deflator. Table 4 presents *p*-values associated with Phillips-Perron test statistics for stationarity using data estimated over 1980-2006. The table shows that the estimates for Kuwait, Russia, Saudi Arabia and United Arab Emirates contain stationary residuals at standard levels of significance (*p*–values < 0.05) whereas for the other two countries, the estimates are stationary at weaker levels of significance (*p*-values are around 0.3).

To assess whether consumption tilting is taking place, it is necessary to test whether the coefficient estimates are significantly different from unity. This involves a chi-squared test between the sum of squared residuals in the unrestricted equation and a restricted equation with the coefficient on consumption set to unity. The chi squared test statistics in table 4

---

where $\Delta Z_{it} = [\Delta NCF_{it},\ \Delta NCF_{it-1}]'$ and $\Delta W_{it-1} = [\Delta ROW_{it-1},\ \Delta ROW_{it-2}]'$ with *NCF* and *ROW* denoting real per capita non-oil cash flow and real oil wealth, respectively. The expected values of future non-oil cash flow can be generated by iterating the VAR forward for given path of *ROW*.

indicate that consumption tilting occurs for Malaysia and Russia with consumption tilted toward the future in both countries.

Table 4. Consumption Tilting Estimate: 1980-2006

	Estimate	Number of Observations	Test for stationarity (p value)	Test for consumption tilting (Chi squared statistic)
Venezuela	0.890	27	0.290	0.4
Kuwait	0.680	16	0.001	1.41
Malaysia	1.650	22	0.340	13.1 ***
Russian Federation	1.350	14	0.070	15.2 ***
Saudi Arabia	0.840	26	0.060	1.04
United Arab Emirates	0.910	27	0.020	0.92

Notes: Test for stationarity is based on the Phillips-Perron test statistic
Test for consumption tilting is based on comparing the residual sum of squares for the unconstrained regression with a regression that forces the consumption tilting estimate to be unity
*** indicates significance at the 99 percent level of confidence

Table 5. Components of equilibrium non-oil current account
(In percent of 2012 GDP)

Country	Annual Return on oil wealth **[1]**	PDV of non-oil cash flow 1/	**[2]**	Consumption tilting 1/	**[3]**	Domestic Consumption **[4]**	Equilibrium non-oil position **[1]+[2]+[3]+[4]**
Venezuela	-15.9	15.0	0.0	-8.2	0.0	5.3	-10.6
Kuwait	-19.5	7.0	0.0	15.1	0.0	4.7	-14.9
Malaysia	-2.5	-26.3	* -26.3	36.5	* 36.5	5.8	13.4
Russia	-9.3	-33.3	* -33.3	29.9	* 29.9	4.6	-8.0
Saudi Arabia	-16.4	13.2	0.0	-12.3	0.0	4.0	-12.4
United Arab Emirates	-11.5	0.7	0.0	-21.1	0.0	0.0	-11.5

Sources: British Petroleum Statistical Review; *WEO* database, and IMF staff estimates.
1/ Country specific constants that are significant are denoted by an asterisk and are included in the calculation of the equilibrium non-oil current account position, insignificant terms are set to zero in the calculation of the equilibrium non-oil current account position

Overall assessment of equilibrium non-oil current account

Since we are interested in an estimate of the current account at equilibrium, with cyclical factors absent, the components of the equilibrium current account are expressed in terms of 2012 output based on WEO forecasts. The present discounted value of non-oil cash flow is large in the economies with the smallest oil sectors (Malaysia and Russia) at about 26 and 33 percent of 2012 GDP (Table 5). Of course, these estimates could be biased upward if the convergence process is still taking place since they would revert to the estimates of leading countries once the convergence process is complete.

As indicated in equation (7), a correction for domestic oil consumption needs to be made. Since data on non-oil GDP is available for Kuwait, Saudi Arabia, United Arab Emirates and Republica Bolivariana de Venezuela, oil consumption was estimated as the difference between oil output and oil exports. This should represent an upper bound on consumption since it also includes oil investment. Interestingly, the value was almost zero for United Arab Emirates and averaged between 4 and 5 percent of GDP for Kuwait, Saudi Arabia, and Republica Bolivariana de Venezuela. For Malaysia and Russia, oil consumption is estimated based on oil consumption figures from the British Petroleum Statistical Review and indicate oil consumption of almost 6 percent of GDP for Malaysia and 4 ½ percent of GDP for Russia.[6]

Aggregating all of the components of the equilibrium non-oil current account, all countries with the exception of Malaysia should be running large non-oil current account deficits, ranging from about 8 percent of GDP for Russia to 17 percent of GDP for Kuwait.

V. Sensitivity Tests of the Annual Return on Oil Wealth

This section focuses on various sensitivity tests for the annual return on oil wealth, inter alia, variations in the return on oil wealth, the future profile of the oil price, and revisions made to oil reserve estimates.

In terms of oil reserve estimates, there are two sources of uncertainty. Different agencies have different estimates of the current stock of oil reserves in various countries. For example, the latest estimate from the British Petroleum Institute indicates that the current stock of oil reserves in Russia is about 80 billion barrels, while estimates from various agencies range from about 69 billion barrels to 120 billion barrels (United States Geological Survey). If we substitute the highest estimate of oil reserves for Russia the oil return rises by about 4 ½ percentage points to 14 percent of GDP (Table 5, column 1).

[6] Using consumption data from BP for the other countries yields comparable results except for Saudi Arabia since for this country, the BP data indicate domestic consumption of 9 percent of GDP compared to 4 percent of GDP using the data on non-oil GDP

Table 6. Revisions to Estimates of Oil Reserves
(percent difference, using 1996 and 2001 as benchmarks)

Country	1996	2001
Venezuela	12.66	1.02
Kuwait	2.66	2.66
Malaysia		14.28
Russia		32.88
Saudi Arabia	1.06	1.35
United Arab Emirates	-0.31	1.66
Median	1.86	2.16

Notes:
The revision is estimated using the latest British Petroleum figures for oil reserves in 1996 and 2001 and comparing these figures with estimates made in 1996 and 2001 by the Oil and Gas Journal
Sources: International Monetary Fund; and IMF staff estimates.

Revisions have taken place over time using the same source of estimates. Historically, estimates of oil reserves provided by the British Petroleum Institute have been obtained from the Oil and Gas Journal. In order to assess the extent to which estimates of oil reserves have changed over time, the most recent estimates from the BPI for 1996 and 2001 were compared to those made by the Oil and Gas Journal in both years. Comparisons are made with revised data for the same year to minimize the influence of subsequent oil extractions. Table 6 indicates that the upward revisions have in general been quite small: the median cross-country estimate for the disparity between the most recent BPI estimate (June 2007) for 1996 and the corresponding Oil and Gas Journal estimate for the same year is 1.9 percent while the median cross-country estimate of reserve stock revisions between both sources for the year 2001 is 2.2 percent.

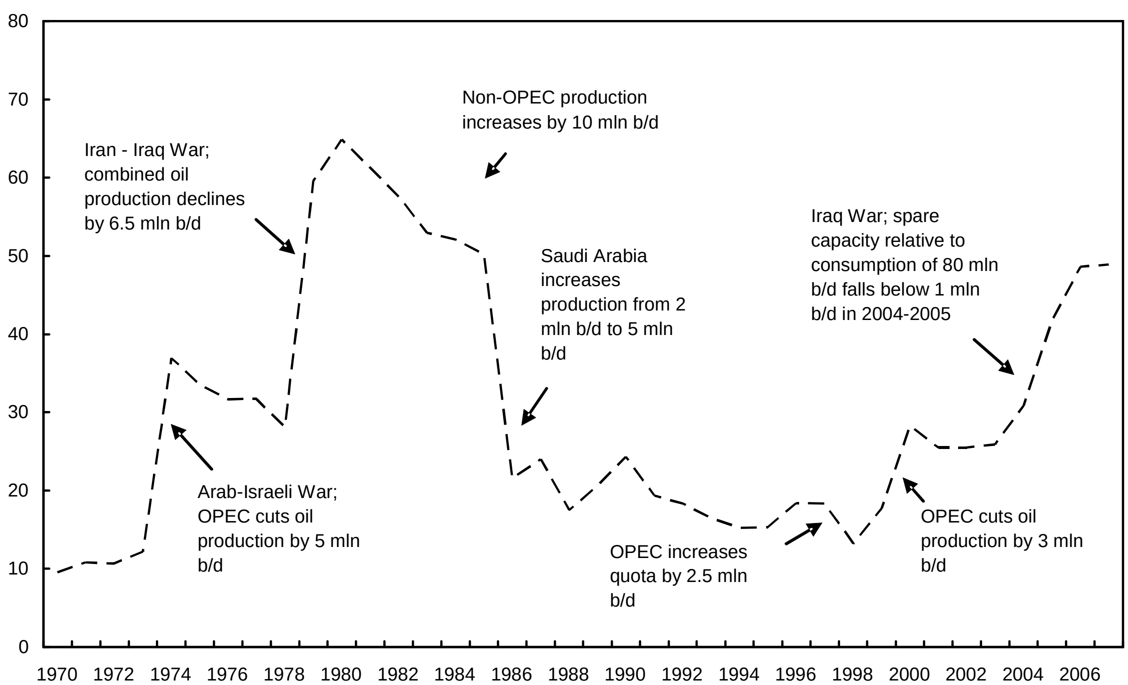
The estimates of oil wealth for the Middle Eastern countries are sensitive to assumptions made about the discount rate because they are projected to have high population growth estimates over the next 10-15 years. As the discount rate is lowered, the population corrected return on wealth approaches zero. The largest effect of a decline in the discount rate from 4 to 3 percent is for Kuwait since the estimated annual return on oil wealth declines from almost 20 percent of GDP to below 9 percent of GDP.

The estimates of the return on oil wealth for all countries are sensitive to assumptions made about the future profile of oil prices. Figure 1 shows the profile of the real oil price defined as the average oil price for Brent, Dubai, and New York market oil deflated by the US GDP deflator. The figure shows that the real oil price rose sharply during the early and late 1970s following the Yom Kippur and Iran-Iraq wars when oil production fell dramatically. During the early 1980s, oil production by countries outside of OPEC rose rapidly, leading to a sharp decline in prices. This boost to production was bolstered by a large increase in Saudi

Arabia's oil production in 1986. Oil prices remained at historic lows within the range of 10-20 dollars (in 2000 prices) until 2000. At this time OPEC cut its production by three million barrels per day, and, combined with spare capacity constraints in 2004 and 2005, the real oil price rose to the level experienced during the late 1970s.

If we value current oil wealth in the major exporting countries using the average real oil price over the 1985-2000 period, the alternative estimates of the return on oil are much lower than the baseline estimates (Table 7). The average real oil price over the 1985-2000 period is only about 36 percent of the current estimate (at about US$25 per barrel at current prices) and applying this adjustment would lower the return on oil considerably. Using these estimates, the return on oil wealth would vary between 1 percent for Malaysia to 7 ½ percent of GDP for Kuwait. On the other hand if we value oil using the latest WEO forecast of a medium-term estimate of US$124 per barrel, the return on wealth would vary between 17 and 37 percent of GDP, except for Malaysia at 4 ½ percent of GDP.

Figure 1. Developments in the Real Oil Price, 1970-2007 1/
(In 2000 Prices)



Source: WTRG Economics.
1/ Average price for Brent, Dubai, and UK oil deflated by the US GDP.

Table 7. Sensitivity Analysis of Annual Return on Oil Wealth
(In percent of 2012 GDP)

Country	Baseline	Sensitivity analysis		
	Oil price at US$67; discount rate at 4%	Oil price at US$67; discount rate at 3%	Oil price at US$25; discount rate at 4%	Oil price at US$124; discount rate at 4%
Venezuela	15.9	12.4	6.0	29.6
Kuwait	19.5	8.6	7.4	36.8
Malaysia	2.5	1.6	0.9	4.6
Russia 1/	9.3	7.5	3.4	17.0
Saudi Arabia	16.4	9.6	6.2	30.8
United Arab Emirates	11.5	6.7	4.4	21.6

Sources: British Petroleum Statistical Review; *WEO* and *WDI* database, and IMF staff estimates.

VI. Equilibrium Non-oil Current Account Assessment

A. Historical Accuracy of the Consumption Smoothing Model

Before assessing prospective non-oil current accounts in these countries based on the consumption smoothing model, it is necessary to assess whether the model has been able to replicate behavior in the past. To do this, the historical non-oil current account was compared to the equilibrium non-oil current account based on historical data on oil reserves and the real oil price. The oil reserves are used to calculate the present discounted value of oil production. The return on wealth is presented with a negative sign to account for the fact that this would normally represent consumption and therefore would be a drain on the current account. The consumption tilting factor is of course positive and explains why the combination of the return on oil wealth and the consumption tilting factor is positive for Malaysia.

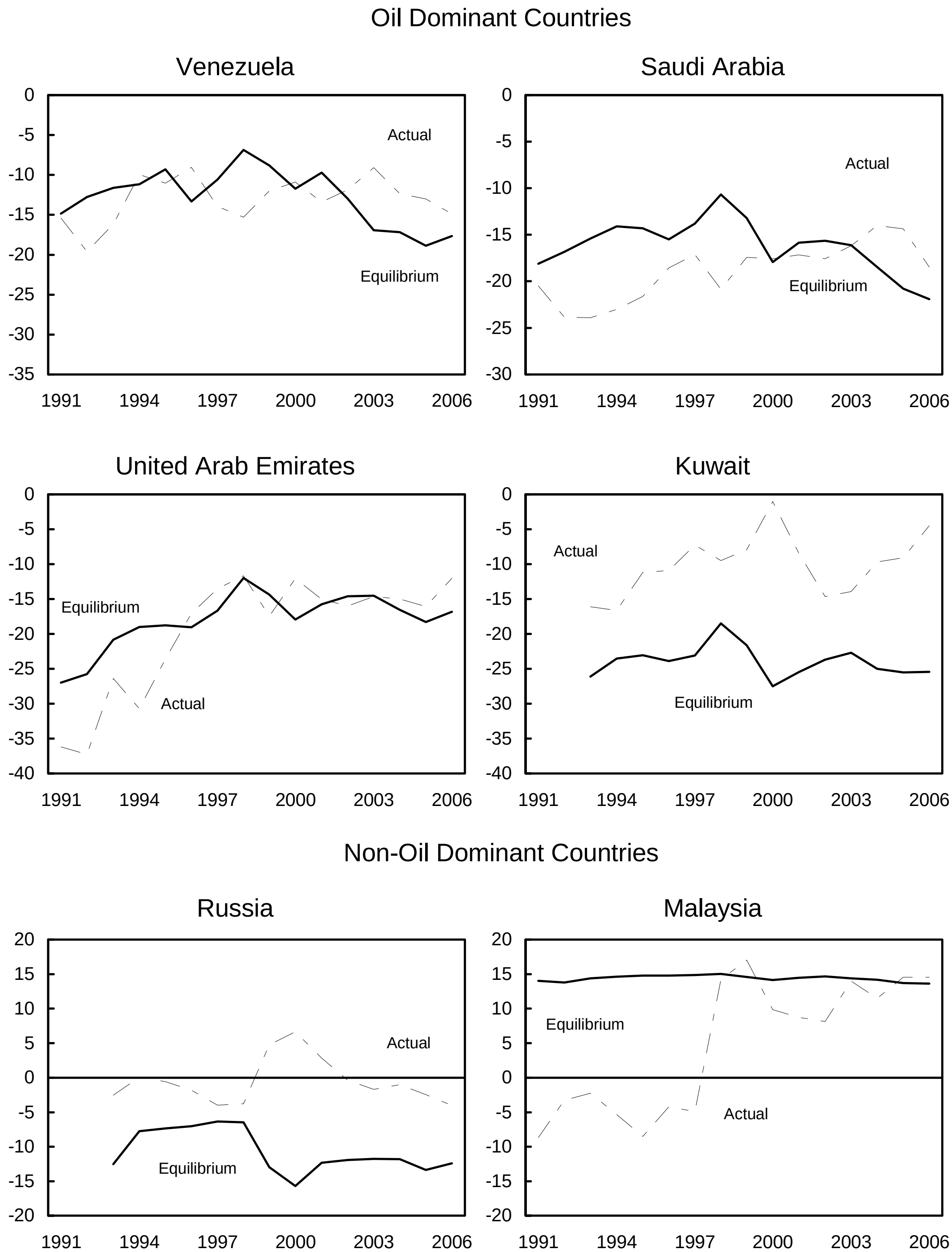
The panel charts in Figure 2 show that the model replicates the historical behavior well in Republica Bolivariana de Venezuela, Saudi Arabia and United Arab Emirates and that it replicates the behavior in Malaysia since the Asian crisis of 1997-98. However, it does not pick up the historical behavior in Kuwait and Russia.

B. Country Estimates of Non-oil Current Account

How do the consumption smoothing estimates compare with likely medium term non-oil current account outcomes for these countries? One benchmark for the non-oil current account projection is to use the medium-term forecast by IMF staff to minimize cyclical effects. Compared to the recent past, the non-oil current account positions are projected to deteriorate over the medium term in all countries with sizeable declines in Kuwait, Saudi Arabia and Russia. The non-oil trade deficit in percent of GDP is projected to deteriorate by between 3-5 percentage points in these countries over the 2007-2012 period to register a non-oil current account deficit of about 15 percent of GDP in Kuwait, 22 percent for Saudi Arabia and about 8 percent for Russia (Figure 2 and Table 8). The deficits in United Arab Emirates and

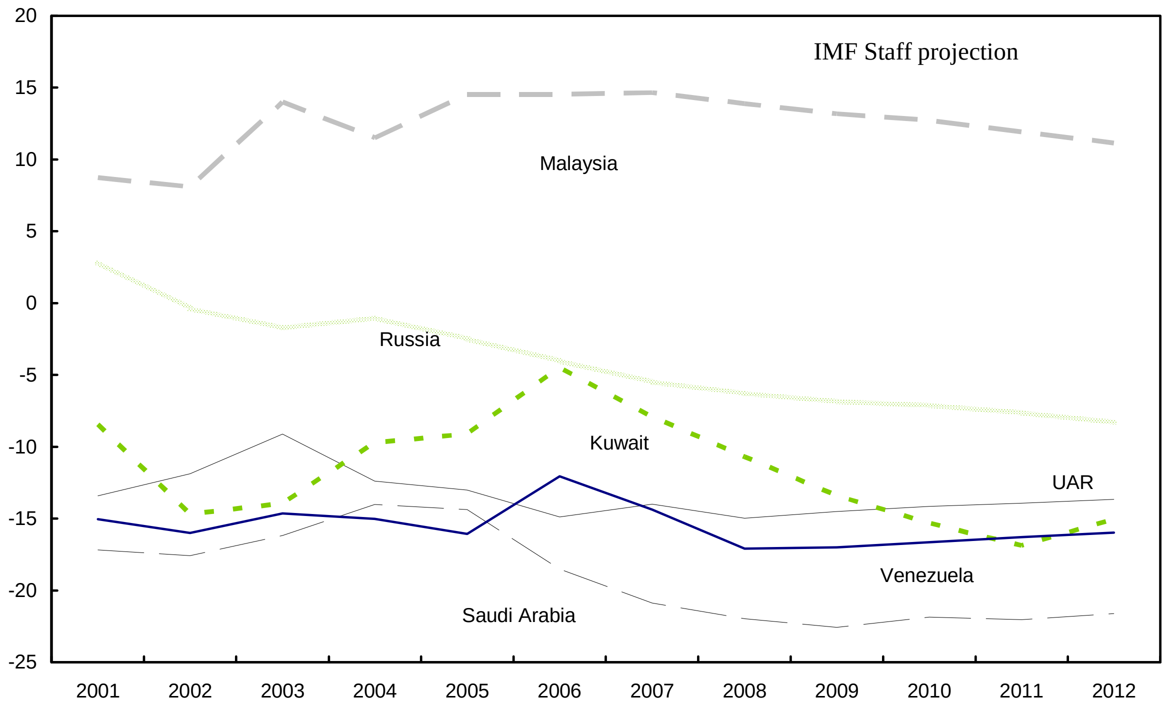
Republica Bolivariana de Venezuela are projected to remain fairly stable at about 14-16 percent of GDP while the surplus in Malaysia is projected to fall to about 11 percent of GDP in 2012.

Figure 2. Historical Comparison of Actual and Equilibrium Non-Oil Current Account (in percent of GDP)



Sources: International Monetary Fund; and IMF staff estimates.

Figure 3. Non-oil current account
(in percent of GDP)



The equilibrium non-oil current account is extremely sensitive to changes in oil prices. At US$67 per barrel, Saudi Arabia and United Arab Emirates are the only countries that exhibit a sizeable difference (i.e. at least 4 percentage points of GDP) between the equilibrium non-oil current account based on the consumption smoothing model and the medium-term non-oil current account projection. For both countries, the non-oil current account is below the equilibrium level. If the oil price assumption is maintained but a discount rate of 3 percent is used, the difference between the equilibrium non-oil current account and the medium-term non-oil current account projection becomes larger for both countries and, in this case, Kuwait and Venezuela's non-oil current account projection is now far below the equilibrium level. When oil prices are set at the average level over the 1985-2000 period, the equilibrium non-oil current account estimates for all countries would be considerably stronger than the medium-term non-oil forecast. On the other hand, if oil prices remain at current levels, the equilibrium non-oil current account estimates for all countries (except for Malaysia) would be considerably weaker than the medium-term non-oil forecast. [7]

[7] It should be noted that for Saudi Arabia, if the correct estimate of domestic consumption of oil is 9 percent of GDP (based on BP data), the equilibrium non-oil current account would be comparable to the underlying non-oil current account even at current oil prices.

Table 8. Non-oil Current Account Assessment
(In percent of 2012 GDP)

Country	Equilibrium concepts under various assumptions: Oil prices at summer 2007 WEO levels, discount rate at 4%	Oil prices at summer 2007 WEO levels, discount rate at 3%	Oil prices at 1985-2000 historical average, discount rate at 4%	Oil prices at summer 2008 WEO levels, discount rate at 4%	Forecast
Venezuela	-10.6	-7.1	-0.7	-24.3	-13.7
Kuwait	-14.9	-3.9	-2.8	-32.2	-15.0
Malaysia	13.4	14.3	15.0	11.3	11.2
Russia	-8.0	-6.2	-2.2	-15.7	-8.3
Saudi Arabia	-12.4	-5.5	-2.2	-26.8	-21.6
United Arab Emirates	-11.5	-6.7	-4.4	-21.6	-16.0

Sources: British Petroleum Statistical Review; *WEO* and *WDI* databases, and IMF staff estimates.

VII. Conclusions

This paper has provided an alternative methodology for calculating equilibrium non-oil current account estimates for oil-exporting countries. Intertemporal consumption smoothing is of particular relevance for these countries because, for most of them, their national income is predominantly derived from non-renewable oil resources and is thus expected to fall in the future. In this context, countries are assumed to be in long-run equilibrium with no need for exchange rate adjustments if the non-oil current account implied by the consumption smoothing profile is comparable to the medium-term non-oil current account balance. This methodology captures the past behavior of the non-oil current account for Republica Bolivariana de Venezuela, Saudi Arabia, United Arab Emirates, and Malaysia since the Asian crisis, but is unable to replicate the historical pattern of the non-oil current account for Kuwait and Russia.

The methodology is most suited to countries with large stocks of oil wealth since there is considerable uncertainty in estimating non-oil cash flows. Moreover, it is also arguable whether differences in time preference across countries should be included in the model since they can have sizeable effects on the estimation of the equilibrium current account. These reservations could argue against using this methodology for a country like Malaysia whose return on wealth is much lower than for the other countries.

Even for the countries where oil is dominant, the estimation of the equilibrium current account is very sensitive to parameter assumptions, especially discount rates, population growth estimates and oil prices. Using oil prices prevailing in the summer of 2007 (US$67 per barrel) the consumption smoothing and predicted non-oil current accounts are comparable for Republica Bolivariana de Venezuela, Kuwait, Malaysia and Russia. For Saudi Arabia and United Arab Emirates, the equilibrium non-oil current account deficit is significantly less than the projected outcome. Valuing oil wealth at the WEO medium-term forecast (US$124 per barrel) would result in equilibrium non-oil current account estimates for all countries (except for Malaysia) that would be considerably weaker than the medium-term non-oil forecast. On the other hand, valuing oil wealth using the average real oil price over the 1985-2000 period (US$25 per barrel) reduces the equilibrium non-oil current account estimates for all countries below the medium-term non-oil forecast.

The sensitivity to oil prices is hardly surprising since the methodology used in this paper is based on oil stocks, which implies that sensitivity analyses for different oil prices are, in effect, tracking the impact on the current account of a “permanent” change in the oil price. In general, this stock approach is more sensitive to a permanent price shock than the corresponding flow approach while the opposite is true for a temporary price shock. Similarly, the stock approach is quite sensitive to assumptions about the extraction rate since current production is valued considerably more than production in the future. Given the difficulty in discerning between temporary and permanent oil price shocks and in choosing the most realistic extraction rate, the methodology of this paper should be used in tandem with the macroeconomic balance approach of the IMF.

Finally, for tractability reasons, the methodology used in this paper abstracts from precautionary saving associated with income uncertainty arising from volatile oil prices. As a result, the estimated equilibrium current account is likely to understate the optimal current account balance especially for major oil-producing countries whose national income depends heavily on oil revenue. It should be noted, however, that what matters for precautionary saving is the volatility of *permanent* changes in oil price because precautionary saving is an insurance against the risk of unexpected fall in the permanent income. Bems and de Carvalho Filho (2008) have incorporated precautionary saving into the standard dynamic consumption smoothing model and find that countries with larger uncertainty about future production will save more today to insure against negative production surprises.

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