

Algorithm for the computation of capital flight

Definition of capital flight

We define capital flight as the difference between total capital inflows and recorded foreign exchange outflows. In a given year t for a country i capital flight is computed as:

$$KF_{it} = \Delta DEBTADJ_{it} + DFI_{it} - (CA_{it} + \Delta RES_{it}) \quad (A1)$$

where $\Delta DEBTADJ$ is the change in total external debt outstanding adjusted for exchange rate fluctuations (see below), DFI is net direct foreign investment, CA is the current account deficit, and ΔRES is net additions to the stock of foreign reserves.

Adjustment for exchange rate fluctuations

To correct for potential discrepancies due to exchange rate fluctuations, we adjust the change in the long-term debt stock for fluctuations in the exchange rate of the dollar against other currencies. For country i , the U.S. dollar value of the beginning-of-year stock of debt at the new exchange rates is obtained as follows:

$$\begin{aligned} NEWDEBT_{i,t-1} &= \sum_{j=1}^7 (\alpha_{ij,t-1} * LTDEBT_{i,t-1}) / (EX_{jt} / EX_{j,t-1}) + \\ &IMFCR_{i,t-1} / (EX_{SDR,t} / EX_{SDR,t-1}) + LTOOTHER_{i,t-1} + LTMULT_{i,t-1} + \\ <USD_{i,t-1} + STDEBT_{i,t-1} \end{aligned} \quad (A2)$$

where $LTDEBT$ is the total long-term debt; α_{ij} is the proportion of long-term debt held in currency j , for each of the seven non-US currencies;¹ EX is the end-of-year exchange rate of the currency of denomination against the dollar (expressed as units of currency per U.S. dollar); $IMFCR$ is the use of IMF credit; $LTOTHER$ is long-term debt denominated in other unspecified currencies; $LTMULT$ is long-term debt denominated in multiple currencies; $LTUSD$ is long-term debt denominated in U.S. dollars; and $STDEBT$ is short-term debt.

The exchange rate adjustment is obtained as:

$$ERADJ_t = NEWDEBT_{t-1} - DEBT_{t-1} \quad (A3)$$

We then obtain the adjusted change in debt as:

$$\Delta DEBTADJ_t = \Delta DEBT_t - ERADJ_t \quad (A4)$$

Since $\Delta DEBT_t = DEBT_t - DEBT_{t-1}$, it follows that (4) is equivalent to:

$$\Delta DEBTADJ_t = DEBT_t - NEWDEBT_{t-1} \quad (A4')$$

Adjustment for debt write-offs

We adjust the change in debt to account for debt write-offs, given that they reduce the stock of debt although they have no corresponding flow of debt service. Hence, they lead to an overstatement of debt service and an understatement of the change in debt obtained as the change in annual debt stocks over consecutive years. We add the value of debt write-offs (absolute value, in 2004 dollars) to the estimated capital flight in equation (A1).

¹ The seven currencies are the euro (from 2000); French franc and the Deutsche mark (up to 2000); Swiss franc, Yen, SDR, and British pound.

Adjustment for trade misinvoicing

We estimate trade misinvoicing by comparing the country's export and import data to those of its trading partners.² We assume that the trade data from industrialized countries are relatively accurate, and interpret the discrepancy between these and the data from their African trading partners as evidence of misinvoicing. For an individual African country i in year t , export discrepancies with the industrialized countries ($DXIC$) are computed as follows:

$$DXIC_{it} = PXIC_{it} - (XIC_{it} * CIF_t) \quad (A5)$$

where $PXIC$ is the value of the industrialized countries' imports from the African country as reported by the industrialized trading partners, XIC is the African country's exports to industrialized countries as reported by the African country, and CIF is the c.i.f/f.o.b factor, representing the costs of freight and insurance.³ A positive sign on $DXIC$ indicates export underinvoicing.

Import discrepancies with the industrialized countries ($DMIC$) are computed as:

$$DMIC_{it} = MIC_{it} - (PMIC_{it} * CIF_t) \quad (A6)$$

where MIC is the African country's imports from industrialized countries as reported by the African country, and $PMIC$ is the industrialized countries' exports to the African country as reported by the industrialized trading partners. A positive sign on $DMIC$ indicates net overinvoicing of imports; a negative sign indicates net underinvoicing.

² The trade misinvoicing adjustment could not be calculated in the case of South Africa due to lack of consistent data.

³ The series for the c.i.f./f.o.b. factor reported in the IMF's *Direction of Trade Statistics Yearbooks* are in some cases anomalous both in terms of absolute values and year-to-year variations. For example, the reported c.i.f./f.o.b. factor for Congo-Zaire is higher than that of land-locked Burundi. Hence we use the average factor for each year for Africa as a whole in our computations.

To obtain global totals, we multiply these discrepancies by the inverse of the average shares of industrialized countries in the African country's exports ($ICXS$) and imports $ICMS$.⁴ We obtain total trade misinvoicing as the sum of export discrepancies and import discrepancies:

$$MISINV_{it} = \frac{DXIC_{it}}{ICXS_i} + \frac{DMIC_{it}}{ICMS_i} \quad (A7)$$

Adding trade misinvoicing to the initial estimate of capital flight from equation (A1) we obtain adjusted capital flight as:

$$ADJKF_{it} = KF_{it} + MISINV_{it} \quad (A8)$$

Adjustment for underreporting of remittances

A number of sub-Saharan African countries receive substantial inflows of remittances from their citizens who are working in Europe and, to a lesser extent, the United States and other industrialized countries. These inflows are often underreported in the African countries' official balance-of-payments (BoP) statistics. Officially recorded remittances enter into the BoP statistics primarily under three headings: "workers' remittances, compensation of employees, and migrant transfers."⁵ Econometric analysis suggests that underreporting in the BoP statistics is particularly

⁴ In some cases, the data reported in the IMF *Direction of Trade Statistics Yearbooks* show occasional wide, unexplained fluctuations in the shares of industrialized countries in some African countries' exports and imports. In our calculations, we use the average shares for each country over the 1970-2004 period, except for the 30 countries contained in the Boyce and Ndikumana (2003) for which the average shares is for the 1997-2004 period (given that capital flight series for 1970-96 are taken from Boyce Ndikumana (2003) and only converted into 2004 dollars).

⁵ Summary BoP measures of remittance inflows and outflows for the years 1970-2006 are available from World Bank (2007). For discussion of the methodology by which these measures were extracted from the BoP accounts, see World Bank (2006, pp. 105-108). The World Bank (2006, p. 91) speculates that the share of formal (recorded) as opposed to informal (unrecorded) remittances rose in response tightened financial regulations after September 11, 2001. On the other hand, IFAD (2007, p. 7) suggests that by increasing the cost of using formal channels, the same regulatory changes may have led to greater reliance on informal remittance networks. In the absence of direct evidence on this matter, we assume no overall change in the share of unrecorded remittances.

large in Africa, with unrecorded remittances accounting for more than half of total remittance flows (World Bank, 2006: 92).

Unrecorded remittance inflows have an effect on capital flight estimates analogous to that of unrecorded export earnings: the amount of foreign exchange entering the African country is greater than what is captured in the official BoP. This foreign exchange could be used to finance (recorded or unrecorded) imports, or it could enter the formal banking system and ultimately add to the central bank's official reserves, or it could go into capital flight. Regardless of its actual use, omitting these inflows from residual-based estimates of capital would lead to underestimation of its true magnitude.

Alternative estimates of remittance inflows have been reported by the International Fund for Agricultural Development (IFAD, 2007). These were derived by combining data on total numbers and locations of migrant workers in 2006 with survey data, for various host-origin country pairs, on the percentage of migrants who send remittances and the average amount of these remittances. In general, these estimates support the view that the official BoP data understate the true magnitude of remittance flows, at times substantially. The IFAD estimate of the remittance inflows from industrialized countries to Nigeria in 2006 amounted to \$5.4 billion, for example, compared to the BoP measure of \$3.3 billion. In Angola, to take another example, the IFAD estimate shows an inflow of \$969 million whereas the BoP data report no remittances whatsoever.

The IFAD estimates include remittance inflows from all countries, including intra-African transfers. The data on number of migrants and their remittance behavior appears to be less reliable for intra-African flows. Accordingly, we estimate the volume of unreported remittances by comparing estimated inflows from industrialized countries to the total inflows recorded in the official BoP statistics.⁶ In principle, the latter should be larger because it is meant to include remittances from the entire world, not only from the industrialized countries. Where, instead, the former estimates exceed the latter, we take this as strong evidence of underreporting. We calculate the discrepancy based on 2006 data (the year for which the alternative estimates are available), and extrapolate from this to estimate discrepancies for earlier years based on the trend in overall African remittance inflows reported in the BoP statistics:

$$RID_{it} = (ARI_{i,2006} - BPRI_{i,2006}) * BPRI_t / BPRI_{2006} \quad (A9)$$

where RID_{it} = remittance inflow discrepancy in country i in year t ; $ARI_{i, 2006}$ and $BPRI_{i, 2006}$ are the alternative and BoP measures, respectively, of remittance inflows in country i in the year 2006; and $BPRI_t$ and $BPRI_{2006}$ are the BoP measures of remittance inflows to African countries as a whole in years t and 2006, respectively.

Adding these estimated discrepancies to the adjusted estimate of capital flight from equation (A8) we obtain corrected capital flight as:

$$CADJKF_{it} = ADJKF_{it} + RID_{it} \quad (A10)$$

⁶ We are grateful to Dr. Manuel Orozco of the Inter-American Dialogue in Washington, DC, for providing us with the African remittance inflow estimates prepared for the IFAD study, disaggregated and cross-tabulated by sending countries.

Inflation adjustment

To make annual capital flight estimates comparable over an extended period of time, we convert nominal flows to constant dollars, using the US producer price index for this purpose.

Real capital flight (adjusted for trade misinvoicing) is calculated as:

$$RADJKF_{it} = CADJKF_{it} / PPI_t \quad (A11)$$

where PPI is the US producer price index (base 2004=1.00).

Adjustment for interest earnings

We compute the stock of interest-earnings adjusted capital flight ($SADJKF$) as follows:

$$SADJKF_{it} = SADJKF_{i,t-1}(1 + TBILL_t) + CADJKF_{it} \quad (A12)$$

where $TBILL$ is the interest rate on short-term US Treasury bills.