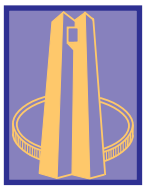
Article
Quarterly Bulletin
June 2001



South African Reserve Bank

The dynamics of capital flows in South Africa: an empirical investigation

by G R Wesso

Contents

Introduction
An overview of capital flows in South Africa since 1991
Determinants of capital flows
Empirical investigation
Concluding remarks
References

List of tables

Basic statistics on components of net capital flows in South Africa
Autocorrelations
ADF tests for stationarity in variables
Regression results of the error-correction model
Correlation matrices

List of graphs

Composition of net capital flows in South Africa
Impulse response functions from the vector auto-regression model
Variance decomposition of a change in total net capital flows

The dynamics of capital flows in South Africa: an empirical investigation

by G R Wesso[1]

South Africa needs foreign capital in order to support economic growth in the country. Tax reforms, fiscal discipline and the gradual liberalisation of exchange control were all aimed at increasing South Africa's attractiveness as a destination for foreign investment. Apart from changes in investor sentiment, capital flows are also sensitive to changes in economic growth, government deficits, exchange-rate-adjusted returns on investment and domestic inflation relative to the rest of the world. Identifying relevant factors is therefore important in formulating effective policy. This paper investigates capital mobility into and out of South Africa by examining the commonly used determinants of capital flows in developing economies. An error-correction technique and an unrestricted vector auto-regression (VAR) model are used to determine the dynamics between capital flows and other relevant economic variables, using South African quarterly data from 1991 to 2000. The results show that there is a negative relationship between net capital flows (R millions) and relatively high domestic inflation rates, whereas the effect of economic growth is positive in the long run. It is also shown that higher exchange-rate-adjusted government bond rates relative to those in the US attract foreign capital, but larger government deficits reduce net capital flows into the country.

1. Introduction

Many investors have rediscovered South Africa since the democratisation process started in 1994. Political developments paved the way for the re-introduction of the South African economy to the world economy, and for the awakening of new interest in its economic potential. South Africans have suddenly found themselves in a world where there is keen competition, and where a number of emerging and developing countries are sometimes slightly ahead in a race for the excess savings of more developed communities.

South Africa has re-entered this changing environment in full awareness of the pressing need for economic growth and development, for the creation of jobs and for the generation of income to improve the standard of living of its entire population. Out of its own saving, running at an unsatisfactorily low rate of only 15,5 per cent of gross domestic product in the fourth quarter of 2000, it will hardly be possible to sustain a high economic growth rate. A net inflow of foreign capital therefore becomes a basic precondition if South Africa is to catch up on the huge backlogs of existing unemployment. Tax reforms, fiscal discipline and the gradual liberalisation of exchange control are all aimed at increasing South Africa's attractiveness as a destination for foreign investment. Apart from changes in investor sentiment, capital flows are also sensitive to changes in economic growth, government deficits, exchange-rate-adjusted returns on investment and domestic inflation relative to those in other economies. Identifying relevant factors is therefore crucial in designing an effective policy.

This article therefore investigates capital mobility in South Africa through an examination of the commonly used determinants of capital flows in developing economies. Following the introduction, Section 2 gives an overview of capital flows into and from South Africa since 1991. Determinants of capital flows and their composition appear in Section 3. Section 4 summarises the empirical evidence on the factors influencing capital flows. In this section, error-correction techniques and an unrestricted vector autoregression (VAR) model are used to determine the dynamics between capital flows and other relevant economic variables, using quarterly South African data from 1991.1 to 2000.4.[2] Section 5 offers some concluding remarks and directions for future research.

1 Valuable assistance in the preparation of the article was provided by Messrs C Pretorius and S Walters from the Research Department of the Reserve Bank, Prof B Smit from the Bureau for Economic Research of the University of Stellenbosch, and Dr L Mahadeva from the Bank of England. Assistance in the form of helpful comments and suggestions by various staff members of the Reserve Bank is also gratefully acknowledged. However, the views expressed in this article are those of the author and do not necessarily reflect those of the South African Reserve Bank.

2 Due to the capital flow reclassification of the South African Reserve Bank, data on the various components of capital flows are, at this stage, only available from 1991. The study was based on statistics released in the March 2001 Quarterly Bulletin.

2. An overview of capital flows in South Africa since 1991

The South African Reserve Bank has recently reclassified capital flows by using three main categories for describing foreign investment flows, namely: foreign direct investment, which involves investment in a firm where foreign investors have at least 10 per cent of the voting rights; foreign portfolio investment which includes the purchase and sale of bonds and equities listed on international and domestic capital markets; and other foreign investment which consists of foreign loans and deposits between banks, companies and governments. For the purpose of this study, total net capital flows represent the change in capital transfer and financial accounts, including unrecorded transactions, measured in millions of rands. It includes the net value of liabilities and assets in the financial account.

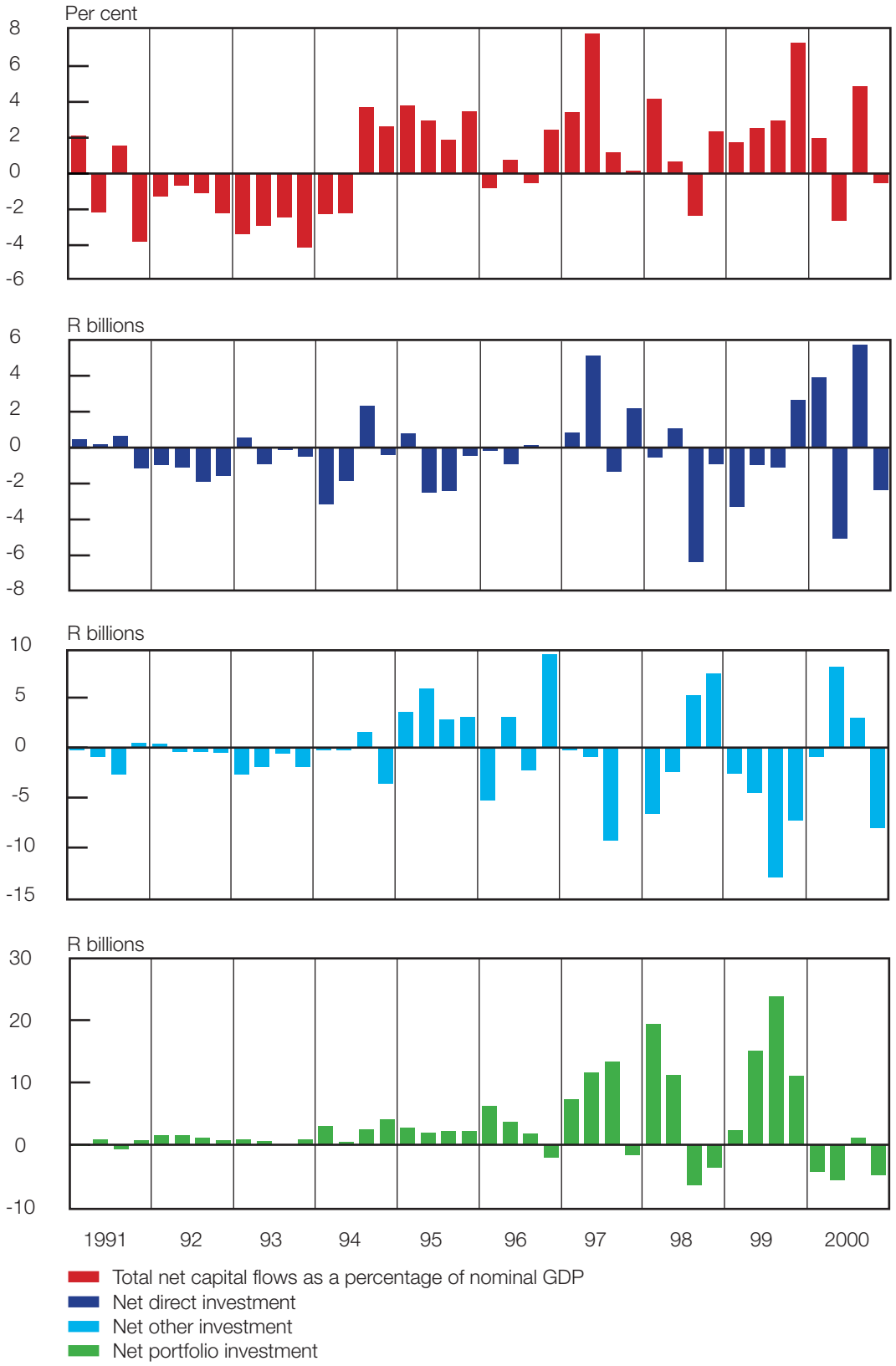
Several developing countries have recorded large capital inflows in recent years, reversing a trend of outflows for most of the 1980s (see Gooptu, 1993). Much of this new capital inflow has been in the form of portfolio investment. This surge in portfolio flows has raised the question whether these flows will be sustained or will instead be reversed in the near future. Some observers argue that the recent flows are inherently unsustainable because in many cases they have short maturities (see Reisen, 1993:2). In South Africa, the size of portfolio flows, and therefore their importance, is much larger than other types of investment.

After having recorded large outflows from 1991 up to the middle of 1994, South African capital flows switched from a net outflow of R13,7 billion in 1993 to a net inflow of R2,6 billion in 1994. During 1995 there was a further net inflow of capital, totalling R16,6 billion. Various factors contributed to the large net inflow of capital over the twelve months ending in June 1995. These included the normalisation of international financial relations, the regaining of access to international capital markets, and the availability of foreign trade financing at relatively favourable costs. In addition, there was a marked improvement in non-resident investor confidence, helped in part by the inclusion of the Johannesburg Stock Exchange in the International Finance Corporation's emerging-market index, and the significant number of foreign companies which returned or made new investments in South Africa.

The improved financial-account position also led to a marked strengthening of the overall balance of payments position from the middle of 1994. After having dropped by R3,2 billion in the first half of 1994, South Africa's net gold and other foreign reserves rose by R6,4 billion in the second half of 1994, and by R4,2 billion in the first half of 1995. Since 1994, South Africa has annually received foreign capital averaging 1,0 per cent of gross domestic product. Inflows of portfolio capital represented a sizeable portion of foreign financing in the period since 1994.

The significant improvement in the overall balance of payments position in 1994, and the first half of 1995, allowed the Reserve Bank to turn its attention to dismantling the exchange controls on non-residents by abolishing the financial rand mechanism. This eventually took place in the middle of March 1995, and proved to have had very little effect as the discount between the financial rand and the commercial rand was in any case very small at the time of the abolition of the financial rand. The new unified exchange rate for the rand initially appreciated modestly against the dollar.

Graph 1 Composition of net capital flows in South Africa



For the five years from 1995 to1999, South Africa recorded an aggregate current-account shortfall of about R42 billion. The dangers of over-reliance on foreign portfolio capital inflows are only too well known internationally, even more so if they

also lead to an overvalued exchange rate. Indeed, South Africa has had painful first-hand experience of these dangers. From the second half of 1995 into 1996, a wave of foreign concerns about South Africa's political prospects led to a huge decline in the level of net capital inflows. At the same time, the current account was in deficit – a shortfall well above the modest support to the gold and foreign exchange reserves from the capital account. The result was that the rand depreciated strongly. Previous momentum kept economic growth high in 1996, by South African standards, but a downswing of the business cycle was evident by the second half of that year and that trend worsened during 1997 and 1998.

International capital flows to and from South Africa during 2000 were dominated by flows of portfolio capital, which are known for their volatility. Net foreign direct investment was reversed from a net outflow of R2,7 billion in 1999 to a net inflow of R2,2 billion in 2000, despite the large-scale selling of interest-bearing securities. As a result, South Africa in the second quarter of 2000 experienced its first net capital outflow since the third quarter of 1998, when the Russian financial crisis shocked emerging markets.

The deficit on the current account of the balance of payments in the middle quarters of 1999 had been comfortably financed by relatively strong inflows of international capital. In fact, the surplus on the overall balance of payments enabled the Reserve Bank to accumulate international reserves and reduce its net open position in foreign currency. However, the Bank's December 1999 *Quarterly Bulletin* states that the net inflow of international capital during the first three quarters of 1999 was more than fully accounted for by inflows of portfolio capital. It warns that such flows, and more specifically those that enter the economy through the fixed-interest securities market, are known for their capricious behaviour; they are volatile and their direction of flow is often reversed abruptly. The R52,4 billion net foreign portfolio inflows in 1999 had been substantially reversed to a net outflow of R13,8 billion in 2000. In the bond market alone, foreigners had sold a net R18,5 billion since the beginning of 2000, according to Bond Exchange statistics. This means that the money that has been flooding into the bond market can flow out again as quickly as it came in. The implications of that assessment are or should be cause for real concern, and identifying the factors that would help to explain capital flows is therefore important.

3. Determinants of capital flows

Identifying the relative importance of the factors influencing capital flows is crucial for formulating effective policy and therefore worthy of investigation. This has been shown by Fernández-Arias and Montiel (1996), who first summarised a number of arguments describing why large capital flows may, under various circumstances, adversely affect developing countries, unless policies designed to neutralise such effects are adopted.

The World Bank (1997) has provided the most systematic evidence about the importance of domestic factors influencing capital flows. The Bank noticed several trends suggesting that flows have been driven by more than only external factors. Among them, the following should be mentioned:

- Fundamentals affect the long-term rates of return to investors. Countries with the strongest fundamentals (i.e. a high investment to gross domestic product ratio, low inflation and low real exchange-rate variability) have received the largest flows as a percentage of gross domestic product whereas countries with very poor fundamentals have not attracted private flows;

- foreign direct investment is the largest component of private flows to emerging markets but, although sensitive to macroeconomic fundamentals, it is not explained by global interest rates; and
- portfolio flows are more sensitive to interest rates. As a matter of fact, many have assigned to interest rates the predominant role in the current episode of capital flows (see, among others, Calvo, Leiderman and Reinhart, 1996).

Country-specific pull factors reflect domestic opportunity and risk. High domestic real economic growth can be seen as an indication of a favourable domestic investment climate and therefore diminishes capital outflows. As developing countries' creditworthiness is restored, capital (bond and equity) flows are likely to become an increasingly prominent source of external finance. For example, equity-related capital flows may be very large and come in the form of either foreign direct investment or portfolio investment. Economic growth and the opportunity to use local raw materials or employ a local labour force may attract foreign direct investment. Although portfolio equity flows to developing countries have increased sharply in recent years, they are expected to be extremely sensitive to a country's openness, particularly to rules concerning the repatriation of capital and income (see Williamson, 1993). The right to repatriate dividends and capital may be the most important factor in attracting significant foreign equity flows (Goldstein, Mathieson and Lane, 1991). Following the traditional literature in financial economics, share assets are priced so that the riskiest assets offer the highest rate of return. Moreover, as the international financial system becomes more integrated and porfolios more diversified, asset prices are more likely to change than are net capital flows to restore market equilibrium (see Taylor and Sarno, 1997). Therefore, most econometric models express financial linkages in terms of interest rate parity conditions (Goldstein, et al., 1991).

Studies based on interest rate differentials generally provide evidence that there is a high and increasing degree of international capital mobility among the major industrial and developing countries (Montiel, 1993). Rates of return – obviously a crucial determinant of capital flows – are often far higher in the financial markets of developing countries than in many major markets in industrialised countries, reflecting the high risk generated by their typically high volatility. Due to diminishing returns on capital, one would also expect yields to be higher in small economies with limited capital stocks. The credit ratings and secondary-market prices of sovereign debt, reflecting the opportunities and risks of investing in the country, are likely to be important in determining capital flows as well (Bekaert, 1995). Exchange rate overvaluation is seen as an important determinant for capital flight. An overvalued exchange rate leads to an expected future depreciation. To avoid capital losses in terms of domestic currency, residents are encouraged to hold their assets abroad. The problem, however, is determining the equilibrium exchange rate. There are some indications that the real exchange rate of African countries has been adjusted towards its equilibrium since the 1980s (see Hermes and Lensink, 1992). High domestic inflation rates will furthermore reduce the real value of domestic assets. Residents are induced to divert their wealth into foreign assets to avoid this 'inflation tax'. Moreover, present high inflation relative to the rest of the world may lead to an expected depreciation of the exchange rate in the future.

In respect of the relationship between government deficits and an outward movement of capital, theory suggests (see Hermes and Lensink, 1992, and Ajayi and Khan, 2000) that residents expect higher future taxes or increased price instability if government deficits rise, which in turn could encourage an outflow of capital. Higher foreign borrowing by the government increases future repayment obligations. Residents may then expect that the government will pass the costs of

these repayments on to them in the form of higher inflation. Moreover, government guarantees on private debt may explain why capital flight is stimulated by capital inflows. An increasing larger foreign debt position also encourages domestic asset holders to keep their funds abroad if a rising foreign debt forces the government to stimulate exports by a devaluation of the real exchange rate. 'In that case ... the gross real returns on assets held abroad could be higher than the gross real returns on domestic assets' (Fry, 1991: 11).

Interpreting the effectiveness of capital controls on recorded flows is difficult. There is abundant literature on methodologies to test the effectiveness of capital controls. However, data on capital control are either unreliable or scarce, and few empirical studies introduce them directly. Moreover, to the extent that controls themselves respond to fluctuations in capital flows, there is a strong element of endogeneity, and it would not be unexpected for new controls on inflows to be associated with increased inward flows – as in the case of Chile. Cardoso and Goldfajn (1998) point out a number of empirical studies that have failed to use capital control indices as a significant determinant for capital flows. The studies reviewed contain significant econometric problems that cast doubt on the robustness of the estimates. Furthermore, Rogoff (1999) argues that empirical work aimed at understanding the relationship between capital flows and exchange controls is in its infancy. Progress in this area will require constructing suitable indices that are able to adequately capture the 'true' degree of capital mobility in different countries. Since no reliable capital control index has been constructed and tested for South Africa, using such an index is therefore considered to be beyond the scope of this study.

The second set of determinants of capital flows to developing countries is global push factors. For example, the sharp increase in United States (US) capital outflows, which represent a significant share of the portfolio flows received by emerging markets, may have been induced to some extent by the fast and marked fall of US interest rates (short, medium, and long term) in the late 1980s. Moreover the slowdown of the US economy in the late 1980s may also have attracted flows from the US, especially because during that period macroeconomic policies, labour market conditions and exchange rate policies in many developing countries were becoming noticeably more stable (Calvo, Leiderman and Reinhart, 1996). Short-term interest rates in the US declined steadily in the early 1990s and the recessions in Japan made profit opportunities in developing countries more attractive. Agénor et al. (1997) found that variance decompositions indicated that world interest rate shocks explain a large component of medium-term fluctuations in capital inflows in Brazil. Fernandez-Arias and Montiel (1996) conclude that formal evidence shows that falling interest rates in advanced economies have played a dominant role in driving capital to developing countries and that flows were not restricted to countries with good reform records. Foreign interest rates can therefore be an explanatory factor since, if interest rates abroad exceed domestic interest rates, residents will be encouraged to hold their wealth in foreign bank accounts or borrow from their home countries. Portfolio flows from foreigners into South Africa will decrease under such circumstances.

Finally, there are also the contagion effects. Capital flows to a few countries in a region generate externalities to neighbouring countries and an external crisis in one country may spread to others. Negative perceptions of South Africa among international investors also remain a huge hurdle in the country's bid to gain increased foreign investment (see Mboweni, 2000). These trends, although sometimes difficult to quantify, raise important issues concerning the factors motivating capital flows and their effect on the performance of developing countries.

4. Empirical investigation

4.1 Measurements of capital flows

When the uses of international capital movements are studied, the flows of capital are usually measured as the difference between outflows and inflows (net), rather than by examining outflows and inflows separately (see Lipzey, 1999). This is sometimes partly from necessity, for lack of gross flow data. However, in South Africa the components of the financial account are currently observed in the form of changes in foreign liabilities and assets.

Questions regarding the volatility of certain types of capital flows are sometimes caused by concerns about the volatility of the total financial account. Policy makers therefore wish to assess the likelihood of sudden and destabilising changes in total capital flows. Claessens, Dooley and Warner (1995) provide evidence that, in general, movements in the overall financial account are little influenced by the type of capital flow. Because there is much substitution going on between the various flows, analysing individual flows may not be particularly meaningful. For the purpose of this study, attention is paid only to the determination of the overall financial account; for example, the impact of the aggregate external shocks the economy is exposed to, and the overall macroeconomic policies the government pursues. On this basis, only those factors explaining the total net capital flows (represented by the change in capital transfer and financial accounts, including unrecorded transactions) are tested for their statistical significance in this study.

4.2 The model

Research findings on international capital flows differ on whether it is more accurate to treat the flows as exogenous (in respect of the country in question) or endogenous. In this study, although it is not necessary to take a stand on the issue, the way that the interpretation of the findings depends on this issue is clarified.

If capital flows are exogenous from the point of view of the domestic economy, perhaps because they are driven by changes in international financial variables and market perceptions of the country, then the policy maker's concern about the volatility of capital flows makes good sense. Depending on the exchange rate policy being pursued by the country, volatile capital flows may translate into exchange rate volatility (in the case of a flexible exchange rate) or into variations in official reserves (in the case of a fixed or pegged exchange rate). Either consequence may be undesirable because it leads to temporary signals to shift resources in the trade and non-traded sectors or because it requires monetary adjustments. If flows were exogenous, it would clearly be useful to know whether the data support the conventional view that certain kinds of flows are inherently more volatile and that certain flows can be predicted better. If capital flows are endogenous, however, an analysis of the behaviour of capital flows in isolation makes little sense. Here, everything depends on the nature of the shock that gives rise to changes in, for example, the current account. The behaviour over time of the flows would reflect the behaviour over time of the underlying shocks. In the unlikely event that different flows have different ultimate causes and that the causes have different time-series properties, the flows themselves would have different time-series properties. But this seems to be a remote possibility (see Claessens et al., 1995). If capital flows are predominantly endogenous, there is no deep reason to expect any particularly close relationship between types of flows and time-series properties.

It may be argued that, rather than taking a diagnostic approach to the causality question, it would be better to present a model and try to identify the important causes, and then to use that framework to assess the question of persistence of financial flows. It has proven difficult, however, to develop such a structural model empirically using the underlying sources of shocks. Capital flows in general and perhaps even more so portfolio flows to developing countries are difficult to explain. Studies by Calvo, Leiderman and Reinhart (1996); Chuhan, Claessens and Mamingi (1993); and Fernandez-Arias (1994) find low explanatory power, and the authors have difficulty identifying which factors exactly determine capital flows.

In this article the general model for net capital flows states that:

$$NFY = f(INFD, GDPMP6R, IRD, GVDEF5Y, X, \varepsilon) \quad (1)$$

where *NFY, INFD,GDPMP6R, IRD, GVDEF5Y* and *X* are, respectively, the net capital flows as a percentage of nominal gross domestic product (GDP), the domestic inflation rate relative to foreign inflation (difference between the percentage change in foreign wholesale prices and the domestic inflation rate), the real GDP growth rate, the ratio between exchange-rate-adjusted South African and US government bond rates (also known as a financial incentive variable), government deficit (public-sector borrowing requirement) as a percentage of nominal GDP, and *X*, which could include a group of variables such as government spending as a percentage of nominal GDP, the current-account deficit as a percentage of nominal GDP, credit extension, price-earning ratios of shares, and dummy variables for irregular data (ε is a vector of reduced-form residuals). The US Government bond rate is used as a proxy for international interest rates. The data are described below the relevant equation and the results are summarised in Section 4.3.

The error correction mechanism developed by Engle and Granger (1987) is a means of reconciling the short-run behaviour of an economic variable with its long-run behaviour. The conventional general-to-specific procedure for estimating a parsimonious error-correction model (ECM) is adopted, as suggested by Hendry (1983). In practice few macroeconomic time series are stationary in level terms, but most are stationary in first or second differences. The augmented Dickey-Fuller (ADF) test statistics were used to determine stationarity.

The first step of the ECM procedure involves the estimation of a long-run equation, supported by relevant economic theory. After preliminary stationarity tests were executed on the series in order to identify their order of integration I(d), the residuals of the co-integrating regressions described by the long-run equation were tested to see if they are stationary. The second step involves the estimation of a short-term equation or an error-correction model. Given that the dependent variable is I (1), there must be at least one I (1) variable among the explanatory variables; if all of the explanatory variables are I (0), then the short-term equation will be misspecified (see Baffes, 1997). In this study, the final short and long-run components of the equation were estimated simultaneously as described by Amano and van Norden (1995).

A VAR model is used to determine the dynamics between net capital flows and other relevant economic variables. This framework permits inference of the dynamic response of capital flows to other determinants over time. The estimated VAR for net capital flows over nominal GDP *(NFY)* includes the four explanatory variables of Equation 1.

Formally, one can express the system in a reduced-form format:

$$X_t = B(L)X_{t-1} + \varepsilon_t \quad (2)$$

where X is the set of endogenous variables, and $B(L)$ is a lag operator of order L.[3] The system above can be inverted and represented as a moving average of past shocks:

$$X_t = [I-B(L)L]^{-1}\ \varepsilon_t \quad (3)$$

where ε is a vector of reduced-form residuals. The objective is to plot on a graph the impulse response of structural shocks to the endogenous variable. In general, the reduced-form residuals are a linear combination of the structural innovations that can only be obtained once sufficient identifying assumptions are made. It is crucial to disentangle the simultaneous correlation of net flows and the other explanatory variables. Different orderings of the VAR variables were experimented with. Such methodology allows inference of the dynamic response of the system to a shock (of one standard deviation) in any of the variables.

3 The optimal lag order was estimated using the Akaike criterion. In most of the VARs estimated in this section, the optimal lag was calculated as two.

4.3 Results

In this study the determinants of South African capital flows are examined over the period 1991 to 2000, using quarterly data. All tests are performed at a 5 per cent level of significance.

The volatility of capital flows makes the implementation of monetary policy extremely difficult. It will therefore be interesting to determine the sources of volatility in total net capital flows. Turner (1991:95), in his review of capital flows for industrial countries, ranks short-term bank lending as most volatile and long-term bank flows as least volatile, followed by foreign direct investment (FDI) as the next-to-least volatile. Many studies have examined the composition of capital inflows from the point of desirability. Usually they highlight FDI as the most desirable form of capital flow because FDI engenders positive externalities, such as technology and management expertise. In addition, there is the popular perception that portfolio flows have greater volatility because they are less costly to reverse than FDI. It is also argued that FDI has a low sensitivity to international interest rates and is driven by considerations of long-term profitability. Claessens et al. (1995), however, found no statistical support for the argument that long-term flows are less volatile and easier to predict than short-term flows.

Graph 1 in Section 2 provides data on net capital flows in South Africa (in R millions) by type of flows. The graph provides the best corroboration found for conventional ideas about the persistence of various kinds of flows. It shows that net portfolio investment (NPI) displays less volatility over the period of study than net direct investment (NDI) does, and that the net other investment (NOI) is somewhere in between.

Table 1 provides means, standard deviations, and coefficients of variation (CV) for various kinds of flows, broken down by type. To provide an indication of the relative magnitude of these flows compared with the total financial account, the third column of Table 1 presents the average for the flows as a percentage of the balance on the financial account (positive figures denoting inflows). In terms of average share in total financing, net portfolio investment is more important in South Africa. Direct

investment by foreigners was positive and the volatility in net direct investment (as indicated by the CV) was mainly due to South African firms receiving exchange control approval to invest offshore. Note further that the total financial account is sometimes less volatile than its components.

Table 1: Basic statistics on components of net capital flows in South Africa

Period and type of flow	Mean (R millions)	Standard deviation	Average share in total financing (per cent)	Coefficient of variation (CV per cent)
1991.1 – 2000.4				
Financial account				
Direct investment				
Liabilities	1151	1800	54,2	156,4
Assets	-1538	2122	-72,4	-137,9
Net direct investment	-386	2334	-18,2	-604,6
Net portfolio investment	3153	6501	148,5	206,2
Net other investment	-642	4590	-30,3	-714,9
Total net flows	1721	4714	81,0	273,9
Balance on financial account	2124	5756	100,0	271,0

Note: net outflows (-)

One efficient way to summarise the idea of persistence is to calculate autocorrelations for each type of capital flow. The question is whether persistence – as measured by autocorrelations – matches the categories examined, and it is found that often there is no close correspondence. A persistent series will be positively autocorrelated, whereas a transitory series will have a low or negative autocorrelation. In general, the classic case of a long-term investment would be a flow that is highly positively autocorrelated, whereas portfolio capital would exhibit zero or even negative autocorrelations.

One would expect the NDI flows for South Africa to have large positive autocorrelations and the NPI to exhibit far lower or even negative autocorrelations. From the autocorrelations in Table 2, there is little evidence that the allegedly persistent flows – such as net direct investment – exhibit more memory than the other flows, given the time-series plots. Note that net portfolio investment also has fairly low negative autocorrelations. It basically reflects the fact that the lag coefficients in an estimated autoregressive equation will be small.

In the econometric analysis the use of total government deficit *(GVDEF5Y)* may be interpreted as a proxy for determining the influence that debt-increasing capital inflows have on capital flows, whereas relatively high domestic inflation rates *(INFD)* lead to an expected depreciation of the exchange rate in the future. *IRD*, which is the exchange-rate-adjusted interest rate ratio, introduces elements of standard portfolio theory into the equation. It tests the impact of expected rates of return and expected depreciation on capital flows, since higher exchange-rate-adjusted government bond rates relative to US rates attract foreign capital to South Africa. The ninety-day forward rand/dollar exchange rate was used to determine the expected devaluation in local currency.

Table 2: Autocorrelations

Net portfolio investments (NPI)

Sample: 1991.1 to 2000.4
Included observations: 40

Autocorrelation (AC)	Partial correlation (PAC)		AC	PAC	Q-stat	Probability
. |*** |	. |*** |	1	0,372	0,372	5,9703	0,015
.*| . |	**| . |	2	-0,129	-0,310	6,7029	0,035
**| . |	.*| . |	3	-0,232	-0,069	9,1485	0,027
.*| . |	. | . |	4	-0,134	-0,046	9,9849	0,041
. | . |	. | . |	5	0,026	0,041	10,017	0,075
. |*. |	. |*. |	6	0,169	0,112	11,426	0,076
. |*. |	. | . |	7	0,128	0,004	12,264	0,092
. |*. |	. |** |	8	0,167	0,213	13,730	0,089
. |*, |	. |*. |	9	0,186	0,139	15,603	0,076
. | . |	.*| . |	10	-0,035	-0,107	15,670	0,109
**| . |	.*| . |	11	-0,236	-0,114	18,898	0,063
.*| . |	. |*. |	12	-0,101	0,084	19,511	0,077
. | . |	.*| . |	13	-0,025	-0,132	19,549	0,107
. | . |	. | . |	14	0,025	-0,056	19,588	0,144
.*| . |	**| . |	15	-0,073	-0,219	19,945	0,174
. | . |	. | . |	16	-0,048	0,053	20,106	0,215
. | . |	.*| . |	17	-0,050	-0,121	20,289	0,260
. | . |	.*| . |	18	-0,053	-0,084	20,503	0,305
. | . |	. |*. |	19	-0,041	0,066	20,641	0,357
. | . |	. | . |	20	-0,030	0,032	20,716	0,414

Net direct investment (NDI)

Sample: 1991.1 to 2000.4
Included observations: 40

Autocorrelation (AC)	Partial correlation (PAC)		AC	PAC	Q-stat	Probability
**| . |	**| . |	1	-0,230	-0,230	2,2726	0,132
. |** |	. |*. |	2	0,235	0,193	4,7224	0,094
.*| . |	. | . |	3	-0,081	0,007	5,0230	0,170
.*| . |	.*| . |	4	-0,076	-0,148	5,2891	0,259
**| . |	**| . |	5	-0,195	-0,246	7,1082	0,213
.*| . |	**| . |	6	-0,158	-0,230	8,3366	0,214
. | . |	. | . |	7	0,006	0,006	8,3388	0,304
**| . |	**| . |	8	-0,240	-0,230	11,369	0,182
. |*. |	. | . |	9	0,143	-0,051	12,480	0,188
.*| . |	.*| . |	10	-0,074	-0,087	12,790	0,236
. |** |	. |*. |	11	0,283	0,165	17,426	0,096
.*| . |	.*| . |	12	-0,149	-0,157	18,755	0,095
. |** |	. | . |	13	0,202	-0,051	21,294	0,067
. | . |	. | . |	14	0,000	0,043	21,294	0,094
. | . |	. | . |	15	0,007	0,045	21,298	0,128
.*| . |	.*| . |	16	-0,087	-0,131	21,827	0,149
. | . |	. | . |	17	-0,029	-0,049	21,889	0,189
.*| . |	.*| . |	18	-0,076	-0,069	22,334	0,217
. | . |	. |*. |	19	0,007	0,160	22,338	0,268
. | . |	. | . |	20	0,005	-0,055	22,340	0,322

Note: Q-stat denotes the Ljung-Box statistic for residual autocorrelation computed for 20 lags;
* represents the magnitude of the correlation.

As a preliminary step to testing for co-integration, the Augmented Dickey-Fuller (ADF) unit root test statistics were performed on the series used. The results in Table 3 show that *NFY, INFD,* and *GDPMP6R* appear to be realisations from integrated processes of order one, while *IRD* and *GVDEF5Y* are stationary. The test statistics for the non-stationary variables based on first differences all exceeded the critical values at a 5 per cent level of significance and were therefore stationary. The order of integration of the residuals obtained from the long-term equation, which include *INFD, GDPMP6R* and *IRD*, was determined. The test results indicated stationarity and the residual item could therefore be included in the short-term error correction model. Consequently *INFD, GDPMP6R* and *IRD* potentially contribute to the long-run determination of *NFY.*

Table 3: ADF tests for stationarity in variables

Variables	ADF test statistic	5 per cent critical value	Order of integration, I(d)	Stationary
NFY	-2,640	-2,940		No
D(NFY)	-5,633	-2,942	I(1)	Yes
INFD	-2,014	-2,940		No
D(INFD)	-4,208	-2,942	I(1)	Yes
GDPMP6R	-2,329	-2,946		No
D(GDPMP6R)	-3,921	-2,936	I(1)	Yes
IRD	-4,844	-2,940	I(0)	Yes
GVDEF5Y	-7,448	-2,942	I(0)	Yes

Note: all ADF regressions contain a constant and one lag of the dependent variable. The sample period covers 1991.1 to 2000.4. *D* = first-level differences.

The ECM equation was estimated in first differences and the results are shown in Table 4. The final short and long-run (in square brackets) components of the equation were estimated simultaneously and the result is presented as one equation in Table 4 (see Amano and van Norden, 1995). Although space considerations preclude the study from reporting in detail each of the estimated equations experimented with, the equation estimated for net capital flows in South Africa is reasonably representative by the error-correction equation in Table 4.

In Table 4, R^2 denotes the coefficient of determination. The figures in parentheses are Student's t-statistics (a constant term was also included). The variables in square brackets represents the co-integrating residual or error-correction variable. The resulting model appeared to be quite adequate in terms of high coefficients of determination, t-values and residuals that are approximately white noise. The equation shows a strongly significant and relatively large error-correction coefficient, indicating a rapid adjustment in the short run.

The results show that there is a negative relationship between net capital flows and relatively high inflation rates, whereas the effect of economic growth is positive in the long run. The results go further in pointing out that exchange-rate-adjusted interest rates and the government deficits are important determinants in explaining

Table 4: Regression results of the error-correction model

Dependent variable: *D(NFY)*
Method: Least squares
Sample (adjusted): 1991.2 2000.4
Included observations: 39 after adjusting endpoints

Error-correction equation:
*D(NFY) = **[C(2)*NFY(-1)+C(3)*INFD(-1)+C(4)*IRD(-1)+C(5)* GDPMP6R(-2) +C(1)]**+C(6)*D(INFD) +C(7)*D(IRD)+C(8)*GVDEF5Y+C(9)*DUM972+C(10)*DUM0024*

	Coefficient	Std. error	t-statistic	Probability
C(2)	-0,934965	0,128164	-7,295050	0,0000
C(3)	-22,07132	10,06601	-2,192657	0,0365
C(4)	58,20660	28,48772	2,043217	0,0502
C(5)	0,343620	0,189021	1,817890	0,0794
C(1)	-36,62532	30,27150	-1,209895	0,2361
C(6)	-29,43443	19,37386	-1,519286	0,1395
C(7)	36,27617	19,01938	1,907327	0,0664
C(8)	-0,234244	0,132401	-1,769201	0,0874
C(9)	6,496409	2,181457	2,978013	0,0058
C(10)	4,742389	1,642336	2,887587	0,0073

R-squared	0,750048	Mean dependent variable	-0,067879
Adjusted R-squared	0,672477	S.D. dependent variable	3,362003
S.E. of regression	1,924062	Akaike info criterion	4,363309
Sum squared residuals	107,3584	Schwarz criterion	4,789863
Log likelihood	-75,08452	Durbin-Watson statistic	2,081302

D = first-level differences; c*(#)* = number of the coefficient; long-run equation and coefficients are in bold type.

List of variables: (the signs in parentheses denote the expected direction of influence on capital flows)

NFY	=	Total net flows as a percentage of nominal GDP
GDPMP6R (+)	=	Real GDP growth rate, year on year
GVDEF5Y (-)	=	Government deficit as a percentage of nominal GDP (public-sector borrowing requirement)
INFD (-)	=	Domestic inflation relative to foreign inflation, calculated as: *(1+(cpiinr / 100)) / (1+(forinf / 100)), where:*
cpiinr	=	domestic inflation rate
forinf	=	percentage change in the weighted combined index of foreign wholesale prices
IRD (+)	=	The ratio between exchange-rate-adjusted South African and US government bond rates, calculated as: *[1+((i-ee) / 100)] / [1+(iny/100)]*, where:
ee	=	expected exchange rate devaluation = *((f-ner)/ner)*100*
i	=	domestic interest rate on SA long-term government bonds
iny	=	The 10-year US government bond rate
ner	=	nominal R/US$ exchange rate
f	=	3 months' forward cover rates (based on the commercial banks' foreign-exchange transactions)
DUM972 (+)	=	Dummy variable for the sudden upsurge in capital flows in 1997.2 = +1
DUM0024 (+)	=	Dummy variable for irregular data (2000.2 = -1 and 2000.4 = -1)

the dynamics of net capital movements in South Africa in the short run. As predicted by theory, the coefficient of the government deficit as a percentage of nominal GDP variable is negative and significant, emphasising the negative influence of government debt on capital flows in South Africa. The coefficient on *GVDEF5Y* suggests that a one-percentage-point increase in average quarterly deficit by the government in 1999 decreases net capital flows by about R42 million in the

corresponding year, holding all else constant. Conversely, a one-percentage-point increase in annual real GDP growth in 1999 increases total net capital flows by roughly R3 billion from the third quarter of 1999 to the second quarter of 2000. This result is consistent with the evidence for Latin America mentioned in Calvo et al. (1993), and with evidence for developing countries mentioned in Fernandez-Arias and Montiel (1996).

The dummy for the volatile quarters is significant and the coefficient of the exchange-rate-adjusted interest rate ratio is positive, as could be expected. The significance of the relative interest rate variable indicates that investors are chasing high-yield interest-bearing securities. It therefore means that capital will flow out of the country when there is a significant cut in local interest rates, creating a kind of vicious circle in which interest rates have to stay relatively high to prevent outflows, but in which the economy stagnates because of the high rates. The above relationships are also illustrated by the impulse response function discussed later in the text (see Graph 2).

The results are interpreted as evidence in favour of pull effects in explaining the variation in capital flows. The coefficients of other domestic factors do not help to explain the capital flows to South Africa. For example, other variables experimented with, such as credit extension, price-earning ratios and labour productivity, are insignificant. The coefficient of labour productivity has a different sign from what was expected. Furthermore, it should be noted that the above results, as with most of the analyses in the literature on capital flows, do not consider the effect of capital controls.

In order to gain further insights into the dynamic interactions between capital flows and the explanatory variables, a series of unrestricted VARs using quarterly data was estimated. Due to the small number of observations it was not possible to consider very long-lag structures (two lags were considered). The same variables used for the error-correction model were experimented with in the quarterly VAR, using total net capital flows over nominal GDP defined as the dependent variable. The VAR impulse response function was estimated using: *NFY; INFD; GDPMP6R; IRD* and *GVDEF5Y*. The impulse response function traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables. The impulse response results are reported in Graph 2. It is well known that the ordering of the variables in a VAR could affect the impulse response functions and the variance decomposition results in a significant way if the correlation between the variables is 'large' (see Laurens and Cordoso, 1998). Given that a rule of thumb in practical work is that correlation is large when it is over 29 per cent, testing the robustness of results for changes in the ordering of the variables seems relevant (see Table 5). When alternative orderings were tried, most of the results reported in this study were not altered significantly.

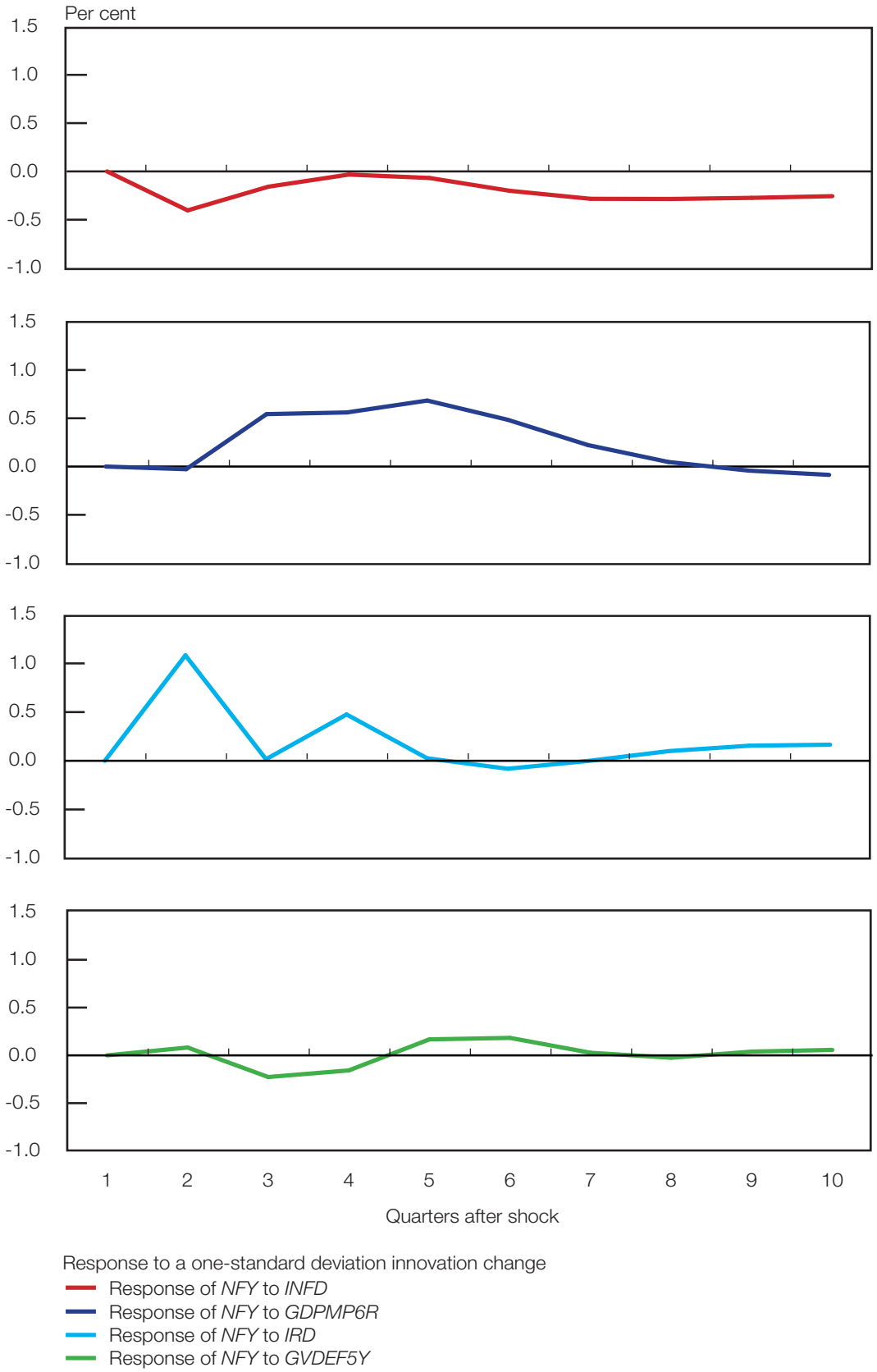
Table 5: Correlation matrices

Variables	*NFY*	*INFD*	*GDPMP6R*	*IRD*	*GVDEF5Y*
NFY	1,000000	-0,377782	0,368790	0,175058	-0,360424
INFD	-0,377782	1,000000	-0,554564	0,000113	0,267100
GDPMP6R	0,368790	-0,554564	1,000000	0,194203	-0,107988
IRD	0,175058	0,000113	0,194203	1,000000	-0,150288
GVDEF5Y	-0,360424	0,267100	-0,107988	-0,150288	1,000000

D = first-level differences

From Graph 2 it can be seen that, as a percentage of GDP, capital flows are negatively affected by government deficits after two quarters, but after four quarters the effect gradually disappears. In this regard it is found that a permanent increase in

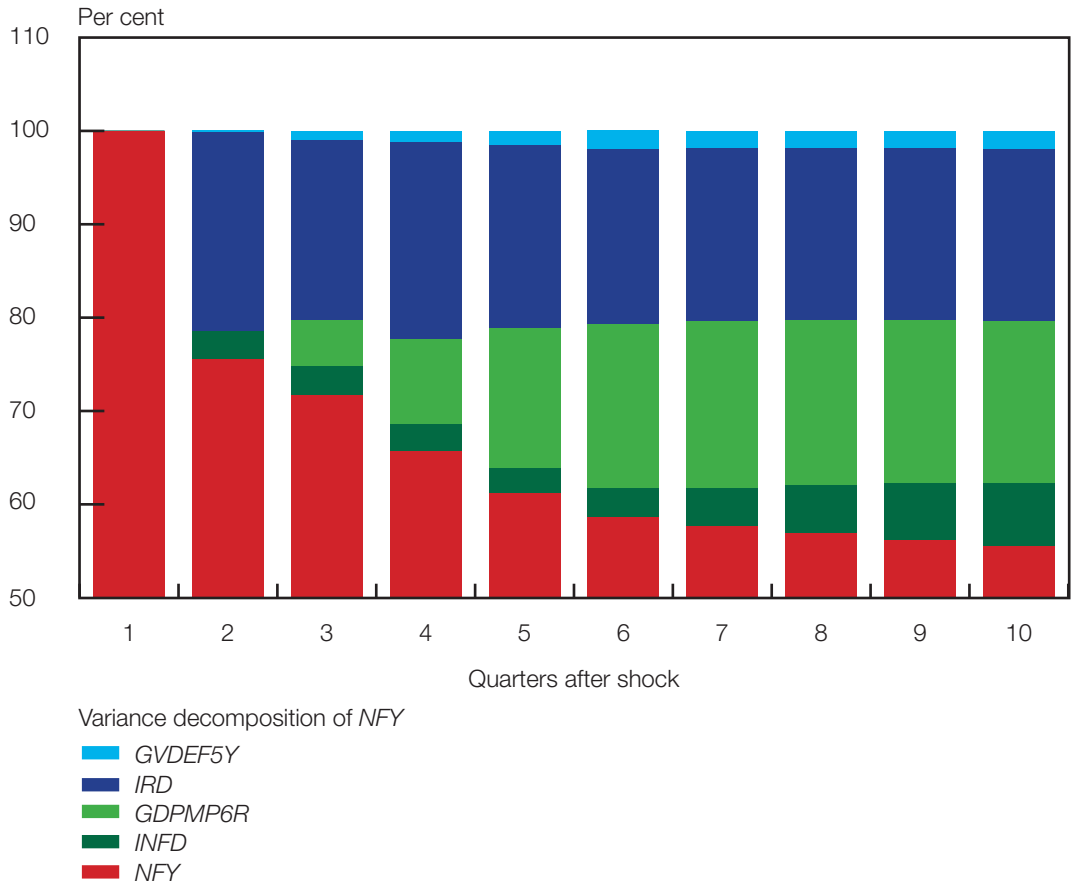
Graph 2 Impulse response functions from the vector auto-regression model



GVDEF5Y has a temporary positive effect on capital inflows with a peak at two quarters after the increase, and then becomes negative afterwards. Higher local inflation relative to foreign inflation has an immediate negative effect on capital flows, with capital flows reaching a minimum after two quarters. As expected, increases in domestic interest rates (adjusted by the exchange rate depreciation) relative to foreign rates and economic growth will boost capital flows to South Africa. Capital flows react immediately to a shock in the exchange-rate-adjusted interest rate ratio *(IRD)* with these flows peaking after two quarters. In the case of a shock in the real GDP growth rate, the flows only react after a two-period lag, peaking at five quarters.

The effectiveness of the explanatory variables can also be gauged by analysing the variance decomposition of a change in total net capital flows in Graph 3. After six quarters, the largest variance in *NFY* is caused by its own lag (58,9 per cent), followed by the exchange-rate-adjusted interest rate ratio (18,5 per cent), the real GDP growth rate (17,6 per cent), relative inflation (3,1 per cent), and the government deficit over nominal GDP (2,0 per cent).

Graph 3 Variance decomposition of total net capital flows



5. Concluding remarks

This study investigates capital mobility in South Africa by examining commonly used determinants of capital flows in developing economies using South African quarterly data from 1991.1 to 2000.4.

It was found that direct investment by foreigners was positive and that the volatility in net direct investment was mainly due to South African firms receiving exchange control approval to invest offshore.

Using an error-correction model, the results show that there is a negative long-run relationship between net capital inflows (in R millions) and relatively high inflation rates. It is also shown that larger government deficits in South Africa reduce net capital inflows, but strong economic growth and higher exchange-rate-adjusted government bond rates relative to those in the US attract foreign capital. The exchange-rate-adjusted interest rate ratio introduces elements of standard portfolio theory into the study. Portfolio flows are more important in South Africa in terms of average share in total financing. Portfolio investors usually chase high-yield interest-bearing securities. Although foreigners have been steady buyers of equities in South Africa, the study shows that this kind of investor will sell when there is a significant cut in local interest rates relative to those in foreign countries. One should furthermore keep in mind that investment decisions may also depend on sentiment, or perceptions of emerging markets as a whole, rather than being based on sound economic fundamentals. The results are interpreted as evidence in favour of pull effects in explaining net capital movements.

Having established the endogeneity of capital flows, the study estimates an unrestricted VAR and derives impulse responses to check the effectiveness of the variables identified for the error-correction model. Higher domestic inflation relative to other economies has an immediate negative effect on net capital flows, with capital flows reaching a minimum after two quarters. Capital flows react positively to a shock in the exchange-rate-adjusted interest rate ratio and real GDP growth, with these flows peaking after two and five quarters, respectively. An increase in the government deficit leads to a capital outflow after two quarters. Higher debt by the government and the associated expectation that this might result in future tax obligations could lead to a reduction in net capital flows into South Africa. Debt reduction may lead to larger capital inflows and better economic performance, which would encourage residents to hold their wealth at home or even repatriate funds from abroad. The results also show that, in order to increase capital flows to South Africa, real economic growth is needed and at the same time a good return should be offered to potential investors after allowing for exchange-rate depreciation.

It therefore appears that in the absence of adequate macroeconomic and financial policies, financial-account liberalisation may increase vulnerability to external and domestic shocks. Macroeconomic conditions and government economic policies will crucially influence the future trend of capital flows in South Africa.

However, some of the main shortcomings of the study are firstly, that the time period of the study covers only 40 quarters. This may bias the results to downplay the effectiveness of interest rates. Secondly, it should be noted that the above results, as well as most of the analyses in the literature on capital flows, do not consider the effect of capital controls. Finally, since many studies consider only the determinants of total net capital flows, research on the individual components of capital flows could enhance policy formulation even further.

References

Agénor, P. R., Hoffmaister, A. and Medeiros, C. 1997. Cyclical fluctuations in Brazil's real exchange rate: The role of domestic and external factors (unpublished, Washington: International Monetary Fund), February 25.

Ajayi, S.I. and Khan, M.S. 2000. External debt and capital flight in sub-Saharan Africa. *International Monetary Fund Publication.* Washington D.C.

Amano, R.A. and Van Norden, S. 1995. Terms of trade and real exchange rates: the Canadian evidence. *Journal of International Money and Finance*, vol.14, no.1, p.83-104.

Baffes, J. 1997. Explaining stationary variables with nonstationary regressors. *Applied Economics Letters,* vol.4, no.1, p.69-75.

Bekaert, G. 1995. Market integration and investment barriers in emerging equity markets. *The World Bank Economic Review,* vol.9, no.1, p.75-107.

Calvo, G. Leiderman, L. and Reinhart, C. 1993. Capital inflows to Latin America: the role of external factors. *Staff Papers,* International Monetary Fund, vol.40, p.108- 51, March.

Calvo, G., Leiderman, L. and Reinhart, C. 1996. Inflows of capital to developing countries in the 1990s. *Journal of Economic Perspectives*, vol.10, no.2, p.124-139.

Cardoso, E. and Goldfajn, H. 1998. Capital flows to Brazil: the endogeneity of capital controls. *Staff Papers*, International Monetary Fund, vol.45, March.

Chuhan, P. Claessens, S. and Mamingi, N. 1993. Equity and bond flows to Latin America and Asia: the role of global and country factors. *Pre-Working Paper no.1160*, Washington D.C: World Bank, International Economics Department.

Claessens, S., Dooley, M. and Warner, A. 1995. Portfolio capital flows: hot or cold? *World Bank Economic Review*, vol.9, p.159-174.

Engle, R.F, and Granger, C.W.J. 1987. Co-integration and error correction representation, estimation, and testing. *Econometrica,* vol.55, no.2, p.251-76.

Fernández-Arias, E. 1994. The new wave of private capital flows: push or pull?, *Working Paper no.1312*, Washington D.C: World Bank, International Economics Department.

Fernández-Arias, E. and Montiel P.J. 1996. The surge in capital inflows to developing countries: an analytical overview. *World Bank Economic Review,* vol.10, no.1, p.51-77.

Fry, M.J. 1991. Current account balance and foreign debt dynamics in 26 developing countries. *International Finance Group Working Papers no.IFGWP-91-10*, Birmingham, 29 May.

Goldstein, M, Mathieson, D.J. and Lane, T. 1991. Determinants and systemic consequences of international capital flows. *Occasional Paper* no.77*.* Washington, D.C: International Monetary Fund.

Gooptu, S. 1993. Portfolio investment flows to developing countries, in: Claessens, S. and Gooptu, S. (eds). Portfolio investment in developing countries. *Discussion Paper* no.228, Washington D.C: World Bank.

Hendry, D.F. 1983. Econometric modelling. The consumption function in retrospect. *Scottish Journal of Political Economy*, vol.30, no.3, p.193-220.

Hermes, N. and Lensink, R. 1992. The magnitude and determinants of capital flight: the case for six sub-Saharan African countries. *The Economist,* vol.140, no.4, p.515-530.

Laurens, B. and Cardoso, J. 1998. Managing capital flows: lessons from the experience of Chile. *Working Paper,* no.168, Washington D.C: International Monetary Fund.

Lipzey, R. E. 1999. The role of foreign direct investment in international capital flows. *NBER Working Paper Series*, no.7094.

Mboweni, T.T. 2000. Why SA does not attract investors, in: Misbach, W. (ed). A report on the Governor's briefing to the Finance Portfolio Committee of the Government. *Sowetan*, 1 September 2000.

Montiel, P. 1993. Capital mobility in developing countries. Policy Research Department. *Pre Paper*, no.1103, Washington D.C: World Bank.

Reisen, H. 1993. The case for sterilised intervention in Latin America. Paper presented at the *6th Annual Inter-American Seminar on Economics,* May 28-29, Caracas, Venezuela.

Rogoff, K. 1999. International institutions for reducing global financial instability. *Journal of Economic Perspectives*, vol.22.

Taylor, M.P. and Sarno, L. 1997. Capital flows to developing countries: long- and short-term determinants. *The World Bank Economic Review,* vol. 11, no. 3, p.51-470.

Turner, P. 1991. Capital flows in the 1980s: a survey of major trends. *BIS Economic Papers* no.30, Basle: Bank for International Settlements, Monetary and Economic Department.

Williamson, J. 1993. Issues posed by portfolio investment in developing countries, in: Claessens, S. and Gooptu, S. (eds.). Portfolio investment in developing countries. *Discussion Paper*, no.228, Washington D.C: World Bank.

World Bank. 1997. *Private capital flows to developing countries: the road to financial integration.* New York: Oxford University Press.