THE RESEARCH BULLETIN

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Bank of Botswana Monetary Policy Statement – 2003

Bank of Botswana

1. INTRODUCTION

1.1   The annual Monetary Policy Statement issued by the Bank of Botswana serves several purposes. First, it provides an opportunity for the Bank to report on inflation and monetary policy developments in the previous year, and to present its assessment of the outlook for inflation in the current year. Second, it enables the Bank to outline policy issues and the approach that will be taken in formulating its policy stance in response to inflation-related developments throughout the year. Third, since 2002, the Statement has contained the Bank's annual objectives for inflation and credit growth, and an explanation of how these were derived. The Monetary Policy Statement, therefore, plays an important role in conveying to stakeholders and the public at large a range of information relating to one of the Bank's core functions, the formulation and implementation of monetary policy. While the transparency entailed in the presentation of the Statement is important in its own right, it is also important in influencing economic and financial expectations and, therefore, the behaviour of economic agents. In this regard, the Bank's aim is to engender a public expectation of sustainable low inflation consistent with the broad objective of macroeconomic balance as a basis for sustainable growth.

1.2   Consistent with past practice, this year's Monetary Policy Statement reviews the trends in inflation and their underlying causes, and assesses the extent to which monetary policy succeeded in achieving its objectives in 2002. This is followed by a presentation of the Bank's analysis of prospective developments during 2003 and, based on that, the policy outlook for the current year. The Statement concludes that although developments in 2002 took inflation to over 11 percent, some way above the desired range of 4–6 percent for the year, this was largely due to exceptional transitory developments, especially the introduction of Value Added Tax (VAT), and that after discounting the impact of VAT, inflation was close to the upper end of the Bank's policy goal. In light of this, as well as the tightening of monetary policy towards the end of 2002 and the more restrained fiscal policy announced in the 2003 Budget, it is considered that there are good prospects of achieving a substantial reduction in inflation during 2003. The aim of monetary policy going forward will be to ensure that the reduction is consistent with the Bank's inflation objective for the year.

2. THE BANK'S MONETARY POLICY FRAMEWORK AND OBJECTIVES

2.1   The principal objective of monetary policy in Botswana is the control of inflation. Specifically, it is the achievement of a sustainable, low and predictable level of inflation that will, among others, enable the maintenance of international competitiveness. In the context of an exchange rate policy that aims to keep the nominal effective exchange rate of the Pula stable, this implies that Botswana's inflation rate should, at a minimum, be no higher than the average inflation rate of its major trading partners, if stability of the real exchange rate is to be achieved. This yields the Bank's annual inflation objective, which is described in detail in Section 7 below.

2.2   To achieve its inflation objective, the Bank uses interest rates to influence inflationary pressures in the economy. This is achieved indirectly through the impact of interest rates on credit and other components of domestic demand. Changes in interest rates, along with other factors such as the exchange rate, balance of payments and the Government's fiscal policy, affect the overall level of demand for goods and services in the economy, relative to a given level of output. Inflationary pressures are likely to emerge when expenditure grows at a faster rate than available goods and services.

2.3   In formulating its monetary policy stance, the Bank looks closely at the sources of any changes in inflation. In particular, the policy responds primarily to changes in inflation that are due to domestic demand pressures, rather than those that may be due to transitory factors or supply fluctuations on which monetary policy would have no direct influence. Therefore, in addition to headline inflation data published by the Central Statistics Office, the Bank also examines the underlying inflation trend, or core inflation, which excludes the impact of transitory factors and exceptional changes in administered prices and/or indirect taxes. The Bank, however, recognises the need to respond to any impact that these excluded items might have on underlying inflation through inflation expectations and second-round effects.

2.4   When implementing monetary policy, the Bank focuses on the intermediate targets that influence the main components of domestic demand. The principal intermediate target in the monetary policy framework is the rate of growth of commercial bank credit to the private sector, which is considered an important contributor to the growth of private consumption and investment and, importantly, can be directly influenced by monetary policy through interest rates. The rate of growth of Government spending is also an important determinant of domestic demand, since a large proportion of this demand is derived from expenditure on public consumption and investment. The continuing

large role of the Government in the economy underscores the need for complementarity between fiscal and monetary policies in achieving the inflation objective.

3. DEVELOPMENTS IN INFLATION IN 2002

3.1   The 2002 Monetary Policy Statement specified the Bank's objective of achieving inflation during 2002 in the range of 4–6 percent. In determining the inflation objective, the Bank was guided by an outlook of stable global inflation as world economic activity remained subdued, albeit with higher growth rates compared to 2001. Throughout the year, the world's major central banks maintained loose monetary policy with the aim of stimulating economic activity. Given excess capacity and the continuing credibility of monetary policy in these countries, inflation was largely controlled. In Botswana, however, domestic demand remained strong, with growth rates for both commercial bank credit and government expenditure higher than the desired rates indicated in the 2002 Monetary Policy Statement. In this context, it was considered that the existing tight monetary policy stance would contribute to a reduced rate of growth of credit, while the specification of the inflation objective and clear indications of the Bank's response to any inflationary developments were expected to anchor inflation expectations downwards.

11.2 percent in December[1], largely as a result of the introduction of VAT in July. For the whole of 2002, inflation averaged 8.1 percent, compared to 6.6 percent in 2001 and 8.5 percent in 2000.

3.3   Following the introduction of the 10 percent VAT, it was anticipated that prices would rise in general by between 4 percent and 6 percent, over and above underlying inflation. The Bank indicated in a press release in June 2002 that any VAT-related price increases would be a one-off temporary adjustment, which in the absence of any significant second-round effects, would not result in a sustained rise in inflation. In the event, and in line with expectations, the month-on-month rate of change in prices rose from an average of 0.5 percent over the previous twelve months to 3.2 percent in July, and progressively slowed down in the subsequent months (1.2 percent in August, 0.6 percent in September and 0.4 percent in October), a clear indication of the one-off impact of VAT. Although some monthly price increases were higher in the last quarter of 2002, this was mostly due to technical adjustments to components of the Consumer Price Index (CPI) basket[2]. Overall, although inflation increased sharply in the second half of the year, an analysis of the inflation trend that discounts the impact of VAT and price data adjustments suggests an underlying rate of between 6 percent and 7 percent for 2002, just above the upper end of the Bank's policy goal.

CHART 1: BOTSWANA INFLATION

3.4   Most categories of commodities experienced higher inflation in 2002 compared to 2001, which was to be expected given the wide-ranging impact of VAT. Food prices, however, rose much faster than those of most other commodities, due partly to drought conditions in the region. Food price inflation rose from 4.1 percent in December 2001 to 14.3 percent in December 2002; this increase alone accounted for almost half of the rise in overall inflation during the year. This reinforces the view that, after taking account of the impact of VAT and other exceptional factors such as food prices, underlying inflation was largely contained during 2002.

3.2   Since the slowdown that began in the second half of 2000, annual inflation stabilised at around 6 percent in the first half of 2002, the upper end of the target range for the year (Chart 1). However, headline inflation rose from 5.9 percent in June to

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[1]   Unless otherwise indicated, inflation rates are shown as the year-on-year change for the period noted.

[2]   Mainly the adoption of a new billing system by Botswana Telecommunications Corporation.

3.5 Inflation was also higher in 2002 compared to 2001 in respect of goods and services classified by tradeability. Prior to the introduction of VAT in July 2002, inflation for non-tradeables and imported tradeables had fallen, but thereafter it rose sharply. Inflation for non-tradeables fell to 6.9 percent in June 2002, from 7.7 percent in December 2001, but rose to 11.7 percent in December 2002. Inflation for imported tradeables fell to 3.8 percent in June 2002, from 4.6 percent in December 2001, rising to 8.2 percent in December 2002. In contrast, inflation for domestic tradeables showed a consistent and more rapid upward trend, reaching 15.2

CHART 2: INTERNATIONAL INFLATION

percent in December 2002, from 8.2 percent in June 2002 and 5.9 percent in December 2001.
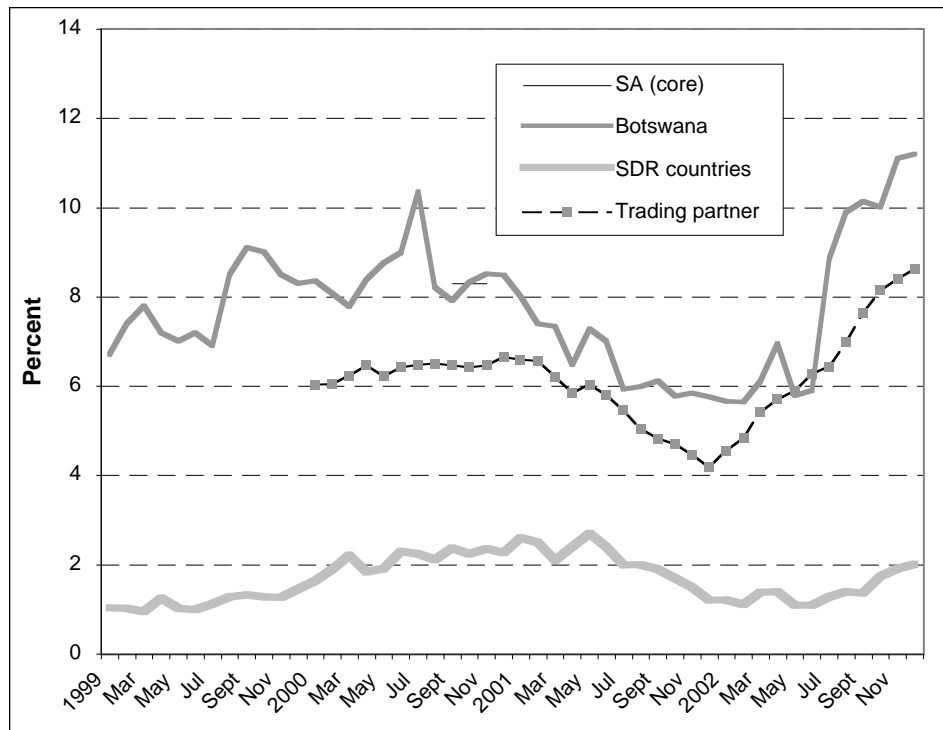
4. INFLUENCES ON DOMESTIC INFLATION

4.1 The international environment was characterised by moderately rising inflation in 2002 (Chart 2). Inflation in advanced economies rose from 1.2 percent in 2001 to 2 percent in 2002, as all major economies experienced higher inflation, mostly resulting from rising energy prices, especially oil. However, with economic growth remaining weak, albeit improving slightly, major world central banks maintained accommodative monetary policies to support growth, taking the view that inflationary pressures were not generally of concern and noting the existence of excess production capacity, restrained consumer demand and benign inflation expectations. In South Africa, inflation rose sharply in 2002, largely reflecting the effects of the depreciation of the rand towards the end of 2001, and increases in food prices and labour costs. Core inflation in South Africa was 12.2 percent in December 2002, considerably higher

than the 5.8 percent at the end of December 2001. The combined effect of all of these developments was that average inflation across Botswana's trading partners rose from 4.2 percent at the end of 2001 to 8.6 percent at the end of 2002. Botswana inflation briefly fell below that of its trading partners in mid-year but ended the year higher, largely due to the impact of VAT.

4.2 Commercial bank credit to the private sector grew, on average, at an annual rate of 18 percent, up from 13.2 percent in 2001, well above the tar-

CHART 3: GROWTH RATES OF CREDIT AND GOVERNMENT SPENDING (YEAR ON YEAR)
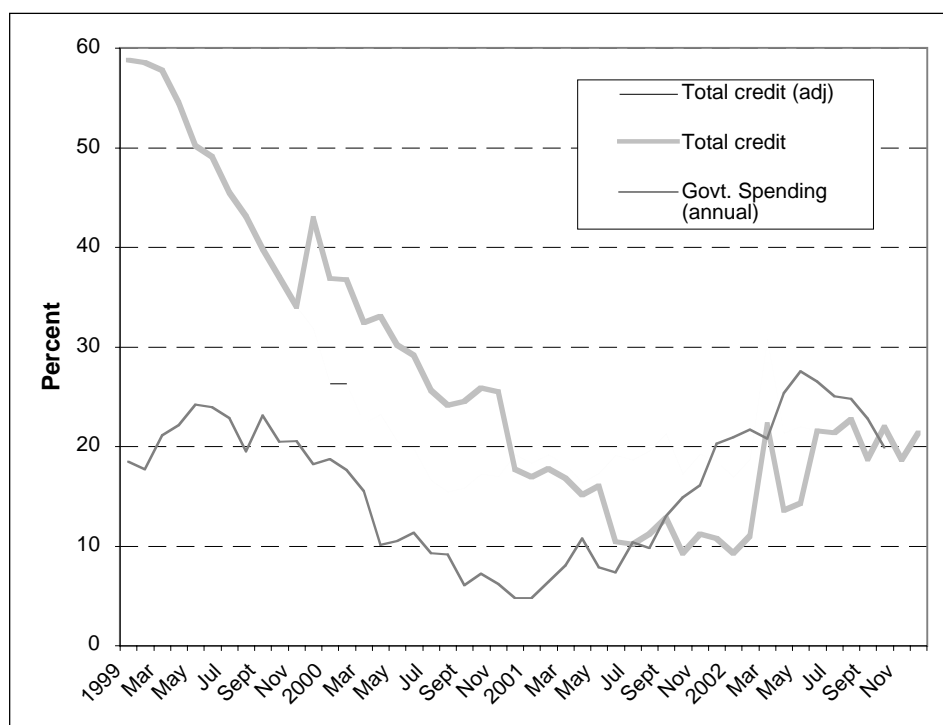
get range of 12.5–14.5 percent (Chart 3). However, once an adjustment is made to take account of the extension and subsequent early repayment of loans, using offshore funds, by some large borrowers, underlying credit growth in 2002 was 21.3 percent, compared to 18.6 percent in 2001.

4.3   Government expenditure is estimated to have grown by 18 percent during 2002, slightly below the 20 percent growth recorded in 2001 (Chart 3). The high rate of growth of government spending continued to be of concern from a monetary policy perspective, since it was not consistent with the inflation objective being pursued and was resulting in an undesirable imbalance between fiscal and monetary policies.

4.4   Economic growth for 2001/02 was 2.3 percent, markedly lower than the 8.4 percent recorded during the 2000/01 national accounts year[3]. The significant slowdown in growth largely reflected developments in the mining sector, where output contracted by 3.1 percent, compared to growth of 17.2 percent in the previous year. However, in many other sectors there was robust growth, and the growth rate of non-mining GDP was a healthy 5.5 percent, up from 4 percent in the previous year. This outturn is close to the trend growth rate of 6 percent for non-mining GDP envisaged over the eighth National Development Plan (NDP 8) period of 1997–2003.

4.5   During 2002, the Pula appreciated in nominal terms against major international currencies, following the recovery of the rand from losses sustained towards the end of 2001 (Chart 4). The 29 percent appreciation of the rand against the SDR[4] is largely attributable to a prudent macroeconomic policy in South Africa, a more favourable assessment of South Africa *vis-a-vis* other emerging markets by international investors, a perception that the rand had become undervalued and the weakness of the US dollar. As a result of the link to the rand through the currency basket[5], the Pula

strengthened by 27.9 percent against the US dollar and 18.6 percent against the SDR during 2002, while depreciating by 8 percent against the rand.

4.6   The trade-weighted nominal effective exchange rate of the Pula was largely stable in 2002; it appreci-

CHART 4: NOMINAL EXCHANGE RATE (NOVEMBER 1996 = 100)
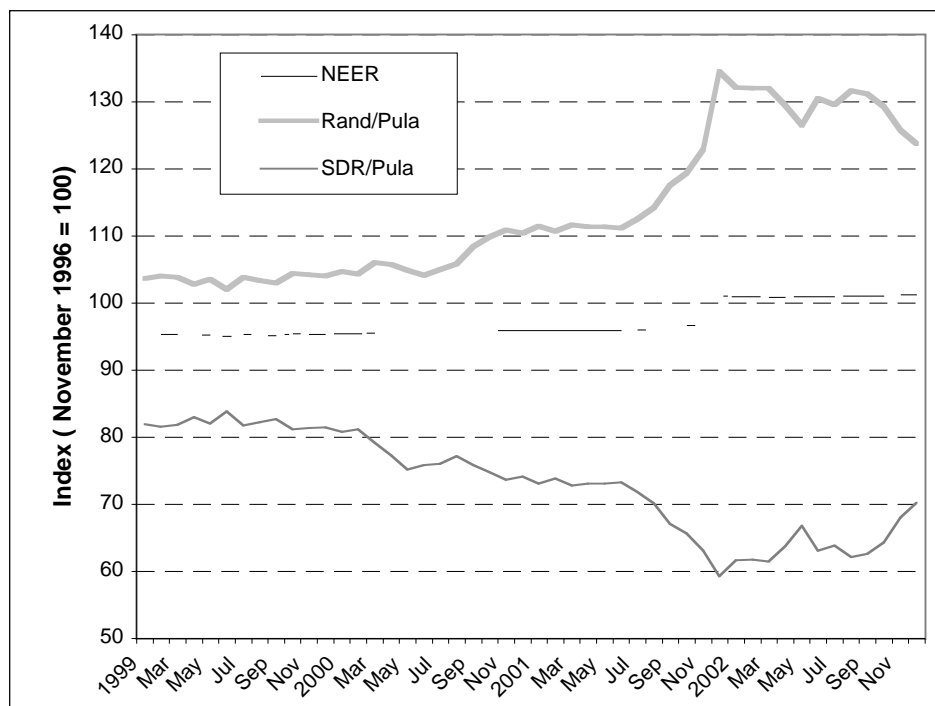
ated by 0.5 percent, as the impact of appreciation against the SDR was offset by depreciation against the rand. As inflation was higher in Botswana than in trading partner countries, mainly due to the impact of VAT, the real effective exchange rate of the Pula appreciated by 2.9 percent in the year to December 2002 (Chart 5), thus eroding competitiveness.

5. MONETARY POLICY IMPLEMENTATION DURING 2002

5.1   The objective of monetary policy in 2002 was to sustain the downward trend in inflation and to keep it within the desired range of 4–6 percent. This was to be achieved by adopting a monetary policy stance designed to restrain the growth of domestic demand, especially demand arising from growth in domestic credit. This policy stance was re-emphasised in the mid-year review of the 2002 Monetary Policy Statement.

5.2   As noted earlier, domestic demand continued to be expansionary. The growth rate of commercial bank credit remained at levels above the desired range throughout 2002, and the growth of government expenditure was similarly inconsistent with the inflation objective. Although underlying inflation is estimated to have been between 6 percent and 7 percent by the end of 2002, close to the de-

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[3]   The national accounts year runs from July to June

[4]   The IMF's Special Drawing Right, which is a weighted composite of the US dollar, Japanese yen, euro and pound sterling.

[5]   The nominal value of the Pula is fixed to a trade-weighted basket of currencies comprising the South African rand and SDR.

CHART 5: REAL EXCHANGE RATE (NOVEMBER 1996 = 100)

ing the increase in the Bank Rate. Open market operations were used to sterilise a substantial increase in market liquidity during 2002, largely due to the P4.9 billion funding of the Public Officers Pension Fund by government and the general increase in government expenditure. These two factors were reflected in a 30 percent decrease in government deposits at the Bank of Botswana and an increase of 49 percent in BoBCs outstanding to P7 664 million at end-2002.

5.5 As a result of the increase in the Bank Rate, which signals the desired direction and levels of interest rates, commercial banks raised their lending and deposit rates. The average 88-day deposit rate rose from 9.81 percent to 10.15 percent, while the prime-lending rate rose from 15.75 percent to 16.75 percent. Real interest rates in Botswana were generally relatively high and stable during the first half of the year, but declined sharply in the second half of the year as inflation rose. As at the end of the year, the real three-month BoBC rate declined to 2.5 percent, from 6.5 percent in January and 6.2 percent in June. Despite the decrease, real interest rates in Botswana were higher than those of major economies and South Africa (Chart 6).

sired range for inflation, it was, nevertheless, clear in the second half of 2002 that public expectations of a more sustained increase in inflation were starting to build up.

5.3 Looking ahead, the Bank considered that the continued high rates of growth of credit and government spending would add to inflationary pressures, leading in due course to an increase in underlying inflation significantly above the desired range. Therefore, in order to reduce demand pressures, especially those emanating from credit expansion, and to influence expectations of low inflation, the Bank Rate was increased by a total of 100 basis points in October and November (50 basis points each time) to 15.25 percent.

5.4 Open market operations were conducted during the year to ensure that yields on Bank of Botswana Certificates (BoBCs) were consistent with the policy stance. Between January and September 2002, the three-month BoBC rate[6] ranged between 12.52 percent and 12.55 percent, increasing to 14.03 percent by the end of the year, follow-
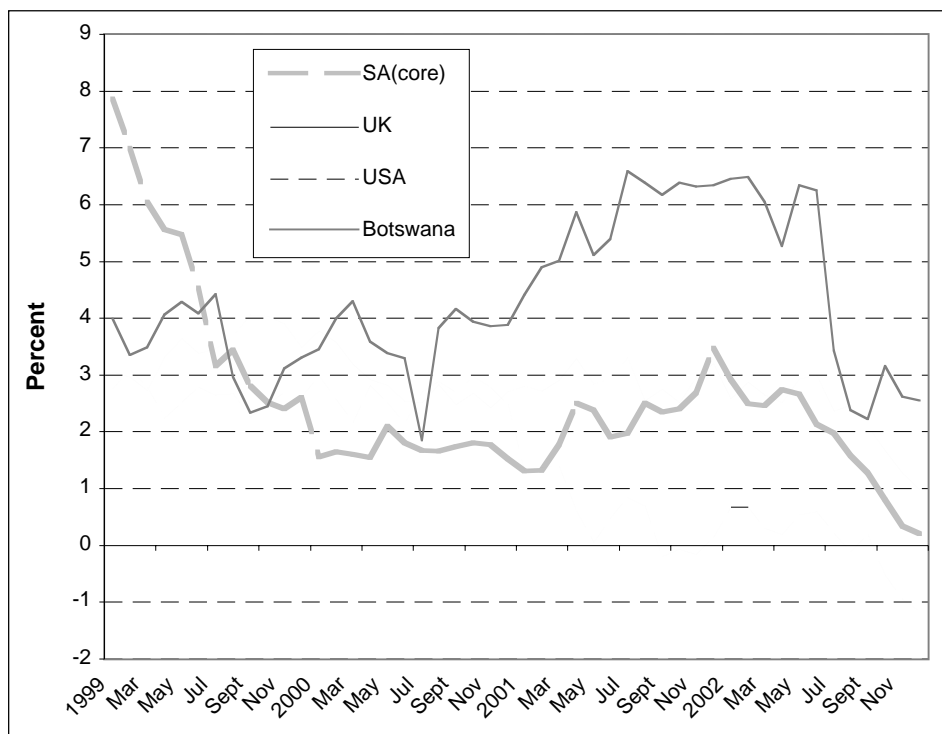
CHART 6: INTERNATIONAL REAL INTEREST RATES

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6 Figures refer to the BoBC mid-rate, as published in the *Botswana Financial Statistics*.

6. OUTLOOK FOR INFLATION IN 2003

6.1 Global economic performance is expected to improve further in 2003, with world output forecast to grow by 2.5 percent, up from an estimated 1.7 percent for 2002. Global inflation is expected, nevertheless, to remain stable and low as world output growth remains below trend. There is, however, uncertainty surrounding oil prices due to a possible war in Iraq. As inflation continues to be largely under control, it is anticipated that the major economies will maintain stimulative monetary policy which, in some instances, will be supported by expansionary fiscal policy.

6.2 Inflation in South Africa, which is the most important external influence on inflation in Botswana, rose sharply during 2002; but it is expected to slow down in 2003, reflecting the recent strengthening of the rand, the tight monetary policy stance and supportive fiscal policy. It is, however, unlikely that South Africa's inflation target of 3 – 6 percent will be met during 2003. Nevertheless, it is not expected that monetary policy will be tightened further unless new inflationary threats emerge, due to concerns about economic growth. Core inflation in South Africa is forecast to fall to between 7 percent and 8 percent in 2003, from 12.2 percent in 2002. For the SDR countries, inflation is forecast at 2 percent in 2003, the same as at the end of 2002. If the nominal effective exchange rate of the Pula is unchanged, Botswana's imported inflation is likely to be lower in 2003 than it was in 2002, although there may be a lagged impact of the 2002 inflation increase in South Africa and globally.

6.3 Although domestic demand, as indicated by the growth in commercial bank credit and government expenditure, remains undesirably high, it is expected that the increase in interest rates in the last quarter of 2002 will, in due course, moderate the demand for credit. Furthermore, the 2003 budget indicates that government expenditure will grow at a much slower rate of 4.1 percent in 2003, which will, together with an expected reduction in credit growth, help to moderate inflationary pressures. The Government's decision not to award a public sector pay rise in 2003 will further help to restrain demand pressures, and it is hoped that this will not be undermined by the findings of the ongoing Salary Structure Review Commission. Prospects in 2003 are of a better balance between monetary and fiscal policies in restraining overall expenditure growth.

6.4 Overall, it is expected that inflation in the first half of 2003 will be around present levels of between 10 percent and 12 percent, before falling significantly in the middle of the year to between 6 percent and 7 percent. This projection reflects the dropping out of the inflation calculation of the VAT-related increase in prices in mid-2002. It also assumes that monetary policy is successful in restraining credit growth, that the growth of government spending is reduced in 2003, and that there are no further undue external inflationary pressures generated by further large increases in food or oil prices.

7. MONETARY POLICY STANCE IN 2003

7.1 As indicated in Section 2 above, the Bank seeks to achieve a rate of inflation that, at a minimum, will maintain relative stability in the real exchange rate and avoid the need for a devaluation of the Pula. The inflation objective, therefore, reflects an assessment of forecast inflation for trading partner countries. Given that forecast trading partner inflation for 2003 is higher than similar forecasts for 2002, on which the inflation objective was based, this could imply a slightly higher range for the inflation objective in the current year than in 2002.

7.2 There are, nevertheless, strong reasons to maintain the inflation objective in 2003 at the range of 4–6 percent. First, by helping to bring Botswana's inflation rate below that of trading partners, it provides an opportunity to regain some of the competitiveness lost last year as a result of the higher rate of inflation in Botswana. Second, excluding the impact of VAT, underlying inflation remains close to the upper end of this objective. In this respect, the 4 – 6 percent range remains a feasible objective. Third, looking ahead and in light of concerns about the risks of a further VAT-included increase in inflationary expectations, the Bank believes that it is important to maintain expectations of sustainable low inflation.

7.3 The range for the growth rate of private credit that is considered to be compatible with achieving this inflation outcome is 12 – 14 percent. As in the past, this range is derived from the expected annual capacity for growth (aggregate supply) of the non-mining sector of the economy, as presented in the ninth National Development Plan (NDP 9), and desired inflation for the year, with an allowance for the process of financial deepening as the economy develops.

8. SUMMARY AND CONCLUSIONS

8.1 Inflation was higher in 2002 compared to 2001, and was above the inflation objective indicated in the 2002 Monetary Policy Statement. The higher inflation was largely explained by the temporary impact of VAT on prices in the second half of the year, while underlying inflation was at the upper end of the 2002 target range. Inflation was also affected by drought conditions in Southern Africa, which had an impact on food prices. Nevertheless, overall domestic expenditure growth was high, raising concerns about future inflation trends.

8.2 During 2003, it is expected that output growth will improve in major industrial countries, while inflation will remain under control. Except for a possible increase in oil prices due to conflict in the Middle East, a possible war in Iraq and the lagged impact of the previous year's increase in South African inflation, there is minimal risk of external pressures on inflation. Domestically, it is anticipated that credit demand will slow in response to the increase in interest rates in 2002, helping to alleviate demand pressures. Fiscal restraint, as shown in the much reduced growth rate for government spending announced in the 2003 Budget, should also contribute to reducing inflationary pressures in 2003.

8.3 The task for monetary policy in 2003 will be to ensure that underlying inflation does not increase and the expected decline in overall inflation is consistent with the Bank's desired range of 4–6 percent by the end of the year. The Bank took a step late last year to increase the cost of credit and, therefore, moderate its growth, as well as curtail higher inflationary expectations. While the Bank will continue to respond appropriately to monetary and inflation developments, the fiscal restraint that characterises the 2003 Government Budget should help to ensure that the burden of containing inflation will be shared in a more balanced manner between monetary and fiscal policies during 2003.

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Portfolio Capital Flows to Developing Countries 1980–1996: An Empirical Investigation

Lesedi Senatla[1]

INTRODUCTION

There has been a noticeable increase in equity investment flows (both portfolio and direct) as well as bond holdings towards developing countries since the late 1980s. Contributing to this increase were financial institutions, institutional investors and individuals who were important purchasers of emerging markets' securities. Portfolio investments took the form of debt and equity instruments. Debt instruments, in turn, comprised bonds, certificates of deposit and commercial paper issues. Of these categories bonds accounted for the largest share (World Bank, 1994). Equity instruments consisted of company shares, depository receipts, investment fund units and purchases by foreigners of equity instruments in local stock markets (World Bank, 1994). Curiously, these capital flows were not widespread but rather mostly went to the middle-income countries (the so-called emerging markets) in Latin America and East Asia. Indeed, the World Bank (1994, p.14) observed that 'Latin America and East Asia together accounted for more than 90 percent of the gross portfolio equity flows to developing countries between 1989 and 1993.' The prominent recipients of these capital flows were Argentina, Brazil, Chile, Mexico, Indonesia, South Korea, Malaysia, Philippines and Thailand. Interestingly, researchers are not in agreement about the determinants of these portfolio capital flows. Some believe that external factors are responsible, i.e., the 'push' view (see Calvo *et al.*, 1993; Fernandez-Arias, 1996; Cardoso and Goldfajn, 1997 and Kim, 2000, among others). Others, however, are convinced of the potency of domestic economic factors in attracting capital flows i.e., the 'pull' view (see Lensink and Van Bergeijk, 1991b and Bekaert, 1995). Research findings from the 'push' view typically attribute portfolio inflows to the decline in nominal interest rates in OECD countries. On the other hand, the pull view proponents emphasise the improved domestic creditworthiness of the host economies, following their economic adjustments and liberalisation efforts.

Beneath the push and pull views' divergence of opinion lies the question of the degree of control on foreign savings inflows. The push view implies lack of influence given the exogenous nature of the determinants. Conversely, the pull view suggests some degree of influence on account of the possible control of the domestic economic factors.

This paper contributes to the economic debate about the relative importance or dominance of the push and pull factors. However, it advances the debate further by investigating whether the interaction of external and domestic factors might provide an additional explanation of portfolio flows. In order to proceed in this investigation a study is made of portfolio flows (bonds and equities) from a panel of nine developing countries for the period 1980–1996 consisting of four Latin American economies (Argentina, Brazil, Chile and Mexico) and five Asian economies (Indonesia, Korea, Malaysia, Philippines and Thailand).

The paper is structured as follows: Section 2 provides a brief review and analysis of the theoretical and empirical studies of portfolio flows. The theoretical arguments of portfolio flows are divided into those that highlight perfect capital markets, those stressing imperfect capital markets and those that emphasise capital (or credit) rationing. On the other hand, the empirical studies are divided into those that pursue the push view interpretation of portfolio flows, those following the pull view and others that see a role for both the push and pull factors. Section 3 provides a description of trends and developments in portfolio flows to countries under study during the 1980–1996 period[2].

Section 4 tests a simple empirical model derived from a neoclassical theoretical framework[3]. It then carries out a comparative policy analysis with the previous empirical papers. In brief, this paper discovers that both domestic and external factors explain portfolio capital flows to developing countries but that there are important regional differences. Domestic factors dominate in Latin America, while external factors dominate in Asian countries.

The results here contradict those of Taylor and Sarno (1997) and Chuhan *et al.* (1998). Taylor and Sarno (1997) find that external factors are relatively more important for Latin America than Asia; while Chuhan *et al.* (1998) discover that domestic factors are comparatively more influential than external factors in Asia. The use of different data sets (from those of the previous literature) may account for the differences in the findings. It is believed that the findings here offer a new insight into

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[1] Principal Economist in the Research Department of the Bank of Botswana. The paper draws on various chapters of the author's 2001 PhD thesis presented to the University of Nottingham entitled 'The Determinants and Behaviour of Capital Flows in Emerging Market Economies'.

[2] Adding data points beyond 1996 made no substantive difference to the results here, and, for the purpose of this paper, data points covering the capital flows crisis periods of 1997 and 1998 are not included.

[3] Due to space limitations the full theoretical model is not specified here. Only the empirical version of the model is shown.

the causes of portfolio flows and thus represent an important contribution to the literature.

Section 4 also advances the literature by examining the role of the interactive effects in driving portfolio flows. It finds strong evidence for these effects. Previous literature has thus far not investigated the role of the interactive effects. The conclusion is in Section 5.

A Brief Review of Relevant Theoretical and Empirical Studies

(a) Theoretical Treatment of Portfolio Capital Flows

Theoretical analysis of portfolio capital flows can conveniently be subdivided into those that emphasise perfect capital markets, those stressing imperfect capital markets and those highlighting credit rationing.

Theories with Perfect Capital Markets

Theories with perfect capital markets rely principally on the 'efficient market hypothesis' which posits that investors base their investment decisions on the information with which they are provided (e.g., the price of securities or the performance of the stock market). This information is then used as a basis for pursuing high returns while, at the same time, seeking to minimise risks.

As the name implies, the 'efficient market hypothesis' envisages a well-functioning capital market that is free of distortions and other barriers, which thus affords investors an opportunity to rationally use all the available information at their disposal in their investment decisions.

Theories with Imperfect Capital Markets

It might not be helpful, though, to disregard the impediments to the free flow of portfolio capital flows that exist in practice. Thus, theories with imperfect capital markets attempt to redress this possible shortcoming of theories that assume perfect capital markets by incorporating different kinds of imperfections in their models. Imperfections might be in the form of legal barriers such as discriminatory taxation or restrictions on ownership of foreign securities (Jorion and Schwartz, 1986; Eun and Janakiramanan, 1986); or they could be in the form of lack of information about foreign firms; or the fear of expropriation among others (Adler and Dumas, 1975; Eun and Janakiramanan, 1986). As for legal barriers, Eun and Janakiramanan (1986) observe that host countries may impose these on firms regarded to be strategically important to national interests. Regarding lack of adequate or reliable information, Leland and Pyle (1977) observed that borrowers may not be expected to honestly supply correct information to investors, hoping that by over-stating the performance of their firms they might obtain more investment funds from the investors. Verifying the information received can only be achieved at a cost (Townsend, 1979).

The existence of imperfections implies that the international capital market might not be completely integrated. But Jorion and Schwartz (1986) caution that the existence of barriers of a legal nature, in particular, might not ensure segmentation since investors may find innovative ways of avoiding barriers to capital flows.

Eun and Janakiramanan (1986) studied the effect of the legal barriers that limited domestic investors to owning a certain fraction of shares of foreign firms. Their model suggested that a constraint of this nature would lead to a higher premium being paid by domestic investors on the price of foreign securities over the price without restrictions. This is because the restrictions lead to demand for foreign shares exceeding supply. Also legal barriers force domestic investors to hold more domestic shares than they would if such restrictions did not exist. Other studies have also shown that legal restrictions tend to lead to substitution away from the restricted assets into unrestricted ones.

Consistent with others emphasising problems of imperfect markets, Gertler and Rogoff (1990) and Boyd and Smith (1997) showed that capital flows to developing countries tend to be depressed by lack of adequate information.

Capital Rationing Literature

The capital rationing literature takes the view that because of the real possibility that the entrepreneur or borrower might default on his/her contract, leading to losses for the investor he/she, therefore, has to find ways of limiting this possibility. This suggests that an investor would withhold loans to the entrepreneur after a certain point has been reached irrespective of how high the yield the entrepreneur promises to pay. Literature notes that part of the problem the lender has is the inability to distinguish a 'bad' borrower from a 'good' one. If he/she could, a bad borrower would never get a loan at any interest rate.

Faced with imperfect information regarding the nature of the borrower, the lender tends to resort to credit rationing; loan demand is not equal to loan supply, thus excess demand results. This behaviour, it is argued, is a perfectly rational response in view of the risk considerations involved.

When faced with an excess demand situation, the lender will be reluctant to raise interest rates to accommodate excess demand since this will lead to adverse selection and moral hazard problems. The adverse selection effect arises in that as the interest rate rises good borrowers, who have every intention of paying back, would drop out of the market leaving only the bad risks. Moral hazard problems arise in that the high interest rate itself would lead borrowers to engage in excessive risk taking behaviour that promises high returns. Thus

excess demand is an equilibrium solution.

(b) Empirical Studies of Portfolio Flows

As stated above the empirical studies of portfolio flows can be divided into the push and pull factors' categories. The push factor argument states that portfolio capital flows are driven (or pushed) out of place of origin (home) into another (host) country by the macroeconomic conditions in the home country. For example, a decline in interest rates in OECD countries might push portfolio capital flows to developing countries in pursuit of relatively higher returns. On the other hand, the pull factor argument attributes portfolio capital inflows to favourable macroeconomic conditions in the host economy.

A short summary of the empirical findings along the push and pull interpretations of portfolio capital flows is presented here. Particular attention is paid to the studies carried out in the 1990s and current studies since they address causes of increases in portfolio capital flows to emerging markets after the late 1980s.

(i) Push-Factor Studies

Table 1 provides a summary of studies that pursue the push-factor argument. The information contained in the table will not be repeated in the comment on the studies to avoid repetition. Miller and Whitman (1970) experimented with a set of US economic variables and discovered that a fall in US income pushes portfolio flows out. Kreicher (1981) found evidence suggesting that a fall in the change in real interest rates may also push portfolio flows out of the country.

Calvo et al. (1993) examined a list of US variables in their investigations of the determinants of portfolio capital flows in Latin American economies. They discovered that a decline in these external factors led to an increase in portfolio capital inflows to Latin American economies.

The use of change in external reserves by the Calvo et al. (1993) study to proxy for capital flows is, however, potentially problematic. This is because it tends to confuse cause and effect since reserves could be more appropriately viewed as a determinant (cause) of capital flows and not as proxies for capital flows themselves. Fernandez-Arias (1996) and Chuhan et al. (1998) also make an observation similar to the one being made here. Other problems include ignoring domestic factors which have the potential to influence capital flows. Quite likely their estimations suffer from the omitted variable bias problem as Kim (2000) also notes. Furthermore, there is no mention of tests for unit roots which could limit the usefulness of the results because of potential spurious correlation effects.

Fernandez-Arias (1996) used the country-specific intercept term in a fixed effects model to capture the domestic investment climate, the annualised ten-year US bond nominal yields to capture international returns and the debt secondary market prices – where available – to capture country creditworthiness, as explanatory variables. He found that external factors, as represented by the international interest rate, had much more powerful effects in driving capital flows to emerging markets than domestic factors.

The two major weaknesses in the Fernandez-Arias method of analysis consist of using the in-

TABLE 1: PUSH-FACTOR STUDIES

Study	Data	Home Country	Host	Method	Measure
Miller and Whitman (1970)	1957:2 -1966:3, T	USA	10 OECD[1]	OLS	A change in the ratio of foreign to total risky assets
Kreicher (1981)	1967:4 -1974:4, T 1966:2 -1974:4, T 1967:2 -1974:4, T 1967:4 -1974:4, T	IT, GE UK GE, USA UK, IT	UK GE IT USA	OLS	A change in long term portfolio liabilities to foreigners from private sector agents
Calvo et al. (1993)	1988:1 -1991:12, T	USA	10 LDCs[2]	Principal component and VAR	Changes in reserves
Fernandez-Arias (1996)	1990:1-1993:2, P	OECD	13 LDCs[3]	Fixed effects model	Equity and debt as ratio of GDP
Cardoso & Goldfajn (1997)	1988:1-1995:12, T	OECD	Brazil	OLS	Equity and debt as ratio of GDP
Kim (2000)	1958:3 -1995:3, T 1982:2 -1995:1, T 1961:2 -1995:3, T 1972:2 -1995:1, T	OECD	Mexico Chile Korea Malaysia	VAR	Capital account balance as a ratio of GDP

Notes: T *denotes time series,* P *is panel data and* OLS *is ordinary least squares.* GE *is Germany and* IT *is Italy.*

[1] *Australia, Canada, Denmark, France, Germany, Japan Netherlands, Norway, UK and Switzerland.*

[2] *Argentina, Bolivia, Brazil, Chile, Columbia, Ecuador, Mexico, Peru, Uruguay and Venezuela.*

[3] *Algeria, Argentina, Brazil, Chile, Korea, Malaysia, Mexico, Panama, Philippines, Poland, Thailand, Uruguay and Venezuela.*

tercept to capture important domestic factors rather than explicitly finding proxy variables to capture domestic factors. Secondly, the sample period covered is much too short (i.e., four years) which weakens the statistical analysis.

Cardoso and Goldfajn (1997) sought to explain capital inflows in Brazil and discovered that US interest rate had a dominating role as an explanatory factor, thus implying a push interpretation. The basic problem with Cardoso and Goldfajn's analysis is the OLS procedure which may give rise to spurious results.

Kim (2000) used a set of US economic variables as well as domestic ones as explanatory variables. The VAR estimation procedure showed the external factors as the dominant explanatory variables. The problem with the analysis, though, is the use of the overall capital account balance to measure capital flows. This balance is too broad to be useful for policy-making purposes. Rather, an analysis based on the individual elements of the capital account might be more helpful.

(ii) Pull-Factor Studies

Lensink and Van Bergeijk (1991) used a Logit model to study a country's probability of accessing private funds in the international capital market during the years 1985, 1986 and 1987 by examining data for 96 developing countries from Asia, Latin America, Africa and Europe. The results showed the significance of a variety of domestic macroeconomic factors in enabling a country to access international capital markets. The findings were also that Asian countries have a much higher probability of accessing international capital than Sub-Saharan African countries since Asian countries have much better economic fundamentals. However, since this study does not experiment with foreign factors, it is impossible to assess how important they were relative to domestic factors. Hence, this omission would seem to be a major weakness of the study.

Bekaert (1995) sought to discover whether it was global factors or domestic country factors that could account for the gradual integration of the emerging markets economies with the international capital markets using monthly data for 1986–1992. The results showed that the domestic factors were overwhelmingly more important in the integration process relative to the global factors. This study supports the pull view.

(iii) Other Studies

Taylor and Sarno (1997) studied the relative importance of the push and pull factors in driving portfolio capital flows to nine Latin American and nine Asian economies using monthly data for January 1988 to September 1992. The results showed that both push and pull factors were significant determinants of portfolio flows (both equity and bond flows). In general, they found that US inter-

est rates had a much more powerful effect on portfolio flows to Latin American economies than to Asian economies. They also found that bond flows are determined more by global factors (US interest rates) than by domestic factors while equity flows are responsive to country-specific factors. This study seems to be hampered by the use of a short sample period. 1988–1992 sample period is too short a time frame for the purpose of cointegration methods (which were used) and the associated long run relationship analysis; consequently such a short period could generate doubt as to the robustness of the results.

Chuhan et al. (1998) used the same data set as Taylor and Sarno but made use of a panel data approach. The results showed the equal importance of both the push and pull factors in explaining capital flows. In particular, they found that the push factors were much more important in explaining portfolio flows to Latin America, while the pull factors were the dominating force in explaining portfolio flows compared with the global (push) factors in Asian countries. In contrast to Taylor and Sarno, Chuhan et al. found that bond flows are determined more by domestic factors than by global factors while equity flows are more responsive to global factors.

The shortcomings of these two papers seem to consist of the following: Portfolio flows from non-US sources was ignored. This is potentially problematic since it is known, for example, that Japanese investors favour investing in Asia (see Ahmed and Gooptu, 1993); secondly, with regard to Chuhan et al., most of the variables are potentially endogenous, except the foreign variables. Notwithstanding the fact that GLS or panel data method was used, it would have been appropriate to do an instrumental variable (or two stage least squares) estimation to find out whether similar results will hold.

While the debate about the push and pull factors is still ongoing, evidence so far seems to attribute the causes of portfolio capital flows to the external factors. Edwards (1999), however, opines that capital flows are a reflection of more than the international financial and economic factors but are also an indication of the attractiveness of the host country's economic conditions. He argues that capital inflows generally take place in countries that have carried out or are carrying out economic reforms (e.g., Latin American countries). Furthermore, the push-factor proponents are unable to explain why capital flows are not evenly spread throughout all the developing countries since, presumably, all the developing countries are equally affected by external economic developments (Ahmed and Gooptu, 1993).

3. DATA DESCRIPTION

The late 1980s saw an increase in capital flows to emerging market economies in the form of equity flows (i.e., both FDI and portfolio investment). This was in contrast to the 1970s period, which was dominated by commercial bank loans (Baer and Hargis, 1997). Equity financing from the 1980s onwards was viewed (by developing countries, in particular) as a more preferable form of external financing since it leads to the sharing of risk between the international investor and the host country (Ahmed and Gooptu, 1993). But, equity financing went mainly to middle income countries in Latin America and Asia during the 1980s and 1990s period because they were considered more creditworthy. This section tentatively attributes the causes of portfolio capital flows to both domestic policy changes and/or foreign factors, thus laying the foundation for formal tests.

Trends and Developments in Portfolio Flows to Latin America and Asia

Chart 1 plots the time series of portfolio flows[4] as a ratio of GDP for the Latin American economies (Argentina, Brazil, Chile and Mexico), while Chart 2 plots the series for the South East Asian economies (Malaysia, Indonesia, Philippines, South Korea and Thailand) during 1980–1996.

Chart 1 show a sustained increase in portfolio flows to most Latin American economies beginning 1989. This increase coincided with the resolution of earlier debt problems. The chart also shows that Latin American economies were faced with a virtual cessation of external financing during the debt crisis period of the early 1980s. This led to major economic reform programmes to regain access to external financing (El-Erian, 1992), including abolishing exchange controls, trade liberalisation, tax reforms and liberalising the financial sector (Edwards, 1999). Possibly, these reforms had the effect of reducing perceptions of

country transfer risk (El-Erian, 1992).

Chile is different from the other Latin American economies, however, in that it had the longest record of reforms dating back to the 1970s (UN, 1996). It embraced economic reforms in the 1970s following accession to power by a pro-market government. Still, Chile experienced an increase in portfolio flows coincidental with others possibly reflecting 'bandwagon effects' (Schadler et al., 1993). In other words, Chile had to await the return of confidence of investment potential in the Latin American region. Indeed, foreign investors are often accused of acting in a herd-like behaviour (Edwards, 1999).

Besides economic reforms there were other economic developments taking place in the region. These were, first, the gradual liberalisation of stock markets although some restrictions remained in some countries[5]. Opening domestic stock markets allows foreign savings to enter through this medium although domestic companies may access foreign capital in international capital markets. Second, there was the implementation of the Brady plan in the 1980s, which entailed the negotiation of debt between the debtor and the creditor banks leading to debt buy-backs, the exchange of bank claims for bonds at a lower face value and/or the rescheduling of debt servicing on loans (UN, 1994).

CHART 1: PORTFOLIO FLOWS IN LATIN AMERICA AS A RATIO OF GDP

The reduction of debt burdens through the Brady plan might have generated perceptions of the im-

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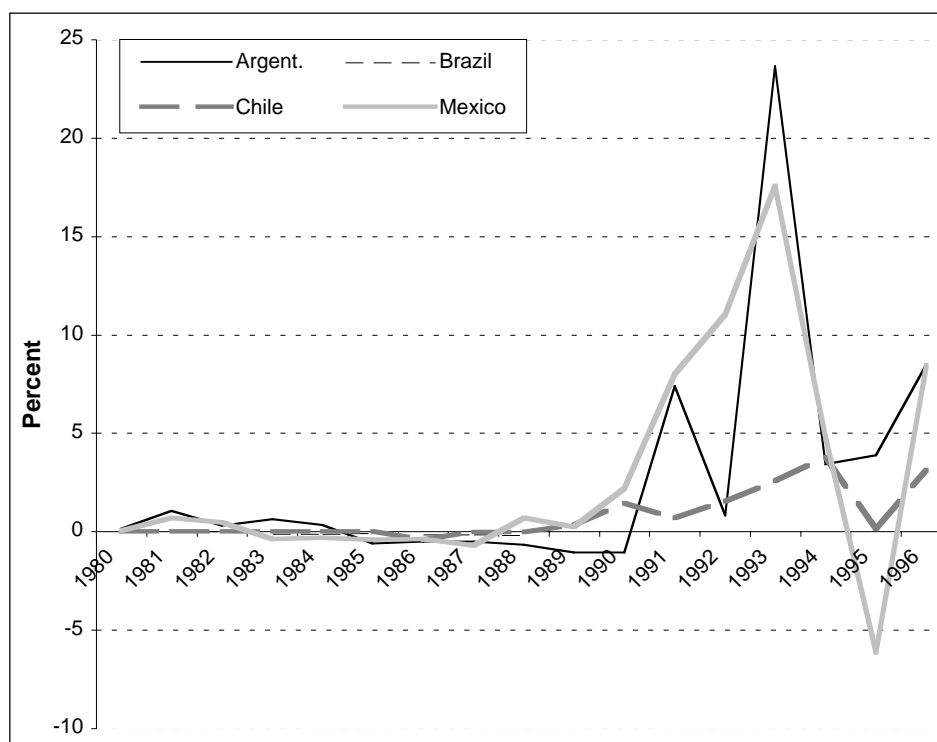
4   The *International Financial Statistics (IFS)* describes portfolio flows as constituting 'transactions with non-residents in financial securities of any maturity (such as corporate securities, bonds, notes, money market instruments and financial derivatives) other than those included in direct investment'. In effect portfolio flows lump together bonds and equities.

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5   For instance, in Chile as at 1995, foreign investors were required to register with the authorities before they could buy domestic listed stocks (UNCTAD, 1997).
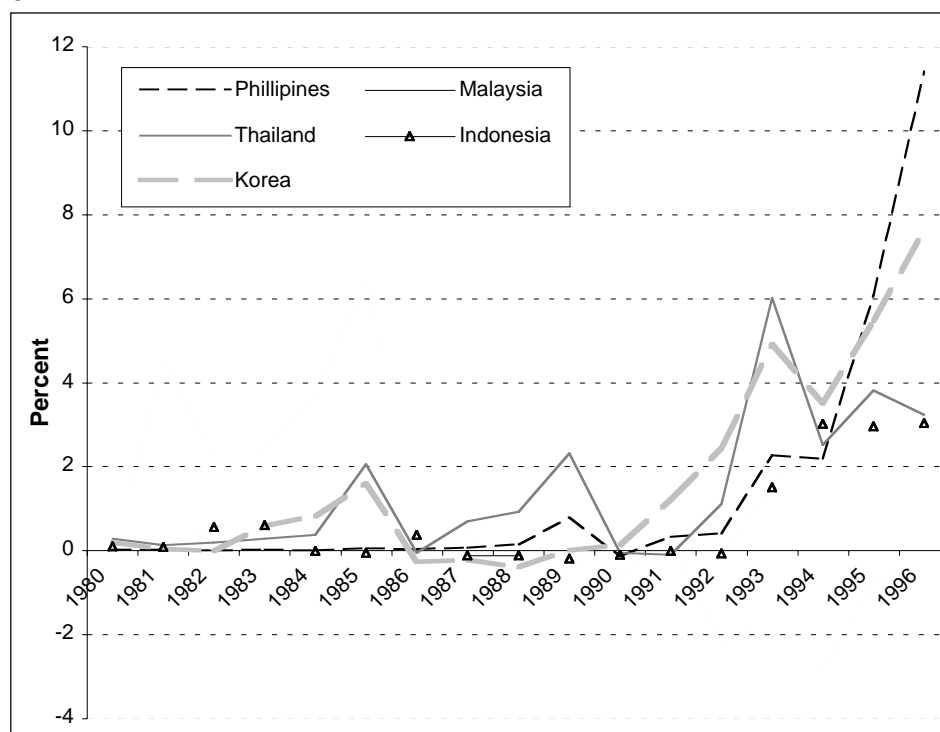
proved creditworthiness of the debtor countries (El-Erian, 1992). However, the Brady plan was open only to countries that undertook serious economic reforms. Finally, regulatory changes in developed countries in 1990 particularly 'Regulation S' and 'Rule 144A' (in the US) which helped reduce transactions costs because foreign securities were exempted from registration requirements, may also have played a part in the increase of capital flows to emerging markets (El-Erian, 1992).

Chart 1 shows interesting discrete jumps in the data. The increases and falls in the data follow important events such as privatisation episodes, the introduction of inflation stabilisation policies and the flight of foreign investors. For example, the sudden jump in portfolio flows to Argentina in 1993 captures increases in portfolio equity inflows resulting from the privatisation of the state oil and gas company[6], and the increase in portfolio flows to Brazil in 1994 followed the replacement of the *cruzeiros reais* with the *real* currency. This helped reduce inflation from 2500 percent in 1993 to single digits by January 1995 (UN, 1995). The reduction in monthly inflation rates could help explain the attractiveness of *real*-denominated assets to foreign investors in 1994 (Turner, 1995). The decline in portfolio flows to Mexico in 1995 was precipitated (mainly) by

the devaluation[7] of the Mexican peso in December 1994, although increases in US interest rates might also have had an influential effect. Increases in US interest rates (in 1994) might have made US securities relatively more attractive[8] (UN, 1995). Chilean portfolio flows data show less dramatic increases owing perhaps to the less dramatic reforms that were needed during the 1980s and 1990s.

Chart 2 shows portfolio inflows to South East Asia. Factors mentioned above such as the liberalisation of stock markets[9] and regulatory changes in the industrial countries could have played a role in inducing portfolio flows to Asian economies. Furthermore, falls in international interest rates

CHART 2

in the 1990s possibly also played a part in heightening investor interest in Asian countries' securities (Ishii and Dunaway, 1995). These factors might have been particularly important in explaining the apparent increases in portfolio flows to Thailand, Korea and Indonesia from 1990 onwards[10]. Most Asian economies did not experience debt problems[11]– except the Philippines, which announced its difficulties in paying its external debt in 1983. Indeed, while Latin American economies were faced with a virtual absence of portfolio flows in the early 1980s, most of the Asian economies were enjoying relatively moderate increases in portfolio flows. Still, even the Asian countries were not unaffected by

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6   See also Claessens and Gooptu (1994).

7   The devaluation of a currency increases the local currency cost of a country's foreign liabilities and thus puts an extra burden on the country's external position. This exchange-rate-induced debt burden makes it more likely that a country could default on its external obligations (IMF, 1998). Unsurprisingly, therefore, a currency devaluation causes uneasiness among foreign investors and normally leads to the flight of their money.

8   Mexico also experienced political problems in 1994, which included the assassination of a leading presidential candidate. But these political problems '…did not seem to shake investor confidence in the Mexican economy…' (UN, 1995, pp. 78).

9   As at 1995, foreign investors were required to register with the authorities to buy domestic stocks in Indonesia, Korea and Thailand. In the Philippines, foreign investors were restricted to certain classes of stocks specifically designated for them. Malaysia, on the other hand, did not have restrictions on foreign purchase of domestic stocks in 1995 (World Investment Report, 1997).

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10   We explain portfolio flows' movements in Malaysia and Philippines separately in what follows.

11   The question of why Asian countries did not have a debt problem is outside the scope of this paper. For an attempt at answering this question see Singh (1995).

the general withdrawal of foreign investors from developing countries in the early 1980s.

Since the Philippines (in tandem with Latin American economies) had experienced debt payment difficulties in the early 1980s, it too faced negligible inflows of portfolio capital in the 1980s leading to economic reforms in order to regain access to capital flows. Malaysia experienced a dramatic fall in portfolio capital flows since 1985. The persistent negative inflows beyond 1985 and into the 1990s may reflect the authorities' inclination to discourage portfolio flows in order to mitigate their potentially harmful effects[12]. For example, in 1994 Malaysia prohibited its residents from selling short-term monetary instruments to non-residents, although such a prohibition was rescinded later in the same year (Corbo and Hernandez, 1996). Still, despite the cancellation of this prohibition, foreign portfolio investors might nevertheless have felt uneasy about investing in Malaysia.

In brief, this section has suggested that domestic policy changes, e.g., privatisation and declines in international interest rates are the key factors accounting for foreign capital inflows to emerging markets.

4. EMPIRICAL SPECIFICATION AND RESULTS

This section applies panel data econometrics to a model of portfolio capital flows for a longer time-span than most of the previous studies mentioned in Section 2[13]. The model to be used is a hybrid between a flow and a stock concept consistent with some of the literature (e.g. Leamer and Stern, 1970, Calvo et al., 1993 and Chuhan et al., 1998).

The dependent variable is portfolio investment (or flows) as a proportion of gross domestic product (PIRD). The data is annual and covers nine developing countries[14]. The explanatory variables are the following: nominal US interest rates (USRT, i.e. medium-term government bond yields) were used to capture the return on a safe asset in the advanced country. We further experiment with the six-month London Inter-Bank Offer Rate (LIBOR) to test the robustness of the findings. Similarly, we also test the impact of measures of real returns (as

opposed to nominal returns) on portfolio flows. Two possible measures of real returns are used: (1) the return on UK ten-year indexed bonds[15] (UKBONDS) and (2) the nominal return on a ten-year US bond deflated by consumer price inflation over the following two years (RUSRT). We anticipate negative signs on the coefficients of interest rate variables following from the fact that declines in interest rates 'push' portfolio capital flows to emerging market economies.

We employ the real share price index (SHP) to represent expected returns. This follows the efficient markets hypothesis that any news with the potential to affect expected returns should be reflected in equity prices. Such news may be in the form of the announcement of policy reforms or changes in the probability of such an announcement. We expect a positive coefficient on this variable.

We include a range of country-specific macroeconomic indicators to capture creditworthiness. Haque et al. (1996, 1998) demonstrated that these macroeconomic factors were useful measures of creditworthiness. These factors comprise current account balance as a share of GDP (CA) and foreign exchange reserves as a ratio of imports (FRIM).

Following Brewer and Rivoli (1990), we use the current account as a ratio of GDP (CA) to capture trade performance. The idea is that countries displaying strong trade performance are in a good position to obtain the hard currency they need to service their external obligations. Indeed they may be paid in foreign currency since much of world trade is conducted in US dollars. CA should have a positive coefficient.

Foreign exchange reserves – measured here as a proportion of imports – (FRIM) enable a country to service its external obligations in the event of a liquidity problem. Indeed, countries hold foreign reserves principally to cushion them during hard times and avoid unwanted pressure on fixed exchange rates. We anticipate a positive sign on the coefficient of this variable. Other variables experimented with were the growth rate of GDP, export to GDP ratio, external debt to export ratio and volatility in the exchange rate. These were found to be statistically insignificant.

The empirical model to be estimated is the following:

$$F_t = b_0 + b_1(1 - a_1 B)R_t + b_2(1 - a_2 B)H_t + \underline{b}_4(1 - \underline{a}_4 B)\underline{M}_t + u_t \tag{1}$$

$$F_t = b_0 + b_1(1 - a_1 B)R_t + b_2(1 - a_2 B)H_t + b_3(1 - a_3 B)R_t H_t + \underline{b}_4(1 - \underline{a}_4 B)\underline{M}_t + u_t \tag{2}$$

where F_t represents portfolio capital flows in

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[12] A full discussion of the potentially harmful effects of portfolio flows is outside the scope of this paper. However, it is to be noted that portfolio capital inflows may disturb macroeconomic stability through, for example, increasing domestic demand and exerting pressure on prices of goods and financial assets (see Schadler et al., 1993).

[13] Note that Kim's (2000) study is an exception since it considered a longer time period than ours. See details in Chapter 2.

[14] The data is published in various issues of IFS. Explanatory variables were sourced from various issues of IFS, Bank of England, IFC Emerging Stock Markets' Factbook, Bloomberg Investment Machine and Webec.

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[15] Since the UK only began issuing indexed bonds in 1981, we assumed that the 1981 bond returns were the same as in 1980.

year t to a particular country, R represents interest rate measures described above, H is the country real share price index, M with a bottom bar is a vector of country-specific macroeconomic indicators and B is the backward shift operator (i.e. $Bx_t = x_{t-1}$). Equations (1) and (2) differ only to the extent that the latter includes the interactive term between interest rates and real share price indices.

Only candidate variables which are statistically significant and of the expected sign are shown here. In this respect, after a series of experiments, the results are shown in Tables 2 and 3[16]. Although the Hausman test statistics favoured the random effects model, for purposes of comparison we show the outcome of both the random and the fixed effects models. Our results show no important perceptible differences between the results of either of these models as can be seen from the coefficients and t-values of the explanatory variables. Furthermore, the introduction of the time effects (not shown) into the specification left the results unchanged.

We proceed to analyse our findings with a specific focus on the random effects model results (shown in Table 2), chosen on the basis of a Hausman test statistic. It is noted that the regression results do not have estimation 'problems'. Autocorrelation is not present or is trivial as can be seen from the estimated autocorrelation of 0.0883 in Table 2. Heteroscedasticity is nonexistent by construction in Table 2 because of the trans-

formed nature of the variables as required by the GLS method, and also because we have a balanced panel. On the whole, the disturbance term appears well-behaved which implies that the estimations are efficient. Thus, inferences to be made have some validity.

Table 2 reveals that both the pull (domestic) and push (external) factors drove portfolio capital flows to emerging market economies. The coefficients of the explanatory variables have the expected signs and their t-values show them to be statistically significant from zero at the 5 percent level for all but *FRIM*.

The results from the push factors variable (represented by *USRT)* suggest that a one percent fall in this variable increases portfolio flows by 0.313 percent of GDP. The t-ratio of -3.236 is statistically significant at 1 percent level. This finding implies that portfolio flows went to emerging markets in search of high returns following the fall in US interest rates (or more generally world interest rates) during the period of study[17].

Domestic economic variables (represented by the real share price index, current account balance and foreign exchange/import ratio) have all played a role in stimulating portfolio inflows. The coefficient of the real share price index (*SHP*) suggests that a one percent increase in this variable increases portfolio flows by 0.416 percent of GDP[18]. Hence, the performance of the stock market (as one would expect) enhances the expected profit-

TABLE 2: RESULTS OF RANDOM EFFECTS MODEL (GLS ESTIMATOR) (1980–96, *PIRD* AS DEPENDENT VARIABLE)

Variable	Coefficient	Standard Error	T-Stat.	Prob. Value
α	.7503	1.4035	.535	.5930
USRT	-.3131	0.0968	-3.236	.0012
SHP	.4161	.1075	3.872	.0001
CA	.1053	.0485	2.172	.0298
FRIM	.0188	.0115	1.633	.1025

Breusch &

Pagan LM test[a] 3.76

Hausman test[b] 1.82

χ^2_k[c] 9.488

R^2 0.2570

[a]. LM *test is a test of REM against classical regression model. Large values of* LM *favour the REM model.* [b] *Hausman's chi-squared statistics tests whether the GLS estimator is an appropriate alternative to the LSDV estimator (see LIMDEP Manual). Large values of Hausman test statistic favour the LSDV model whereas small values favour the REM model.* [c] *Tabulated cvs for the Hausman test at 5 % level.*

[16] Note that panel unit root test provided by Levin and Lin (1992) were conducted and non-stationarity was not found to be a problem for most of these variables. Only interest variables appeared to suggest the presence of a unit root, but the introduction of time dummies did not change the basic results. This suggested that the model results are valid. The data sample suggest that the Levin and Lin test is as good as any other panel unit root test e.g., Im *et al* (1997).

[17] Experimentation using *LIBOR* rates in place of *USRT* (results not shown) produced very similar results. Thus, our findings are not dependent on specific (international) interest rates chosen in the study.

[18] See discussion of instrumental variable results under sub-section 4.2.

ability of investment in the countries under investigation, enticing foreign portfolio inflows in the process[19]. The apparent statistical significance of the current account balance and the ratio of reserves to imports variables can be interpreted as additional country-specific indicators of creditworthiness[20].

procedure allows us to determine the extent to which portfolio flows were being explained by the change in our regressors in each country.

Table 4 reveals regional differences in the results. In Latin American economies, the pull factors as represented (in particular) by the real share price index dominate the push factors. On the other

Table 3: Results of Fixed Effects Model (1980–96, *PIRD* as dependent variable)

Variable	Coefficient	Standard Error	T-stat	Prob. value
USRT	-.3013	0.0990	-3.043	.0028
SHP	.4268	.1086	3.930	.0001
CA	.1116	.0496	2.252	.0258
FRIM	.0224	.0132	1.695	.0922

$F_{(12, 140)} = 6.19$ $\quad R^2 = .3467$ $\bar{R}^2 = .2908$

Estimated Autocorrelation = .088296

Akaike info. Criteria = 4.852

N = 153 Degrees of Freedom = 140

Further experimentation involving both real and nominal interest rates was conducted (results not shown). Real interest rates used were *UKBONDS* and *RUSRT* as explained above. In the main, the results from using real interest rates were not that dissimilar from those using nominal rates only. However, the strength of real interest in driving portfolio flows was somewhat inferior to that of nominal interest rate variables. For the sake of consistency with the previous literature, it was decided to stick with the nominal interest rate variables. It is, however, fair to infer that using either real (particularly *UKBONDS*) or nominal interest rates to measure the push factors may not make much material difference to the findings.

Table 4, which is based on the differencing method, shows the relative importance of the pull and push factors in explaining portfolio inflows in each country. While the results discussed above provide a general picture of the significance of our explanatory variables they cannot be used, in their present form, to assess the impact each of our explanatory variables had on the dependent variable in each country. To construct Table 4, we differentiate each of our variables (in each country) between 1984 and 1994 period and multiply this resultant difference by the estimated coefficient for each variable using the results from Table 2. This

hand, the push factors are more influential than the pull factors in Asian economies. These results might be reflecting the fact that Latin American economies were able to obtain portfolio capital inflows following serious economic policy reforms.[21] The performance of the stock market may have indicated bright investment prospects in the Latin American economies. On the other hand, most Asian economies have not experienced domestic economic problems to the extent that Latin American economies have[22]. As a result, domestic economic factors in Asian countries may not have been issues of concern to investors. Thus we would expect that since there was nothing new in domestic factors, then changes in external factors would instead be more likely to be the dominant factors in Asia.

We created *USHPI*, obtained as a product of *USRT* and *SHP*, to gauge the influence of the interactive effects. A negative statistically significant coefficient of this term would suggest the important facilitating role of the pull factors to the push factors. On the other hand, an insignificant coefficient of this term would imply that portfolio flows would occur on the basis of developments in US interest rates irrespective of the domestic economic conditions.

Table 5 provides estimation results with *USHPI* included. The multiplicative variable is highly significant, with the expected negative coefficient, but some (domestic) macroeconomic variables (i.e., *CA* and *FRIM*) have much diminished importance. The external factor variable (*USRT*) also loses its significance and has an unexpected positive sign. Nevertheless, the significance of the multiplicative variable indicates strong support for the hypoth-

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[19] We experimented with real share price index adjusted for stock market liberalisation. To do this we created dummy variables to capture dates in which stock markets were liberalised. We then regressed real share price index on these dummies and consequently replaced real share price index by the resultant residuals. Our results were similar to those that were obtained here.

[20] We experimented with dropping Malaysia from the regression (results not shown) since it was suggested in Section 3 that, unlike most other countries, it had experienced negative portfolio inflows during most of the study period. Our basic results were not affected.

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[21] Edwards (1999) makes a similar point.

[22] East Asia's financial crisis started (in earnest) in 1997, i.e. outside our period of study.

esis of an interaction between domestic and external economic factors.

Instrumental Variable Estimation

Although the interest rate variables can reasonably be taken as exogenous there is possible endogeneity between portfolio flows and the share price index, the current account and foreign exchange reserves. It could be argued that the current account balance, foreign exchange reserves and the share price index variables increased as a result of portfolio inflows. The problem of endogeneity (or correlation between regressors and the disturbance term), however, exists only in the fixed effects but not the random effects model. The fixed effects model is calculated based on OLS method while the random effects model relies on GLS method.

ous literature are not easy because of differences in countries covered, estimation techniques and so forth. Still, the central issue is the same, *viz.* the question of the relative importance of the push and pull factors in driving portfolio capital flows to Asian and Latin American economies.

Fernandez-Arias (1996) and Calvo *et al.* (1993) conclude that emerging market economies are mostly vulnerable to external economic developments. They argue that a rise in US interest rates would lead to an outflow of capital from emerging market economies. According to these authors, domestic economic factors play no role in capital movements. Our results do not entirely support these authors' strong policy conclusions. We find that both the push and pull factors have significant influences on portfolio capital flows. But, we also find that the relative importance of the push

TABLE 4: DECOMPOSITION OF THE PUSH AND PULL FACTORS BASED ON DIFFERENCING (1984–1994, PERCENTAGE OF GDP).

Country	Push factor		Pull factors	
	USRT	SHP	FRIM	CA
Argentina	1.76	2.54	0.77	0.39
Brazil	1.76	2.31	0.55	0.03
Chile	1.76	1.85	0.95	-1.17
Mexico	1.76	2.65	-0.92	1.24
Philippines	1.76	1.36	0.34	0.16
Malaysia	1.76	0.48	0.35	0.02
Thailand	1.76	0.94	0.75	0.10
Indonesia	1.76	0.81	0.07	-0.17
Korea	1.76	0.82	0.30	-0.01

We chose as instruments one-period lagged values of *CA*, *FRIM* and *SHP* variables. Table 6 presents the instrumental variable estimation results. The picture that emerges is very much the same as in Table 3. Thus, consistency of the estimates does not seem to have been affected by the suspected endogeneity of the regressors.

Comparative results implications

Comparative results implications with the previ-

and pull factors differ by region. Indeed, as shown above, our findings suggest that the domestic (pull) factors – through the real share price index, in particular – dominate the external factors in Latin American economies. Only in the Asian economies' case do our results appear to concur with these authors' findings in stressing the dominating importance of the push over the pull factors. The reasons for the regional differences were explained above.

TABLE 5: RESULTS OF RANDOM EFFECTS MODEL (GLS ESTIMATOR) INCLUDING USHPI (1980–96, PIRD AS DEPENDENT VARIABLE)

Variable	Coefficient	Standard Error	T-Stat.	Prob. Value
α	-6.1385	2.4285	-2.528	.0115
USRT	.4681	0.2465	1.899	.0575
USHPI	-.1276	.0373	-3.421	.0006
SHP	1.6063	.3626	4.430	.0000
CA	.0698	.0482	1.448	.1476
FRIM	**.0081**	**.0118**	**0.684**	**.0494**

Breusch &

Pagan LM test [a] 2.62

Hausman test [bc] 1.70

R^2 0.3199

Notes [a] *and* [b] *the same as in Table 2.* [c] *Tabulated critical values are the same as in Table 3.*

TABLE 6: RESULTS OF INSTRUMENTAL VARIABLE ESTIMATION

Variable	Coefficient	Standard Error	T-Stat.	Prob. Value
USRT	-.3498	.0971	-3.603	.0004
SHP	.3393	.0987	3.437	.0008
CA	.1007	.0502	2.009	.0464
FRIM	.0278	.0131	2.115	.0361

$F(12, 140) = 6.02 \quad R^2 = .3402 \quad \bar{R}^2 = .2837$

Estimated Autocorrelation = .096746

Akaike info. Criteria = 4.862

$N = 153$ Degrees of Freedom = 140

Taylor and Sarno's findings are most consistent with ours in emphasising the importance of both the push and pull factors. But the details are different. While their results suggested that interest rates are a more important determinant of portfolio flows to Latin America than to Asia, our results suggest the opposite.

Chuhan *et al.* (1998) find that global variables are as important as domestic variables for Latin America, and this is at odds with our findings. Again in the case of Asia their findings are the exact opposite of ours. They find country-specific variables to be more important than global variables in Asia. The limitations of Chuhan *et al.* and Taylor and Sarno's studies were highlighted (in Section 2) which may account for the differences between the findings contained in this paper.

5. CONCLUSION

The messages of this paper are as follows. One is that domestic policy makers in developing countries are able to influence portfolio capital inflows to their countries. Improvements in the domestic investment climate (resulting from economic reforms) seem to be rewarded with portfolio inflows. Indeed, there is scope for even more portfolio investments to occur in the future if the domestic investment climate continues to be favourable, since these economies invariably tend to be underweight in the portfolios of industrial country investors (Claessens and Gooptu, 1994). It is worth noting that all developing countries that aspire to access international capital markets or flows can learn from the experience of the Asian and Latin American economies. The key to receiving portfolio capital flows is economic policy reform and stability, which provides favourable investment conditions, which together with the push factors (low returns elsewhere) tend to spur the inward movements of portfolio capital flows.

The second message is that interactive effects are important. Nominal interest rates may have negligible effects on portfolio flows when confidence in developing countries is low, and quite significant effects when confidence is high. This finding is consistent with the effective collapse in the mar-

ket for developing-country financial instruments at high levels of risk. In effect, it does not seem realistic to suggest that the job of driving portfolio flows should be left either to external factors or domestic factors alone. Put differently, the push and pull factors are individually necessary but neither is necessarily a sufficient condition to ensure portfolio capital inflows.

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Money Laundering and Electronic Banking – Challenges for Supervisory Authorities in The Southern African Development Community (SADC) Region

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INTRODUCTION

Globalisation and the liberalisation of financial markets have increased the risks of money laundering and, therefore, all countries that are integrated into the international financial system should put measures in place to combat all crimes that generate 'dirty' money. The growth in electronic banking also presents challenges to the war against money laundering. Joyce (2001) has observed, that 'the progression of electronic commerce activity, electronic banking operations and electronic payments technologies comprises a unique basket of money laundering opportunities and threats to the individual consumer, corporate business, community and governmental institutions'. Different agencies around the world gather statistics on money laundering but it is not easy to obtain accurate figures because it is impossible to record all crimes that generate 'dirty' money. Steven Philippsohn (2001) has noted that the features of the Internet that make it ideal for commerce also make it ideal for money laundering. These features include, among others, speed, access, anonymity and the capacity to extend beyond national borders. The events of September 11, 2001 have added another dimension to the meaning of money laundering. It is no longer viewed as just 'dirty' money from criminal activity, such as drug trafficking, extortion, arms smuggling and other crimes, but has been broadened to include 'clean money' that is used for the 'financing of terrorist activities'.

The objectives of this paper are to find out the extent of money laundering activities and the level of development of electronic banking in the Southern African Development Community (SADC) region; to outline the supervisory challenges posed by these development; and to assess whether the region is prepared for the challenges, such as, to combat money laundering that could be facilitated

through electronic banking activities. The second part of the paper discusses the general background on money laundering and electronic banking and the relationship between the two. It touches on international initiatives and standards for combating money laundering, and the Basel Committee's position on the development of electronic banking and e-money activities. The third part, which forms the core of the paper, focuses on the supervisory challenges posed by money laundering and electronic banking. It begins with a brief review of the rationale for regulation and supervision of the financial sector and concludes by assessing whether SADC countries will cope with the challenges presented by a combination of money laundering and electronic banking. Part four takes Botswana as a case study. It examines the development of electronic banking in Botswana and the types of criminal activities that could generate 'dirty' money. The laws that criminalise money laundering are identified, and the various initiatives taken by the Financial Action Task Force (FATF), the Commonwealth and other international organisations towards combating money laundering, which Botswana has adopted, are highlighted. The role of the central bank in electronic banking and anti-money laundering (Know Your Customer) supervision will also be explored. The final part of the paper contains the conclusion and recommendations for supervisory authorities in developing countries.

GENERAL BACKGROUND ON MONEY LAUNDERING AND ELECTRONIC BANKING

What is Money Laundering?

Money laundering is described as a process by which the proceeds of crime ('dirty' money) are put through a series of transactions, which disguise their illicit origins and make them appear to have come from a legitimate source ('clean' money) (Grabosky and Smith, 1998). By so doing criminals avoid prosecution, conviction and confiscation of their ill-gotten funds. Sophisticated launderers involve many unwitting accomplices, such as banks and securities houses, financial intermediaries, accountants and solicitors, surveyors and estate agents, company formation agents and management services companies, casinos, bullion and antique dealers, car dealers and others dealing in high value commodities and luxury goods. The poorly regulated institutions and services, and offshore centres that offer guarantees of secrecy and anonymity are the most vulnerable (Commonwealth Secretariat, 2000).

Money laundering takes place in three stages, namely, placement, layering and integration, which may occur as separate and distinct phases; they may also occur concurrently, or may overlap. Placement involves the actual disposal of cash proceeds derived from illegal activities. This might be done

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by breaking up large amounts of cash into less conspicuous smaller sums that are then deposited into a bank, or by purchasing a series of monetary instruments (money orders, travellers cheques) that are then collected and deposited into accounts at another location. Layering occurs when the illicit proceeds are separated from their source by engaging in a series of conversions or movements of funds to distance them from their source. Examples of layering include telegraphic money transfers, purchase and sale of investments, resale of acquired assets, and deposit of cash in banks. Integration gives apparent legitimacy to criminally derived wealth by reintroducing the laundered proceeds back into the economy to support legitimate business activities and/or consumption.

Why Take Action Against Money Laundering?

Money laundering is a criminal activity which can bring social evils if left unchecked. For example, it leads to disregard for the law and its ill-gotten gains could be used to finance further crimes. Therefore, it is very crucial that this criminal activity is stopped before it grows to uncontrollable levels.

Money launderers make large sums of money from various criminal activities such as drug trafficking, fraud, slavery, prostitution and corruption, which they could use to invest in any business venture, and could ultimately gain control of the business ventures or companies. Once they are in this position, they could bribe and corrupt other businessmen and government officials in the quest to gain power. With their accumulation of economic and financial power, they could undermine national economies and disrupt democratic systems.

Another disturbing consequence of money laundering is that the accumulated money is transmitted around the globe frequently and quickly to an extent that it may end up causing distortions in exchange rates, money demand, international capital flow and investment. In the process, intermediary banks, can be exposed to prudential risks. The above effects of money laundering can distort government macroeconomic policies as well as responses to it (Commonwealth Secretariat, 2000).

International Initiatives and Standards

A number of international organisations have come up with initiatives and standards to counter money laundering; this include the Financial Action Task Force (FATF), International Monetary Fund (IMF), Commonwealth Secretariat, United Nations (UN) and the Basel Committee on Banking Regulation and Supervisory Practices. The FATF has published 40 recommendations to serve as a comprehensive regime against money laundering. These cover the role of national legal systems, the role of the financial system and the strengthening of international cooperation. The IMF is of the view that the economic and financial reform policies it promotes are in line with the efforts aimed at defeating money laundering activities (Commonwealth Secretariat, 2000).

The 1988 Vienna Convention commits countries that sign up to criminalise drug trafficking and associated money laundering, enact legal statutes for the confiscation of proceeds of drug trafficking and empower their courts to order that banks' financial or commercial records be made available to law enforcement agencies, regardless of bank secrecy laws (Commonwealth Secretariat, 2000).

The Commonwealth Secretariat has drawn up a model law for the prohibition of money laundering which is targeted at common law countries, and it embraces all the issues covered by the 40 FATF recommendations. In addition, this model law includes an 'all crimes' money laundering offence. The Basel Committee has issued a statement of principles, which require all banking institutions to comply with all anti-money laundering measures. (BIS, 2002).

Following the events of September 11, 2001, the FATF expanded its mission by issuing new international standards to combat money laundering for terrorist financing. In addition, the UN has called upon all countries to ratify the 1999 UN International Convention for the Suppression of the Financing of Terrorism and the UN Security Council Resolution 1373 (2001).

Money laundering calls for an international response appropriate to the financial and economic realities of each country. With increasing developments in technology, the world is now confronted with electronic money laundering. Strengthening the prudential supervision and reputation of the financial system through effective anti-money laundering guidelines could substantially assist in the prevention of money laundering. The work of the Financial Stability Forum (FSF) in raising international standards within offshore centres, both in the area of financial regulation and anti-money laundering measures, is most welcome given that it is in these centres criminals tend to find safe havens.

Electronic Banking

Technological developments have brought new opportunities for banks. The advent of electronic banking promises to expand the banks' markets for new products and services. On the negative side, although banks have always been exposed to risks such as fraud and error, the magnitude of those risks and the swiftness with which they can crop up have changed dramatically due to the banks' dependence on the technological innovation in computers and telecommunication systems.

The BIS (1998) defines electronic banking as 'the provision of retail and small value banking products and services through electronic channels as well as large value electronic payments and other wholesale banking services delivered electronically'. Such products and services can include deposit

taking, lending, account management, the provision of financial advice, electronic bill payment and the provision of other electronic payments products and services such as electronic money.

Electronic Banking Products and Services

Electronic banking products and services are many and are still evolving. They include, among others, card transactions, internet banking, electronic funds transfer systems, home/telephone banking services, and electronic money. O'Hanlon and Rocha (1993) have discussed these products and services in detail while Grabosky and Smith (1998) have discussed them in the context of crime in the digital age. A brief description of some of these products and services is given below.

(a) Card Transactions

These enable users to carry out transactions from a location distant from the central database such as a bank. The cards are inserted into a card reader where the total amount of purchases will be keyed in. The card reader will then produce a receipt requesting the customer's signature if the transaction has been approved or declined, which could be due to various reasons, like clearing house not responding or lack of funds in the customer's account. Card transactions are done using credit cards and debit cards. Two types of card terminals are available for use, namely, Automated Teller Machines (ATMs) and Electronic Funds Transfer at Point of Sale (EFTPOS) (Grabosky and Smith, 1998).

(b) Internet Banking

Internet banking refers to banking products and services offered by institutions on the internet through access devices, including personal computers and other intelligent devices (Bank of Mauritius Guidelines on Internet Banking, 2001). Most Internet banks set up transactional websites and still continue to operate their traditional 'brick and mortar' branches. Singh (1999) has noted that electronic commerce remains a US and western based activity, thus it may take some time before the developing world fully adopts Internet banking.

(c) Electronic Funds Transfer (EFT) Systems

In the inter-bank market electronic banking is noted by the use of EFT systems such as the Society for Worldwide Interbank Financial Telecommunications (SWIFT), Fedwire, Interbank Data Exchange (IDX), Clearing House for Interbank Payment Systems (CHIPS) and Clearing House Automated Payment Systems (CHAPS). The corporate EFT generally relates to the electronic transfer of financial data and funds between companies and banks in the settlement of business transactions.

(d) Home/Telephone Banking

This is carried out by using either a telephone or a computer terminal located in a customer's home or office. This arrangement allows the customer to do almost all his banking transactions, such as transferring funds between accounts, stopping cheque payments, ordering a cheque book or a bank statement and many others. These services have possibilities of being intercepted, which could be a serious security risk to customer accounts. The cost implications may also be too high in other areas, particularly developing countries.

(e) Electronic Money (E-money)

Electronic funds can now be stored on computers as well as on plastic cards, thereby enabling the funds to be transferred through telecommunications channels such as the internet. The BIS (1996) has defined electronic money products as 'stored value' or 'prepaid' products in which a record of the funds or 'value' available to a consumer is stored on an electronic device in the consumer's possession.

An arrangement is made between the bank and its customers whereby the customers request the bank to transfer funds from their bank accounts into an electronic cash system. This system then generates and validates what are known as e-coins. The customer can then use the coins on the Internet using software provided by electronic cash service providers (Grabosky and Smith, 1998).

Since electronic money is becoming a popular means of payment, this raises policy concerns for central banks, which are the overseers of payment systems, managers of monetary policy, regulators of the financial system, and issuers of currency. Electronic money developments also bring in some consumer protection issues, and gives rise to competition between traditional banks and non-bank issuers of electronic cash.

The accessibility of bank information through computer terminals and telephones improves customer services and internal operations but, at the same time, it increases the risks of error and abuse of the bank's information. There is a possibility of information getting lost and/or intercepted and ultimately falling in the hands of criminals. It is, therefore, the responsibility of banks to ensure that security is adequate to guard against unauthorised access to customer information.

Operational risks can arise from customer misuse, and from inadequately designed or implemented electronic banking and electronic money systems (BIS, 1998). Other disadvantages originate from organisational and legal implications of electronic banking for banks.

Electronic banking continues to be adopted by banks, retailers and customers because of the advantages it has over traditional banking. Some issues such as legal obstacles and security loopholes will take time to overcome.

The Link Between Money Laundering and Electronic Banking

The Commonwealth (2000) has noted that there are currently few case studies of money laundering through on-line banking. This could be because on-line banking is still at a developmental stage. On the other hand, Grabosky and Smith (1998) have observed that the use of telecommunications technology in the banking sector has increased the chances of laundering dirty money. Given the increasing number of financial institutions providing electronic banking products and services, and electronic money activities, criminals are also sharpening their skills to take advantage of the technology to further their activities.

Electronic money laundering also takes place through the process of placement, layering and integration of the ill-gotten proceeds into the financial system. Placement may occur through direct electronic transfer of funds to offshore institutions or to 'cyberspace' or underground banks, without the knowledge of the law enforcement agencies (Grabosky and Smith, 1998). Alternatively, electronic money could be used to place dirty money into the financial system without raising suspicion by carrying huge sums of hard cash or having to endure 'Know Your Customer' (KYC) procedures as is the case in face-to-face transactions.

The speed at which electronic transactions can be processed facilitates the layering stage of electronic money laundering. For example, a launderer sitting in front of his personal computer can transfer electronic money into different accounts, at different places within a day without raising suspicion. In the process dirty money is separated from its illegal source. Electronic mail and encryption technology enable the money launderers to proceed with the layering of their illegal proceeds. In the case of internet banking, Philippsohn (2001) argues that there is legal debate as to where the transaction actually occurred, hence prosecutors from one jurisdiction face serious problems when they want to trace the audit trail of such transactions. Grabosky and Smith (1998) have noted that 'integration will be assisted by the development of stored value cards, to which funds can be downloaded from institutional sources.'

Electronic money laundering threatens traditional due diligence systems. Therefore, electronic due diligence, particularly the establishment of a comprehensive security control process, authentication of electronic banking customers, establishment of clear audit trails for electronic banking transactions and privacy of customer information, should be initiated wherever there are electronic banking activities. These risk management principles have the potential to augment other anti-money laundering initiatives intended to combat electronic money laundering.

MONEY LAUNDERING AND ELECTRONIC BANKING ACTIVITIES AND THE SUPERVISORY CHALLENGES FACING THE SADC REGION

Rationale for Regulation of the Financial Sector

Bamber *et al* (2001) have highlighted that the three main objectives of financial regulation and supervision of financial institutions are to sustain systemic stability, maintain the safety and soundness of financial institutions, and protect consumers. Two types of regulation could be used to address the above objectives, namely, prudential regulation and conduct of business regulation. Prudential regulation focuses on the solvency, safety and soundness of financial institutions, whereas the conduct of business regulation focuses on how financial firms conduct business with their customers, with emphasis on information disclosure, honesty and integrity of the firms. Both types of regulation cover consumer protection issues.

The KYC policies and procedures are the main tools used by financial institutions to combat money laundering. Sound KYC policies and procedures can ensure the safety and soundness of financial institutions. Failure to have KYC policies and procedures could lead to reputational, operational, legal and concentration risks for banks (BIS, 2001). On a related point, the reliance of electronic banking on information technology has created complex operational and security loopholes, which could be exploited by criminals to perpetrate crime. Penetration of banks' computer systems by criminals could compromise the KYC policies and procedures that the banks would have established, and ultimately the safety and soundness of the financial institution. Nieto (2001) has noted that the main challenges faced by the financial regulator in the information technology era are, security and data privacy, the global character of the provision of e-finance services and the entrance of non-regulated new intermediaries.

In light of the above, regulation and supervision are essential for both anti-money laundering measures and electronic banking activities. However, electronic banking is still developing and regulation should be done cautiously to avoid stifling innovation and creativity. Regulation is costly to the regulated firms and sometimes it can be so stringent that it becomes a barrier to innovation and entry by new firms. It is important that the regulatory regime provides an environment that would promote the development of electronic banking and also deter illegal activities.

Tables 1 and 2 below illustrate the potential for money laundering activities and electronic money developments in some SADC countries.

It is noted from the table that four countries out of eight are considered to have low potential for money laundering, and that all countries ex-

Table 1-Potential for Money Laundering Activities in Selected SADC Countries

Country	Potential for money laundering Activities			Regulation	Remarks
	Low	Medium	High		
Botswana	_			Proceeds of Serious Crime Act, 1990. Banking Act, 1995. Corruption and Economic Crime Act, 1994	No indication that any significant amount of money laundering is taking place. No statute specifically called the prevention of money laundering Act. The anti-money laundering provisions are in several statutes.
Malawi	_			Banking Act, 1989	Not considered a centre for money laundering. Anti-Money laundering Act has been drafted.
Mauritius			_	Anti-money Laundering and Economic Crime Act, 2000	Has a domestic drug consumption problem and a vibrant financial services sector.
Seychelles	_			Anti-money Laundering Act, 1996	The Islands are neither a significant producer nor a transit point for illicit narcotics.
South Africa			_	Financial Intelligence Centre Act, 2001	Major financial centre in sub Saharan Africa. Major transhipment point for cocaine and heroine trafficking. World largest consumer of mandrax. Corruption becoming a serious problem.
Tanzania			_	Not available	No regulation regarding the use of the banking system for purposes of money laundering.
Zambia			_	Narcotic Drugs and Psychotropic substances Act, 1993 Corruption Practices Act	It is reported that new banking regulation to combat money laundering are being drafted.
Zimbabwe	_			Serious Offences (confiscation of profits) Act Prevention of Corruption Act.	Reports of corruption in high places have significantly increased.

Source: Briscoe (1999)[2]

cept Tanzania, have some legislation against money laundering. South Africa and Mauritius, both of which have vibrant financial sectors, are considered to have high potential for money laundering and, unlike Zambia, which is also rated as having high potential for money laundering in the banking sector, they have legislation in place, that is, the Financial Intelligence Act, 2001 (South Africa) and the Anti-money Laundering and Corruption Act, 2000 (Mauritius). Namibia, Lesotho and Swaziland also have legislation/guidelines on anti-money laundering measures.

A worrying situation is the fact that reports of corruption in high places have significantly increased in some of the countries rated low, such as Zimbabwe and Malawi. The Global Corruption Report (2001) has reported that there is not much political will from Southern African leaders to combat corruption. It further noted that the anti-cor-

ruption institutions that have been set up are not independent from government, and as a result they fail to probe senior officials suspected of corruption.

Information on electronic banking and electronic money activities is not readily available for developing countries. This is probably because the development of these activities is still at an early stage for these countries. Out of the four countries for which information was available, we noted that South Africa and Mauritius were a step ahead of others in electronic banking and electronic money activities, possibly because they already have vibrant financial services sectors. These two countries have made significant progress in creating the necessary legislative arrangements and procedures for the monitoring and management of electronic banking activities by both the regulators and the financial institutions.

Zimbabwe, which also has a well-developed banking sector, has limited electronic banking activities. However, it does not have any specific legislation or guidelines governing these activities. The

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2   Because of the developments that are taking place in the area of money laundering, some of the information in the table may have changed by time of print.

TABLE 2 – Electronic Banking and Electronic Money Developments in Some Selected SADC Countries

Country	Electronic Money Developments	Regulation/Guidelines	Remarks
Mauritius	E-money has not been introduced by domestic banks. Several commercial banks offer card-based payment services, such as, credit and debit cards, and direct debit. Some banks offer telephone banking, home banking and internet banking.	Electronic Transfer Act, 2000. Guidelines on internet banking.	All licensed institutions seeking to launch transactional websites are required to obtain prior approval of the Bank of Mauritius.
South Africa	Development of network-based products is still in early stages. E-money products are available and can be activated through ATMs, telephone devices, personal computers, intelligent cards and card reading devices.	Position paper on Electronic money issued by the South African Reserve Bank in April 1999.	There are about 600 000 on-line banking customers.
Tanzania	Efforts are being made by multi-national banks to offer electronic banking and e-money schemes.	Guidelines on the introduction and operation of auditable card based electronic money schemes.	The guidelines provide that the Bank of Tanzania as regulator of the banking industry, will undertake some roles and responsibilities in supporting operations of any authorised inter-bank auditable e-money schemes based on payment cards.
Zambia	No development in e-money	Not available	Zambia is participating in the COMESA Mondex electronic cash application project.

Source: CPSS Survey of Electronic Money Developments (2001)[2]

country relies on existing laws and regulations to monitor these developments (Reserve Bank of Zimbabwe Annual Report, 2000). In Namibia, the Commercial Bank of Namibia, First National Bank and Standard Bank all offer some electronic banking services (Bank of Namibia, 2002).

What are the Supervisory Challenges?

Criminals have discovered that crime can be carried out with fewer risks through the use of computers than when using traditional ways of bank robberies and other crimes; this is a direct result of technological development. It is imperative, therefore, for regulators and bankers to review systems and procedures used to combat money laundering and to monitoring electronic banking activities so as to manage new risks and challenges brought about by rapid technological changes. The challenges presented by electronic banking and electronic money laundering include, but are not limited to, risk management challenges; strengthening KYC requirements especially for electronic products and services; setting up the necessary infrastructure to attract electronic banking and developing national strategies to combat money laundering; capacity building for supervisory authorities and addressing problems brought about by informal financial sector. A discussion of these challenges follows below.

(a) Risk Management Challenges

Electronic banking offers a number of risk management challenges for the supervisory authorities.

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3 Electronic money developments are treated as part of electronic banking.

The Electronic Banking Group (EBG) of the BIS has observed that electronic banking does not introduce new risks to banking, instead, it makes the already existing risks more precarious, in particular, operational risk, reputational risk and strategic risk. The EBG has highlighted the following as some of the risk management challenges presented by electronic banking activities (Risk Management Principles for Electronic Banking, 2001).

(i) The speed of change relating to technological and customer service innovation in electronic banking is unprecedented. Historically, new banking applications were implemented over relatively long periods of time and only after in-depth testing. Today, however, banks are experiencing competitive pressure to roll out new business applications in very compressed time frames – often only a few months from concept to production. This competition intensifies management challenge to ensure that adequate strategic assessment, risk analysis and security reviews are conducted prior to implementing new electronic banking applications.

(ii) Transactional electronic banking websites and associated retail and wholesale business applications are typically integrated as much as possible with legacy computer systems to allow more straight-through processing of electronic transactions. Such straight-through automated processing reduces opportunities for human error and fraud inherent in manual processes, but it also increases dependence on sound systems design and architecture as well as system inter-operability and operational scalability.

(iii) Electronic banking increases banks' dependence on information technology, thereby

increasing the technical complexity of many operational and security issues and furthering a trend towards more partnerships, alliances and outsourcing arrangements with third parties, many of whom are unregulated. This development has been leading to the creation of new business models involving banks and non-bank entities, such as Internet service providers, telecommunication companies and other technology firms.

(iv) The Internet is ubiquitous and global by nature. It is an open network accessible from anywhere in the world by unknown parties, with routing of messages through unknown locations and via fast evolving wireless devices. Therefore, it significantly magnifies the importance of security controls, customer authentication techniques, data protection, audit trail procedures, and customer privacy standards.

The above risk challenges could also exacerbate money laundering activities. For example, the rolling out of new business in a very short time frame could lead to banks attracting business from criminals because the screening process would not have been thorough. It is also possible that outsourcing arrangements with third parties, most of whom may be unregulated, could result in banks having relationships with companies controlled by criminals. The accessibility of the Internet worldwide also provides an opportunity for electronic money laundering, which threatens to be a menace in the digital age.

It is, therefore, important that SADC supervisors see to it that banks in their jurisdictions adhere to the risk management principles for electronic banking, which are grouped into three broad areas of board and management oversight, security controls, legal and reputational risk management.

(b) Strengthening KYC Requirements

According to the BIS consultative document on Customer Due Diligence (2001), national supervisors are expected to set out supervisory practices governing banks' KYC programmes, monitor that banks apply sound KYC procedures and that they are maintaining ethical and professional standards on a continuous basis. This challenge is best achieved by incorporating the KYC requirements in the laws that govern banks. The KYC requirements should cover procedures for identifying on-line customers. On-site compliance examinations should be conducted to check whether banks comply with the provisions of the law. The examination should review customer files, sample accounts and look for any suspicious transactions, and assess those suspicious accounts that would have been picked by banks' systems. The examination should also focus on both the technical and non-technical aspects of electronic banking activities. The overall level of risks that electronic banking activities pose

to the institution and the adequacy of the approaches adopted to manage those risks should be thoroughly reviewed during the examination process.

The BIS recommends that the law should provide firm supervisory actions for those institutions that fail to comply with the KYC requirements. The Commonwealth Secretariat advocates a review of banking secrecy laws and enactment of the necessary amendments to ensure that financial institutions' records can be made available to competent authorities. The ultimate goal is meant to achieve a safe and sound banking sector, and to protect the integrity of the financial system.

(c) Adopting International Standards Against Money Laundering and Adhering to the Risk Management Principles for Electronic Banking

The region should work hard towards meeting international standards against money laundering and implementing the risk management principles in order to promote the safety and soundness of electronic banking activities. SADC should encourage member countries to adhere to international standards against money laundering by harmonising the legislative and institutional mechanisms so that the region does not face regional reputational risk emanating from some non-cooperating members.

Money laundering and electronic banking activities can be carried out across borders. To avoid regulatory arbitrage and safeguard the integrity of both domestic and international banking systems, supervisors in the SADC region should work towards harmonising their banking laws, particularly KYC standards. By so doing, they would discourage criminals who may wish to start their activities in countries with weak legislation.

(d) Setting up the Necessary Infrastructure to Attract Electronic Banking Activities and Developing National Strategies Against Money Laundering

O'Hanlom and Rocha (1993) predicted that 'electronic retail banking will replace traditional forms of banking in the next millennium, on a worldwide scale...because it offers greater convenience, speed and information than traditional banking services'. These are good reasons for supervisors, in collaboration with their governments, to provide an enabling environment for the development of electronic banking activities.

The supervisory authorities in the SADC region have to develop guidelines for their specific jurisdictions for the provision of electronic banking and electronic money services and products. They should also establish national strategies against money laundering, such as the formation of national co-ordinating committees; criminalising money laundering, setting financial sector obligations and establishing a central reporting agency

that would process/investigate reports, provide feedback to reporting institutions, and compile statistics and trends on money laundering activities.

(e) Capacity Building within the Supervisory Authorities

As much as supervisors expect banks to recognise, address and manage the risks brought about by electronic banking activities, they should also be in a position to comment authoritatively on whether or not banks respond prudently to all the electronic banking risk management challenges. This can be achieved by ensuring that supervisors get the necessary training in electronic banking activities. Supervisors should be able to review the electronic banking activities as and when the banks introduce them, and give advice, particularly to those institutions that may lack the experience and expertise in this new business area. It is also essential to enhance the general skills levels of supervisory staff to a level where they would keep pace with financial innovation and development, more especially in risk management practices.

(f) The Informal Sector and other Illegal Entrants in the Electronic Banking Sector

The informal financial sector is very active in many countries (Commonwealth, 2000) and because it is unregulated in most SADC countries, the region could still become a safe haven for launderers once comprehensive anti-money laundering measures are applied to the formal financial sector. It is, therefore, important that an anti-money laundering legislation be extended to all sectors of the economy and that guidelines for electronic banking activities should apply to both banking and non-banking entities.

How Far is the Region in Addressing the Above Challenges?

The SADC region has a number of regional groupings, which focus on integrating the political, and socio-economic activities of member countries and on the harmonisation and facilitation of cross-border financial services by the regulatory and supervisory authorities. Three such groupings are particularly relevant when discussing electronic banking and anti-money laundering activities. They are the SADC Committee of Central Bank Governors, the East and Southern Africa Banking Supervisors Group (ESAF) and the Eastern and Southern African Anti-money Laundering Group (ESAAMLG). The Committee of Central Bank Governors' activities focus on broad central banking issues, e.g., economic convergence. ESAF has the mandate to coordinate all banking supervision related training in the region. ESAAMLG is spreading the anti-money laundering message to all members of the grouping, and assisting member countries to strengthen the review of money laundering methods and counter measures.

In a bid to address the problem of the informal sector, some member countries regulate activities such as money lending and other ancillary financial service providers (Central Bank of Lesotho Supervision Department Annual Report, 2000). Others are working on policy guidelines for micro finance institutions. ESAF envisages a harmonised approach to micro finance in the region. The illegal electronic banking and electronic money laundering activities are relatively new pursuits and it would take sometime for the region to understand and combat such activities.

BOTSWANA AS A CASE STUDY

Botswana is a middle-income country in Southern Africa with a per capita GDP of US $3000 per annum (SADC Review, 2001) and a small but thriving financial sector. The country has different classes of banks, insurance companies, pension funds, collective investments undertakings, a money and capital market, an international financial services centre, specialised government owned financial institutions and other small scale informal financial service providers. The Ministry of Finance and Development Planning (MFDP) and the Bank of Botswana are the two regulatory and supervisory authorities of the above institutions. The central bank is responsible for the supervision of commercial banks, investment/merchant banks, collective investment undertakings, Botswana Savings Bank, IFSC activities (offshore banks), and bureaux de change. MFDP regulates insurance, pension funds and non-bank financial institutions. Botswana is a member of ESAF, ESAAMLG and SADC Committee of Central Bank Governors.

Electronic Banking Developments in Botswana

(a) Card Transactions

Botswana has not conducted any survey on the extent of electronic banking and e-money activities as yet. However, the local financial institutions are following the international trend by introducing electronic banking services and products as and when they feel it is the right time to do so. Card transactions are the most common form of electronic banking activities in Botswana. ATMs were introduced in the 1990s (Bank of Botswana Annual Report, 2001). Barclays Bank, First National Bank and Standard Chartered Bank issue Visa Electron badged cards, which can be used at any ATM that has a visa sign anywhere in the world.

(b) Corporate Electronic Products

Corporate electronic products available in the Botswana market include cash management services (First National Bank and Standard Chartered Bank), corporate access terminal systems (Stanbic Bank), business master (Barclays Bank), sweeping

facility (Standard Chartered Bank and Stanbic Bank), and automated regular payments and collections services.

(c) Other Products and Services

First National Bank offers on-line banking services known as video bank, which is 'a remote banking service that offers business customers the convenience of 24-hour secure desktop banking from their own homes or offices, using the Internet as a delivery platform' (First National Bank, May 2002). Barclays Bank offers telephone banking services (Barclays Tariff Guide, 2002). In the inter-bank market the SWIFT system is widely used for both domestic and international money transmission.

(d) Botswana National Payments System

The financial institutions, Botswana Government and the Bank of Botswana are working together to develop a modern national payments system. The automation of the clearing house has been completed. This means that cheque details are now read electronically. Other initiatives that have been embarked upon include the introduction of an electronic funds transfer system for high volume low value payments, the implementation of a large value low volume electronic transfer system, and the establishment of an automated and comprehensive settlement system. The committee responsible for these developments is aiming at having a modernised payments system that will comply with internationally accepted standards by 2005 (Bank of Botswana Annual Report, 2001).

Anti-Money Laundering Measures in Botswana

As shown in Table 1, Botswana was considered to have low potential for money laundering three years ago (Briscoe, 1999). However, criminal activities exist which could generate 'dirty' money such as diamond smuggling, poaching, motor vehicle theft, and armed robberies. Moreover, the liberalisation of exchange controls in 1999, the setting up of the international financial services centre in 2000, and the advent of electronic commerce could increase the potential for money laundering. However, despite the electronic banking developments, the country is still largely a cash based society.

Botswana has in place, a national coordinating committee on anti-money laundering measures, legislation that criminalises money laundering (The Proceeds of Serious Crime Act, 1990) and international cooperation with organisations such as the UN, IMF, and the Commonwealth Secretariat. The country has incorporated the basic requirements of the FATF and Basel Statements of principles into its Banking Act, 1995. It has also ratified the essential international conventions against money laundering and related crimes, such as the 1988 Vienna Convention and the 1999 UN Convention for the Suppression of the Financing of Terrorism.

Work needs to be done to broaden the definition of the financial sector to ensure that all who are likely to be involved in money laundering are covered and to establish appropriate financial sector obligations. A supportive effective enforcement structure with centralised reporting point for suspicions of money laundering and trained financial investigators is also essential.

The Role of Bank of Botswana

The Bank of Botswana ensures that there is public confidence in, inter alia, the solvency of financial institutions through constant regulatory surveillance and effective prudential controls over the domestic financial system. The Bank conducts regular on-site examinations to check for compliance with available anti-money laundering legislation and to verify that the financial institutions have proper systems in place to manage risks emanating from electronic banking related activities. In addition guidelines are issued from time to time to assist banks to address new developments in banking and finance.

SUMMARY AND CONCLUSIONS

In this paper, we have shown that money laundering activities are increasing all over the world. We have gone further to note that technological developments have brought knew products and services in banking, some of which have opened a basket of money laundering opportunities and threats.

Most SADC countries were shown to have high potential for money laundering. On a positive note, most member countries had legislations against money laundering which have to be refined to be in line with international standards. Regarding electronic banking activities, it was noted that most of the countries in the region did not have guidelines/legislation for electronic banking activities, except South Africa and Mauritius.

On the basis of the above conclusions, it is advisable that SADC countries should establish national coordinating committees to oversee anti-money laundering initiatives. These committees should review and strengthen all the anti-money laundering legislation to bring them to international standards. The countries should further consider incorporating electronic due diligence in their anti-money laundering policies and procedures. Individual countries should conduct surveys to ascertain the extent of electronic banking and electronic money activities in their jurisdictions, and draft guidelines on how to manage risks in electronic banking based on the BIS model.

Policy responses to the implications of e-money on monetary policies of individual countries should also be considered. In addition, countries will have to set aside resources for public education to sensitise consumers on the security risks they face when using electronic banking products and on the

dangers of money laundering to democratic societies. Finally, capacity building in the areas of information technology in supervisory and law enforcement authorities should be made a priority. Almost all countries will in future, require information technology bank examiners, and trained financial investigators.

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GARCH Modelling of Volatility on Option Pricing: An Application to the Botswana Market

Pako Thupayagale[1]

INTRODUCTION

This paper is motivated by an interest in how uncertainty and volatility affect the pricing of assets; in particular for financial assets where the current price is in part determined by expectations about the future price, including the associated uncertainty. The analysis of such pricing raises issues at both the theoretical and empirical level. Theory may be able to help provide a framework to indicate how optimal pricing should be determined. However, the next step of empirical input and, more specifically, obtaining relevant measures of volatility in practice, raises further challenges.

In this paper, both these aspects are examined in relation to a particular form of financial asset known as an option, the purpose of which is to help investors hedge their exposure to volatility in asset prices. The approach taken here is, by necessity, at a highly technical level, which may not be immediately accessible to all readers. However, the various concepts and results that are presented are accompanied by non-technical explanations including, at the end of the paper, a glossary of terms for easy reference (see appendix).

In conventional econometric models, the variance of the disturbance is assumed to be constant both unconditionally and conditionally. However, the phenomenon of changing variance and covariance is often encountered in financial time series. The growing interest around models of changing variance and covariance has been motivated by their suitability both in describing the so-called 'stylised facts' of many economic and financial variables, and in the pricing of contingent assets. An example of a contingent asset is an option, which allows the option owner the right, but not the obligation, to trade the underlying asset at a given price in the future.

In option pricing, the uncertainty associated with the future price of the underlying asset is the most important determinant in the pricing function[2]. As volatility increases, the probability that the financial asset will perform either exceptionally well or very poorly rises. For the owner of the asset these outcomes tend to offset each other; however, this is not the case for the owner of a call or put. In particular, the owner of a call option benefits from price increases but has limited downside risk in the event of price decreases, since the most that he can lose is the price of the option. Similarly, the owner of a put option benefits from price decreases but has limited downside risk in the event of price increases. Therefore, the value of both calls and puts increases as volatility increases; hence, pricing an option involves valuing volatility.

In general, the models of changing variance and covariance are called 'volatility models'. The main representatives of this class of models are the Autoregressive Conditional Heteroscedasticity (ARCH) models (Engle, 1982) and the Generalized ARCH (GARCH) models (Bollerslev, 1986). These models allow the conditional variance to change over time as a function of past errors, leaving the unconditional variance constant. Option price estimates derived from ARCH models can be used to test whether observed market options are efficiently priced. This is because ARCH models capture the dynamic behaviour of market volatility using specific volatility equations of the asset-return series without presupposing any option-pricing formula, or using observed option prices. However, GARCH models are preferred since they are capable of reflecting changes in the conditional volatility of the underlying asset in a parsimonious manner.

In this paper the GARCH Option Pricing Model (OPM) is employed in order to examine the efficiency of a hypothetical foreign currency option market in Botswana[3]. The popular GARCH $(1,1)$ specification is employed in the estimation of volatility for the continuously compounded returns of the exchange rate between the Pula and two currencies: the US dollar and the British pound. This forecasting method provides one common conditional volatility estimate for both call and put option prices obtained by solving the option valuation problem via Monte Carlo simulations. Such estimated prices, for different strike prices and maturities, are compared with the option prices prevailing in the local currency options market to evaluate its efficiency in pricing options. The results obtained indicate that the GARCH $(1,1)$ OPM generally underprices calls and overprices put options.

The paper is organised as follows. Section 2 considers models of changing variance, with special attention given to observation-driven models, in particular the GARCH model. The pricing of contingent assets is discussed in Section 3. The lead-

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[1]   Dealer in the Financial Markets Department of the Bank of Botswana. The paper was developed while the author was doing his MSc in economics at the University of Warwick. The author is grateful for useful comments from colleagues at the Bank of Botswana and from his supervisor at Warwick University.

[2]   See Bollerslev *et al* (1992).

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[3]   Some commercial banks in Botswana trade in currency options. We use European currency options to proxy Botswana currency options (i.e., by converting those prices into their Pula equivalent).

ing role of the Black-Scholes Option Pricing Formula (BSOPF) is highlighted. The next section reviews some theoretical and applied work into option pricing theory when the Black-Scholes assumption of constant volatility is relaxed. Section 5 presents the analysis of the continuously compounded returns of the US dollar/Pula and British pound/Pula exchange rates, and the estimation of the GARCH (1,1) process. Section 6 discusses the results of the GARCH (1,1) OPM and evaluates its statistical properties *vis-à-vis* the prevailing currency option prices, as a test for market efficiency. Section 7 concludes the analysis.

MODELS OF CHANGING VARIANCE

Volatility models can be categorised into observation and parameter-driven models, where the former express the variance (σ_t) in terms of past observations and the latter adopt a direct approach in which σ_t is modelled by an independent stochastic process. The most familiar example of an observation-driven model is the ARCH model developed by Engle (1982), which can account for the difference between the unconditional and the conditional variance of a stochastic process. The ARCH process allows the conditional variance to vary over time, leaving the unconditional (or long run) variance constant.

In this model, the variance is modelled directly as a linear function of the squares of past observations:

$$\sigma_t^2 = \alpha_0 + \alpha_1 y_{t-1}^2 \ldots + \alpha_q y_{t-q}^2 \qquad (1)$$

with $\alpha_0 > 0$ and $\alpha_i \geq 0$, $i=1,\ldots,q$, to ensure that the conditional variance is positive.

A more general representation of the above model is the Generalised ARCH (GARCH) process introduced by Bollerslev (1986). The GARCH models are capable of capturing leptokurtosis, skewness and volatility clustering[4], which are the three features most often observed in high frequency financial time series data.

In the GARCH model, the conditional variance is specified as:

$$\sigma_t^2 = \alpha_0 + \alpha_1 y_{t-1}^2 \ldots + \alpha_q y_{t-q}^2 + \beta_1 \sigma_{t-1}^2 + \ldots + \beta_p \sigma_{t-p}^2$$
(2)

where the inequality restrictions $\alpha_0 > 0$, $\alpha_i \geq 0$, for $i = 1, \ldots, q$, and $\beta_i \geq 0$ for $i = 1,\ldots p$, are imposed to ensure that the conditional variance is strictly positive. That is, the conditional volatility is specified as in (1) with the addition of its past conditional variances. A GARCH process with orders p and q is denoted GARCH (p,q). The GARCH model can parsimoniously represent a high order ARCH process, which makes it easier to identify and es-

timate.[5] Bera and Higgins (1993) report that the GARCH (1,1) process is able to represent the majority of financial time series. In addition, they point out that a model of order greater than GARCH (1,2) or GARCH (2,1) is very unusual.

The GARCH (1,1) specification has the useful property that shocks to volatility decay at a constant rate and the speed of decay is measured by the estimate of $\alpha + \beta$. The sum $\alpha + \beta$ also measures volatility persistence (i.e., the extent to which shocks to current volatility remain important for long periods into the future). As the sum $\alpha + \beta$ approaches unity, the persistence of shocks to volatility becomes greater. If $\alpha + \beta = 1$ then any shock to volatility is permanent and the unconditional variance is infinite. In this case, the process is called an I-GARCH process (integrated in variance process, Engle and Bollerslev (1986))[6]. If the sum $\alpha + \beta$ is greater than unity, then volatility is explosive; i.e. a shock to volatility in one period will result in even greater volatility in the next period (Chou, 1988).

An important disadvantage of the GARCH model is represented by the assumption that only the magnitude, not the sign, of the lagged residuals determines conditional variance. In other words, the conditional variance is unable to respond asymmetrically to rises and falls in y_t. This suggests that a model in which σ_t^2 responds asymmetrically to positive and negative residuals may be more appropriate in certain circumstances, for example, in relation to stock returns, where volatility is observed to rise in response to negative investor confidence ('bad news') and fall in the context of positive market sentiment ('good news')[7].

Parameter-driven models allow the conditional variance to depend on some unobserved or latent structure which is assumed to follow a particular stochastic process. Models of this kind are referred to as Stochastic Volatility Models (SVM). However, SVMs are less tractable than observation-driven models; hence, concentration and application in this paper is on the GARCH model.

THE PRICING OF CONTINGENT ASSETS

Contingent assets (more commonly known as derivatives) are financial instruments that are valued according to the expected price movements of an underlying asset, which may be a commodity, a

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[4] Volatility clustering implies that large (small) price changes follow large (small) price changes of either sign.

[5] The GARCH (p,q) allows for both autoregressive and moving average components in the heteroskedastic variance. If all the b_i equal zero, the GARCH (p,q) is equivalent to an ARCH (q) model.

[6] The I-GARCH process implies that the volatility persistence is permanent and, therefore, past volatility is significant in predicting future volatility over all finite horizons.

[7] Nelson (1991) proposed a class of exponential ARCH, or EGARCH models to resolve this problem.

currency, or a security. For example, a stock option is a derivative whose value is contingent on the price of a stock. Options can be divided into two basic types: call and put options. A call option gives the holder the right, but not the obligation, to buy the underlying asset by a certain (maturity) date for a certain (strike) price. By contrast, a put option gives the holder the right, but not the obligation, to sell the underlying asset for a certain price by a certain date. A call option is usually purchased in the expectation of a rising price while a put option is bought in the expectation of a falling price. Another important distinction is between American and European options. The former can be exercised at any time up to maturity while the latter can be exercised only on the expiration date. Since European options are generally easier to analyse than American options, attention here is restricted to European-type options.

The expected value of a derivative at time $T + t$ in the case of a European call option, is its expected value at maturity:

$$E^*\left[max\left(S_{T+t} - K, 0\right)\right] \tag{3}$$

where E^* represents expected value in a risk-neutral world, S_{T+t} is the underlying stock price at maturity and K is the strike price. The call option price, C, is subsequently obtained by discounting the expected maturity value of the option at the risk-neutral rate of interest, r, that is:

$$C = e^{-rt}E^*\left[max\left(S_{T+t} - K, 0\right)\right] \tag{4}$$

The distribution of the value of the option at time $T+t$ can be derived from the distribution of the terminal stock value. Furthermore, if this distribution is known, the value of the option can be obtained by integration. The Black-Scholes option pricing formula (BSOPF) results from these calculations:

$$C = S_T N(d_1) - Ke^{-n}N(d_2)$$
where
$$d_1 = \frac{ln\left(S_T/K\right) + \left(r + \sigma^2/2\right)t}{\sigma\sqrt{t}} \tag{5}$$
$$d_2 = d_1 - \sigma\sqrt{t}$$

The only parameter in the BSOPF that cannot be observed directly is the volatility of the stock price. Hence, it follows that pricing an option is equivalent to valuing volatility. Furthermore, since the holder of an option has the right but not the obligation to exercise his option, the value of the option is a non-decreasing function of the volatility. To measure price uncertainty, two measures are typically used in financial econometrics. The most basic approach consists of computing from the data on market returns the standard deviation and then using it to make inferences about future volatility. The estimated volatility can then be used to calculate the option price. The alternative approach uses derivative prices to solve for the implied volatility. This is the value of σ, which, once substituted into (5), gives the price of the option, C. However, (5) is not invertible. As a result, iterative procedures must be applied to calculate the implied volatility.

However, the preceding analysis is compromised by the pre-supposition that stock returns follow a geometric diffusion process with constant variance. This assumption contrasts with the empirical recognition that many financial time series are typically heteroscedastic. This implies that equation (5) may not be the most appropriate rule on which to derive option pricing procedures.

The Pricing of Contingent Assets Under Changing Volatility

The next two sections concentrate on the empirical analysis of a GARCH (1,1) option pricing model. The estimation procedure consists of collecting a set of put and call options with different maturities and strike prices (all observed at the same time) and in comparing their market prices with those obtained from the estimated GARCH (1,1) option pricing model. The price of the option, C_t, is calculated as the expected discounted value of payoffs at terminal date, discounted at the risk-neutral interest rate, r, assuming the risk-neutral evaluation method, discussed above, can be applied thus:

$$C = e^{-rt}[\max \{S_{T+t} - K, 0\}] \tag{6}$$

where S_{T+t} is the underlying stock price at maturity and K is the strike price. The expectation in (6) is derived following Engle and Mustafa (1992) and Heynen, Kemma and Vorst (1994), from the following recursion:

$$ln\left(S_{T+t}/S_t\right) = \sigma_{t+1}\varepsilon_{t+1}$$
where
$$\sigma_{t+1}^2 = \omega + \alpha\varepsilon_t^2\sigma_t^2 + \beta\sigma_t^2 \tag{7}$$
$$\varepsilon \sim i.i.d. N(0,1)$$

The current estimate of the variance will be obtained from an historical fit of a GARCH (1,1) model. Using the risk-free rate, r, the theoretical option price will be calculated through Monte Carlo simulation for a particular set of the parameters ω, α and β.

Estimation of ARCH and GARCH MODELS

This section starts the empirical part of the work by estimating GARCH models for the study of the dynamics of the rate of return on holding foreign currencies. In particular, the properties of conditionally heteroskedastic data are illustrated by es-

timating observation-driven models for the daily rate of return of the exchange rate between the Pula and two currencies: US dollar and British pound. The data are daily exchange rates[8] over the period January 4, 2000 to August 8, 2002 giving a total of 646 observations. The estimation procedure for the daily rate of return in the US dollar/Pula currency market will be shown while, for the British pound, only the estimation results are reported.

FIGURE 1: PLOT AND SAMPLE STATISTICS OF THE PERCENTAGE RATE OF RETURNS
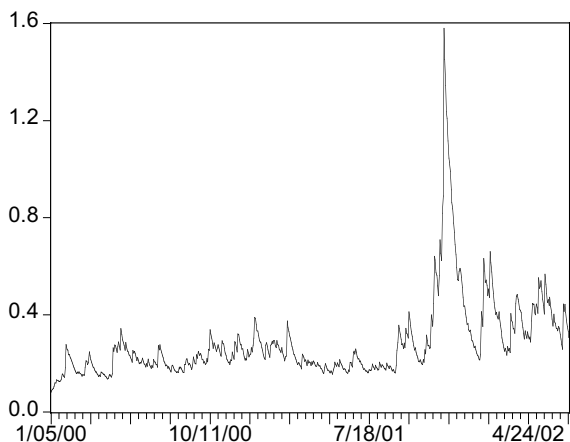
Denoting the price of the US dollar in terms of the Pula as s_t, the continuously compounded percentage rate of return from holding the US dollar one day is given by $y_t = 100[\ln(s_t) - \ln(s_{t-1})]$. Figures 1 and 2 illustrate the plot and the sample statistics of this series. A preliminary analysis of the plot suggests that the mean appears to be constant while the variance changes over time and large (small) changes tend to be followed by large (small) changes of either sign. In other words, the series under consideration exhibits volatility clustering.

Descriptive statistics from this series suggests the presence of excess kurtosis ($KU = 27.97$) compared to the normal distribution ($KU = 3.00$) implying that the distribution of the continuously compounded percentage rate of return has thick tails. Moreover, the skewness coefficient ($SK = 1.81$) indicates some evidence of asymmetry in the data. These properties are referred to as 'stylised facts' in the literature since they are peculiar to many economic and financial time series.

Given time series data it is possible to decompose the statistical processes characterising the data into its conditional mean and conditional variance, both depending upon the information set available from the previous period. Hence the mean equation will be estimated through the identifica-

tion of the best fitting model for the daily returns. In this case, it is an ARMA(1,1) process[9]. Moreover, since a more parsimonious parameterisation of an ARCH process can be obtained by estimating a GARCH process for the variance equation, it follows that the conditional variance of the errors will be specified as a GARCH(1,1) process. Maintaining, the conditional normality assumption, the estimated model is:

$$y_t = -0.0217 + 00.5349 y_{t-1} - 0.6023_{-t-1} \qquad (8)$$

$$(0.0076) \quad (0.2684) \quad (0.2507)$$

$$l(\theta) = -35.5736$$

$$_{-t} = 0.0020 + 0.1538 + 0.8361_{-t-1}$$

$$(0.0006) \ (0.0223) \ (0.0197)$$

where $l(\theta)$ is the maximised log likelihood value. Both the α and β coefficients are positive and statistically significant. In addition, since their sum is less than one, then it follows that the conditional variance is finite.

For a GARCH (1,1) model, the persistence of volatility shocks depends on $\alpha + \beta$. In the case under analysis these coefficient add to a figure very close to unity ($\alpha + \beta = 0.99$). This suggests that shocks to volatility are close to being permanent. This characteristic is important in option markets, since traders will be willing to pay higher prices for options if they perceive that shocks are permanent with respect to the life of the option.

Reported below are the results of the estimated GARCH (1,1) models of the British pound (more information is available in the appendix):

FIGURE 2: CONDITIONAL STANDARD DEVIATION OF GARCH (1,1) AND HISTOGRAM OF STANDARDISED RESIDUALS
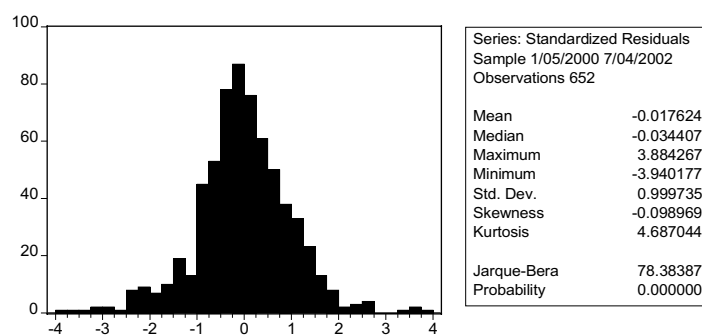
British pound/Pula

$$y_t = -0.0140 + 0.4979 y_{t-1} - 0.6273_{-t-1} \qquad (9)$$

$$(0.0085) \ (0.2091) \quad (0.1769)$$

$$l(\theta) = -151.5115$$

The coefficients of the variance equation are all statistically significant. In addition, the sum of the

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8   The exchange rates are defined as the number of Pula per foreign currency unit.

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9   The choice of the appropriate mean equation is guided by various selection criteria, namely the Akaike and Schwartz information criteria.

various αs and βs is close to, but less than, unity. This suggests that shocks to volatility are persistent. As can be seen volatility of the returns of the three exchange rates has been parameterised as a GARCH(1,1) process. Next, these parameterisations will be used to calculate the theoretical prices of options using the GARCH (1,1) option pricing model.

THE GARCH OPTION PRICING MODEL:
EMPIRICAL RESULTS

Monte Carlo simulation provides a simple and flexible method for valuing derivatives[10]. In addition, the standard deviation of the estimate can be derived and, therefore, it is possible to evaluate the accuracy of the results so obtained[11].

The value of an option is the risk-neutral expectation of its discounted payoffs. An estimate of this expectation can be obtained by computing the average of a large number of discounted payoffs. Consider an option which pays C_T on the maturity data T. In order to find its value, the process for the stock price from its value today is simulated from time zero, to the maturity date T and then the payoff of the contingent claim is computed, C_{Tj} for this simulation, j. This payoff is then discounted using the risk-neutral interest rate:

$$\hat{C}_0 = \frac{1}{M} \sum_{i=1}^{M} C_{0,j} \qquad (11)$$

where C_0 is an estimate of the true value of the option C_0. The standard deviation is given by:

$$SD(C_{0,j}) = \sqrt{\frac{1}{M-1} \sum_{j=1}^{M} \left(C_{0,j} - \hat{C}_0\right)^2} \qquad (12)$$

The distribution tends asymptotically to a normal distribution and confidence intervals on the estimate can be obtained on this basis. Therefore, for large M an approximate 95 percent confidence interval for $C_{0,j}$ may be constructed in the following way:

The distribution $\left(\hat{C}_0 - C_0\right)/\left[SD(C_{0,j})/\sqrt{M}\right]$ tends asymptotically to a normal distribution

$$Pr\left(\begin{array}{c} \hat{C}_0 - \dfrac{1.96 * SD(C_{0,j})}{\sqrt{M}} \leq C \leq \\ \hat{C}_0 + \dfrac{1.96 * SD(C_{0,j})}{\sqrt{M}} \end{array}\right) = 0.95 \qquad (13)$$

For each simulated path the payoff of the option is computed and the estimate of the option price is simply the discounted average of these simulated payoffs. In the case of a call option[12],

TABLE 1: RESULTS OF MONTE CARLO SIMULATION EXERCISE

Option	Maturity	Actual	Crude MC Estimate	Crude MC Std. Dev	95 percent Confidence Interval
GBP Call	June	14.91	19.08	9.48	18.89; 19.27
	September	16.22	21.94	6.95	21.80; 22.08
	September	16.50	11.76	3.70	11.69; 11.83
	December	14.08	20.55	8.29	20.39; 20.71
GBP Put	September	18.43	15.49	7.12	15.35; 15.63
	September	19.67	24.89	8.54	24.72; 25.06
	December	18.99	26.60	7.29	26.46; 26.74
	December	22.03	29.41	9.33	29.23; 29.59
USD Call	June	4.76	4.48	5.89	4.36; 4.60
	September	7.32	8.32	9.42	8.14; 8.50
	December	3.87	1.12	8.87	0.95; 1.29
	December	6.65	10.01	6.44	9.88; 10.14
USD Put	September	9.43	5.72	6.01	5.60; 5.84
	September	6.60	7.87	5.15	7.77; 7.97
	December	8.77	4.11	7.37	3.97; 4.25
	December	6.09	8.36	6.85	8.23; 8.49

$$C_{0,j} = e^{-rT} C_{T,j} \qquad (10)$$

The simulations are repeated many (say M) times and the average of all the outcomes is taken:

this can be expressed as follows:

$$\hat{C}_0 = e^{-rt} \sum_{j=1}^{M} max(S_{T,j} - K, 0) \qquad (14)$$

Using the current estimate of volatility from a historical fit of a GARCH(1,1) model a set of $M = 10$

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10   See Boyle (1977) and Pontin (2000) for more elaboration.

11   The main drawback of the Monte Carlo simulation method arises from the fact that in most cases there exists a trade-off between accuracy and computational costs. The standard error of the Monte Carlo estimator is inversely proportional to the square root of the number of simulation trials.

12   In the case of a put option, equation (14) has to be modified by computing the payoff in the following way: $max(K - S_{T,j}, 0)$.

13   The interest on Bank of Botswana Certificates (BoBCs) are used as a measure of the treasury bill rate.

000 replications is simulated for a particular set of the GARCH (1,1) parameters. This quantity is then discounted at the current treasury bill rate[13], r, to give an estimate of the option value. Ninety-five percent confidence intervals are also reported.

The theoretical option prices so obtained are then compared with a set of put and call option prices prevailing in the hypothetical Pula adjusted European currency option market, for different strike prices and maturities, all observed at the same moment. The currency option prices were obtained from the Philadelphia Stock Exchange (PHLX). Most of the option contracts are traded with maturity dates in June, September and December.

Table 1 gives the results of the crude Monte Carlo simulation method and reports the actual option prices prevailing in the markets. The results indicate that the GARCH (1,1) option pricing model generally overprices both calls and puts[14]. The Monte Carlo estimates are not close to the premium quotations on the PHLX (possibly due to the fact that Pula exchange is not considered by investors on the PHLX), and the standard deviations of these estimates are relatively large due to the high volatility of the underlying exchange rate (and the fact that these options are hypothetical to the Botswana context). As a consequence, the standard deviations of simulated prices are large (and 95 percent confidence intervals are relatively wide). For example, the crude Monte Carlo standard deviation in the case of the call option on the British pound/Pula exchange rate maturing in June is 9.48.

CONCLUSIONS

The basic assumptions of the Black-Scholes formula for the valuation of stock option is that the price of the underlying stock is log-normally distributed with constant volatility. This contrasts with the widespread evidence that volatility of many financial variables is changing over time. This recognition has led researchers in finance to model explicitly time variation in volatility. In particular, the popular GARCH (1,1) specification has been successfully adopted to capture the changing volatility for the continuously compounded returns of two exchange rates: US dollar/Pula and British pound/Pula. The results show that shocks to volatility appear to be very persistent. This forecasting method has then been applied to derive theoretical option prices. In this respect, Monte Carlo simulation provides a useful method of obtaining numerical solutions to option valuation problems. Finally, the efficiency of the GARCH(1,1) option pricing model is evaluated by comparing estimated call and put option prices with the option prices prevailing in the European currency option market. The results indicate the GARCH (1,1) option pricing model

overprices both calls and puts. These outcomes may be due to the fact that European options were used as proxies for the Botswana situation, hence the results must be interpreted cautiously. Nonetheless, the techniques employed in this analysis provide a framework (albeit a simple one) for pricing options in Botswana, should they be introduced. However, in view of the large standard errors obtained in this paper, future researchers may wish to improve upon the obtained results by employing a range of variance-reduction techniques to improve the efficiency of simulation estimators.

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14 Overpricing describes how the crude Monte Carlo estimates are greater than the actual prices.

APPENDIX

A: British Pound

i) Plot and Sample Statistics of the Percentage Rate of Return Series
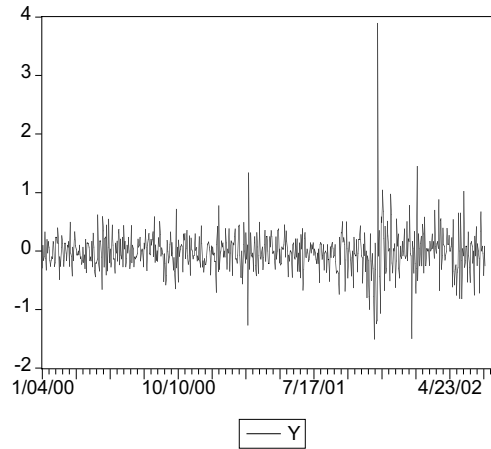
ii) GARCH (1,1) Estimation Results

Dependent Variable: Y
Method: ML – ARCH

Sample (adjusted): 1/05/2000 7/04/2002
Included observations: 652 after adjusting endpoints
Convergence achieved after 25 iterations

	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.014032	0.008492	-1.652439	0.0984
AR(1)	0.497949	0.209107	2.381309	0.0173
MA(1)	-0.627256	0.176905	-3.545717	0.0004
Variance Equation				
C	0.006529	0.002158	3.026136	0.0025
ARCH(1)	0.150449	0.027707	5.429991	0.0000
GARCH(1)	0.795951	0.036056	22.07530	0.0000
R-squared	0.011527	Mean dependent var		-0.016878
Adjusted R-squared	0.003876	S.D. dependent var		0.358393
S.E. of regression	0.357698	Akaike info criterion		0.483164
Sum squared resid	82.65426	Schwarz criterion		0.524392
Log likelihood	-151.5115	F-statistic		1.506613
Durbin-Watson stat	1.944824	Prob(F-statistic)		0.185591
Inverted AR Roots	.50			
Inverted MA Roots	.63			

iii) Conditional Standard Deviation of GARCH (1,1) and Standardised Residuals

B: US Dollar

i) GARCH (1,1) Estimation Results

Dependent Variable: Y
Method: ML – ARCH

Sample (adjusted): 1/05/2000 7/04/2002
Included observations: 652 after adjusting endpoints
Convergence achieved after 36 iterations

	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.021739	0.007556	-2.877135	0.0040
AR(1)	0.534872	0.268434	1.992564	0.0463
MA(1)	-0.602315	0.250717	-2.402374	0.0163
Variance Equation				
C	0.002033	0.000608	3.343399	0.0008
ARCH(1)	0.153838	0.022318	6.892925	0.0000
GARCH(1)	0.836120	0.019659	42.53051	0.0000
R-squared	0.009709	Mean dependent var		-0.021137
Adjusted R-squared	0.002044	S.D. dependent var		0.324615
S.E. of regression	0.324283	Akaike info criterion		0.127526
Sum squared resid	67.93310	Schwarz criterion		0.168754
Log likelihood	-35.57358	F-statistic		1.266678
Durbin-Watson stat	1.975208	Prob(F-statistic)		0.276570
Inverted AR Roots	.53			
Inverted MA Roots	.60			

Glossary

Conditional variance – the conditional variance implies the explicit dependence of the current variance on a past sequence of observations. The key insight of GARCH lies in the distinction between conditional and unconditional variances of the innovations process.

Contingent asset – A contingent asset is a financial instrument that is valued according to the expected price movements of an underlying asset, which may be a commodity, a currency, or a security. Contingent assets can be used to hedge a position or to establish a synthetic open position. Examples of contingent assets include options, futures, swaps, etc.

Generalised Autoregressive Conditional Heteroscedasticity (GARCH) – The GARCH process is a popular stochastic process which has been successfully used in modelling financial time series. In general the GARCH (p,q) process has p+q+1 parameters which must be fit to the data. The GARCH (1,1) model is the simplest of this class.

Hedging – this refers to the use of various financial instruments by dealers to protect their market positions against loss through fluctuation in the price of the financial asset.

Heteroskedasticity – this describes a distribution characterised by a changing (non-constant) variance or standard deviation.

Homoskedasticity – this describes a stochastic variable with a constant variance or standard deviation.

Kurtosis – This is a measure used to describe the peakedness and thickness of the tails of a probability distribution. Normal distributions have a kurtosis of 3 (irrespective of their mean or standard deviation). If a distributions kurtosis is greater than 3, it is said to be leptokurtic. If its kurtosis is less than 3, it is said to be platykurtic. Leptokurtosis is associated with distributions that are simultaneously 'peaked' and have 'fat tails'. Platykurtosis is associated with distributions that are simultaneously less peaked and have thinner tails.

Option – An option refers to the right to buy or sell a fixed quantity of a commodity, currency, security, etc., at a particular date at a particular price (the exercise price). The purchaser of an option is not obliged to buy or sell at the exercise price and will only do so if it is profitable. Options allow individuals and firms to hedge against the risk of wide fluctuations in prices; they also allow market players to gamble for large profits with limited liability.

(i) Call option – A call option is an option to buy and it is usually purchased in the expectation of a rising price.

(ii) Put option – A put option is an option to sell and it is bought in the expectation of a falling price or to protect a profit on an investment.

(ii) European option – In a European option the buyer can only exercise the right to take up the option or let it lapse on the expiry date. That is, European exercise terms dictate that the option can only be exercised on the expiration date.

(iv) American option – With an American option the right can be exercised at any time up to the expiry date. American exercise terms allow the option to be exercised at any time during the life of the option and this makes American options more valuable due to their greater flexibility.

Skewness – This is a measure of the asymmetry of the data around the sample mean. If skewness is negative, the data are spread out more to the left of the mean than to the right. If skewness is positive, the data are spread out more to the right. The skewness of the normal distribution (or any perfectly symmetric distribution) is zero,

Strike price – the strike (or exercise) price is the price per share at which a traded option entitles the owner to buy the underlying security in a call option or to sell it in a put option.

Unconditional variance – the unconditional variance refers to the long-run variance (or long-term behaviour) of a time series and assumes no explicit knowledge of the past.

Volatility clustering – This is a characteristic exhibited by financial time series, in which large changes tend to follow large changes, and small changes tend to follow small changes. In either case, the changes from one period to the next are typically of unpredictable sign. Volatility clustering, or persistence, suggests a time series model in which successive disturbances, although uncorrelated, are nonetheless serially dependent.

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