Estimating Monetary Policy Rules for South Africa

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Monetary policy in South Africa's emerging market economy, given capital account liberalization and severe constraints on fiscal policy, has the major responsibility for curbing inflation and currency instability while trying to ensure sufficient growth for longer-term political stability and the reduction of poverty. South Africa's monetary policy is going through a rapid transition away from an old-fashioned, partly monetarist view that assumed a simple connection between the money supply and inflation. Accumulated international evidence does not support this view, and in South Africa itself the force of circumstance has recently compelled a move away from these ideas. The shift to a regime with an explicit, publicly announced inflation goal in late 1999 demands good forecasting models of inflation, using all available information to guide policy rather than a single intermediate target such as a monetary aggregate.[1] Important, too, is a shared understanding with the private sector of the effectiveness of monetary policy for inflation, as well as greater policy transparency and more open public discussion of the underlying issues (see, among others, Leiderman and Svensson, 1995; Bernanke and Mishkin, 1997; Bernanke and others, 1999).

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1. The feasibility of moving to a formal inflation targeting system was first discussed by the South African Reserve Bank in Casteleijn (1999) and by Kahn (1998).

Monetary Policy: Rules and Transmission Mechanisms, edited by Norman Loayza and Klaus Schmidt-Hebbel, Santiago, Chile.

The quarterly macroeconometric model used by the South African Reserve Bank (SARB) has not wholly been opened to outside scrutiny;[2] by contrast, in the United Kingdom models developed by the Treasury and the Bank of England are published and discussed at conferences and academic panel meetings. Discussions suggest that the SARB's large macro model[3] appeared to omit two of the most important interest rate transmission channels: that via wealth effects, and hence domestic asset prices; and that via expectations.[4] Consequently, it is difficult to arrive at a well-informed view of the size and dynamics of the effects of monetary policy. Further, these models gave insufficient attention to the consequences of regime shifts, such as financial liberalization, and more generally to the highly influential Lucas critique of the use of policy modeling (Lucas, 1976). Such defects in earlier U.K. models played a major role in the costly macroeconomic policy failures of the late 1980s and early 1990s. This paper analyzes the conduct of monetary policy by the SARB, both through a description of the historical record and through formal modeling of various extended Taylor rules for interest rate policy formation.

Table 1 shows the different monetary policy regimes in place in South Africa since the 1960s. The first regime, in effect until the early 1980s, was one based on liquid asset ratios, with quantitative controls on interest rates and credit. This regime was reformed gradually toward a cash reserves-based system by about 1985. Preannounced, flexible monetary target ranges were used from 1986 onward, and the central bank's discount rate was used to influence the cost of overnight collateralized lending and hence market interest rates. Financial liberalization beginning in the early 1980s, and a more open capital account in the 1990s, much diminished any usefulness of such targets. In later years they were therefore formally supplemented by a broader set of indicators (see *South African Reserve Bank Quarterly Bulletin*, October 1997). It is likely that such indicators played a role in previous years as well.

2. An exception is a technical workshop in September 1998, attended by private sector and academic participants, at which certain sectoral equations of the pre-2000 models were discussed, some of which have been published piecemeal in the *South African Reserve Bank Quarterly Bulletin*.

3. A model comprising 400 equations was in use until 2000. This has been replaced by a far smaller model, which is now responsible for the main forecasts of the SARB (also not published).

4. The inflation sector of the model (see Pretorius and Smal, 1994) does, however, include one asset price (the exchange rate) and a simple expectations proxy in the inflation equation, based on lagged inflation and the change in the money supply.

Table 1. Sequence of Monetary Policy Regimes in South Africa

Years	*Monetary Policy Regime*
1960-81	Liquid asset ratio–based system with quantitative controls on interest rates and credit
1981-85	Mixed system during transition (see appendix for details)
1986-98	Cost of cash reserves–based system with preannounced monetary targets (M3)
1998-99	Daily tenders of liquidity through repurchase transactions (repo system), plus pre-announced M3 targets and targets for core inflation
2000-	Repo system with inflation targeting (CPI-X)

Source: Authors' calculations. For more details see section 1.

Starting in early 1998, a new system of monetary accommodation was introduced, with daily tenders of liquidity through repurchase transactions. Monetary growth guidelines continued to be announced, on a three-year rather than an annual basis. Target ranges for core inflation were informally announced beginning in 1998, and an inflation targeting regime was instituted in 2000 (see table 2).

Table 2. Money Growth and Inflation Targets in South Africa

Percent

	Money growth		*Inflation*			
Year	*Guidelines*	*Actual*	*Core target*[a]	*Actual total*	*Actual core*	*CPIX*
1986	16–20	9.3		18.6		
1987	14–18	17.6		16.1		
1988	12–16	27.3		12.9		
1989	14–18	22.3		14.7		
1990	11–15	12.0		14.4		
1991	8–12	12.3		15.3	18.9	
1992	7–10	8.0		13.9	16.8	
1993	6–9	7.0		9.7	12.6	
1994	6–9	15.7		9.0	8.9	
1995	6–10	15.2		8.7	7.9	
1996	6–10	13.6		7.4	7.2	
1997	6–10	17.2		8.6	8.8	
1998	6–10	14.6	1–5	6.9	7.5	7.1
1999	6–10	10.2	1–5	5.2	7.9	6.9

Source: *South African Reserve Bank Quarterly Bulletin,* various issues.
a. Core targets were informally announced. The core inflation rate is the overall consumer price index (CPI) for the metropolitan and other urban areas, excluding certain food prices, interest costs, value-added tax, and municipal rates. In February 2000 a CPIX target of 3-6 percent was announced for 2002, in the context of a new inflation targeting regime. The CPIX inflation rate is the overall CPI for metropolitan and other urban areas, excluding interest rates on mortgages.

Our principal interest in this paper is in the second of these regimes (the one immediately preceding inflation targeting), when the short-term interest rate first became the main monetary policy instrument of the SARB. Setting of monetary policy was particularly opaque in this regime and has never been studied in the context of rigorous empirical models. It is not clear which indicators influenced interest rate policy in practice, or what weights attached to them. Our aim is to clarify the historical record.

Further, despite the major changes in policy now in process and in prospect, continuities with past policies are inevitable. The new interest policy rules under inflation targeting can be seen as variants, using different weights, of the interest rate feedback rules we have found to describe past behavior. Our analysis is intended to contribute toward an understanding of the likely continuities as well as changes in policy. Moreover, many structural economic features persist across different regimes.

Section 1 of the paper describes the institutions of South African monetary policy: the central bank, monetary policy regimes and operating procedures, exchange rate regimes and the capital account, and targeting policies. Section 2 gives narrative evidence across particular episodes of how policy has operated in practice. Periodically, major shocks in the form of significant gold price changes and political crisis or change have resulted in large changes in capital flows, which have complicated monetary management.

Section 3 analyzes quarterly extended Taylor rules as quantitative descriptions of monetary policy in the 1986-97 period (using our own forecasting models up to 1998 for output and inflation, to derive efficient instruments). The basic Taylor rule with partial adjustment and incorporating a foreign interest rate gives a poor description of policy. Indeed, at face value, such a rule suggests an apparently perverse policy with respect to inflation. However, this ignores the reactions of interest rates to excess money growth, which is found to be significant in a further extension of the model, reducing the apparent perversity. We show that a satisfactory policy description needs to control for financial liberalization, which, with the removal of quantitative controls on interest rates and credit and restrictions on competition, was associated with a substantial rise in real interest rates in South Africa after 1980. Weak evidence was found for structural breaks reflecting balance of payments considerations. Even with the more satisfactory model, it is plain that forecast inflation received a lower weight in the reaction function in the 1986-97 period than in most of the economies studied by Clarida, Galí, and Gertler (1998a). Section 4 summarizes the findings and concludes.

1. Institutions of South African Monetary Policy

1.1 The South African Reserve Bank

The legal independence of the SARB is guaranteed by the South African constitution (approved by the Constitutional Court in December 1996), which states: "The primary object of the SARB is to protect the value of the currency in the interest of balanced and sustainable economic growth in the Republic. The SARB, in pursuit of its primary object, must perform its functions independently and without fear, favour or prejudice, but there must be regular consultation between the Bank and the Cabinet member responsible for national financial matters." The constitution can only be altered by a two-thirds parliamentary majority; any other attempt to dilute the independence or alter the objectives of the SARB would be contested in the Constitutional Court. In practice, before 1996 the central bank operated largely with autonomy, although it was not always immune from political interference. Arguably, the constitution formalized the stated ultimate goal of monetary policy between 1989 and 1995, that of low inflation (see, for example, Stals, 1995a).

The constitution further clarifies that the SARB shall be regulated in terms of an act of Parliament, which determines the exact powers and functions of the SARB and the conditions governing their exercise or performance. Both the transparency and the accountability of monetary policy, as regulated by the Reserve Bank Act (1989, with subsequent amendments), have improved with the move to inflation targeting in 1999 and 2000. The act requires the publication of monthly statements of assets and liabilities and submission of an annual report to Parliament, and periodically the governor of the SARB appears before the Standing Committee on Finance. However, during the policy regime with loose monetary guidelines, the law was not explicit about what level of inflation offered sufficient price stability, the time horizon within which it should be achieved, and with whom the ultimate responsibility for price stability rested. Thus there were no explicit benchmarks against which the performance of the SARB could be judged, and this diminished accountability. By contrast, under the new, inflation targeting regime, the target range of 3 to 6 percent specified by the Ministry of Finance is for a particular price index and is to be reached on average for 2002.

This is the clear responsibility of the Monetary Policy Committee of the SARB.[5]

Since its establishment in 1921, the SARB has been privately owned. Its shares are listed on the Johannesburg Stock Exchange, and there is a ceiling on the number of shares that one person or institution may hold. After transfers to reserves, dividend payments, and other provisions, the surplus of earnings is paid to the government. The Reserve Bank Act states that the SARB's management and functions are ultimately the responsibility of the SARB's full fourteen-member Board of Directors,[6] which meets four times a year at present. The minutes of board meetings are not published.

In practice and by law, the operation of the main monetary policy tool, the so-called bank rate, between 1986 and 1999 was at the behest of the governor, after consultation with the deputy governors (see section 1.3).[7] Minutes of these meetings were not published. The minister of finance could also be consulted, but policy could be altered without the minister's approval, and minutes of the minister's meetings with the SARB were not published. The president of South Africa appoints the governor and three deputy governors for terms of five years.[8] Typically, however, the tenure of governors and deputies has been longer than this,[9] which may have enhanced the independence of the SARB but may also have concentrated power in the hands of too few.

5. There are, however, currently some weaknesses in the institutional design of the SARB's inflation targeting regime, which may compromise transparency and accountability. Notably, there are no explicit rules governing what happens when targets are breached, as there are for the Bank of England; rather, there is a vague provision to make allowance for exogenous supply shocks (SARB, 2000, point 3.4).

6. The board consists of the governor, three deputies, three additional officials appointed by the government, and seven persons elected by the SARB's private shareholders (four representing finance or commerce, two representing industry, and one representing agriculture). Note that an exclusion clause was first publicly announced in October, 2001.

7. This arrangement continues, de jure, under the inflation targeting regime, where the governor and deputy governors are the sole voting members of the fifteen-member Monetary Policy Committee and thus hold final decisionmaking power on monetary policy. In practice, however, decisions on interest rate policy are reached by consensus after extensive discussions by the committee, and the committee's Monetary Policy Statement is drafted by the entire committee. Unlike at the Bank of England, the minutes of these meetings are not published.

8. The finance minister may dismiss governors but, under current law, only for malfeasance or incapacity.

9. Governors T. W. De Jongh (1967-80), Gerhard de Kock (1981-89), and Chris Stals (1989-99) and Deputy Governor Chris De Swardt (1990-), all served longer than five years. The new governor, Tito Mboweni, began his term in August 1999.

Apart from the fact that monetary policy rested in the hands of a few people or, ultimately, one person, the process by which decisions were arrived at between 1986 and 1999 is unclear. As will be seen below, a wide range of intermediate variables, such as private credit growth and the level of and change in reserves, have in recent years supplemented the money growth "guidelines" in influencing interest rate decisions aimed at lowering inflation. However, it is not known what weights applied to these indicators in the interest rate rule, or how these weights changed after exogenous shocks or policy regime changes. This rendered policy quite opaque.

1.2 Exchange Rate Regimes

South Africa's exchange rate policy during the 1970s mirrored volatile developments on the international front, and throughout the period a number of significant regime shifts occurred (see appendix table A6).[10] Until 1979 the exchange rate was fixed, with the rand pegged to either the U.S. dollar or the pound sterling. Alterations in the rate were determined by policymakers and took the form of discrete step changes. Exchange controls restricted residents' capital flows, and proceeds from the sale of assets by nonresidents were placed in blocked rand accounts, which made the repatriation of capital difficult. In 1976 the system was modified to allow for the transfer of assets between nonresidents.

Greater flexibility was introduced in 1979 with a dual-currency exchange rate system, following the recommendations of the interim De Kock Commission (De Kock and others, 1978). An official ("commercial") exchange rate was announced on a daily basis in line with market forces. The second, "financial" exchange rate applied to most nonresident portfolio and direct investment transactions, with all other transactions channeled through the commercial rand market. The intended impact of the dual system was to break the direct link between domestic and foreign interest rates, as well as to insulate the capital account from certain categories of capital flows.

In 1983 the commercial rate was set free to be determined in the market, subject to direct intervention by the SARB, and the dual rates were unified as recommended by the De Kock Commission (De Kock and others, 1978, 1984). Controls on nonresident capital movements

10. This section draws on Aron, Elbadawi, and Kahn (2000).

were removed, and although those on residents remained, a more lenient attitude was taken to applications by residents to make direct investments abroad.

The unified currency remained stable for a few months but then, following the gold price decline in 1983, began a sharp descent. In 1985, following a prolonged period of political upheaval, U.S. banks recalled their loans, precipitating a debt crisis, followed by a debt standstill, and subsequently a series of four debt rescheduling agreements. The unified rand fell even further, and eventually the financial rand was reintroduced and capital controls on residents were tightened. The dual-currency system remained in existence until its unification a decade later, in March 1995, under a managed float. The nature of the SARB's varying implicit exchange rate targets are discussed in section 1.4.

1.3 Monetary Policy Regimes and Operating Procedures

Broadly speaking, there have been three monetary policy regimes since the 1960s (table 1 and appendix). Our quantitative interest rate models focus on the second of these. As noted in the introduction, the first regime, operated until the early 1980s, was a liquid asset ratio-based system with quantitative controls on interest rates and credit. Little importance was attached to the interest rate as a corrective tool, the main form of monetary control being the use of liquid asset requirements. Commercial banks were obliged to hold certain assets defined as "liquid" as a specified minimum proportion of their deposits (appendix table A3). The limited supply and low yields of these assets were expected to curtail bank lending and money supply growth. Beginning in 1978 the SARB fixed its accommodation rates at a margin above the market rates of the previous week (this practice ceased in December 1983). The result was an upward ratcheting of interest rates during money market shortages (when banks needed accommodation): market rates followed the accommodation rates, which, in turn, followed the market rates (De Kock and others, 1978, 1984). Since the main instrument of credit control was direct limits on the banking system, considerable disintermediation occurred, particularly between 1976 and 1980, distorting the credit supply figures.

Increasing dissatisfaction with the liquid asset ratio-based system led to enactment of a range of reforms beginning in the early 1980s (appendix table A3), moving toward a cash reserves-based system following the recommendations of the De Kock Commission (De Kock and others, 1978, 1984). The removal of some direct controls

(such as those on deposit rates) in March 1980, and bank credit ceilings later that year, resulted in reintermediation and a decline in the velocity of circulation. There were also technical changes to asset requirements over a few years, and the role of the discount rate was redefined. This second regime was in full operation by mid-1985.

Under the cash reserves system, preannounced monetary targets were used for the first time beginning in 1986 (see section 1.4), to be achieved indirectly through adjusting interest rates.[11] The main policy emphasis was on using the central bank's discount rate to influence the cost of overnight collateralized lending and hence market interest rates.

In practice, to reduce the demand for bank credit, the SARB increased the bank interest rate at which it provided discount-window accommodation to banking institutions against collateral in the form of various government bills. The supply of credit (a major component of money supply changes in South Africa) could be influenced by open market operations and various other policies acting on overall liquidity. By creating a persistent "money market shortage" and setting the bank rate at a relatively high level, the SARB was able to link commercial bank interest rates fairly closely to the bank rate. According to the SARB, monetary control thus operated indirectly by slowing the demand for money, with an estimated lag for its ultimate effect on inflation of over twelve months (see, for example, Stals, 1995a).

Under the third system of monetary accommodation, introduced in 1998 and based on daily tenders of liquidity through repurchase transactions, monetary growth guidelines continued to be announced, as well as an inflation target. Domestic and international financial liberalization further reduced any usefulness of the monetary targets. The government also wished to avoid the political sensitivity of direct interest rate setting in a context of volatile capital flows. The repurchase interest rate is determined at auction. In theory, rather than controlling the price of liquidity by setting the discount rate, monetary policy effectively rations the quantity of liquidity. The SARB signals its policy intentions on short-term interest rates to the market through the amount offered at the daily tender for repurchase transactions (see *South African Reserve Bank Quarterly Bulletin*, June 1999). A full provision of the estimated daily liquidity requirement of banks indicates a neutral position, whereas marginal over- or underprovision of the estimated liquidity requirement signals that the SARB would prefer the

11. In 1990 the term "money supply targets" was replaced by "money supply guidelines."

repurchase rate to stabilize at prevailing levels. Significant over- or underprovision of liquidity signals a preference for movement in the repurchase rate, the degree of which depends on the extent of rationing. Auctions with a predetermined fixed interest rate, much used in the early days of the new system, now only operate under exceptional circumstances, when the SARB seeks an immediate and substantial change in money market interest rates (for example, in the face of a large external shock). However, in practice there has been little difference in interest rate behavior between the current and the previous regime: even under price auctioning, the commercial banks collectively have remained heavily influenced by SARB-directed preferences for the level of the interest rate.

1.4 Explicit Monetary and Implicit Exchange Rate Targets

Monetary Targets. Explicit monetary growth targets for M3 were announced annually from 1986 to 1998, following the recommendations of the De Kock Commission (De Kock and others, 1984).[12] The choice of M3 centered on its supposedly relatively stable relationship over time to current GDP, on the view that it was less sensitive than other money aggregates to disintermediation and reintermediation, and on the assumption that, being so broad, it reflected changes in the budget deficit, private credit extension, and the balance of payments. Target ranges were set annually using a three-month moving average of the aggregate and were announced in the March budget to cover the period from the fourth quarter of the previous year to the fourth quarter of the current year.

The setting of the target aimed both to accommodate projected real GDP growth and to contain inflation, although the procedure used to choose the target was not transparent. As at the German Bundesbank (Clarida and Gertler, 1997), these targets were intended as guidelines rather than strict rules. The SARB had discretion to breach the targets, for instance in the face of external trade and financial shocks. There was no penalty for doing so, nor was a public explanation required (as it is for the Bundesbank).

The target growth zones and money growth outcomes for 1986-98 are given in figure 1. Large deviations are apparent during the 1980s,

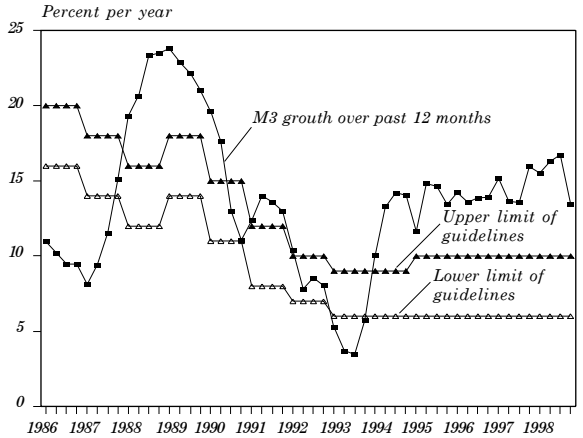
12. M3, newly defined for targeting purposes, is a broad definition of money that includes notes and coins held by the public as well as all types of deposits—short-, medium-, and long-term—of the domestic private sector with South African banking institutions. Since March 1998, M3 growth guidelines have operated over a three-year rather than an annual basis.

and persistent overshooting from 1994 onward, after the resurgence of capital inflows to South Africa. Starting in the 1990s the guidelines were supplemented by an eclectic set of indicators, including the exchange rate, asset prices, the output gap, the balance of payments, wage settlements, total credit extension, and the fiscal stance (*South African Reserve Bank Quarterly Bulletin*, October 1997).

Exchange Rate Targets. Starting in 1979 the SARB engaged in active intervention in both spot and forward foreign exchange markets, although low levels of reserves at certain times limited its extent. There is some evidence that, during 1979-88, exchange rate intervention was directed at maintaining profitability and stability in the gold mining industry by smoothing the real rand price of gold faced by producers despite large fluctuations in the dollar price of gold (Kahn, 1992).[13]

After August 1989, under a new governor, Chris Stals, the SARB appeared to be actively seeking to stabilize the real effective exchange rate, partly out of concern for the international competitiveness of South Africa's manufacturing exports. The apparent aim was to prevent excessive real appreciation of the rand when the currency was tending to appreciate in nominal terms. There was, however, no explicit official policy to stabilize the real exchange rate.

Figure 1. South Africa: Actual and Target Percent per year Money Growth



Source: *South African Reserve Bank Quarterly Bulletin,* various issues.

13. It was only after December 1988 and for a limited period between September 1983 and January 1985 that the SARB paid the gold mines in dollars (50 percent of gold production was paid in dollars during 1983-85) and reduced its role in the foreign exchange market.

Intervention was less successful at stabilizing the exchange rate in the uncertain atmosphere before the elections of April 1994, when huge capital outflows occurred. However, during the first twenty-one months after the elections, the nominal rand-dollar exchange rate moved by no more than 2 percent from 3.65 rand to the dollar. From April 1995 to January 1996 the range was even narrower, with the currency moving in an "implicit" band of R3.65 plus or minus 1 percent. Many investors viewed the stylized fact of a steady bilateral rate in the face of the large capital inflows as a "one-sided" implicit nominal target (see, for example, Union Bank of Switzerland, 1996). Officially, the SARB claimed that the rand was floating and that the interventions were intended only to smooth temporary and reversible short-term fluctuations (Stals, 1995b). After a classic exchange rate crisis in early 1996, with a massive loss of reserves (Aron and Elbadawi, 1999), a pattern of periodic temporary targeting of the nominal exchange rate was apparently resumed. Under inflation targeting such exchange rate management is expected to have a fairly low priority.

2. Monetary Policy and Outcomes, 1980-98

The following brief and selective review of monetary policy and outcomes over two decades is organized around four episodes: 1980-85, 1986-89, 1989-93, and 1994-98. In the first episode, under Governor De Kock from 1981 on,[14] credit controls were rapidly removed and liquid asset ratios more gradually reduced from levels close to 60 percent in the early 1980s to around 25 percent by early 1985. The definition and use of the "bank rate" (the discount rate) underwent important changes. During the second episode, a cash reserves-based monetary policy system operated under De Kock, and flexible money supply targets were announced annually starting in 1986. A new governor, Governor Stals, presided over the third and fourth episodes, which are distinguished from the earlier two by less variable and consistently positive real interest rates. The capital account was opened to nonresidents after democratic elections in 1994. A period of considerable currency volatility ensued, which helped catalyze the change to a repurchase system of monetary policy beginning in March 1998.

14. A useful source on this period is Gidlow (1995).

2.1 From 1980 Q1 to 1985 Q3

The period of the early 1980s was a complicated one for monetary policy, combining major shifts in monetary and exchange rate regimes and a huge gold price shock. Further, the limited political liberalization initiated in the period led to social unrest, which received international publicity. Opprobrium for the apartheid regime and a deteriorating sovereign risk rating were reflected in capital outflows and disinvestment, culminating in an external debt crisis in 1985 and international trade and financial sanctions.

During the 1970s annual inflation had averaged 9.0 percent,[15] with the principal shocks to prices coming from the 1973 and 1979 oil shocks and the sharp gold price rise from 1979 on.[16] The use of import surcharges over and above the tariff regime represented a considerable tightening of trade policy. The surcharges were first used in April 1977, following the cessation of capital inflows in the wake of the 1976 Soweto riots. They remained in force until March 1980, when high gold prices took the pressure off the current account. High import surcharges were reintroduced from February 1982 to November 1983.

The SARB's quarterly discount rate averaged 6.6 percent during the 1970s, declining after each of the oil shocks (figure 2). However, the main downward pressure on interest rates in 1979-80 came from an (unsterilized) accumulation of reserves by the SARB in response to the rising gold price, in an attempt to prevent excessive appreciation of the newly floating rand. By the first quarter of 1980 the discount rate had reached a trough of 4.7 percent, despite inflation at almost 15 percent. The low interest rates helped fuel an investment boom, and later a consumption boom, which partly dissipated the windfall gains. The ensuing current account deficits were financed by a substantial buildup of foreign debt.

This inflationary trend was later reversed after a very sharp rise in interest rates starting in 1981 (figure 2).[17] This occurred in two stages. First, under a new monetary policy regime, interest rates were liberalized (appendix tables A1 and A2), but the discount rate was

15. Inflation figures are reported for the four-quarter log change in the quarterly consumer price deflator, which is the variable used in our inflation forecasting equations. This slightly understates the conventional percentage change measurement, particularly when inflation rates are high.

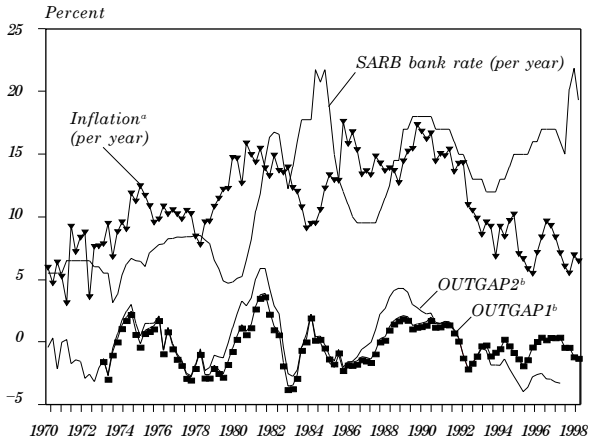
16. The gold price reached a peak of $850 per fine ounce in January 1980.

17. The average quarterly discount rate during 1980 Q1 to 1985 Q2 was 14.1 percent, while annual inflation averaged 13 percent. The quarterly real prime interest rate averaged 4.1 percent.

automatically tied to the market rates in the manner described in section 1. In the aftermath of the gold shock, in 1981-82, the ensuing money market shortage produced a ratcheting up of interest rates.

In the second stage beginning in 1983, the commercial and financial exchange rates were unified, as already noted. This removed the shield to domestic inflation and interest rates provided by the dual exchange rate regime. Large capital outflows induced a sharp fall in the currency. These outflows were not sterilized. In the event, the exchange rate unification was temporary: it was abandoned at the onset of the debt crisis in late August 1985. The effect was to prevent further outflows of capital by foreign investors, except where there was matching inward investment. The nominal effective exchange rate fell from 278 to 145 (1990 = 100) during the unification period. The feed-through to inflation became evident by late 1984, and coupled with continuing strong consumer demand, this induced a sharp rise in interest rates, which reached almost 22 percent in early 1985. Quarterly real prime interest rates averaged almost 10 percent during the unification period. The contractionary effect on the money supply, however, was partly offset by a domestic credit expansion, fueled by the SARB's monetary accommodation policies and financial liberalization (including the removal of interest rate controls and a reduction in bank reserve requirements).

Figure 2. South Africa: Output Gap, Inflation and SARB Bank Rate Percent



Source: Authors' calculations and *South African Reserve Bank Quarterly Bulletin,* various issues.
a. Change in log (consumer deflator).
b. Log (output) deviation from trend. For more details see section 3.2.

2.2 From 1985 Q3 to 1989 Q2

Following the debt standstill in 1985, no new foreign bank loans were forthcoming, apart from trade credits. Coupled with the requirement to repay capital and interest on the existing debt, this implied that the capital account remained in deficit until 1994.[18] Continuing pressure on the capital account required the economy to adjust in order to maintain current account surpluses of over 3 percent of GDP (Leape, 1991). This adjustment was partly achieved by the sharp currency depreciation, and partly by trade policy, with large increases in tariffs and the reimposition of large import surcharges in September 1985. There was a collapse of domestic investment by both private firms and state enterprises.

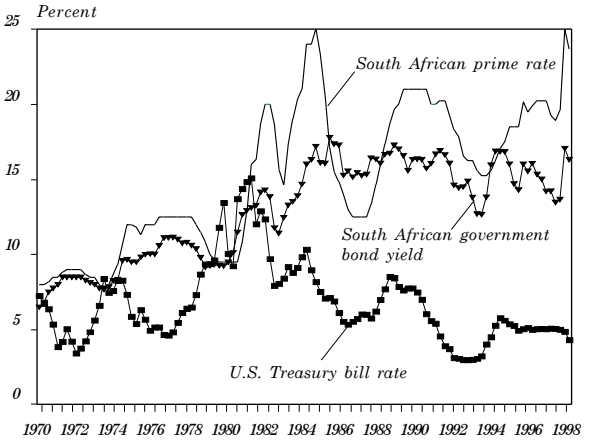
With investor confidence declining, the SARB tried to stimulate demand domestically. Within a year of the crisis, nominal interest rates had more than halved, to trough at 9.5 percent. Inflation continued to rise, averaging 16.4 percent in 1986, and the real interest rate entered negative territory in 1986 for the first time in four years.

However, with gold prices rising from late 1986 through 1988, domestic investment and growth began to increase (figure 2), inducing a current account deficit in the second quarter of 1988. Trade policy was tightened considerably: import surcharges were increased in 1988, at times generating more revenue than the already high tariffs. Interest rates were raised substantially: between the first quarter of 1988 and the second quarter of 1989, the bank rate increased from 10.5 percent to 17 percent, in part influenced by substantial rises in world interest rates over the same period (figure 3). Positive growth trends were reversed. Thus monetary policy may have been influenced by balance of payments considerations.

Significant domestic financial liberalization was under way by the mid-1980s (see section 3.3 and appendix tables A4 and A5), which rapidly increased credit growth (figure 4). Money targets were announced from 1986 onward (table 2). By the end of 1986, M3 growth had turned sharply upward, and within a year it had exceeded its target ceiling (see figure 1). M3 growth remained outside the target for the remainder of this episode, beginning to decline only in the second quarter of 1989, when interest rates reached 17 percent.

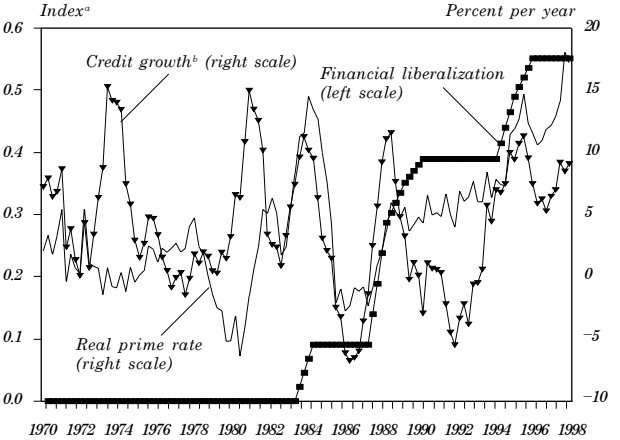
18. At the time of the debt crisis, approximately 70 percent of South Africa's debt, which amounted to 42 percent of GDP, had a maturity of less than one year. The final 1994 debt arrangements provided for the full amortization of the affected debt by August 2001.

Figure 3. Percent U.S. and South African Interest Rates



Source: *South African Reserve Bank Quarterly Bulletin,* various issues.

Figure 4. South Africa: Index Financial Liberalization



Source: Authors' calculations and *South African Reserve Bank Quarterly Bulletin,* various issues.
a. Index constructed using the authodology described in Aron and Muellbauer (2000c).
b. Real growth in credit to the private sector.

2.3 From 1989 Q3 to 1994 Q1

After the accession of Governor Stals in the third quarter of 1989, real interest rates were less variable and consistently

positive.[19] High rates were maintained with the twin objectives of curbing inflation and maintaining a current account surplus. Nominal interest rates rose to 18 percent by the end of 1989 and remained there for a year before falling to 17 percent in 1991. Inflation remained persistent until 1992, usually exceeding 15 percent in these years.

Balance of payments pressures moderated in the early 1990s, partly because of prospects for political reform under a new leadership. The high import surcharges were sustained until the elections but were phased out by the end of 1995. In the uncertain atmosphere before the 1994 elections there were again huge capital outflows. Despite borrowing from the International Monetary Fund and a significant increase in other short-term foreign borrowing, the SARB was unable to prevent a nominal effective depreciation of close to 19 percent between January 1993 and the end of July 1994. (The corresponding real depreciation was about 10 percent.)

During 1992-93 the bank rate gradually declined to 12 percent, at which level it was sustained until the elections. (U.S. interest rates had fallen sharply during 1991 and 1992.) Starting in 1992, a trend decline in inflation began, with inflation reaching single figures in early 1993. The reversal was strongly connected with trade liberalization (see Aron and Muellbauer, 2000a). Under Governor Stals, money targets declined until the mid-1990s. Money growth fell sharply, to within or close to the official targets from mid-1990 until the election (figure 1). Annual real GDP growth fell from 2.4 percent in 1989 into negative territory the next year, recovering somewhat only in 1993, when real growth measured 1.2 percent.

2.4 From 1994 Q2 to 1998 Q1

Following democratic elections in April 1994, the new government committed itself to a long-term development strategy for generating rapid and widely shared growth through two highly publicized programs.[20] It also promised to achieve macroeconomic stability in

19. From 1980 to 1992, inflation displayed strong inertia, fluctuating about the 14 percent level and with a quarterly maximum of close to 18 percent. However, with the discount rate varying from 4.7 percent in 1980, to 22 percent in 1984, to 9.5 percent by end of 1986, and then 18 percent by the end of the decade, there was substantial variability in real interest rates.

20. The broad goals of the earlier Reconstruction and Development Programme (RDP) were reinforced by the Government's Growth, Employment and Redistribution strategy (GEAR), announced in June 1996.

the short to the medium run. The initial assessment by international capital markets was that the country would achieve a sustained growth path, in a situation where strong and sophisticated financial markets, a robust civil society, and transparent and democratic governance were seen as comparative advantages.

However, after an initial upturn, growth performance after the elections was disappointing. Real GDP growth was 0.5 percent in 1998 and 2.4 percent in 1997, compared with 4.2 percent and 3.1 percent in 1996 and 1995, respectively. Apart from labor market inflexibility, trade competition, and a declining gold price from late 1996 onward, probably the most important factor affecting growth performance was high real interest rates.[21] These were a direct consequence of rapid liberalization of the capital account and the need to manage the ensuing large, volatile capital inflows.

Capital flows to the country increased markedly after the elections, although from a very low base following more than a decade of financial sanctions. Flows accelerated with the effective removal of exchange controls on nonresidents in March 1995, after the dual exchange rate system was again unified (appendix table A7). A large proportion of the inflows consisted of short-term flows, making the economy vulnerable to flow reversals.

Aron and Elbadawi (1999) argue that the SARB had dual objectives during the period of large net capital inflows from April 1994 until the first currency crisis in February 1996.[22] These were to contain inflation through an interest rate policy based on explicit monetary targets, and to stabilize the nominal exchange rate, de facto, through an implicit one-sided target. As is well known from the literature on currency crises, under persistent capital inflows a policy trade-off arises where sustaining an exchange rate "target" may come at the expense of higher inflation, higher interest rates, and eventually reduced output.

The SARB intervened heavily in the market to prevent the currency from appreciating, at the expense of the monetary targets (Stals, 1995b). Note that the money target floor did not alter in this episode, but the ceiling was raised in 1995, widening the band and reflecting the diminished status of the monetary targets under a capital account

21. See, for example, the output forecasting model in Aron and Muellbauer (2000a).

22. Subsidiary goals were to withdraw from the forward foreign exchange market and to accumulate foreign reserves (Stals, 1994).

liberalized to inflows (as described in section 1.4). Sterilization of the effects of the reserve accumulation began only late in 1994. Consequently, large increases in the liquidity of the banking sector induced an "endogenous" financial liberalization, compounding the recent explicit liberalization, for instance through the mortgage market (see section 3.3). Private sector credit grew strongly, partly because of demand-led pressures from new borrowers under the new political dispensation. Adding to balance of payments pressures was a progressive liberalization of trade policy, while trade volumes responded strongly to the ending of trade sanctions.

The excess money growth is evident in figure 1. As a consequence, monetary policy was tightened considerably. The bank rate rose sharply from 12 percent at the time of the elections to 15 percent by mid-1995, minimum cash reserve requirements for banks were increased, and open market operations were initiated. The trend decline in inflation, which had begun around 1992, persisted after the elections, although with some volatility (figure 2). Annual inflation averaged 8 percent during 1994 Q2 to 1997 Q4, compared with 13.6 percent during the previous episode (1989 Q3 to 1994 Q1). However, it then increased after the elections, reaching double digits again in mid-1995.

Interviews conducted by the authors suggest that, toward the end of 1995, foreign investors had become concerned about the widening current account deficit, apparently rising inflation, the size of the domestic public debt, and the real effective appreciation of the rand (modest though it was). Further, it was anticipated that domestic exchange controls would be significantly relaxed in the Budget (early March 1996). In the event, the intended decontrol package was put on hold until July 1997, given the currency crisis that had begun in mid-February. By late April the rand had depreciated by 20 percent from its mid-February level. The SARB intervened massively to try to prevent this depreciation, with a net cumulative intervention of $5.3 billion from mid-February to the end of April (Centre for Research into Economics and Finance in Southern Africa, 1996).

Crises recurred in October 1996, November 1997, and April 1998, triggered largely by contagion effects from the Asian crisis, but also by declines in the prices of gold and other metals. After the April 1998 crisis, in which there was also substantial intervention, the rand was some 40 percent below its average value between the elections and the first crisis.

The bank rate rose to 17 percent after the first crisis and remained at that level until the end of 1997; it then fell to 15 percent just before the April 1998 crisis, when it was raised to over 20 percent (figure 2). Given that inflation averaged just over 6 percent in 1998, this implied very high real interest rates. Unsurprisingly, output was seriously reduced. Investors had generally revised their expectations about emerging markets in the aftermath of the Asian crises, but nevertheless domestic factors such as the widening current account deficit and poor growth prospects further damaged investor confidence in South Africa.

3. Interest Rate Rules: Specification and Estimation

3.1 Simple Interest Rate Rules

A substantial literature has accumulated on the Taylor rule (Taylor, 1993),[23] which describes interest rate-setting behavior by central banks with some autonomy over monetary policy (Taylor, 1999). The simple Taylor rule characterizes an interest rate feedback policy that is a linear function of both the deviation of actual from target inflation and the output gap (that is, a measure of the deviation of output from capacity or trend output):

$$i_t^* = \alpha + \beta\left(\pi_t - \pi^*\right) + \gamma\left(y_t - y_t^*\right) , \tag{1}$$

where $\alpha \equiv \bar{r} + \pi^*$, $\beta > 1$, and $\gamma > 0$. The target interest rate defined by the rule is i_t^*, $\bar{r}$ is the long-run equilibrium real interest rate, π^* is the target inflation rate, y_t is real output, and i_t^* is trend output.[24] Inflation adjusts gradually to its target through the adjustment of real interest rates, and with $\beta > 1$, the nominal rate adjusts more than one for one with inflation. The role of the output gap is to adjust countercyclically with demand shocks but to accommodate supply shocks reflected in i_t^*.

23. Related early work is that by McCallum (1988), and Henderson and McKibbin (1993) examined a rule similar to equation (1) below.

24. In practice, Taylor (1993) used a backward-looking measure of inflation: the deviation between inflation in the past year and target inflation. He did not estimate the rule for the United States but used judgment to suggest that parameter values of $\beta = 1.5$ and $\gamma = 0.5$ for $\bar{r} = 2$ and $\pi^* = 2$ well described U.S. interest rate policy during 1987-92.

There is a large literature, going back to Phillips (1954), on optimal control in dynamic, stochastic macroeconomic equation systems. Optimal control policies for any but the simplest systems tend to be sensitive to model misspecification and are complex and nontransparent. Since an important aim of stabilization policy is to influence private sector expectations, recent research has instead emphasized simple, robust rules that are more easily understood by the private sector. Thus part of this research effort has been devoted to finding "good" parameter values for particular classes of relatively simple linear feedback rules. Policy simulations with macroeconometric models for a range of countries suggest that variants of the Taylor rule have desirable stabilization properties (see, for example, Taylor, 1999, and Levin, Wieland, and Williams, 1999).

We present a generalized and forward-looking version of the Taylor rule based on work by Clarida, Galí, and Gertler (1998a), which encompasses the simple Taylor rule and other variants as special cases. Batini and Haldane (1999) have recently emphasized the importance of forward-lookingness in monetary policy, and in practice it is highly relevant in inflation-targeting countries.[25] The target for the nominal short-term interest rate, i_t^*, is given by

$$i_t^* = \bar{i} + \beta\left[\mathrm{E}\left(\pi_{t+n}/\Omega_t\right) - \pi^*\right] + \gamma\left[\mathrm{E}\left(y_t/\Omega_t\right) - y_t^*\right] + \xi\mathrm{E}\left(z_t/\Omega_t\right), \qquad (2)$$

where E is the expectation operator and Ω_t is a vector representing the central bank's information when setting interest rates at time t, $\bar{i}$ is the long-run equilibrium nominal interest rate, π_{t+n} is the forecast rate of inflation between time t and $t + n$, y_t is real output, y_t^* and π^* are desired output and target inflation, and z_t is a vector of additional variables that may influence on policy.

Much of the literature on the Taylor rule has focused on the United States, a large, relatively closed economy. Inclusion of the z_t variables can be motivated by modeling considerations from small, open economies, or by the use of money targets by the country in question. Candidates for the z_t variables thus include foreign interest rates,

25. Rotemberg and Woodford (1999) argue that there are circumstances where backward-looking rules can work well. In their example, private agents are forward-looking and believe that the central bank will adhere to its rule and that economic activity depends on expected future interest rates or long-term rates, and not just on current short-term rates.

the money supply (or its deviation from an announced target), and the real exchange rate (or the deviation of the nominal rate from an announced target).[26]

The case for including foreign interest rates is the following. For small, open economies subject to some degree of international capital mobility, domestic interest rates will necessarily tend to follow foreign rates if the domestic monetary authority wishes to stabilize the nominal exchange rate. In the extreme case of perfect capital mobility, under the uncovered interest parity condition, international interest rate differentials reflect expected changes in the nominal exchange rate and risk premiums. Analogously, for a monetary authority wishing to stabilize the real exchange rate, domestic real interest rates will tend to follow foreign real rates (see Taylor, 1995, p. 16). Recent literature emphasizes the importance of exchange rate targets, implicit or otherwise, in small, open economies. Indeed, the role of the exchange rate increases in importance in policy formulation, the shorter the inflation target horizon (see Ball, 1999).

Clarida, Galí, and Gertler (1998a) emphasize the importance of the parameter β in evaluating policy rules. The implicit real interest rate target corresponding to equation (2) is

$$U_t^* = U + (\beta - 1)\left[\left(\pi_{t+n}/\Omega_t\right) - \pi^*\right] + \gamma\left[\left(y_t/\Omega_t\right) - y_t^*\right] + \xi\left(z_t/\Omega_t\right), \tag{3}$$

where r_t^* is the target for the real short-term interest rate and $\bar{r}$ is the long-run equilibrium real interest rate. The target rate adjusts relative to the equilibrium interest rate when inflation or output deviates from the target. If β exceeds 1, as in the simple Taylor specification in equation (1), the target rate adjusts to stabilize inflation and output; if β is less than 1, the target rate accommodates changes in inflation (real interest rates fall).

One widely adopted modification of the Taylor rule is to permit the central bank to smooth changes in the interest rate. Central banks typically try to avoid interest rate volatility, in order to promote financial market stability and avoid loss of credibility from interest rate reversals (see, for example, Mishkin, 1999, p. 247). Clarida, Galí,

26. Clarida, Galí, and Gertler (1998a) also examine lagged inflation, to test the simple Taylor rule against their forward-looking specification.

and Gertler (1998a) assume a partial adjustment of the central bank's rate to the target rate as follows:

$$i_t = (1-\rho)i_t^* + \rho i_{t-1} + \upsilon_t \,, \tag{4}$$

where υ_t is a random shock. Equation (2) can be simplified by setting $\alpha \equiv \bar{i} - \beta\pi^*$ and

$x_t \equiv y_t - y_t^*$, or

$$i_t^* = \alpha + \beta \mathrm{E}(\pi_{t+n}/\Omega_t) + \gamma \mathrm{E}(x_t/\Omega_t) + \xi \mathrm{E}(z_t/\Omega_t) \,, \tag{5}$$

where z_t includes the foreign interest rate (the U.S. rate, i^{USA}, in our case). Formalizing a comment in Clarida, Galí, and Gertler (1998a), an alternative interpretation of the interest rate target as the weighted average of an extended Taylor rule and the foreign interest rate is

$$\begin{aligned} i_t^* = (1-\lambda)\big[\alpha + \beta(\,(\pi_{t+n}/\Omega_t\,) + \gamma(\,(x_t/\Omega_t\,) + \xi(\,(z_t'/\Omega_t\,)\big] \\ + \lambda(\,(i_t^{USA}/\Omega_t\,) \,. \end{aligned} \tag{6}$$

Note that z_t' now refers to other variables excluding the foreign interest rate. When $\alpha > 0$ and $\beta > 0$, this has the effect of raising the implied reaction to inflation in the Taylor rule, compared with equation (5).

The combination of partial adjustment with the model in equation (5) gives

$$\begin{aligned} i_t = (1-\rho)(1-\lambda)\big[\alpha + \beta(\,(\pi_{t+n}/\Omega_t\,) + \gamma(\,(x_t/\Omega_t\,) + \xi(\,(z_t'/\Omega_t\,)\big] \\ + (1-\rho)\lambda(\,(i_t^{USA}/\Omega_t\,) + \rho i_{t-1} + \upsilon_t \,. \end{aligned} \tag{7}$$

Note that the special case of inflation targeting is nested within this specification, where the weight on the output gap and z_t terms is zero, and the policy rate responds only to expected inflation (see Batini and Haldane, 1999).

3.2 Estimating an Extended Taylor Rule for South Africa

Estimating extended Taylor rules can lend insight into past policy rules when the size of the weights applied to different indicators in

interest policy formation is unknown, or where policy may deviate in practice from stated policy.[27]

Rewriting equation (7) in terms of realizable variables gives the following estimable function:

$$i_t = \delta_0 + \delta_1 i_{t-1} + \delta_2 \Delta_4 \ln P^F_{t+k} + \delta_3 x^F_{t+m} + \delta_4 z^F_t + \delta_5 i^{USA}_{t-1} + \varepsilon_t , \qquad (8)$$

where $\delta_0 = (1-\rho)(1-\lambda)\alpha$, $\delta_1 = \rho$, $\delta_2 = (1-\rho)(1-\lambda)\beta$, $\delta_3 = (1-\rho)(1-\lambda)\gamma$, $\delta_4 = (1-\rho)(1-\lambda)\xi$, $\delta_5 = (1-\rho)\lambda$, and ε_t is the error term. The central bank's short-term discount rate is i_t, $\Delta_4 \ln P_{t+k}$ is the annual rate of change of the consumer price deflator over the horizon of k quarters, and x_{t+m} is the output gap at $t + m$ quarters. F denotes the forecast value of these two variables using information available at $t - 1$. The horizon of k and m is at the discretion of the central bank but will be constrained by its forecasting ability. Finally, i^{USA}_{t-1} is the foreign short-term interest rate (we use the U.S. three-month Treasury bill rate).

We later extend the set of z_t terms in this model to include deviations of money growth from announced targets, as well as exchange rate and balance of payments effects, and we control for an important regime shift, namely, the financial liberalization of the early 1980s.

The SARB's end-of-quarter bank discount rate was modeled using equation (8) for the period 1986 Q2 to 1997 Q4, using an instrumental variables (IV) technique to instrument forward-looking expectations.[28] The discount rate, scaled by 100, is shown in figure 2. Four alternative horizons were selected.[29] The first gives a backward-looking model where $k = m = 1$. This can be estimated by the ordinary least-squares method. The second uses contemporary inflation and output gaps, $k = m = 0$. The IV estimation is used on the conservative assumption that the SARB's information set is

27. For instance, Clarida and Gertler (1997) argue that, despite the Bundesbank's claims to base interest rate policy largely on ensuring that monetary growth falls within specified target ranges, a modified Taylor rule provides a better description of its actual behavior.

28. Clarida and Gertler (1997) use the generalized method of moments to estimate the parameter vector for a Taylor rule similar to equation (8).

29. Note that in estimating equation (8) we assume that, over a short horizon, short-term interest rates and inflation are stationary, that is, I(0). The evidence is given in table 3. Note that the augmented Dickey-Fuller test (Dickey and Fuller, 1979) has low power against the alternative of stationarity over the short sample.

dated $t-1$.[30] The third model uses forward-looking inflation and the current output gap. Thus $k = 3$, implying the four-quarter-ahead inflation rate seen at $t-1$, and m = 0. The final specification takes forward-looking versions of both, $k = m = 3$.

Our models of the discount rate are estimated only from 1986 onward, for two reasons. First, the transition in the early to mid-1980s from a liquid assets-based system to a cash reserve-based system of monetary control was not accomplished immediately, and liquid asset requirements were reduced only gradually during 1980-85 from the abnormally high levels prevailing in 1980 (see section 1). The formal monetary growth target ranges were introduced for the first time in 1986. Second, during the debt crisis of 1985, interest rates were raised to extraordinary levels in a vain attempt to attract foreign capital inflows and prevent default on the external debt. Clearly a Taylor rule will fail to describe this shock.

The output gap is constructed using an extended version of stochastic trend models of the type recommended by Harvey (1993; see also Harvey and Jaeger, 1993). This can be estimated using the STAMP program of Koopman and others (1995). We used several different measures of the output gap. For the first measure, the model has the following form:

$$\log y_t = \alpha_0 + STOCH_t + \alpha_1 \log y_{t-1} + \sum_j \beta_j X_{jt} + \varepsilon_t \ , \tag{9}$$

where y_t is real GDP and $STOCH_t$ is a smooth, stochastic trend reflecting the underlying capacity of the economy to produce. The X_{jt} capture cyclical factors: we use distributed lags of changes in log capacity utilization and changes in the log real gold price for an estimation period of 1973 Q1 to 1998 Q4. The stochastic trend is defined as a moving average of random shocks. More precisely, *STOCH* is an I(2) variable, which requires twice-differencing to give a stationary series:

$$\Delta^2 STOCH_t = \eta_t \ , \tag{10}$$

where η_t is a random shock. The technique gives good results and is to be preferred to the widely used Hodrick-Prescott filter, because it does not rely on any arbitrary calibration of the variance

30. This is approximately correct for information available in the South African national accounts, although this is subject to revision. Information on prices and money and credit aggregates tends to be available with lags of a few weeks or less, and information on interest rates is almost instantaneous.

of the underlying shocks η_t (see Harvey and Jaeger, 1993, for a discussion). Instead, all the parameters of the model are estimated from the data.[31]

The resultant output gap, defined as $(\log y_t - \alpha_0 - STOCH_t)/(1 - \alpha_1)$, was used to construct the first output gap measure, OUTGAP1 (figure 2). This trend was compared in estimations with the alternatives of a cubic function of time and with split time trends. For almost all specifications reported below, the output gap derived from the stochastic trend model gives a better fit than these two alternatives. The second measure of the output gap, OUTGAP2, also shown in figure 2, employs a stochastic trend from a richer model of output taken from Aron and Muellbauer (2000a).[32] The principal differences between the two measures occur in the aftermath of the 1980-81 gold price shock and the smaller price shock in 1987, when OUTGAP2 indicates lower excess capacity in the economy, and after 1994, when OUTGAP2 indicates greater excess capacity.[33]

We also used two models for forecast inflation to derive instruments for the interest rate rule. A simple inflation forecasting model, similar in conception to the SARB models used at the time, was derived from a model linking consumer inflation, respectively, one

31. Standard augmented Dickey-Fuller tests suggest that, over 1973-98, $\log(y_t)$ is I(1), implying that $\Delta\log(y_t)$ is a stationary variable. The combination of equation (8), where the X_{jt} are clearly I(0), and equation (9), appears to contradict this, since $STOCH_t$ is I(2). However, the hypothesis that a variable such as $\log(y_t)$ is I(1) is hard to distinguish from alternatives, for example that $\log(y_t)$ has a large autoregressive component and is stationary about a deterministic trend, or a deterministic trend with a change in trend at some point in the sample. A low-variance I(2) stochastic trend resembles the latter. In other words, the hypothesis that $\log(y_t)$ is I(1) is quite hard to distinguish from the alternative of I(0), on the one hand, and I(2) on the other, when the I(2) component is a smooth, low-variance series.

32. This is a four-quarter-ahead forecasting model for the log of real GDP. The model uses a stochastic trend to measure long-run changes in the capacity to produce. On the demand side there are important negative interest rate effects, although these have been altered by changes in the monetary policy regime. The ratios of the trade surplus and the government surplus to GDP, which also respond to interest rate changes, and improvements in the terms of trade, all have a positive effect on future output. The deviation of output from the four-quarter lag of the stochastic trend defines the output gap.

33. The main economic reason is the inclusion of the real interest rate among the economic variables. This variable is I(1), and in the 1990s it rose strongly, depressing output, in part by contracting capital accumulation. Conceptually, therefore, OUTGAP2 differs from OUTGAP1. In recent years a demand boost from lower interest rates would generate more inflation using the OUTGAP1 measure. The OUTGAP2 measure effectively implies that capacity would respond to lower real interest rates, thus reducing the inflationary pressure.

quarter and four quarters ahead, with lags in consumer price and wholesale price inflation, wage changes, money growth, interest rate changes, and the output gap. This model does not have an equilibrium correction form, so that relative price levels play no role. A more sophisticated model is described in detail in Aron and Muellbauer (2000a).[34]

The results of estimating the extended Taylor rule in equation (8) for the four horizons are shown in table 4 (variables are defined in table 3, and the set of instruments is shown in the footnotes to table 4). The South African discount rate and the annual log change in the consumer expenditure deflator, our measure of annual inflation, are shown in figure 2. The foreign interest rate, again taken as the three-month Treasury bill rate for the United States, and two South African interest rates are shown in figure 3.

The results are striking. In all specifications the interest rate has a strongly significant *negative* response to domestic inflation, whether lagged or forward-looking. At the least this suggests that some important omitted factors influence short-term interest rates in South Africa. The U.S. Treasury bill rate is always significant, and the hypothesis can be accepted that, ceteris paribus, a 1-percentage-point rise in the U.S. rate is eventually followed by a more than 1-percentage-point rise in the South African rate.[35] The output gap is always significant. If the U.S. nominal interest rate is excluded, the fit of the model deteriorates markedly. There was little difference between using the more sophisticated and simpler forecasting inflation models as instruments, and we report results for the former. We tested robustness over both

34. The four-quarter-ahead inflation model has an equilibrium correction form, which clarifies medium- or longer-run influences on inflation, including opening the economy to foreign imports. This model implies that if consumer prices deviate from the trend of wholesale prices, an adjustment process tends to bring them closer together again. Further, when the real exchange rate is high (that is, the currency is strong in real terms), domestic price setters find it harder to push through price rises. The nominal exchange rate affects inflation through both these channels since wholesale prices are strongly linked to import prices. The model confirms the importance of the output gap and the influence from recent changes in the ratio of the current account surplus to GDP, both of which are sensitive to short-term interest rates. However, a rise in interest rates can also raise inflation in the short run, through a rise in the real prime rate and in mortgage interest payments (a component of the consumer price index). The one-quarter-ahead inflation forecast derives from the four-quarter-ahead forecast made three quarters earlier, updated using the intervening information on consumer prices, wholesale prices, and foreign inflation.

35. In all specifications the addition of the real U.S. Treasury bill rate, defined as the nominal rate less annual U.S. consumer price inflation, produces an insignificant, negative coefficient. Also note that the U.S. interest rate is defined as a period average, whereas the quarterly South African discount rate is measured at the end of each quarter. The implication is that the U.S. interest rate dated t is potentially part of the relevant information set of the SARB. We tested for this possibility but found it insignificant.

Table 3. Variable Definitions and Statistics

Variable	*Definition*	*Mean, 1986Q2-1997Q4*	*Standard deviation, 1986Q2-1997Q4*	*I(1),[a] 1980Q1-1997Q4*	*I(2),[a] 1980Q1-1997Q4*
Discount rate	SARB bank rate divided by 100	0.144	2.76E-2	–3.43*	–5.45**
U.S. Treasury	Three-month U.S. Treasury bill rate divided by 100	5.46E-2	1.52E-2	–3.41*	–5.19**
Inflation	Annual inflation rate of the consumer expenditure deflator	0.120	3.48E-2	–1.60	–3.79**
Output gap measure	Deviation of real GDP from a stochastic trend	1.69E-3	1.36E-2	–3.77**	
Excess M3 growth	Annual growth rate of M3 less the annual growth target rate	3.12E-2	4.96E-2	–4.97**	
FLIB	Financial liberalization measure (see text for full definition)	0.411	0.163		
DumANC	Equals 1 for 1994Q2-1997Q4 and 0 otherwise				
DumANC*excess M3 growth	DumANC interacted with excess M3 growth ($t-1$)				
ZBOP	Negative values only for the ratio of the (lagged) current account surplus to GDP (in percent) minus 2				

Source: Authors' calculations.

a. For a given variable X, the augmented Dickey-Fuller (1979) statistic is the t statistic on π from the following regression: $\Delta X_t = \pi X_{t-1} + \sum_{i=1}^{k} \theta_i \Delta X_{t-i} + \Psi_0 + \Psi_1 t + \varepsilon_t$, where k is the number of lags on the dependent variable, ψ_0 is a constant term, and t is a trend. The kth-order augmented Dickey-Fuller statistic is reported, where k is the last significant lag of the five lags employed. The trend is included only if significant. For null order I(2),ΔX replaces X in the equation above. Critical values are obtained from MacKinnon (1991). Asterisks * and ** denote rejection at the 5 percent and 1 percent critical values, respectively. The stationarity tests are performed for the variables in levels before time transformation, that is, before taking moving averages and changes. For the variable excess M3 growth, the sample period for the stationarity tests is 1986Q2-1997Q4. The output gap measure is OUTGAP1 (see text).

Table 4. Results of Regressions Testing Taylor Rules with Partial Adjustment and Foreign Rates [a]

	Regression equation			
Explanatory variable	*(1)*	*(2)[b]*	*(3)[c]*	*(4)[d]*
Intercept	0.032 (4.0)	0.028 (4.1)	0.032 (3.5)	0.017 (3.3)
Discount rate ($t-1$)	0.830 (22.6)	0.852 (27.0)	0.809 (22.0)	0.889 (25.7)
U.S. Treasury bill rate ($t-1$)	0.287 (4.2)	0.281 (3.7)	0.387 (4.9)	0.353 (2.8)
Lagged inflation	0.194 (5.8)			
Current inflation		0.188 (5.6)		
Future inflation			0.225 (4.9)	0.180 (5.3)
Lagged output gap	0.365 (3.7)			
Current output gap		0.373 (3.1)	0.424 (2.8)	
Future output gap				0.281 (2.1)
SER	0.00552	0.00614	0.00682	0.00721
R^2	0.964	0.955	0.944	0.938
Adjusted R^2	0.960	0.950	0.939	0.932
DW	2.40	2.42	1.84	1.72
F statistic[e]		3.00 p = 0.010	2.27 p = 0.041	2.50 p = 0.020

Source: Authors' calculations.
a. The dependent variable is the SARB discount rate. The sample period is 1986Q2 to 1997Q4. Absolute values of asymptotic t statistics are in parentheses. The output gap measure is OUTGAP1, the inflation forecasting equations are the more sophisticated models, and the broad set of instruments is used. The instruments used for regression equations (2) to (4) are the lagged financial liberalization indicator, the lagged deviation of annual M3 growth from target, one lag each of quarterly and annual inflation rates, two lags in the rate of change in capacity utilization, two lags in the rate of change of the nominal exchange rate, and the lagged annual growth rate of real private sector credit.
b. Fitted values from our equations for annual inflation and the output gap are added, using $t-1$ information.
c. Forecast value of the three-quarters-ahead annual inflation rate is added, using $t-1$ information.
d. Forecast value of the three-quarters-ahead annual rate of growth of output is added, using $t-1$ information.
e. The F test is a test for overidentifying restrictions on the instruments.

measures of the output gap, and for a narrower set of instruments, and found very similar results in each case.

It would appear therefore that, in the 1986-97 period, the SARB was concerned with stabilizing output: that is, it raised interest rates when output or prospective output was above trend. However, it apparently

moved interest rates perversely with inflation or prospective inflation. This seems not to be the most obvious way of controlling inflation, although to the extent that the output gap is a cause of subsequent inflation, the focus on the output gap is likely to have been beneficial. However, a specification test of overidentifying restrictions for regression equations (2) to (4) in table 4 rejects all the specifications.[36]

3.3 Further Extensions of the Taylor Rule

Since, on the evidence just presented, the extended Taylor rule represented by equation (8) clearly makes little sense for South Africa, further extensions of the set of z_t terms in equation (6) were considered.

Extensions of the Taylor Rule for Excess Money Growth. Since in 1986 the SARB declared its official policy to be one of following monetary growth targets, one can include in the equation the deviation of actual monetary growth from the announced target (taking the latter to be the average of the upper and lower ranges set for the guidelines; figure 1). Experimentation suggested that the deviation of annual monetary growth perceived at t − 1 was a better measure than the current growth measure (instrumented appropriately). The results are shown in table 5. The excess money growth term has a significantly positive effect in all four specifications. The fit of all the equations improves compared with table 4. The counterintuitive result of a negative inflation effect remains but is much weaker, and indeed is insignificant in the current and forward-looking inflation specifications. Again there was little difference between regressions using the more sophisticated and those using the simpler forecasting inflation models, and between different measures of the output gap, and for a narrower set of instruments than reported.

Although the results in table 5 are less implausible than those of table 4, the combination of results from the two tables suggests that excess money growth is negatively related to recent, current, and future inflation, given the other variables in the hypothesized interest rule relationship. Clearly the excess money growth variable in table 5 eliminates about half the negative inflation effect in table 4.

36. The test compares the fit of the unrestricted reduced-form regression of the dependent variable on all the instruments with the fit obtained when the endogenous explanatory variables in equation (8) are replaced by their fitted values from ancillary regressions of these variables on the instruments.

Table 5. Results of Regressions Testing an Extended Taylor Rule with Excess Money Growth[a]

	Regression equation			
Explanatory variable	*(1)*	*(2)[b]*	*(3)[c]*	*(4)[d]*
Intercept	0.030 (4.0)	0.023 (5.0)	0.025 (3.6)	0.020 (4.9)
Discount rate ($t-1$)	0.801 (22.7)	0.815 (30.0)	0.798 (23.9)	0.822 (28.0)
U.S. Treasury bill rate ($t-1$)	0.182 (2.5)	0.146 (1.2)	0.175 (1.6)	0.152 (1.3)
Lagged inflation	–0.105 (–2.4)			
Current inflation		–0.055 (0.8)		
Future inflation			–0.066 (1.3)	–0.050 (1.3)
Lagged output gap	0.231 (2.3)			
Current output gap		0.141 (1.0)	0.150 (1.4)	
Future output gap				0.110 (1.3)
Excess M3 growth ($t-1$)	0.075 (2.9)	0.096 (4.1)	0.102 (4.7)	0.108 (5.6)
SER	0.00508	0.00537	0.00547	0.00553
R^2	0.970	0.966	0.965	0.964
Adjusted R^2	0.966	0.962	0.961	0.960
DW	2.74	2.74	2.55	2.56
F statistic[e]		2.08 p = 0.066	1.22 p = 0.320	1.18 p = 0.343

Source: Authors' calculations.
a. The dependent variable is the SARB discount rate. The sample period is 1986Q2 to 1997Q4. Absolute values of asymptotic t statistics are in parentheses. The output gap measure is OUTGAP1, the inflation forecasting equations are the more sophisticated models, and the broad set of instruments is used. The instruments used for equations (2) to (4) are the lagged financial liberalization indicator, the lagged deviation of annual M3 growth from its target, one lag each of quarterly and annual inflation rates, two lags in the rate of change in capacity utilization, two lags in the rate of change of the nominal exchange rate, and the lagged annual growth rate of real private sector credit.
b. Fitted values from our equations for annual inflation and the output gap are added, using $t-1$ information.
c. Forecast value of the three-quarters-ahead annual inflation rate is added, using $t-1$ information.
d. Forecast value of the three-quarters-ahead annual rate of growth of output is added, using $t-1$ information.
e. The F test is a test for overidentifying restrictions on the instruments.

The test of overidentifying restrictions for regression equations (2) to (4) now marginally accepts the specifications.

Controlling for Financial i iberalization in the Taylor Rule. The major changes in the financial system in South Africa in the 1980s and

1990s were discussed in section 1. The government initiated financial liberalization following the De Kock Commission reports (De Kock and others, 1978, 1984), which advocated a more market-oriented monetary policy. Some interest and credit controls were removed in 1980, and banks' liquidity ratios were reduced substantially between 1983 and 1985. Competition rose in the mortgage market following the 1986 Building Societies Act and amendments to the act in 1987-88. Demutualization and takeovers in 1989-90 consolidated the stronger competition in the credit market. In the 1990s pensions were increasingly used to provide additional collateral for housing loans, and from 1993 on, special mortgage accounts ("access bond accounts") allowed households to borrow and repay flexibly from these accounts up to an agreed limit set by the value of their housing collateral. After the 1994 elections more black South Africans obtained formal employment, particularly in the public sector, gaining access to credit that they may previously have been denied (total formal employment, however, continued to decline). Exchange controls on nonresidents were eliminated in early 1995: large nonresident capital inflows beginning in mid-1994 induced a temporary, endogenous financial liberalization. Finally, exchange controls on domestic residents, in existence since before the 1960s, were partially relaxed after 1997.

With the removal of interest rate controls, credit restrictions, and barriers to competition, supply and demand for credit have become increasingly market-determined. This has the implication, other things being equal, that higher rates of interest are required to equilibrate the market for credit. In Aron and Muellbauer (2000b and c) we develop a univariate indicator of the degree of liberalization of credit markets, which we denote as *Fi IB*. We include this indicator in the Taylor rule as a measure of the regime change, since the bank rate set by the SARB cannot be immune from the effects of financial liberalization.

An innovation in Aron and Muellbauer (2000b and c) is to treat financial liberalization as an unobservable indicator entering both quarterly household debt and consumption equations. The indicator, *Fi IB*, is proxied by a linear spline function, whose parameters are estimated jointly with the consumption and debt equations (subject to cross-equation restrictions on the coefficients in the spline function). The debt and consumption equations also incorporate a rich set of economic variables including income and income expectations, important wealth effects, and interest rate effects. The estimated parameters for *Fi IB* in the model reflect the key institutional changes in credit

markets. Our estimated indicator shows strong rises in 1984, 1988, and 1995, with more moderate increases in 1989, 1990, and 1996 (figure 4). It is noteworthy that both the consumption function and the debt equation are subject to major structural breaks (failing Chow tests) when allowance is not made for financial liberalization.

The estimation results for the extended Taylor rule, equation (8), including both the money target variable and *Fi IB*, are shown in table 6. The results improve dramatically. *Fi IB* has a significant positive effect in all four specifications, and the inflation effect becomes positive throughout. The specification with current-dated inflation and the current-dated output gap gives the strongest inflation effect, as well as the best fit, although the effect of the output gap is weak.[37] The fit is substantially worse for the specifications with future inflation. However, all the variables now have the expected direction of effect, with excess money growth and the U.S. interest rate remaining significant in all specifications.[38] The current output gap tends to be insignificant when current inflation is included, and the future output gap is insignificant when future inflation is included. Table 6 includes a selective sample of results to indicate sensitivities to an alternate specification of the output gap, alternative inflation forecasts, and different sets of instruments. All four specifications easily pass the test of overidentifying restrictions.

We also investigated the hypothesis that low domestic saving-to-GDP ratios, which might have been expected to affect real interest rates, influenced the bank rate. However, these effects are insignificant when included in the table 6 specifications.

We now interpret these results in the light of equation (7), using as representative the results from equation (2a) in table 6. The coefficient on the lagged interest rate, ρ, is estimated at 0.320. This implies that the long-run coefficient on the U.S. interest rate, λ, is 0.587, whereas β, which measures the response to domestic inflation, is 0.83. In this equation the output gap is insignificant. When the corresponding structural equation (7), which is nonlinear in parameters, was

37. We compare the results both for the sophisticated inflation forecasting model, regression equation (2a), and a simpler model, regression equation (2b), in each case using the broad set of instruments. The relevance of inflation relative to the output gap is decreased for equation (2b). We found similar results for the same comparison using regression equation (3). Comparing regression equations (4a) and (4c), table 6, which incorporate the inflation forecast at $t - 1$, four quarters ahead, it is noteworthy that the simpler model gives the stronger inflation coefficient.

38. As before, including the lagged U.S. real interest rate gives positive but insignificant coefficients.

Table 6. Results of Regressions Testing an Extended Taylor Rule with Excess Money Growth and Financial Liberalization[a]

	Regression equation							
Explanatory variable	*(1)*	*(2a)*	*(2b)*[b]	*(2c)*[c]	*(3)*	*(4a)*	*(4b)*[b]	*(4c)*[d]
Intercept	0.018	0.001	0.008	0.003	0.016	0.010	0.008	0.003
	(2.1)	(0.16)	(0.9)	(0.6)	(2.4)	(1.6)	(1.3)	(0.4)
Discount rate ($t-1$)	0.457	0.320	0.421	0.326	0.595	0.645	0.633	0.583
	(3.2)	(4.0)	(4.3)	(4.8)	(8.0)	(10.8)	(11.2)	(10.6)
U.S.Treasury bill rate ($t-1$)	0.395	0.399	0.367	0.417	0.297	0.249	0.248	0.243
	(3.6)	(5.5)	(4.6)	(6.1)	(3.6)	(2.8)	(2.8)	(2.9)
Lagged inflation	0.059							
	(0.8)							
Current inflation		0.234	0.151	0.192				
		(3.7)	(2.2)	(3.5)				
Future inflation					0.029	0.068	0.084	0.148
					(0.6)	(1.4)	(1.8)	(2.8)
Lagged output gap	0.251							
	(2.6)							
Current output gap		0.072	0.123	0.114	0.188			
		(0.6)	(1.2)	(1.8)	(2.1)			
Future output gap						0.052	0.040	–0.022
						(0.7)	(0.5)	(0.3)

Table 6. (continued)

	Regression equation							
Explanatory variable	*(1)*	*(2a)*	*(2b)*[b]	*(2c)*[c]	*(3)*	*(4a)*	*(4b)*[b]	*(4c)*[d]
Excess M3 growth ($t-1$)	0.053	0.069	0.066	0.046	0.060	0.078	0.078	0.076
	(2.1)	(3.3)	(3.3)	(2.2)	(2.6)	(3.8)	(3.8)	(3.6)
FLIB ($t-1$)	0.075	0.112	0.089	0.117	0.052	0.047	0.049	0.062
	(2.5)	(5.7)	(3.8)	(6.5)	(2.9)	(2.9)	(3.2)	(4.0)
SER	0.00478	0.00432	0.00436	0.00414	0.00478	0.00494	0.00492	0.00496
R^2	0.974	0.979	0.978	0.980	0.974	0.972	0.972	0.972
Adjusted R^2	0.970	0.976	0.975	0.978	0.970	0.968	0.968	0.968
DW	2.36	2.28	2.44	2.47	2.64	2.62	2.61	2.51
F statistic[e]		2.30			0.56	0.84		
		p = 0.947			p = 0.781	p = 0.560		

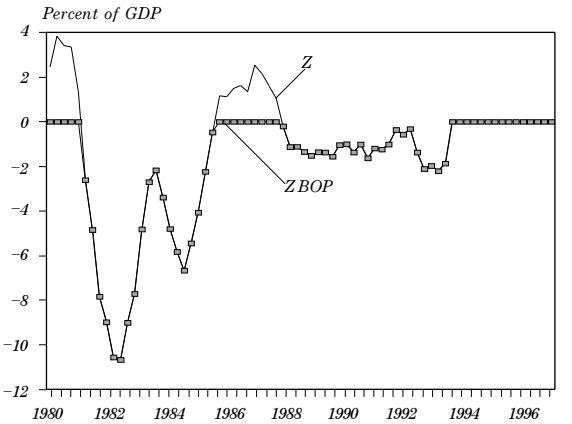
Source: Authors' calculations.
a. The dependent variable is the SARB discount rate. The sample period is 1986Q2 to 1997Q4. Absolute values of asymptotic t statistics are in parentheses. The output gap measure is OUTGAP1, the inflation forecasting equation is the more sophisticated model, and a broad set of instruments is used, unless otherwise indicated. The instruments used for equations (2) to (4b) are the same as in the preceding two tables.
b. The simpler inflation forecasting equation is used.
c. The output gap measure is OUTGAP2.
d. The simpler inflation forecasting equation and a narrower set of instruments are used: the exogenous or lagged variables in the equation, forecast inflation, and the forecast output gap, using t - 1 information.
e. The F test is a test for overidentifying restrictions on the instruments.

estimated by the IV method, and the output gap omitted, the estimated value of β was 0.87, with a standard error of 0.19, suggesting that the hypothesis that β = 1 is acceptable.

Extension of the Taylor Rule for Balance of Payments Constraints. As discussed in section 2, South Africa has periodically experienced major shocks to the balance of payments from external trade shocks and political shocks: first under a closed capital account, and after March 1995 under a capital account fully open to foreign flows and international contagion. These shocks may have resulted in monetary policy being subordinated for long periods to balance of payments considerations. We have attempted to test for such effects.

First, we examine the period after the debt crisis of September 1985, in which a debt standstill was followed by rescheduling arrangements, which remained in force until the debt was fully paid off in 1994. We test whether interest rates were higher in this period than could be justified simply by the fundamentals, because of massive capital outflows (including debt repayments) and insignificant new inflows. We define a variable *Z* as the lagged ratio of the current account surplus to GDP less a value of 3 percent, which has been suggested as the basic surplus required for debt repayments (Leape, 1991). In figure 5 we show both *Z* and *ZBOP*, which is defined to be all the negative values of *Z* and is the variable we include in our interest rule regression in table 7. However, given that South Africa made extensive use

Figure 5: South Africa: Percent of GDP Balance of Payments Constraints



Source: Author's elaboration.

made of an alternative, flexible trade policy instrument to suppress import demand (high import surcharges exceeded tariff rates in many years; see section 2), one may not expect to see much of an effect from *ZBOP*. The result is shown in regression equation (2) in table 7: although the coefficient is negative, it is not significant.

We also tested for an implicit bilateral exchange rate target from the second quarter of 1994 until the first currency crisis of February 1996 (see section 1.4) but were unable to find an effect over this short

Table 7. Regression Results Testing an Extended Taylor Rule for Balance of Payments Effects[a]

	Regression equation		
Explanatory variable	*(1)*	*(2)*	*(3)*
Intercept	–0.002 (–0.47)	–0.002 (0.0)	0.002 (0.4)
Discount rate ($t-1$)	0.306 (2.5)	0.315 (2.7)	0.276 (2.6)
U.S. Treasury bill rate ($t-1$)	0.405 (4.9)	0.426 (5.9)	0.488 (6.4)
Current inflation	0.266 (3.7)	0.234 (2.9)	0.207 (2.4)
Excess M3 growth ($t-1$)	0.078 (4.3)	0.076 (4.2)	0.078 (4.3)
FLIB ($t-1$)	0.116 (4.3)	0.111 (4.1)	0.124 (5.3)
ZBOP		–0.162 (–1.3)	
DumANC*excess M3 growth			–0.094 (1.8)
SER	0.00436	0.00426	0.00416
R^2	0.978	0.979	0.980
Adjusted R^2	0.975	0.976	0.977
DW	2.20	2.37	2.38

Source: Authors' calculations.
a. The dependent variable is the SARB discount rate. The sample period is 1986Q2 to 1997Q4. Absolute values of asymptotic t statistics are in parentheses. The estimations employ the narrow set of instruments (see table 6) and the more sophisticated inflation model.

period of six quarters. However, there was some evidence (a t-statistic of 1.8) for a reduced weight on excess M3 in the policy rule from the second quarter of 1994, implying that excess money growth was effectively abandoned as a guide to intermediate policy; see regression equation (3) in table 7. The impact of capital inflows from July 1994 onward, with accumulated reserves unsterilized until the following year (when monetary policy tightened sharply), is clear from the sharp rise in excess M3, afterward sustained at the new high level (figure 1). As shown in Aron and Elbadawi (1999), there was a trade-off between monetary policy and exchange rate objectives in the period, leading to a currency crisis early in 1996.

4. Summary and Policy Issues

Monetary policy in South Africa has gone through major evolutionary changes, particularly in the 1980s, when there was extensive financial liberalization, with monetary targeting initiated in 1986, and since 1998, with the move to inflation targeting. In this paper we have modeled extended Taylor rules for interest policy over the period 1986-97, using our forecasts of inflation and the output gap to 1998 in the instrument set.

There are four key results. First, attempts to fit a Taylor rule, extended for the lagged dependent variable and the U.S. short-term interest rate, do not give sensible results. Astonishingly, it appears that the SARB changed the interest rate perversely with lagged, current, or future inflation: the estimated coefficients are strongly significant. Only when excess money growth and an indicator of financial liberalization are introduced—both factors that raised real interest rates and happen to be negatively correlated with inflation over the sample—does the SARB's policy rule look more sensible.

Second, in the context of a liberalization of credit and other financial markets, and given the international interest rate environment, the SARB followed a rule that included current inflation in its interest rate policy formulation, despite claiming to focus largely on money growth targeting. The rule appears to target inflation and to deemphasize the output gap. Future inflation has no weight placed on it; this result is robust for both simple and sophisticated models of inflation forecasts and may have been influenced by the limited development of inflation forecasting models in the SARB. Moreover, given the large structural changes in money and credit markets, the attempt

to target money probably led to worse output and inflation outcomes than if a more sensible version of the Taylor rule been followed.[39]

The force of this last point is weakened, however, by the fact that policy had competing preoccupations starting in late 1985, the principal one being the need to maintain surpluses on the current account, given the virtual cessation of capital inflows. Our third finding is on the relevance of structural breaks related to the difficulty of managing large capital outflows during 1986-94 after the debt crisis, and later, the large inflows following democratic elections in 1994 and the freeing of capital controls on foreign investors. We find evidence that excess money growth is less important after 1994, and weak evidence that balance of payments concerns had some influence on monetary policy during 1986-94.

Finally, even with the interpretation of the long-run coefficient on the inflation term given in equation (8), the weight attached to inflation is below that found for policy rules in other countries, or indeed, with pure inflation targeting. For the United States, Clarida, Galí, and Gertler (1998b) find that, when inflation rose, the pre-1979 Federal Reserve raised interest rates by less than the rise in inflation, so that real interest rates fell (β is less than 1). After 1979, in contrast, when inflation rose, real interest rates also rose, so that policy reaction was more anti-inflationary (β is greater than 1; this policy strategy is termed "leaning against the wind"). For a range of countries, Clarida, Galí, and Gertler (1998a) found values for β of 1 or higher in the post-1979 period (for example, β is estimated at 1.8 for the Federal Reserve, 2 for the Bank of Japan, and 1.3 for the Bundesbank). We find weights in the region of 0.8 to 1.1 for β in South Africa, using nonlinear IV estimation for equation (7), as described in section 3.1. One can accept the hypothesis of a weight of 1 on the basis of standard errors. This suggests that, after controlling for excess money, financial liberalization, and the foreign interest rate, there was little "leaning against the wind" by the central bank, but that the real interest rate was almost invariant with inflation. This does not suggest a highly anti-inflationary stance after 1986, as has been claimed, although clearly there were competing considerations concerning the balance of payments.

39. The United Kingdom had effectively abandoned monetary targeting by 1986, in large part because of the lack of stability in the relationship between money growth and output, inflation, and interest rates. By then, it had been demonstrated in a number of econometric studies (for example, Hendry, 1985) that inverting a money demand equation does not give a sensible model of inflation, except perhaps in countries with hyperinflation or budgetary problems so severe that the authorities are tempted to resort to the inflation tax as a major source of revenue.

APPENDIX

Financial Liberalization in South Africa, 1960-97

Table A1. Liberalization of Interest Rates[a]

Date	*Measure*
	Deposit rate controls
March 1965 to July 1966	Upper limits first imposed on rate of interest payable on bank and building society deposits
December 1969	Reintroduced at 7 percent per year
August 1970	Dropped. Government decides to subsidize certain interest rates
March 1972	Reintroduced
March 1980	Dropped
	Lending rate controls
Before 1967	Clearing bank prime rates for overdrafts: Minimum and prime overdraft lending rates set by agreement with the SARB at 1.5 and 2 percent above the bank rate
1967 to mid-1975	Minimum and prime overdraft lending rates set at 2 percent and 2.5 percent above the bank rate
July 1975	A newly defined prime rate ("the lowest rate at which a clearing bank will lend on overdraft") is set by individual banks within the margins of 2.5 to 3.5 percent above the bank rate (changes to be discussed first with the SARB)
February 16, 1982	Banks released from the obligation to keep the prime rate within specific limits (but still have to inform the SARB of intended prime rate changes)
	Loan and credit transactions: Maxima have been in force since before the 1960s in terms of various Usury and Finance Acts. Maximum finance charge rates are now linked to clearing banks' prime rates by formula, for various categories of money loan and credit and leasing transactions.
	Mortgage rates: Informal constraints removed only in the early 1980s

Source: Bandiera and others (2000); De Kock and others (1984); *SARB Quarterly Bulletin*, various issues; *Money and Banking Statistics of South Africa*: 1970-92.

a. Adjustments to deposit and lending rates were made at various times to the maximum rates and various classes of intermediaries and liabilities subject to these controls, and the coverage and level of credit ceilings was adjusted on several occasions.

Table A2. Directed Credit

Date	*Measure*
November 1965	Total of discounts and advances by monetary banking institutions to the private sector restricted to the level of such credit on March 31, 1965
December 1966	Ceiling reduced to 92.5 percent of the March 1965 level
August 1967	"Voluntary" controls made mandatory by proclamation
May 1968	Extended ceilings to cover bank investment in private sector securities
August 1970	Extended to nonmonetary banks to curb competition
September 1972	Intention announced to phase out ceilings, but ceilings are raised by 7.5 percent
November 1972	Credit ceilings abolished
February 1976	Credit ceilings reimposed for bank credit to the private sector
1977-80	Ceilings further tightened at various points
August 1980	Credit ceilings finally withdrawn

Source: Bandiera and others (2000); De Kock and others (1984); *SARB Quarterly Bulletin*, various issues; *Money and Banking Statistics of South Africa:* 1970-92.

Table A3. Cash Reserve and Liquid Asset Requirements

Date	*Measure*
	Liquid asset requirements[a]
August 1980	Two categories of banks with differing requirements; for example, category A: 58 percent (short-term), 35 percent (medium-term), 5 percent (long-term)
September 27, 1982	Two categories of banks: for example, category A: 54 percent (short-term), 34 percent (medium-term), 5 percent (long-term)
July 19, 1983	All banks have the same percentage requirements: 48 percent (short-term), 28 percent (medium-term), 5 percent (long-term)
September 20, 1983	All banks have the same percentage requirements: 40 percent (short-term), 20 percent (medium-term), 5 percent (long-term)
December 8, 1983	All banks have the same percentage requirements: 30 percent (short-term), 20 percent (medium-term), 5 percent (long-term)
March 14, 1984	All banks have the same percentage requirements: 25 percent (short-term), 18 percent (medium-term), 5 percent (long-term)
March 29, 1985	All banks have the same percentage requirements: 22 percent (short-term), 16 percent (medium-term), 5 percent (long-term)

Table A3. (continued)

Date	*Measure*
August 31, 1985	New method to calculate short-term liabilities results in a larger calculated amount of such liabilities. Requirements for all banks: 20 percent (short-term), 15 percent (medium-term), 5 percent (long-term)
February 1991	Definition of short-term liabilities extended to include repurchase agreements and other liabilities not previously included. Requirement for all banks: 20 percent of short-term liabilities
April 1993	Certain types of assets (such as banker's acceptances) lose liquid asset status. Requirement for all banks: 5 percent of total liabilities
	Cash reserve requirements
April 11, 1980	Two classes of banks: 8 percent (short-term, non-interest-bearing); additional: 7 percent (short-term, non-interest-bearing), 5 percent (medium-term, interest-bearing with the National Finance Corporation, NFC)
September 12, 1980	Two classes of banks: for example, class A: basic: 8 percent (short-term, non-interest-bearing); additional: 10 percent (short-term, non-interest-bearing), 3 percent (medium-term, non-interest-bearing), 2 percent (medium-term, interest-bearing with NFC)
March 31, 1982	Two classes of banks: for example, class A: basic: 8 percent (short-term, non-interest-bearing); additional: 4 percent (short-term, non-interest-bearing), 3 percent (medium-term, non-interest-bearing), 2 percent (medium-term, interest-bearing)
September 27, 1982	All banks: basic: 8 percent (short-term, non-interest-bearing); additional: 2 percent (short-term, non-interest-bearing), 2 percent (medium-term, interest-bearing with NFC)
September 30, 1983	All banks have only basic requirements: 8 percent (short-term, non-interest-bearing), 2 percent (medium-term, non-interest-bearing), 2 percent (medium-term, interest-bearing with NFC)
March 15, 1984	All banks: 8 percent (short-term, non-interest-bearing), 2 percent (medium-term, non-interest-bearing)
July 31, 1985	Bank's vault cash included in cash reserves
April 1, 1986	All banks: 5 percent (short-term, non-interest-bearing), 2 percent (medium-term, non-interest-bearing)
February 1, 1991	All banks: 4 percent (short-term, non-interest-bearing)
July 21, 1992	All banks: 4 percent (short-term, non-interest-bearing); additional 1 percent (short-term, interest-bearing)
April 26, 1993	All banks: 3 percent (short-term, non-interest-bearing); additional 1 percent (short-term, interest-bearing)
August 1993	All banks: 1.5 percent (short-term, non-interest-bearing), 1 percent all other liabilities; additional 1 percent (short-term, interest-bearing)

Source: Bandiera and others (2000); De Kock and others (1984); *SARB Quarterly Bulletin*, various issues; *Money and Banking Statistics of South Africa:* 1970-92

a. Liquid asset requirements were the principal monetary policy instrument fom 1960 through mid-1982.

Table A4. Competition in Financial Markets

Date	*Measure*
February 28, 1983	Register of Co-operation (an agreement among commercial banks limiting competition) ended
1983	A substantial number of new banks are allowed to start operations (few new banking institutions had been established prior to 1980)
	Takeovers and mergers
1989	Nedbank and SA Permanent Society merge to form Nedperm Bank
1991	United, Volskas, and Allied Societies form ABSA
1992	ABSA takes over Bankorp (leaves four major banking groups)
1994 onward	Foreign banks enter South Africa
	Financial innovation
1990s	Credit cards; "access bonds" where households can borrow against housing collateral; pension assets can be used as collateral for mortgage lending

Source: Bandiera and others (2000); *SARB Quarterly Bulletin*, various issues; interviews conducted by the authors.

Table A5. Supervisory and Prudential Regulatory Changes

Date	*Measure*
1986	Building Society Act: tax benefits and other advantages giving building societies a monopoly of the mortgage market are phased out
1988	Amendments to banking and building society legislation make cash reserve and liquid asset requirements the same for each. Previously building societies required no cash reserve requirements against liabilities to the public, substantially lower liquid asset requirements, and no supplementary liquid asset requirements
1990	Deposit-taking Institutions Act of 1990: banks and building societies brought under the same legislation, except for small mutual building society sector (covered by separate act)

Source: Bandiera and others (2000); *SARB Quarterly Bulletin*, various issues; *Money and Banking Statistics of South Africa*: 1970-92.

Table A6. Exchange Rate Liberalization

Date	*Measure*
1961-75	Fixed exchange rate regimes of various types
September 22, 1975	Rand is devalued 17.85 percent; new rate is R1.00 = $1.15
January 24, 1979	Two-tier exchange rate system established: official rate renamed the commercial rate and put on a controlled float, applicable to foreign trade, authorized capital transfers, and current payments including remittance of dividend and interest payments. Free-floating financial rand applicable to nonresidents' financial transactions, including foreign direct investment, repatriation of capital and profits, and outward capital transfers by residents and emigrants
February 7, 1983	Dual exchange rates unified to a controlled float of an effective rand
September 2, 1985	Two-tier system reestablished, with commercial and financial rands
March 1995	Dual rates finally unified in a "managed" float

Source: Aron, Elbadawi, and Kahn (2000): Bandiera and others (2000); De Kock and others (1984); *SARB Quarterly Bulletin*, various issues.

Table A7. Capital Account Liberalization

Date	*Measure*
	Nonresidents
March 1995	Dual exchange rates unified (abolition of all controls on the transactions of nonresidents)
June 1996	Local borrowing limit for 100 percent foreign investors doubled to 100 percent of effective capital
	Residents
July 13, 1995	Institutional investors allowed to swap up to 5 percent of their total assets with foreign investors (insurance companies, pension funds, and unit trusts)
June 1996	The limit on institutional investors for asset swaps is raised to 10 percent. Financial institutions can place up to 3 percent of 1995 cash flows abroad in 1996 by end-1996, and foreign exchange access is made easier for corporations wishing to invest in neighboring states. Exports still have to be repatriated within 7 days but can offset foreign exchange needs for imports within 30 days
October 1996	Authorized foreign exchange dealers' foreign exchange cash limits doubled to $1.5 billion (since April 1996 they had been allowed to exceed these limits)

Table A7. (continued)

Date	*Measure*
March 12, 1997	Reforms announced in budget speech, effective from July 1997, include the following: • Corporates can transfer up to R30 million per new investment to countries outside the Common Monetary Area, and up to R50 million per new investment in Southern Africa Development Community member countries • Firms can raise offshore financing based on balance sheet strength of their parent company • Long-term insurers, pension funds, and unit trusts authorized—in addition to swap facilities previously sanctioned—to transfer capital abroad in 1997 equal to 3 percent of net inflow of funds to these institutions during 1996, with overall limit of 10 percent of total assets to be held in foreign currency-denominated securities • Qualifying institutional investors allowed to invest 2 percent of net domestic income surpluses during 1996 in securities listed on stock exchanges in SADC member countries, subject to the overall limit of 10 percent of total assets

Source: Bandiera and others (2000); *SARB Quarterly Bulletin*, various issues; *Money and Banking Statistics of South Africa*: 1970-92.

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