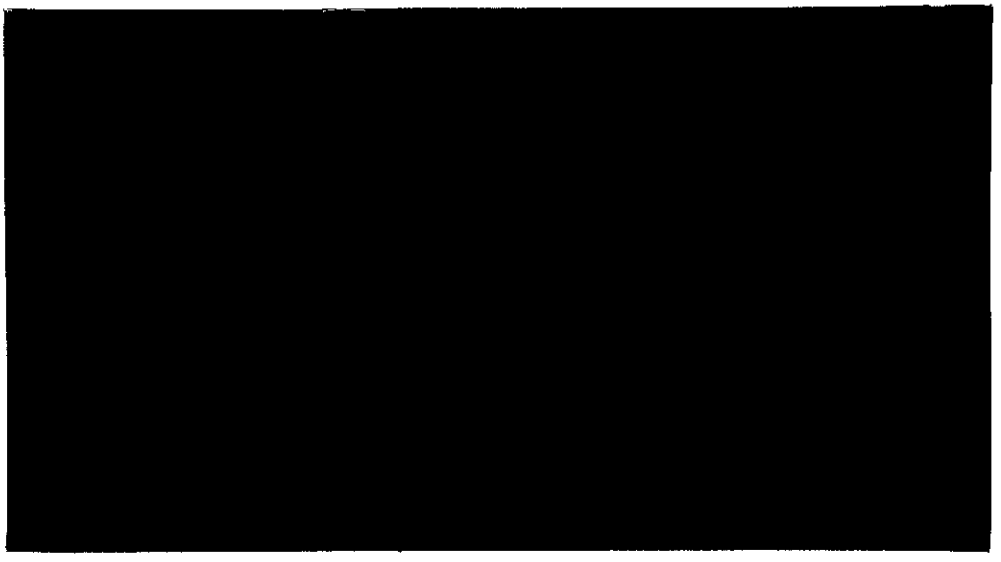
# XXXII ANNUAL MONETARY STUDIES CONFERENCE



KINGSTON, JAMAICA

30 OCTOBER - 02 NOVEMBER 2000

# MACRO-ECONOMIC FLUCTUATIONS, ECONOMIC POLICY AND THE JAMAICAN STOCK MARKET

**Karlene Bailey**
**Research Economist**
**Bank of Jamaica**


# Macroeconomic Fluctuations, Economic Policy and the Jamaican Stock Market (1991-1999)

**By**

**Karlene Bailey**

*The analysis and conclusions drawn are the sole responsibility of the Author and not necessarily those of the Bank of Jamaica.*

**Bank of Jamaica**

**Working Paper**

**October 2000.**

## Abstract

*This paper analyses the effects of macroeconomic variables on the behaviour of Jamaican stock prices using impulse response functions from a Vector Autoregressive Model. This is against the background of the recent surge in activity on the Jamaica Stock Exchange, which has revived the debate on the macroeconomic determinants of stock price behaviour. The variables and their ordering are based on Blanchard (1981). We find that monetary and fiscal variables do affect stock market activity. More specifically, changes in unanticipated monetary and fiscal policies have a significant short run impact on the stock market. However, the long-run impact of these policies is limited. A plausible explanation for these limitations may be the presence of market imperfections and inconsistencies in the conduct of macroeconomic policy.*

# CONTENTS

## *Section 1: Introduction*

Between January and May 2000, the Jamaican Stock Index increased by 36 percent to 32381 points, a level that was close to the highest level recorded in 1993. This rally renewed interest in understanding the factors that influence stock price movements in Jamaica. More specifically, given the importance of the stock market in capital formation, policy makers are keen to ascertain the impact of economic policy on recent developments in the stock market. Of concern is the fact that despite the relatively high cost of debt financing, there has not been a notable shift towards the use of the stock exchange to initiate and expand business activity.

A number of studies have attempted to assess the behaviour of stock prices and the efficiency of stock market returns on the Jamaica Stock Exchange e.g. Agbeyegbe (1994), Koot, Miles and Heitmann (1991) and Leon (1996). This paper complements these earlier works by analysing empirically the impact of monetary and fiscal policy developments on the stock market. It is based on the work of Blanchard (1981) which examined the interaction between stock prices and changes in anticipated and unanticipated monetary and fiscal policies.

The results show that an expansionary monetary policy whether anticipated or unanticipated has a positive effect on the value of the stock market. On the other hand, an unanticipated expansion in government expenditures leads to a rise in the stock market, while an anticipated expansion has the opposite effect. In examining the strength of these policy outcomes, it was found that in the instance where the change in macroeconomic policy is unanticipated (whether fiscal or monetary) there is a more significant impact on the stock market. However, despite the responsiveness, the effects of changes in policy on the stock market were found to be short lived. The difficulties of policy in sustaining a stable environment, and issues relating to the market micro-structure have been identified as possible causes. The main implications of the findings are that economic policy has a limited effect on capital formation through the stock market over the long run, as it has not been able to maintain a stable and predictable environment. Market deficiencies such as the low turnover rate, low levels of liquidity, high market concentration as well as

informational asymmetries limit the growth prospects and the efficiency of the stock market as a mechanism of savings mobilisation and investment allocation.

The paper is organised as follows, Section 2 discusses the recent trends and developments in the Jamaica Stock Exchange and the macroeconomy for the period of the 1990s. Section 3, details the theoretical specifications of the model. Section 4, discusses the empirical methodology, while Section 5 presents the empirical results. The final section presents the conclusion and policy implications of the model.

## *Section 2: Recent Trends and Developments*

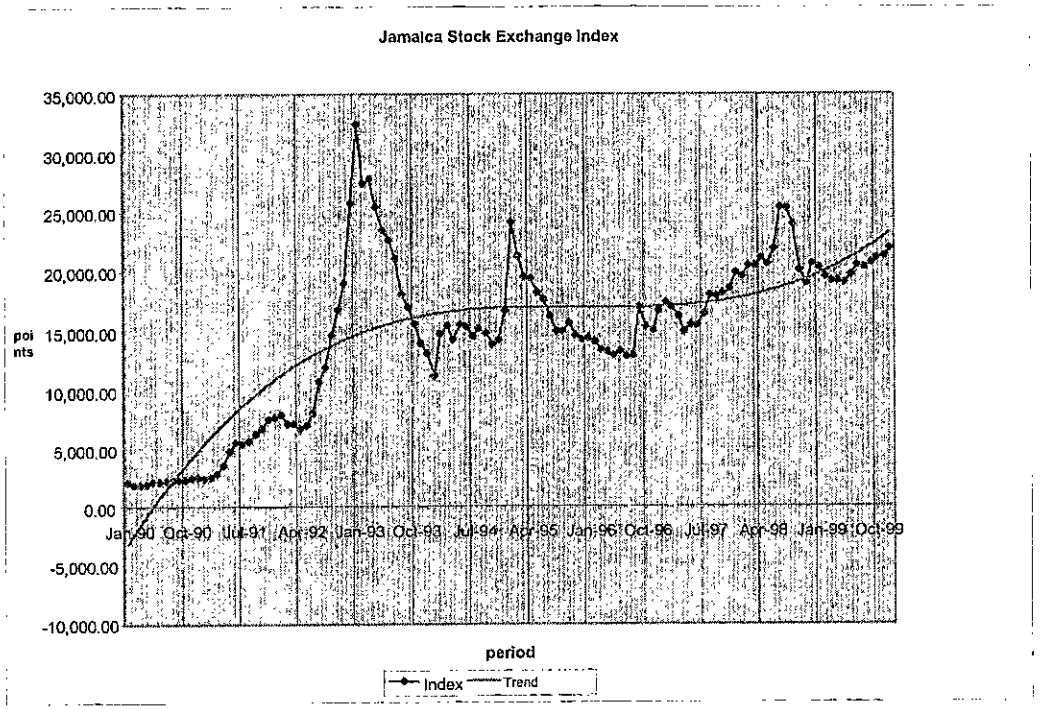
### 2.1 Macroeconomic Trends

The development and overall performance of the Jamaican stock market during the period of the 1990s can be considered against the background of trends in key macroeconomic variables. The beginning of the 1990s saw the liberalisation of the exchange rate determination mechanism with the introduction of an inter-bank system of foreign exchange trading. The period immediately subsequent to the exchange rate liberalisation was marked by a sharp depreciation of the Jamaican currency against its U.S. dollar counterpart. This steep depreciation of the exchange rate fuelled instability in the economy and resulted in historically high inflation rates and significant growth in the monetary base.

These macroeconomic developments facilitated significant growth in the Jamaica Stock Exchange All Composite Index, with the index peaking at an historic high of 32,421.71 points by January 1993. Leading up to this historic high, market capitalisation increased to $76.8 billion in 1992 from $7.3 billion in 1990. The volume traded also increased

significantly to 395.0 million units in 1992 from 57.9 million units in 1990[1]. (See Figure I).

Figure I.




Subsequently, efforts were made to moderate inflation by restraining the growth of monetary aggregates, which resulted in rising nominal and real interest rates. The nominal rate on BOJ certificates of deposits (CD) reached a high of over 49 percent by April 1992. The shock to real interest rates that accompanied the tightening of monetary policy shifted the incentive structure away from investment in the stock market towards government securities. By March 1993, stock prices plummeted as market capitalisation was reduced to $41.8 billion. At the end of 1993, the stock market index had declined significantly to 13,099.68 points, a decline of 49 percent from the previous year's level. For the period 1994-1995, the stock market continued to experience limited growth with the index advancing by an average 6 percent. (See Figure I)

[1] See Appendix I for a breakdown of the volume traded, market capitalization etc. for the Jamaica Stock Exchange from 1980-1999.

By September 1996, a more aggressive monetary stance by the Central Bank resulted in moderation in exchange rate movements as well as a decline in the rate of inflation to 15.8 percent from 25.5 percent in 1995. However, in a context of tight monetary and fiscal policies, growth in real GDP declined by 1.7 percent in 1996 from a growth of 0.7 percent in 1995. The slow down in the economy had an adverse impact on the profitability of many listed companies and further contributed to the decline in the stock market index.

The tight fiscal policy stance that had duly supported monetary policy during the early 1990s was reversed by 1997, with fiscal expansion resulting in rising fiscal deficits. The government's reliance on domestic sources of financing put upward pressure on domestic interest rates and presented strong challenges to macroeconomic stability. However, the strict monetary policy stance maintained by the Central Bank moderated the impact of fiscal imbalances on inflation and interest rates. As a result, there was a steady decline in the growth in the monetary base, a downward adjustment in the Central Bank's 30-day reverse repurchase agreement to 18.35 percent at December 1999 from 21 percent at December 1998 and a decrease in inflation to 6.8 percent at December 1999. However, real interest rates have remained relatively high, due primarily to the government's continued reliance on domestic debt financing and low inflation. The decline in output has also continued albeit at a slower pace than in previous years. Notably for 1999, real GDP declined by 0.4 percent as against a 0.7 percent contraction for 1998.

Despite the achievement of relative macroeconomic stability the performance of the stock market index continued to be sluggish. At the end of 1999, the index was 21,892.6 points, an advance of 6.3 percent above the outturn of 20,593.33 points for 1998. The inability to achieve growth in GDP coupled with relatively high real interest rates continued to impact negatively on the performance of the stock market. The lack of activity on the primary market and the bearish secondary market in recent years was partly attributed to the fact that the equity market has to compete with high real interest rates being offered on risk-free government securities. Given the role of the stock market in capital

formation, the dominance of government securities as a means of saving has reduced real investment and hindered the growth of the stock market.

## 2.2 Trends in the Institutional Settings

During the 1990s, there have been many institutional changes in the Jamaica Stock Exchange. To facilitate the increased levels of stock market activity, trading moved from two to three days a week in 1990 and subsequently to a four-day trading week by October 1991. Further, an upgrading of the management and operations of the stock exchange resulted in a staff restructuring and an increase in the staff complement. The growth of the stock market since its inception and especially within the early 1990s also revealed the need for an upgrading of the infrastructure of the securities industry to keep pace with these rapid developments. Consequently, a modernisation programme for the Jamaica Stock Exchange was developed. The fundamental objective of the Exchange's modernisation programme was to eliminate the major risks and operational constraints, which were intrinsic in the paper-based settlement system.

As a first step in the modernisation plans, a circuit breaker system was implemented in 1996 to minimise the manipulation of stock prices[2]. The Jamaica Central Securities Depository (JCSD) was also installed in June 1998 to manage trade settlements and ownership transfer of securities and an electronic trading platform implemented in January 1999, which replaced the open outcry system. These innovations along with the circuit breaker system introduced in June 1996 have helped to increase the efficiency and speed of trades as well as reduce the risks of trading. For example, the establishment of the JCSD now assures investors that all trades will settle within the same timeframe[3], hence significantly lowering settlement risk. Additionally, the electronic trading system

[2] Under Circuit Breaker system, trading in a security is halted for 15 minutes on a 10% gain or fall in its price, or its issued shares traded allowing traders breathing space to assess what is happening with the security. The logic of the new system is to minimize or altogether eliminate manipulation of stock prices.
[3] Transfer and ownership of shares are now completed within five business days.

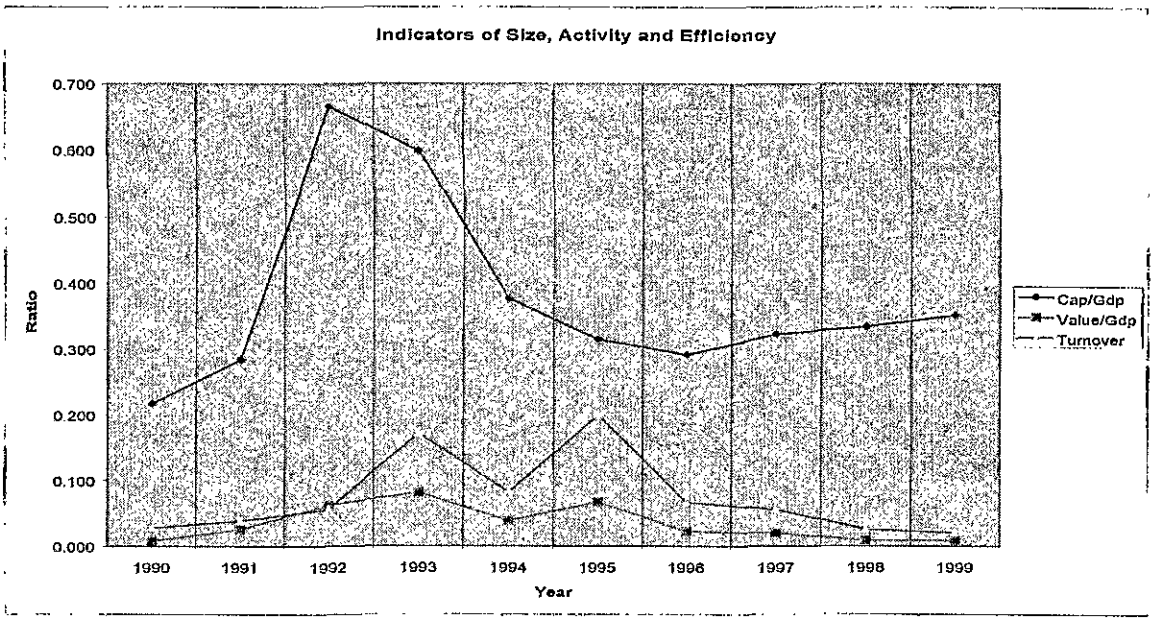
that was established allows the Exchange to instantaneously capture and disseminate trading data and interfaces with the JCSD in a tightly coupled system. Therefore, these improvements have contributed towards improving the operational efficiencies of the Jamaica Stock Exchange as well as lessening the asymmetries present in information flows.

## 2.3 Development and Structure of the Jamaica Stock Exchange

Figure II shows the evolution of selected indicators of stock market size, liquidity and efficiency. The *stock market capitalisation to GDP*, which is the ratio of the value of listed shares to GDP, is used here as an indicator of the performance of the market in mobilising capital and diversifying risk. A ratio of 1 (or greater than 1) indicates a large market while 0.10 shows a very small or limited market. As shown in Figure II, the size of the stock market increased over the period 1990-92, with the stock market being largest in 1992. However, there has since been a contraction in the market as the ratio of market capitalisation to GDP has fallen to 0.35 in 1999 from 0.66 in 1992. The decline in this ratio may be a sign of the limited success of the market in mobilising savings, especially in the latter part of the 1990s.

The *stock market turnover ratio* measures the liquidity or activity of the stock market relative to its size and is used as an efficiency indicator. Liquidity within this context is defined as the ability to easily buy and sell securities. A small, but active market will have a high turnover ratio whereas a large, but less liquid stock market will have a low turnover ratio. A high turnover is sometimes reflective of low transaction costs. As can be seen in Figure II, the turnover ratio increased to 0.17 in 1992 from a low of 0.022 in 1990, indicating an increase in the liquidity of the stock market. However, since 1992 the turnover ratio of the market has declined. In 1999 the ratio stood at 0.024, once again nearing its 1990 level. This implies a decline in market activity as lower turnover rates may indicate decreased levels of liquidity and higher costs of transacting in the stock market.

Figure II.




The *ratio of total value traded to GDP*, a measure of market activity, complements the turnover ratio. While the ratio of stock market total value traded to GDP captures trading compared to the size of the economy, turnover measures trading relative to the size of the stock market. The ratio of stock market total value traded to GDP showed great improvements over the period 1990-1993 but has also declined in the latter period of the sample. These two indicators combined may point to a decline in stock market liquidity as well as efficiency.

A measure of market concentration is often utilised in conjunction with the above indicators given that in some countries few companies dominate the stock market. The share of market capitalisation accounted for by the ten largest stocks is the measure used. For the period 1990-1999, the ten largest stocks were an average 79 percent of the market[4]. The high degree of concentration in the Jamaica Stock Exchange index during

[4] Note that in 1999, the total number of companies listed on the Jamaica Stock Exchange All-Composite Index was 45.

the sample period 1990-1999 may be an indicator of the thinness of the stock market and may help to explain the decline in the turnover ratio.

Generally, the Jamaican Stock Exchange exhibits characteristics found in many emerging stock markets. In these markets, imperfections such as the high costs of transactions due to the low turnover rate, stock price volatility and high market concentration are commonplace. The effects of these market imperfections on the market's allocation of investment resources may be significant. As mentioned by Leon (1996), inefficiencies may result in reduced mobilisation of small savings, the financing of low return investments and inadequate risk reduction through diversification.

## *Section 3: Theoretical Specification*

The channels through which macroeconomic fluctuations affect stock prices have been the subject of much debate and research in economic literature. Models developed by Murinde and Evans (1995) and Darrat (1990) inter alia have endeavoured to analyse empirically the impact of monetary and fiscal policy variables on the stock market. These models were based on the work of Blanchard (1981).

Blanchard (1981) developed an *IS-LM* model with stock prices, which examined the effect of a change in anticipated and unanticipated monetary and fiscal policies on stock market, interest rates and output. Underlying this model was the assumption of Efficient Market Hypothesis[5]. Current and anticipated output was taken as a main determinant of asset values while in turn asset values were viewed as the chief elements in the process of output determination.

In the model, aggregate demand is given as:

[5] According to this theory a security's price fully reflects all available information in an efficient market.

$$d = aq + \beta y + g \qquad a > 0, \beta \varepsilon [0,1)$$

All variables are real, $d$ denotes spending, $q$ is the stock market value, $y$ is income and $g$ denotes an index of fiscal policy. The stock market being a part of wealth is seen as affecting consumption and through its role in the determination of the value of capital it also affects investment. For equilibrium, output will adjust to spending over time. Therefore:

$$\begin{aligned} \dot{y} &= \sigma (d - y) \\ &= \sigma (aq + g - by) \end{aligned} \qquad (1)$$

where the dot denotes changes in the variable over time and $\sigma > 0$ and $b = 1 - \beta > 0$.
Equation (1) implies two important relationships. Firstly, an increase in aggregate demand will necessitate an increase in production, given the assumption that inventories are depleted due to higher demand and secondly, that spending adjusts slowly over time.
For asset market equilibrium, portfolio balance is characterised by the conventional LM relation.

$$i = cy - h(m - p) \qquad (2) \qquad c > 0; h > 0$$

where, $i$ denotes the short-term nominal interest rate, $y$ is income and $m$ and $p$ are the logarithm of nominal money and the price level. It is assumed that shares, short and long term bonds are perfect substitutes. Hence, for there to be no arbitrage between them implies that they have the same expected short-term rate of return. The short-term real rate is defined as :

$$r^e \equiv i - \dot{p}^e \qquad (3)$$

where the $p^e$ is the expected rate of inflation. The model assumes flexible prices and perfect foresight in the goods market. Price adjustment is given as:

$$p = \dot{p}^e = \theta (\bar{p} - p) \qquad (4)$$

Equations (2), (3) and (4) imply that:

$$r^e = cy - h(m - p) + \theta(p - \overline{p}) \qquad (5)$$

Given that $q$ is the real value of the stock market then expected real rate of return on holding shares is:

$$\dot{q}^e / q + \pi / q$$

where $\pi$ denotes real profit. Real profit is assumed to be an increasing function of output and for simplicity is given as:

$$\pi = \alpha_0 + \alpha_1 y$$

Thus, for there to be no arbitrage between short term bonds and shares implies that the expected real rate of return from holding stock is equal to the short term real rate i.e.

$$r^e = \frac{\dot{q}^e}{q} + \frac{\alpha_0 + \alpha_1 y}{q} \qquad (6)$$

The steady state value of output and the stock market are

$$y^* = \frac{a}{b} q + \frac{1}{b} g \qquad (7)$$

$$q^* = \frac{\pi}{r} = \frac{\alpha_0 + \alpha_1 y}{cy - h(m - p) + \theta(p - \overline{p})} \qquad (8)$$

The above equations (1-6) characterise output, the stock market and interest rates as functions of policy variable $m$ and $g$, expectation $q^e$ and $p^e$ and the price level.

From equations (7) and (8) we can write the long run stock price equation as a function of monetary and fiscal variables.

$$q = \varphi(g) + \vartheta(m - p^d) \qquad (9)$$

The adjustment of the stock market to changes in policy, whether monetary or fiscal, depends on whether the change is anticipated or unanticipated. First, in the anticipated monetary policy case, the announcement of the expansionary monetary policy to be pursued itself has a positive effect. The stock market jumps at time of announcement in anticipation of higher profits and lower interest rates after implementation. Output and spending also increase during the period before implementation. Additionally, the real short-term rate declines as a result of a higher expected price level. However, at the time of implementation, the principal effect of the policy is a further decline in the short-term rate due to higher real balances, as the stock market does not react. After implementation the behaviour of the economy is qualitatively similar to the case of an unanticipated increase.

In the unanticipated monetary policy case, there are two principal effects of the change in monetary policy, the real balance effect and the "Mundell" effect. The first effect results in higher real balances, as prices cannot instantaneously adjust to the increase in nominal money. The Mundell effect work through the mechanism of higher expected prices (inflation) due to the monetary expansion which decreases the real rate of interest given the nominal rate. Hence, both effects work to lower the real rate of interest. Consequent on the lowering of the real rate, there is an anticipation of a higher level of profits, which results in a jump in the value of the stock market. In the short run, it is expected that output will also begin to increase as a result of the expansion in money

With an anticipated fiscal expansion, the effect on the stock market may be ambiguous. The announcement of fiscal expansion may have a perverse effect on the stock market and output even before the policy is implemented. If it is expected that a change in fiscal policy will result in an increase in short term interest rates after the policy is implemented then the stock market value will fall at the time of announcement. The decline in stock market value results in a decrease in private spending and therefore a decline in output.

Conversely, if it is anticipated that consumption and profits will increase as a result of higher future government spending then fiscal policy may instead have a positive impact on the stock market. In this case, higher spending more than offsets the anticipation of higher interest rates and thus facilitates the stock market rise. The ultimate response of the stock market will depend on how the increase in expenditure is financed. If it is debt-financed, then higher real interest rates causes the stock market to fall. In the case where the expenditure is financed through taxation measures the negative impact on the stock market may be somewhat muted.

In the case of an unanticipated fiscal expansion the impact is also somewhat imprecise and is similar to the anticipated case. An unexpected increase in government expenditure, which results in an increase in the short-term rate, causes the value of the stock market to fall. Spending increases as a result of the higher public spending but output does not adjust immediately to the change in policy and increases slowly over time. The adjustment of the stock market and output is therefore slower than in the anticipated case. Again, the impact will depend on which of the two effects dominate: spending and rising output or higher interest rates.

In summary, the effect of a change either in anticipated and unanticipated policy, fiscal or monetary, is a discrete change in the stock market due to the change in the anticipated sequence of profits and interest rates. Whether policy is anticipated or unanticipated is important as an announcement itself can lead to a change in profits and interest rate. The change in the stock market and output precede the implementation of an anticipated policy change so that at actual implementation the policy may have little apparent effect. In the unanticipated case, the stock market and output react and reflect immediately the effects of the policy change.

## *Section 4: Empirical Methodology*

As a first step, the impact of broad macroeconomic variables on the stock market are assessed using a simple VAR. The variables used are the fiscal balance, monetary base, exchange rate, the inflation rate, short-term interest rates[6], and real GDP[7]. Stock market activity is measured by changes in the Jamaica Stock Exchange All Composite Index. Monthly data spanning the period 1991:04 to 1999:12 are used in the estimation.

The main argument developed and tested in this paper is that changes in the value of the stock market depend on whether monetary or fiscal policy actions are anticipated or unanticipated. We therefore first estimate dynamic models of monetary and fiscal policies.

Monetary policy reaction function is modeled as follows:

$$\Delta MB_T = f(p^d_{t-1}, y^d_{t-1})$$

Where $p^d$ is the deviation of the price from its targeted level, $y^d$ the deviation of output (GDP) from its programmed level, $MB_t$ is the logarithm of the monetary base[8]. Thus, the Central Bank adjusts its operating target, the money base, in response to the deviations in prices and output from their target levels in the previous period. We expect that the impact of output will be negligible.

Fiscal policy is

$$G = f(Rev, Debt)$$

Where $G$ is government expenditure, $Rev$ is taxation revenue and $Debt$ is the total debt and spending depends on revenue and the debt burden. Both models are estimated in

[6] Rate on180-day Treasury Bill.
[7] Series intrapolated using an index of exports and imports.
[8] An alternate model of monetary policy using Repurchase Agreements is also estimated. The results are shown in the Appendix II.

error correction form to capture the short-run effects and long-run adjustment. A general-to-specific modelling approach was adopted, where Likelihood Ratio and information criteria were used to arrive at the most parsimonious model. For the monetary and fiscal policy equations, a Johansen Cointegration test is first used[9] to determine the possible existence of any long-run relation i.e. the long-run policy reaction function. Fitted values from each regression are used as observations for the anticipated policy measures while the residuals are used as measures of unanticipated policy.

Stock prices are subsequently modelled as a function of anticipated and unanticipated fiscal and monetary policies in a VECM in order to capture feedback effects amongst the variables and the long run adjustments. Thus, the stock price equation is given as:

$$SP_t = \zeta + \sum_{i=1}^{l} \beta SP_{t-i} + \sum_{i=1}^{l} \alpha AF_{t-i} + \sum_{i=1}^{l} \lambda UF_{t-i} + \sum_{i=1}^{l} \theta AM_{t-i} + \sum_{i=1}^{l} \rho UM_{t-i} + \upsilon_t \cdots\cdots (3)$$

where $SP_t$ is the stock price index, $AF_t$ denotes the anticipated fiscal policy, $UF_t$ is unanticipated fiscal policy, $AM_t$ anticipated monetary policy and $UM_t$ is unanticipated monetary policy.

A multivariate Granger Causality test is applied to establish causation between the variables. According to the theory postulated, changes in the anticipated monetary and fiscal policies will have no significant lagged effect on the value of the stock market. Innovation analysis is then used to assess the reaction of the market to policy changes.

## *Section 5: Empirical Results*

All variables were formally tested for unit roots using the Augmented Dickey Fuller (ADF) test. All the variables were found to be non-stationary, specifically, all the

[9]The Johansen Cointegration test is performed on a VAR estimated in levels and at the optimal/appropriate lag length previously chosen.

variables are I(1)[10]. A simple VAR in differences was estimated in order to ascertain the impact of broad macroeconomic variables on the stock market. Two lags were utilised in this estimation, as this was the lag length found most suitable by the Hannan-Quinn and Schwartz information criteria (Appendix II Table 2). Figure III gives the impulse response of the stock market to innovations in the selected macroeconomic variables. The impulse response of the stock market index to innovations in the monetary and fiscal variables followed a priori expectations.(See Figure III). Intuitively, one expects that higher deficits will have a dampening effect on the stock market. The impulse response function showed that a one-unit positive shock to the fiscal balance resulted in a small decline in the stock market index after two to three months. The response of the index to the deficit however was very limited and declined quickly after four to five months. The negative relation between fiscal deficit and stock prices is not surprising given that an increase in government spending, in the case of Jamaica, with relatively stable or declining tax revenues may be financed through increases in government debt which may put upward pressure on interest rates[11]. Through the mechanism of higher interest rates, stock market activity may be diminished.

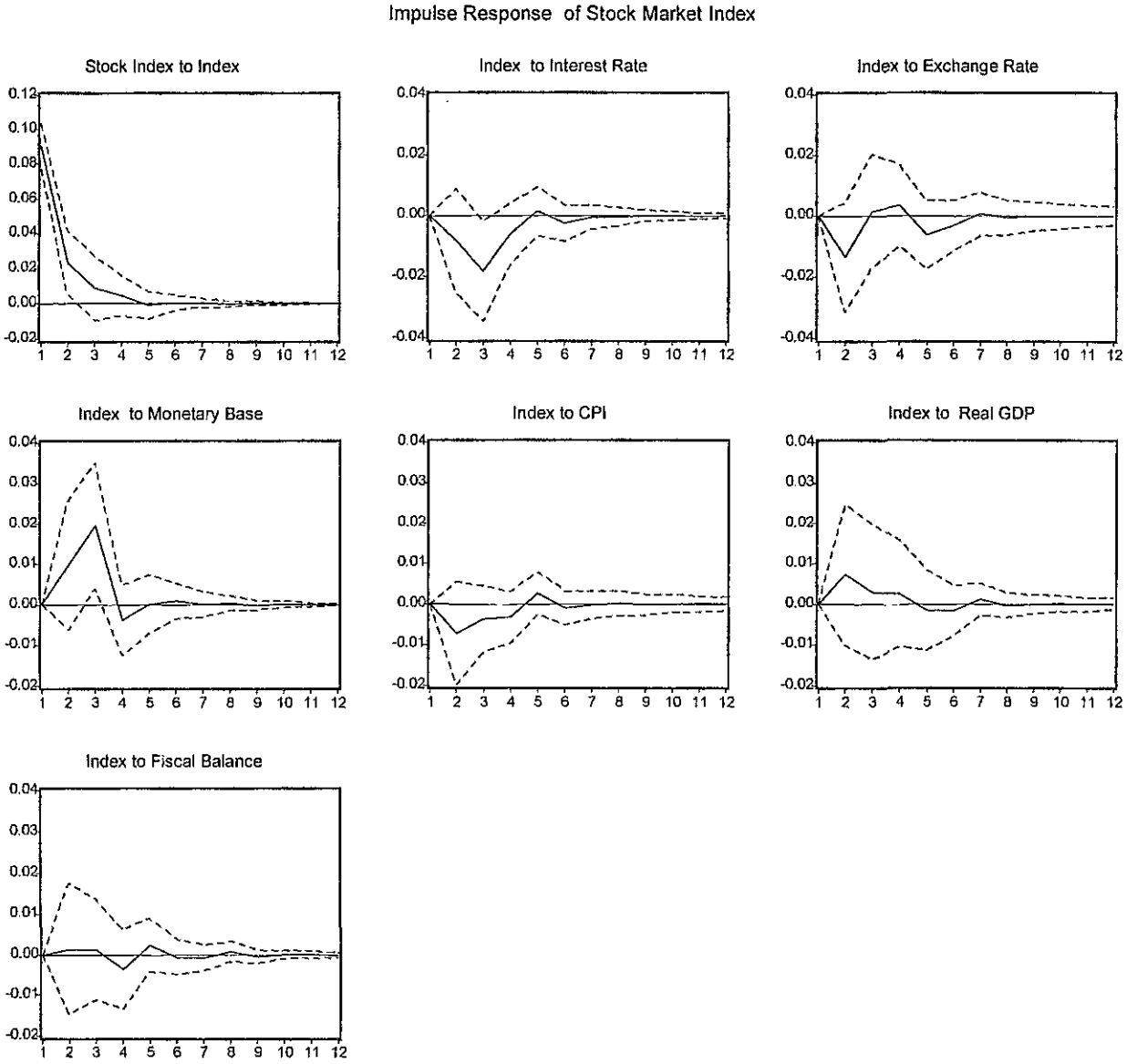
Innovations to the monetary variable had a large positive impact on the index. This is explained by the premise that a rise in nominal money balances without an instantaneous adjustment in price results in a rise in real balances. This increase in real balances, in conjunction with the rise in inflationary expectations, initially reduces real interest rates hence increasing the real value of the stock market.

The impact of shocks to real GDP on the stock market also followed a priori expectations. The impulse response showed that an increase in output has an expansionary effect on stock prices, albeit temporary. Further, the response of the index showed that innovations to the interest rate, inflation rate and the exchange rate had a dampening effect on the stock market index. Conventionally, one expects rising interest

[10] See Appendix for results of the ADF test .
[11] This is under the assumption that a monetisation of the deficit is avoided given stringent base money management and attempts to separate fiscal and monetary policy by the authorities.

rates to have a negative impact on the stock market index. High interest rates increase investments in instruments such as government bonds and Treasury Bills and shifts funds away from the stock market. As shown in Figure III, a one unit positive innovation to interest rates results in a significant decline in the stock market index, which dissipates after six to seven months.

Figure III.



A one-unit positive innovation to the inflation rate resulted in a decline in the index. This result is consistent with other studies that argue a negative relationship between the inflation rate and the stock market index[12]. The negative effect is explained by the simultaneous rise in interest rates or by the view that higher expected inflation rates shift investment from non-interest bearing financial assets such as common stocks to other interest bearing instruments, which lowers the expected real return on such stocks.

The effect of innovations to the exchange rate on stock prices generates some degree of ambiguity. One theory postulates a positive relationship between exchange rates and stock prices in the context of a small open economy[13]. A depreciation of the exchange rate, in a nation with heavily export-oriented industries, lowers the relative price of exports. This improves the competitiveness of exports and results in higher profits for trading firms, which raises the value of the firm. The end result of the increase in firm profitability is therefore a more buoyant stock market. On the other hand, the idea that a sharp depreciation may lead wealth holders to transfer their investment holdings from the stock market to foreign assets implies a negative relation between stock prices and exchange rates. By shifting their investments from the stock market to foreign assets, investors can hedge against the risk that a depreciating currency will lower the real value of their investments. In the model estimated, a one unit positive innovation to exchange rate was found to have a negative effect on the stock market index. This result may indicate that in the case of Jamaica, the wealth effect is dominant.

The results of the simple VAR model indicate that while monetary policy has a relatively strong influence on the stock market, the impact of fiscal policy is minimal. It may be the case therefore that in order to evaluate the full effects of fiscal and monetary policies on the stock market one has to consider whether these policies are expected or unexpected. A dynamic model of monetary and fiscal policies is estimated to capture these considerations and its results are presented below.

---

[12] See seminal work by Eugene Fama (1981) "Stock Returns, Real Activity, Inflation and Money".

[13] See studies by Friberg and Nydahl (1997) Openness and the Exchange Rate exposure of National Stock Markets-A Note in Economics and Finance (No. 195).

In estimating the monetary and fiscal equations, the Johansen test for cointegration was first applied to each equation. Results indicate at least two cointegrating vectors for the monetary equation and the fiscal policy model (See Appendix II Tables 4a and 5a). Subsequently, the Error Correction Model (ECM) was estimated using general- to – specific modelling with the LR test and information criteria applied to determine the most parsimonious model. Tables 4b and 5b in Appendix II show the results of the lag length tests while the ECM for the monetary and fiscal equations are shown in Table 4c and 5c. The fitted and residual values from the estimation of the monetary and fiscal equations were used in the estimation of the stock price model. The fitted values were used as anticipated policy actions while the residuals were applied as representing unanticipated fiscal and monetary policy measures.

In the stock price model, tests for cointegration showed the presence of four cointegrating vectors. Six lags were chosen as suitable according to the information criteria (See Appendix II Tables 6a and 6b). The results of the multivariate Granger Causality tests, shown below in Table A, revealed that anticipated and unanticipated fiscal and monetary policy actions Granger-cause changes in the value of the stock market. This contradicts theory, which proposes that lagged values of anticipated policy should not have a significant (large) effect on the stock market[14]. This result may indicate that information in respect to current policy is slowly incorporated into the stock market, which indicates the presence of informational asymmetries in the Jamaican case.

Table A Results of Granger Causality Test

| | | |
|---|---|---|
| $H_0$: Anticipated Fiscal does not Granger-cause Stock Price | | |
| Chi-Squared(24)= | 69.2756 with Significance Level | 0.00000 |
| $H_0$: Anticipated Monetary does not Granger-cause Stock Price | | |
| Chi-Squared(24)= | 61.3555 with Significance Level | 0.00004 |
| $H_0$: Unanticipated Fiscal does not Granger-cause Stock Price | | |
| Chi-Squared(24)= | 121.0404 with Significance Level | 0.00000 |
| $H_0$: Unanticipated Monetary does not Granger-cause Stock Price | | |
| Chi-Squared(24)= | 86.0120with Significance Level | 0.00000 |

[14] The coefficient on the anticipated variables must decrease over time and will not have a large effect on the stock market as all important and relevant information in regards to these variables has been incorporated into stock prices.

Figure IV. shows the impulse response function of the stock market to shocks on the variables contained in the VECM. In the case of anticipated fiscal policy, a one-unit positive innovation resulted in a decrease in the value of the stock market after approximately two months. The negative relation between fiscal policy and stock prices may be explained if the increase in government expenditure was financed by an increase in debt. The resultant rise in interest rates therefore acts as a disincentive to stock market investment.

On the other hand, innovations to the unanticipated fiscal policy variable had a positive impact on the value of the stock market. A one standard deviation shock to unanticipated fiscal policy resulted in an immediate and significant rise in stock prices. This result indicates that higher government expenditure may have resulted in higher levels of consumption and spending, which increased the expectations of greater profits and precipitated the initial jump in the value of the stock market. In this case the expectations of higher aggregate demand and output dominate any negative effect that higher interest rates may have on the stock market.

A positive innovation to the anticipated monetary policy variable resulted in a rise in the value of the stock market. The effect of this unit shock to the anticipated monetary policy variable occurs immediately, with the cumulative effects stabilising over time. A priori, one expects an expansion in the anticipated monetary policy variable to have a positive impact on the stock market. A monetary expansion raises expectations of higher profits and increases spending and output. Real interest rates also fall as the higher expected price level results in expectations of greater inflation. Similarly, the response function of the stock market to a positive innovation in unanticipated monetary policy followed a priori expectations. A one-unit shock to unanticipated monetary policy resulted in a significant rise in the value of the stock market. The positive effect may be as a consequence of the real balance effect and the Mundell effect, which work in tandem to reduce interest rates.

Figure IV.

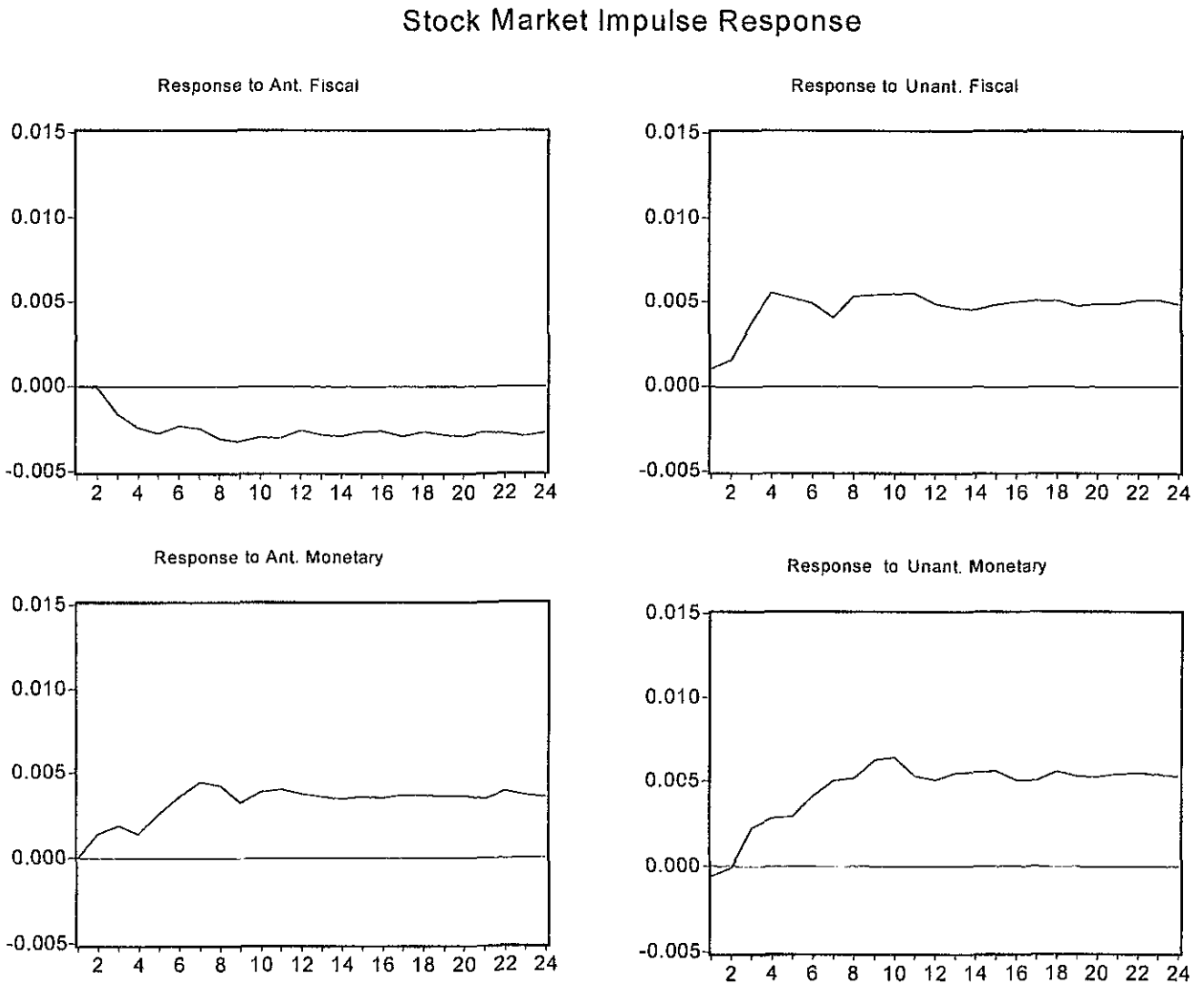

Stock Market Impulse Response
Response to Ant. Fiscal
Response to Unant. Fiscal
Response to Ant. Monetary
Response to Unant. Monetary
0.015
0.010
0.005
0.000
-0.005
2 4 6 8 10 12 14 16 18 20 22 24

Table B shows the Variance Decomposition of the change in the stock market index over the short term (6 months), the medium term (12 months) and the long term (24 months).

Table B

Variance Decomposition of Changes in the Stock Market

| Horizon | Index | Anticipated Fiscal | Unanticipated Fiscal | Anticipated Monetary | Unanticipated Monetary |
|---|---|---|---|---|---|
| 6 | 80.35 | 2.32 | 10.45 | 2.81 | 4.07 |
| 12 | 71.06 | 3.15 | 11.07 | 5.10 | 9.60 |
| 24 | 68.34 | 3.42 | 11.09 | 5.57 | 11.57 |

Results show that a significant proportion of the movement in the index can be explained by innovations to the index itself. This effect is significant and declines slowly over the short to long term horizon. Importantly, the variance decomposition shows that apart from the index itself, unanticipated fiscal and monetary policy measures have the largest effect on the index. Notably, as the effect of unanticipated monetary and fiscal policies increase over time, the impact of the index on it itself is reduced. The effect of anticipated fiscal and monetary policies, on the other hand, is limited.

These results have significant implications. Firstly, the proportion of movements in the index that is a result of "own shocks" implies that variability in the value of the stock market may be due to other salient factors. These factors may include a weak institutional framework, the presence of speculative forces, a high market concentration and inefficiency in how the market and its participants incorporate all available information into stock prices. Secondly, the impact of monetary and fiscal policies, although limited by the large effect of the stock market index on itself, has important implications for policymakers. Within this context, the credibility and consistency of the policies pursued are necessary elements to guarantee the desired policy outcomes. Additionally, it is of utmost importance that policy makers consider the optimal timing of their actions and the implications this may have on the behaviour of the stock market.

## *Section 6: Conclusion*

This paper has investigated the impact of anticipated and unanticipated monetary and fiscal policy actions on the Jamaican stock market. This has been done within the framework of a dynamic model, which utilises the VAR methodology. The results show that an expansionary monetary policy whether anticipated or unanticipated has a positive effect on the value of the stock market. On the other hand, while an unanticipated expansion in government expenditures leads to a rise in the stock market, an anticipated expansion has the opposite effect. In examining the proportion of the changes in the index that are accounted for by changes in policy, it was found that in the instance where the change in macroeconomic policy is unanticipated, whether fiscal or monetary, there is a significant and more lasting impact on the stock market. However, in considering the results of the model further one notes the strong proportion of the changes in stock prices that are accounted for by "own" shocks.

The stock market plays a vital role in the process of savings mobilisation and capital accumulation. The empirical results show that the Jamaican stock market does respond to macroeconomic policy and therefore that monetary and fiscal policies may be useful instruments in creating a climate that allows for growth in the equities market. The resurgence of the stock market index in the first two quarters of the year 2000 was illustrative of the impact of these policies on the stock market. The government's announcement of its intention to lower the fiscal deficit and lessen its reliance on the domestic debt market, thereby facilitating a reduction in interest rates stimulated investor confidence in the stock market. These measures in conjunction with the lowering of the tax on dividend income and the Central Bank's reduction of the cash reserve ratio contributed significantly to the advance in the stock market index during this period.

However, the model developed further shows that despite the positive influence of macroeconomic policy, the long run impact on capital formation through the stock market is limited. One possible reason for this is that macro-economic policy has not been consistent, over the period analysed, and as such, has not been able to foster a stable environment conducive to the development of the equity market. Government's

economic policy pronouncements and the achievement of its economic targets sends signals to stock market participants. Therefore, stable and consistent policies are necessary to engender credibility and to aid policy in achieving its desired outcome.

Other possible reasons relate to imperfections within the market itself. These include the high concentration of trading in a few firms, low market liquidity, the decline in the turnover rate and other weaknesses in the institutional framework, which decrease the efficiency of the market's allocation of investment resources. These factors in addition to the high costs associated with the raising of equity publicly such as advertising, legal and accounting fees also inhibits the growth of the stock market and its effectiveness as a channel for savings. Improvements in the overall efficiency of the stock market thus require a deepening of the market and a further reduction in operational inefficiencies that exist.

A revival of the primary market as well as steps towards the regionalisation of stock markets may be important factors that can aid in improving the effectiveness and efficiency of the Jamaican stock market as an instrument of savings mobilisation. The paper also highlights the need for further research with regards to the institutional structure and its impact on the efficiency of the market in order to better understand the presence of informational asymmetries and its effect on stock prices.

## *References*

Agbeyegbe, T., (1994) "Some Stylised Facts about the Jamaica Stock Exchange" Social and Economic Studies, Vol 43, No. 4.

Ali, Syed M. and Hasan, Aynul M., (1993) "Is the Canadian Stock Market Efficient with respect to Fiscal Policy? Some Vector Autoregression Results" Journal of Economics and Business, Vol 45, Iss. 1, February, pp. 49-59.

Beck, T., Demirguç-Kunt, A and Levine R., (1999) " A New Database on Financial Development and Structure" Working Paper 2146, World Bank.

Darrat, A..F.(1990), "Stock Market Returns, Money and Fiscal Deficits", Journal of Financial and Quantitative Analysis, 25, No. 3, September, pp. 387-98.

Demirguç-Kunt, A. and Levine R., (1995) "Stock Market Development and Financial Intermediaries: Stylised Facts. Working Paper 1462, World Bank.

Evans, Dwyfor and Murinde Victor, (1995) "The Impact of Monetary and Fiscal Policy Actions on the Stock Market In Singapore" Savings and Development, No. 3, pp. 297-313.

Fama, Eugene, (1981) "Stock Returns, Real Activity, Inflation and Money", American Economic Review, pp. 545-564.

Friberg, Richard and Nydahl, Stefan, (1997)"Openness and the Exchange Rate Exposure of National Stock Markets-A Note" Working Paper in Economics and Finance No. 195.

Ibrahimi, F., Oxelheim, L and Wihlborg C, (1995) "International Stock Markets and Fluctuations in Exchange Rates and Other Macroeconomic Variables". In *Global*

*Portfolio Diversification: Risk Management, Market Microstructure and Implementation Issues*, eds. Aggarwal R and Schirm D, Academic Press, Boston.

Koot, R., Miles J. and Heitmann G., (1989) "Security Risk and Market Efficiency in the Jamaican Stock Exchange" Caribbean Finance and Management, Vol. 5, No. 2.

Leon, Hyginus (1996)," Volatility Persistence On Jamaican Stock Returns" in *Problems and Challenges in Modelling and Forecasting Caribbean Economies*, eds. Nicholls, S, Leon, H and Watson, P, Caribbean Centre for Monetary Studies, University of the West Indies

# APPENDIX I

Data Sources:

**Real GDP**: Monthly series intrapolated using an index of exports and imports.

**Reverse Repurchase Agreements**: Bank of Jamaica equivalent 30-day series. Years prior to April 1994 are the equivalent 30-day rate based on the now retired Certificate of Deposit series. The REPO replaced the Certificate of Deposit as the Central Bank's prime monetary policy instrument in January 1995.

**Treasury Bill Rate:** Rate on 180-day T-Bill. **:** Bank of Jamaica Statistical Digest.

**Inflation rate**: Change in the logarithm of the Consumer Price Index (CPI). The CPI is compiled from the Statistical Institute of Jamaica sources.

**Exchange Rate:** Bank of Jamaica Statistical Digest. The rates refer to the weighted average selling rate of the U.S. Dollar.

**Money Base:** Defined as the currency in circulation, statutory reserves held with the Bank of Jamaica and commercial banks current account balances.

**Fiscal Balance:** Central government expenditure minus revenues (all in natural logarithm). Fiscal years 1990-1993 are proxied by the Central Government financing figures. There may be discrepancies between the fiscal balance and the financing figures due to problems with the timing of flows and the posting of these flows to the accounts.

**Stock Market Index:** End of month figures provided by the Jamaica Stock Exchange.

# APPENDIX II

## Table 1: Stock Market Figures

| YEAR | MKT_CAP $000 | LISTED | VOLUME '000 | VALUE $000 | INDEX | TRANSACTIONS | NO. of BROKERS |
|---|---|---|---|---|---|---|---|
| 1980 | 124,149.00 | 41 | 7,390 | 5,101 | 69.83 | 502 | 5 |
| 1981 | 225,761.00 | 33 | 4,198 | 3,332 | 152.23 | 799 | 5 |
| 1982 | 315,964.00 | 32 | 5,542 | 10,156 | 211.16 | 1,375 | 5 |
| 1983 | 359,199.00 | 32 | 5,185 | 9,820 | 240.38 | 1,566 | 5 |
| 1984 | 697,729.00 | 32 | 9,744 | 26,017 | 461.1 | 2,117 | 5 |
| 1985 | 1,456,590.00 | 33 | 37,640 | 117,146 | 941.5 | 3,049 | 6 |
| 1986 | 3,085,766.00 | 36 | 59,252 | 374,617 | 1,499.87 | 6,691 | 8 |
| 1987 | 3,468,661.00 | 41 | 71,877 | 399,971 | 1,515.09 | 11,187 | 8 |
| 1988 | 4,290,291.00 | 44 | 43,522 | 136,739 | 1,439.22 | 6,446 | 8 |
| 1989 | 6,228,384.00 | 44 | 95,202 | 516,456 | 2,075.85 | 13,892 | 8 |
| 1990 | 7,321,285.00 | 44 | 57,960 | 230,782 | 2,539.36 | 8,691 | 9 |
| 1991 | 22,214,715.00 | 44 | 144,258 | 1,156,609 | 7,681.50 | 24,072 | 9 |
| 1992 | 76,974,281.00 | 48 | 395,606 | 4,687,337 | 25,745.88 | 49,791 | 9 |
| 1993 | 41,879,310.00 | 48 | 567,454 | 8,346,770 | 13,099.68 | 55,519 | 9 |
| 1994 | 58,018,064.00 | 50 | 741,754 | 5,155,463 | 16,676.74 | 43,144 | 10 |
| 1995 | 50,755,753.00 | 51 | 3,565,607 | 11,560,485 | 14,266.99 | 42,600 | 10 |
| 1996 | 66,116,257.00 | 50 | 561,508 | 4,634,787 | 16,615.99 | 23,189 | 8 |
| 1997 | 79,619,594.00 | 49 | 905,419 | 4,594,418 | 19,846.66 | 18,623 | 8 |
| 1998 | 79,038,726.00 | 48 | 604,545 | 2,064,243 | 20,593.33 | 13,748 | 8 |
| 1999 | 104,041,538.00 | 45 | 520,531 | 2,218,714 | 21,892.58 | 9,256 | 8 |

**Table 2: ADF Test Results**

| Variables | Levels | Ist Difference |
|---|---|---|
| CPI | 2.61 | 4.67 |
| Exchange Rate | 1.32 | 5.53 |
| GDP | 1.86 | 4.65 |
| Fiscal | 0.92 | 5.11 |
| Interest Rate | 2.19 | 6.21 |
| Monetary Base | 2.49 | 4.49 |
| Index | 2.75 | 6.23 |
| $Y^D$ | 1.02 | 6.86 |
| $P^D$ | 2.22 | 5.73 |
| Govt. Expenditure | 1.44 | 7.10 |
| Taxation Revenues | 2.51 | 3.03 |
| Total Debt | 0.89 | 4.44 |
| Anticipated Fiscal | 2.72 | 5.43 |
| Unanticipated Fiscal | 2.48 | 4.57 |
| Anticipated Monetary | 1.78 | 5.14 |
| Unanticipated Fiscal | 2.68 | 5.51 |

The critical value is 2.88

## Table 3: Results For Simple VAR Model:

### 3a) Lag Length Test

| Lag Length | 2 | 3. | 4 | 5 | 6 |
|---|---|---|---|---|---|
| AIC | -16.68 | -17.004 | -16.72 | -17.18 | -17.64 |
| SBC | -13.86- | -12.86- | -11.26 | 10.4 | 9.55 |
| Hannan-Quinn | -15.7336 | -11.3047 | -14.7064 | -9.95199 | -14.5677 |
| Log Liklelihood | 897.43 | 961.69 | 997.20 | 1068.19 | 1139.186 |

The LR test statistic is given by:

$$LR = -2(l_r - l_{ur})$$

Where $l_r$ is the log likelihood for the restricted model and $l_{ur}$ is the log likelihood for the unrestricted model. The unrestricted model is six lags and is tested against various lag restrictions to ascertain the most suitable lag length.

| | P-value |
|---|---|
| $H_0$: Restriction of 2 lags holds | 0.00 |
| $H_0$: Restriction of 3 lags holds | 0.00 |
| $H_0$: Restriction of 4 lags holds | 0.00 |
| $H_0$: Restriction of 5 lags holds | 0.00 |

## Table 4: Results for Monetary Equation

### 4a) Cointegration Test

Series: Monetary Base, $Y^D$, $P^D$

Lags interval: 1 to 4

| Likelihood Ratio | 5 Percent Critical Value | 1 Percent Critical Value | Hypothesized No. of CE(s) |
|---|---|---|---|
| 77.07795 | 29.68 | 35.65 | None ** |
| 24.85682 | 15.41 | 20.04 | At most 1 ** |
| 5.798334 | 3.76 | 6.65 | At most 2 * |

*(**) denotes rejection of the hypothesis at 5%(1%) significance level

L.R. test indicates 2 cointegrating equation(s) at 5% significance level

4b) Lag Length tests for Error Correction Model

| Lag Length | 2 | 3. | 4 | 5 | 6 |
|---|---|---|---|---|---|
| AIC | -3.15 | **-3.22** | -3.20 | 3.19 | 3.20 |
| SBC | -2.99 | **-3.01** | -2.94 | 2.87 | -2.85 |
| Hannan-Quinn | -3.06 | **-3.08** | -3.00 | -2.94 | -2.90 |
| Log Liklelihood | 160.47 | 166.04 | 166.93 | 168.55 | 171.19 |

Unrestricted model estimated at 6 lags. Three lags found suitable.

| | P-value |
|---|---|
| $H_0$: Restriction of 2 lags holds | 0.04 |
| $H_0$: Restriction of 3 lags holds | **0.32** |
| $H_0$: Restriction of 4 lags holds | 0.20 |
| $H_0$: Restriction of 5 lags holds | 0.15 |

## 4c) Error Correction Model

Monetary Equation

Method: Least Squares

Sample(adjusted): 1991:08 1999:12

Included observations: 101 after adjusting endpoints

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.004925 | 0.005295 | -0.930130 | 0.3547 |
| RESIDF(-1) | -1.294928 | 0.102395 | -12.64637 | 0.0000 |
| D(PRICE(-1)) | 0.101050 | 0.480192 | 0.210436 | 0.8338 |
| D(PRICE(-2)) | -0.325952 | 0.464221 | -0.702147 | 0.4843 |
| D(PRICE(-3)) | -0.260616 | 0.410982 | -0.634130 | 0.5276 |
| D(OUTPUT(-1)) | -0.382748 | 0.666335 | -0.574407 | 0.5671 |
| D(OUTPUT(-2)) | -0.724529 | 0.707147 | -1.024581 | 0.3082 |
| D(OUTPUT(-3)) | 2.150321 | 0.662951 | 3.243561 | 0.0016 |

| | | | |
|---|---|---|---|
| R-squared | 0.653582 | Mean dependent var | 0.001242 |
| Adjusted R-squared | 0.627507 | S.D. dependent var | 0.075613 |
| S.E. of regression | 0.046149 | Sum squared resid | 0.198061 |
| F-statistic | 25.06592 | Durbin-Watson stat | 1.918126 |

## Table 5: Results for Fiscal Policy

### 5a) Cointegration Tests

Series: Expenditure, Debt, Revenue

Lags interval: 1 to 6

| Likelihood Ratio | 5 Percent Critical Value | 1 Percent Critical Value | Hypothesized No. of CE(s) |
|---|---|---|---|
| 55.60938 | 29.68 | 35.66 | None ** |
| 23.25817 | 15.41 | 20.04 | At most 1 ** |
| 0 7.069057 | 3.76 | 6.65 | At most 2 ** |

*(**) denotes rejection of the hypothesis at 5%(1%) significance level

L.R. test indicates 2 cointegrating equation(s) at 5% significance level

### 5b) Lag Length Tests for Error Correction

| Lag Length | 2 | 3. | 4 | 5 | 6 |
|---|---|---|---|---|---|
| AIC | 0.01 | 0.071312 | 0.066564 | 0.131513 | 0.161311 |
| SBC | -3.14 | -3.15 | -3.17 | -3.14 | -3.12 |
| Hannan-Quinn | 0.16 | 0.27 | 0.31 | 0.427 | 0.507 |
| Log Liklelihood | 10.24 | 11.72 | 16.53 | 17.89 | 20.99 |

Unrestricted model estimated at lags1-6. Could not reject the hypothesis that 2 lags were acceptable.

| | P-value |
|---|---|
| $H_0$: Restriction of 1-2 lags holds | 0.36 |
| $H_0$: Restriction of 1-3 lags holds | 0.48 |
| $H_0$: Restriction of 1-4 lags holds | 0.76 |
| $H_0$: Restriction of 1-5 lags holds | 0.57 |

## 5c) Error Correction Model

Fiscal Policy Equation

Method: Least Squares

Sample(adjusted): 1991:07 1999:12

Included observations: 102 after adjusting endpoints

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| DLDEBT(-1) | 0.049152 | 0.669308 | 0.073438 | 0.9416 |
| DLDEBT(-2) | -1.170267 | 0.658335 | -1.777617 | 0.0786 |
| DLREV(-1) | 0.875626 | 0.200563 | 4.365835 | 0.0000 |
| DLREV(-2) | 0.172189 | 0.186867 | 0.921452 | 0.3591 |
| ERR1(-1) | -0.783915 | 0.104331 | -7.513695 | 0.0000 |
| C | 0.020449 | 0.038623 | 0.529451 | 0.5977 |

| | | | |
|---|---|---|---|
| R-squared | 0.617448 | Mean dependent var | 0.024377 |
| Adjusted R-squared | 0.597523 | S.D. dependent var | 0.536339 |
| S.E. of regression | 0.340259 | Sum squared resid | 11.11455 |
| F-statistic | 30.98921 | Durbin-Watson stat | 2.036265 |

## Table 6: Results for Stock Price Equation

### 6a) Cointegration Test

Sample: 1991:08 1999:12

Included observations: 94

Test assumption: Linear deterministic trend in the data

Series: LSP AF1 UF1 AM1 UM1

Lags interval: 1 to 6

| Likelihood Ratio | 5 Percent Critical Value | 1 Percent Critical Value | Hypothesized No. of CE(s) |
|---|---|---|---|
| 119.6302 | 68.52 | 76.07 | None ** |
| 77.35945 | 47.21 | 54.46 | At most 1 ** |
| 42.23908 | 29.68 | 35.65 | At most 2 ** |
| 23.69223 | 15.41 | 20.04 | At most 3 ** |
| 5.730517 | 3.76 | 6.65 | At most 4 * |

*(**) denotes rejection of the hypothesis at 5%(1%) significance level

L.R. test indicates 4 cointegrating equation(s) at 5% significance level

### 6b) Lag Length Test

| Lag Length | 2 | 3. | 4 | 5 | 6 |
|---|---|---|---|---|---|
| AIC | -12.14 | -12.79 | -13.23 | -13.29 | -13.55 |
| SBC | -10.67 | -10.64 | -10.41 | -9.79 | -9.39 |
| Hannan-Quinn | -13.92 | -14.24 | -14.05 | -13.75 | -13.58 |
| Log Liklelihood | 271.66 | 165.56 | 107.04 | 60.14 | 20.99 |

Unrestricted model estimated at 6 lags. Could not reject the hypothesis that 6 lags were acceptable.

| | P-value |
|---|---|
| $H_0$: Restriction of 2 lags holds | 0.0000 |
| $H_0$: Restriction of 3 lags holds | 0.0000 |
| $H_0$: Restriction of 4 lags holds | 0.0000 |
| $H_0$: Restriction of 5 lags holds | 0.0000 |

## Table 7 Results for Repurchase Agreement (REPO) Model

### 7a. Cointegration Test

Sample: 1991:04 1999:12

Included observations: 100

Test assumption: Linear deterministic trend in the data

Series: REPO OUTPUT PRICE

Lags interval: 1 to 4

| Likelihood Ratio | 5 Percent Critical Value | 1 Percent Critical Value | Hypothesized No. of CE(s) |
|---|---|---|---|
| 43.16330 | 29.68 | 35.65 | None ** |
| 12.38040 | 15.41 | 20.04 | At most 1 |
| 0.468629 | 3.76 | 6.65 | At most 2 |

*(**) denotes rejection of the hypothesis at 5%(1%) significance level

L.R. test indicates 1 cointegrating equation(s) at 5% significance level

### 7b. Error Correction Model

Method: Least Squares

Sample(adjusted): 1991:07 1999:12

Included observations: 102 after adjusting endpoints

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.192692 | 0.328212 | -0.587098 | 0.5585 |
| ERROR(-1) | -0.848253 | 0.105230 | -8.060919 | 0.0000 |
| D(OUTPUT(-1)) | 29.25367 | 41.39065 | 0.706770 | 0.4814 |
| D(OUTPUT(-2)) | -7.977621 | 41.38176 | -0.192781 | 0.8475 |
| D(PRICE(-1)) | -3.215444 | 25.92065 | -0.124050 | 0.9015 |
| D(PRICE(-2)) | -32.39419 | 24.61175 | -1.316208 | 0.1912 |

| | | | |
|---|---|---|---|
| R-squared | 0.429347 | Mean dependent var | -0.026275 |

| | | | |
|---|---|---|---|
| Adjusted R-squared | 0.399625 | S.D. dependent var | 3.739929 |
| S.E. of regression | 2.897842 | Akaike info criterion | 5.022832 |
| Sum squared resid | 806.1588 | Schwarz criterion | 5.177242 |
| Log likelihood | -250.1644 | F-statistic | 14.44564 |
| Durbin-Watson stat | 1.991951 | Prob(F-statistic) | 0.000000 |