INFLATION TARGETING FRAMEWORK FOR JAMAICA: AN EMPIRICAL EXPLORATION:

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ABSTRACT

The paper seeks to explore the applicability of Inflation Targeting (IT) as an effective framework for guiding monetary policy forward in Jamaica and reducing and sustaining inflation at low single digit. Although the Bank of Jamaica (BOJ) has been successful at containing inflation within single digit through management of base money, the worsening state of the fiscal accounts, the significant exchange rate depreciation and the adverse terms of trade and external shocks has brought to light the need for a target instrument that affords the central bank more credibility and transparency.

The paper examines and tests a series of practical issues that need to be considered for an IT framework to work in Jamaica. A VAR model is used to explore issues relating to the definition of the price index and the monetary control lags. A Monte Carlo simulation illustrates how IT could work for Jamaica. The results show that as long as the BOJ's legal framework is reformed to establish full autonomy of the central bank, Jamaica can implement an IT regime over an 18-month horizon.

[1] The views expressed in this paper are those of the author and do not necessarily reflect the views of the Bank of Jamaica. The author would like to thank the entire staff of the Macro-modeling unit at the Bank of Jamaica and the editorial committee at the bank for valuable and insightful comments. The author will also like to thank Alex Hoffmaister of the IMF and Jide Lewis from the BOJ who provided assistance in the simulation exercise.

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1. Introduction

Inflation targeting *(IT*) as a framework for monetary policy has spread rapidly to developing countries since the 1990's. In most instances, the adoption of this framework by some countries has been in response to challenges in conducting monetary policy along traditional lines[2], as well as, a deliberate attempt to improve inflation records. The benefits of increased accountability and transparency of the operating procedures of monetary authorities arising from the adoption of IT augurs well for improved monetary policy credibility. By providing a nominal anchor both for monetary policy and inflation expectations, IT has engendered more transparency and accountability in the design and implementation of policies in a number of countries.

The emerging market economies that have adopted *IT* are large and have relatively well developed domestic financial systems. The experience of these countries suggests that the foundation for successful IT is built on a strong fiscal position, entrenched macroeconomic stability, central bank instrument independence and a reliable transmission mechanism. For most of these countries, IT was implemented only after having achieved a substantial reduction in inflation.

Although IT has been successful in some economies, there are fundamental institutional differences in a number of other countries that needs to be taken into account in an effort to develop sound macroeconomic polices. The case for Jamaica is quite an interesting one. In particular, Jamaica has a very small open economy that specializes mainly in the production and export of primary goods, such as bauxite, sugar and banana as well as, tourism services. The production processes depend heavily on imports and to a large extent, the prices of imports and exports are determined on the international market. This makes the economy vulnerable to adverse terms of trade and other external shocks.

In addition, over the past ten years the domestic economy has been characterized by relatively low growth rates due largely to the instability in the macroeconomic environment. The liberalization of the financial markets in the 1990's has led to sharp movements in the value of the exchange rate. Interest rates have also increased over the period and become more volatile relative to our main trading partners i.e. US, U.K, Canada and CARICOM. The

[2] It may be using an exchange rate peg or some monetary aggregate as the main intermediate target.

instability was also manifested in inflation rates, which has been higher than our main trading partners due primarily to oil price shocks.

These adverse macroeconomic conditions have been exacerbated by the inconsistency between monetary and fiscal policy objectives, in light of the recurring fiscal deficit and its impact on reducing the effectiveness of monetary policy. Given the latter point, IT's applicability for Jamaica may be somewhat restricted. However, the possible solutions available to the Bank in addressing the fiscal burden if *IT* is a desired monetary policy framework are the pursuit of full central bank independence, eliminating the obligation to accommodate fiscal expansion, or restricting the possibility of fiscal dominance.

In recent years, Jamaica has adopted some of the features of an IT framework. Of note is the public announcement of the target for inflation and the preparation and announcement of a detailed quarterly report discussing monetary policy in light of inflation developments. In addition, the relative instrument independence of the central bank has given the Bank the degree of flexibility needed in adjusting monetary policy in achieving the target for inflation. Of increasing concern however, is the instability of the money demand and the precision with which monetary targeting can continue to control inflation in light of increased foreign exchange market volatility, external shocks and the fiscal deficit.

The above discussion highlights some of the factors that need to be addressed before Jamaica can adopt an IT framework. The paper seeks to explore the applicability of IT as a framework for monetary policy. Section 2 discusses how the conduct of monetary policy has evolved in Jamaica. Section 3 examines the institutional settings and operational framework of a number of countries that have adopted IT, while section 4 conducts a series of tests to address practical issues that are considered fundamental prerequisites for an *IT* framework for Jamaica. In particular, a survey approach is used to determine the degree of BOJ's independence, further indicators of financial market depth and seigniorage activities are constructed to gauge the extent of government's reliance on the BOJ for financing its expenditure. The paper employs a vector autoregressive model (VAR) to explore the choice of the price index and the monetary control lags under an *IT* framework for Jamaica. Section 5 details the methodology and analysis of the results from the VAR model. The inflation targeting horizon and the width of the inflation target band are also discussed. In section 6,

a Monte Carlo simulation of how IT could work for Jamaica is explored, and section 7 draws together the policy implications of an *IT* regime for Jamaica.

2. The Conduct of Monetary Policy in Jamaica (1990 – 2003)

The Bank of Jamaica was established under the *Bank of Jamaica Act* of 1960 and began operations in May 1961. Under this Act, the conduct of monetary policy is aimed at regulating the growth of money and credit to meet the objectives of price stability and safeguarding the value of the domestic currency. Another key objective of the central bank is to ensure the stability of the financial system.

The monetary policy framework and strategy of the Bank is currently aimed at using monetary targets to achieve the desired objective of price stability. The central bank uses open market operations to manage bank reserves and currency in circulation. Adjustments in the components of base money influence interest rates, the level of credit and money supply through the money multiplier process, and ultimately the price level. This process relies on a stable and consistent relationship between monetary aggregates and the price level.

The Bank effectively controls liquidity through its use of open market operations and reserve requirements as well as, through its intervention in the foreign exchange market. The seasonality in the foreign exchange earnings necessitates the periodic intervention by the Bank to avoid sharp fluctuations in the exchange rate given the strong pass through to prices. This intervention also helps to support the objective of price stability.

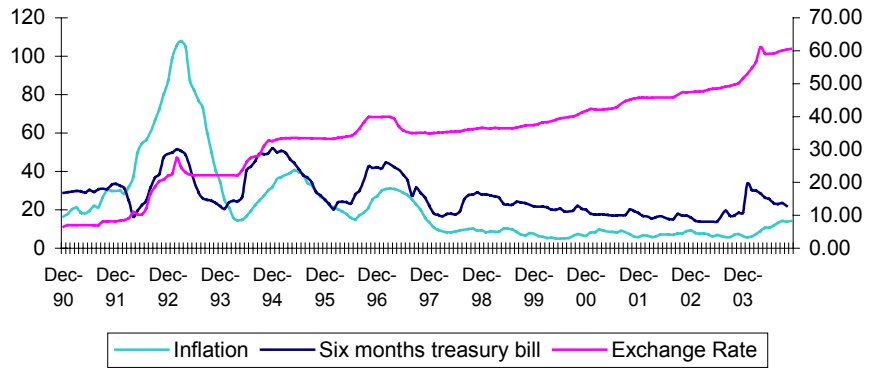
In implementing monetary policy, the initial stages of setting a target for inflation is done by the BOJ and approved by the Minister of Finance. The target chosen is then incorporated in a financial programme, which defines the main economic variables that are consistent with the inflation target, such as the net international reserves (NIR) and money supply. From the money supply target, base money targets are then derived through expectations of the money multiplier. Quarterly, monthly, weekly and daily targets for base money and the related aggregates are then derived from annual projections.

The process of implementing monetary policy in Jamaica has undergone fundamental changes over the period 1990 to 2003. These changes began with the transformation of the

Jamaican economy in 1990 by a wide range of structural reforms aimed at increasing the role of market forces in resource allocation and creating a stable macroeconomic environment. The liberalization of the foreign exchange market in 1990 and the capital account in 1991 represented two major steps in the reform process.

Following liberalization, the economy experienced severe macroeconomic instability, evidenced by substantial depreciation in the external value of the currency, unprecedented rates of inflation and a sharp decline in real interest rates, all in the context of inadequate foreign reserves.[3] Of note is the significant depreciation of 53 percent in the weighted average selling rate in September 1991 to December 1991. This contributed significantly to inflation (point-to-point) reaching a record level of 80.2 percent in 1991 (see Chart 1).

Chart 1:
Inflation Rate, Six-Months Treasury bill rate and the Exchange Rate
For the period 1990 to 2003



Against this background, monetary management was severely challenged by the uncertainties that accompanied the newly liberalized environment and the loss of direct instruments of monetary policy. With the switch to indirect instruments such as reverse repurchase agreements, the Bank's ability to manage liquidity was significantly enhanced.[4] In addition, the fiscal authorities implemented measures aimed at constraining liquidity and limiting domestic borrowing, such as the reduction in expenditure on selected pubic entities

[3] See Nelson-Douglas (2001)
[4] See Bank of Jamaica, The first 40 years (1961 – 2000) pages 95 - 122

and further price liberalization. By the end of 1991, the six-month Treasury bill rate rose sharply to 35.1 percent (see Chart 1).

For the first half of 1992, the Jamaican dollar depreciated further before it stabilized at US$ = J$22.20 by mid-June 1992. This relative stability in the foreign exchange market continued through to the middle of June 1993, as the contractionary monetary and fiscal policy stance slowed the growth in money supply considerably. In addition, the development of an active secondary market for trading securities during this period gave the central bank a greater degree of flexibility in its management of liquidity levels. These developments, in combination with the private sector initiative to augment the supply of foreign exchange in the banking system engendered a greater level of stability in the foreign exchange market and accounted for a deceleration in the inflation rate. In 1992, inflation fell by half to 40.2 percent and further to 30.2 percent in 1993.

By mid 1993, against the background of reduced foreign exchange inflows into the banking system by the private sector and the placement of a US$20.0 million bearer bond issue on the market by the government, the foreign exchange market came under pressure. By early 1994, relative stability in the foreign exchange market was achieved through continued tight monetary policy, which helped to temper the rate of growth in domestic prices and pushed interest rates to high levels. During the latter half of 1994, the continued stability in the foreign exchange market was facilitated by increased supplies of foreign exchange arising from the broadening of the inter-bank market to include merchant banks and the establishment of a network of cambio operations.

Following another substantial depreciation of the Jamaica dollar in 1995, a loss of international reserves and relatively high inflation rates, the authorities focused more sharply on achieving a reduction in inflation that converged to those of Jamaica's major trading partners. Thus, the year 1996 represented a milestone in the conduct of monetary policy in Jamaica. Base money targeting, which sought to achieve inflation in the range of 11 –15 percent for the fiscal year 1996/97 was an important step towards achieving single digit inflation in the ensuing years. As a result, inflation fell to 9.5 percent for the fiscal year 1996/97, which was significantly better than the target.

In spite of the challenges in the macroeconomic environment, the continued management of base money facilitated further reductions in inflation from 9.2 percent in 1997 to 7.3 percent in 2002. However, over the period, the public sector balance worsened, partly reflecting higher wages and interest cost on domestic debt. Within the context of high real interest rates and declining output, the liquidity crises in the financial system surfaced in 1997. The government's effort to 'bail out' some of these institutions in order to reduce the adverse shock on the macro-economy led to higher debt which ultimately resulted in progressively higher deficits in subsequent years.

In 2002, the downgrade in the rating of Jamaica's sovereign debt by Standard and Poor's arising from the deterioration of the fiscal balance and the debt stock led to significant volatility in the foreign exchange market. The resulting loss of investor confidence in the economy led to an increase in the rate of depreciation in the first half of 2003. Inflation, which had remained relatively stable at 6.6 percent in 2002, increased sharply to 5.6 percent for only the first six months of 2003. For the first time in over 6 years, Jamaica recorded double-digit inflation of 14.1 percent in 2003.

For the near-term, the main challenge to the Bank is the restoration of single-digit inflation in the context of uncertainties in international oil prices and the attainment of fiscal objectives. While monetary targeting has been successful in bringing down inflation for the six-year period to 2002, the management of base money has been particularly challenging. Monetary targeting is appropriate in an environment with a stable, reliable and predictable link between the targeted monetary aggregate and inflation. Financial innovation and the liberalization of capital flows and the foreign exchange market have substantially decreased the stability of this link. The rapid technological innovation that has taken place within the financial institutions and the changes which have affected the payment processes are likely to continue in the near future and will have implications for monetary policy. Importantly, these innovations that have impacted money demand as well as, the attempt to identify shifts in money demand may be difficult to estimate. This may render precise targets for monetary aggregates inappropriate in the near future.

The management of the monetary base has also resulted in excessive volatility in short-term interest rates arising mainly from the government's need to finance the deficit and the susceptibility of the economy to external shocks. This was particularly so in 2002, when the

deterioration of the fiscal accounts led to significant movements in the exchange rate and interest rate, while international oil price movement was the primary impetus leading to the higher inflation rate. These factors, in addition to the loss of investor confidence that ensued, has brought to light the need for a target instrument that affords the central bank more credibility and transparency.

It is in this vein that an inflation-targeting framework is being explored for guiding monetary policy in Jamaica. Over the years, the Bank has undertaken a number of initiatives that would assist the process to inflation targeting and improve the quantitative framework of monetary policy. In 1997, the Bank developed a measure of core inflation as an indication of the influence of monetary policy on inflation, which it continues to publish.[5] A quantitative analysis of the monetary transmission mechanism was also developed. The Bank also publishes its Quarterly Monetary Policy Report, which reviews the conduct of monetary policy and the main factors that influenced inflation during the quarter. The report also highlights the challenges facing the conduct of monetary policy in the short-term.

3. International Experience with Inflation Targeting

Inflation targeting is defined as a monetary policy operating strategy that includes the following elements:

1. A commitment to price stability as the primary goal of monetary policy,
2. Accountability of the central bank for attaining its monetary policy goals;
3. The public announcement of targets for inflation;
4. A policy of communicating to the public and the markets the rationale for the decisions taken by the central bank.[6]

In addition to the above, there are special conditions that must exist within a country to ensure the success of *IT*. In particular, the authorities must have the ability to carry out an independent monetary policy[7], and establish a quantitative framework that links monetary policy instruments to inflation. The former requirement does not necessarily imply that the

[5] See Allen (1997)
[6] See Mishkin and Posen (1997
[7] Free of fiscal dominance or commitment to another nominal anchor, like the exchange rate

central bank must be fully independent, but that there should exist some reasonable degree of instrument independence or operational independence that ensures the flexibility of monetary policy in achieving the inflation target[8]. This requirement means that the conduct of monetary policy should not be dictated or constrained by public sector borrowing from the central bank, and that domestic financial markets have enough depth to absorb placements of public debt instruments.

Monetary policy independence under an *IT* framework also requires the absence of any firm commitment by the authorities to target the level or path of any other nominal variable, especially the exchange rate. In a context where the inflation target is the main policy objective, the central banks are required to refrain from making strong commitments about the expected or desired level of the nominal exchange rate. So far, countries that have adopted *IT* have implemented a policy rule for intervention in the foreign exchange market.

Table 1 gives a list of Developed and Emerging Market Economies (EME) that have adopted *IT* and their inflation rates before and after *IT*. The table also shows the dates of adoption of IT for these countries. Within the developed economies, the central bank of New Zealand was among the first country to adopt *IT,* with the remaining countries adopting IT between the period 1991 and 2001. Prior to the adoption of IT, the inflation rates in developed economies were relatively low and averaged 3.72 percent relative to a moderately high inflation rate of 13.11 percent for the EME. Likewise, the first target set for inflation after the adoption of IT in developed economies has realistically been lower than the target set for EME's. Ironically though, the EME's have performed better on average in reducing their inflation levels 12-months after the adoption of IT in comparison to developed countries. This performance has been achieved even though the fundamental prerequisites specified for the adoption of an *IT* framework have been largely absent in developing countries. Overall, the table shows that the majority of countries that have implemented an *IT* framework have attained and maintained a low and stable rate of inflation and most of the developing economies have implemented *IT* with some degree of success.

[8] See Mishkin and Posen (1997)

To examine the feasibility and applicability of IT for developing countries, Masson, et al (1997) in their paper entitled '*The scope for Inflation Targeting in Developing Countries*' focused their concerns on two main areas. The authors were interested in identifying the conditions under which *IT* can be adopted by developing countries as well as, aspects of the existing monetary policy regime in these countries that are contrary to the implementation of *IT*. They argued that for the majority of developing countries, the degree of compliance with the basic prerequisites of *IT* was difficult to assess. In particular, the degree of fiscal dominance and the absence of a firm commitment to targeting other variables were in conflict

Table 1
Inflation Rate Before and After Inflation Targeting
(12-month Accumulated Inflation)

	Date of Adoption Of Inflation Targeting	First Target	Inflation Before Inflation Targeting	Inflation 12-Months After IT
Developed Economies				
Australia	Apr-93	2% - 3%	1.22	1.74
Canada	Feb-91	3% - 5%	6.83	1.68
Iceland	Mar-01	2.5%	4.05	8.72
New Zealand	Mar-90	3% - 5%	7.03	4.52
Norway	Mar-01	2.5%	3.64	1.10
Sweden	Jan-93	2% (+ 1 %)	1.76	1.70
Switzerland	Jan-00	≤ 2%	1.63	0.90
United Kingdom	Oct-92	1% - 4%	3.57	1.35
Average		**2.8**	**3.72**	**2.71**
Median		**2.5**	**3.61**	**1.69**
Emerging Market Economies				
Brazil*	Jun-99	8% (+2%)	3.15	6.51
Chile	Jan-91	15% - 20%	27.31	19.47
Columbia	Sep-99	15%	9.22	9.35
Czech Republic	Jan-98	5.5% - 6.5%	9.98	3.50
Hungary	Jun-01	7% (+1%)	10.78	4.87
Isreal	Jan-92	14% - 15%	18.03	10.74
Mexico	Jan-99	≤ 13%	18.61	11.03
Peru	Jan-94	15% - 20%	39.49	13.71
Poland	Oct-98	≤ 9.5%	10.44	8.82
South Africa**	Feb-00	3% - 6%	2.65	7.77
South Korea	Jan-98	9% (+1%)	6.57	1.46
Thailand	Apr-00	0% - 3.5%	1.04	2.47
Average		**10.3**	**13.11**	**8.31**
Median		**9.3**	**10.21**	**8.30**

Source: Inflation Targeting in Emerging Market Economies, Fraga etal (June 2003)

* In Brazil, the inflation prior to the adoption of IT was affected by the overappreciation of the *real*

**First target established for 2002

with the inflation target. They found that fiscal dominance does not necessarily lead to unsustainably high rates of inflation. However, fiscal dominance, in conjunction with heavy reliance on seigniorage, the lack of capital market depth and the fragility of the banking system, have all hampered the ability of the central banks in these countries to conduct an independent monetary policy.

The scope for conducting an independent monetary policy also depends critically on the exchange rate arrangements practiced in many developing countries. The authors found that even though many countries have adopted a flexible exchange rate system, the authorities have still attached a greater weight to exchange rate objectives in setting monetary policy.

Kadioglu, Ozdemir et al (2000) discussed the scope of *IT* in developing countries by referencing a number of country experiences. They found that the preconditions for IT have not been satisfied by most developing countries, and modeling tools to enable successful inflation forecasts were lacking. There are other studies that have also sought to assess the applicability of *IT* for developing countries. However, observations from individual country experiences such as Chile, Mexico, Brazil and South Africa have revealed that the adoption of *IT* has been relatively successful in spite of the countries' inability to satisfy the prerequisites for *IT*.

According to Mishkin (2000), the Chilean experience with *IT* in 1990 was engendered by the need to reduce inflation from moderately high levels (in excess of 20 percent) to a long run goal of 3.0 percent. Before the implementation of *IT*, the central bank of Chile was granted formal independence in 1990 with price stability as one of its primary objectives. Measures were implemented to enhance the standards and practices of the banking and financial sector. In addition, the Chilean government was able to sustain a fiscal surplus over the period 1991 to 1997. Once the fundamental prerequisites for *IT* were met, Chile pursued a gradualist approach to price stability and the announcement of the target to the public took the form of an official inflation projection rather than formal or 'hard' targets.[9] Once some modicum of success was achieved in lowering inflation, the process of hardening the inflation targets by switching from target ranges to point targets was implemented in 1995. Over a 9-

[9] See Mishkin (2000)

year period, Chile was able to reduce inflation from levels above 20 percent in 1990 to a long run goal of 3.0 percent, while averaging 8.0 percent in output growth over the same period.

Although the Chilean experience suggests that *IT* can be implemented successfully when a gradualist approach to disinflation is employed, Chile has still not accomplished a full fledged *IT* regime. Of note is the absence of a published inflation forecast and inflation report as well as, the mechanisms to hold the central bank accountable for monetary policy.

Schmidt-Hebbel and Werner (2002) noted that the Brazilian transition to *IT* in 1999 was quite different and dramatic in comparison to the Chilean case. After the balance of payments crisis in 1998, Brazil still remained vulnerable to a crises of confidence, due largely to the continued postponement of fiscal adjustments by the government. Subsequently, the government was able to negotiate a financial support package with the International Monetary Fund (IMF), and was initially successful in implementing the fiscal package.[10] However, investor confidence continued to erode and attempts by the authorities to control the Brazilian crawling peg was abandoned for a floating rate as pressures on the foreign reserves became onerous and inflation increased sharply.

As a consequence of this abrupt change in the foreign exchange regime, a new central bank board was elected, which took office in March 1999 and immediately implemented two major policy changes to calm the financial markets. First, short-term interest rates were increased from 39.0 percent to 45.0 percent per annum to maintain real rates of return. Secondly, the Board proposed the adoption of IT as a new monetary policy regime. Although the central bank was not granted formal instrument independence to conduct monetary policy, nor was there an adequate inflation-forecasting model, the board was convinced that a full-fledged *IT* framework was most suited to achieve economic stabilization under a flexible exchange rate regime. A gradualist approach to IT was not recommended, as the board viewed the hike in the inflation rate only as a temporary phenomenon.

Full-fledged *IT* was implemented in July 1999, four (4) months after the decision to adopt *IT.* The Bank also began to publish an inflation report, a schedule of its future monetary policy

[10] See Mishkin (2000)

meetings and the minutes from these meetings. Brazil has been relatively successfully in its implementation of *IT* and the inflation targets were attained in 1999 and 2000.

Mexico's gradual transition to IT in 2001 was in response to public criticism about the lack of transparency in the conduct of monetary policy following the devaluation of the *peso* and the subsequent surge in inflation. The credibility crises led the *Banco de Mexico* to adopt a monetary growth target in 1995, and allowed for market determination of the exchange rate and interest rate. Under the monetary policy framework, the bank determined an annual inflation target of 42.0 percent, 20.5 percent and 15.0 percent from 1995 to 1997. With the attainment of inflation close to the target for 1997, the Bank began a gradual transition towards an explicit IT regime. This was aimed at reinforcing the role of the inflation target, as well as increasing monetary policy transparency and awareness.

In 2001, Mexico formally adopted IT in an effort to achieve inflation convergence to a level of 3.0 percent in 2003.[11] In this context, the bank implemented a number of measures to improve the technical and infrastructural framework and the transparency of monetary policy. In 2000, the Bank began issuing a Quarterly Inflation Report aimed at discussing the impact of economic factors on inflation in the previous quarter and the outlook for inflation, which incorporated the main risks threatening the fulfillment of the target. Mexico also had in place the other main components of a full-fledged IT regime, including an independent monetary authority, the absence of fiscal dominance and a firm commitment not to target any other variable.

For the purposes of building a macroeconomic model to aid understanding of the transmission mechanism, the *Banco de Mexico* constructed a core inflation index and utilizes leading indicators of inflation as well as, surveys of market expectations. The macroeconomic model that was developed has been crucial to the operation of the IT regime and the evaluation of the monetary policy stance.

Overall the findings on Inflation targeting countries have revealed that in all cases, the monetary authorities implemented IT when inflation rates were well above long-term stationary levels. Countries have also utilized explicit quantitative target for future inflation

[11] See Mishkin (2000)

and a model for predicting inflation and understanding the transmission mechanism. The Latin American countries in particular, have adopted IT with relative measures of success given their open economies, floating exchange rate regimes, varying degrees of market intervention and minimal or no fiscal dominance.

For the more developed economies, inflation targeting has been the preferred choice over monetary targeting. The evidence revealed that due to the imprecise relationship between monetary aggregates and inflation, monetary aggregates have not been able to provide an adequate signal about the stance of monetary policy. This makes it difficult for monetary targeting to serve as a communication device that increases the transparency of monetary policy. Furthermore, monetary targeting has generally not been a good guide for assessing the accountability of the central bank and help in lowering inflation expectations. As a result, monetary targeting has been downplayed or abandoned in countries such as the United States, United Kingdom and Canada.

4. Testing the Prerequisites of IT for Jamaica

4a ***Measures of Central Bank Independence (CBI)***

This section conducts two major tests to determine the feasibility and applicability of IT for Jamaica. As noted in section 3, one of the important prerequisites for inflation targeting is that the central bank should have a considerable degree of independence that allow the authorities to gear monetary policy towards achieving the inflation target. To adhere to this requirement, monetary policy should not be unduly constrained by fiscal considerations and the reliance on seigniorage or monetizing of fiscal deficits should be low to non-existent.

Advocates for full CBI under an IT framework have often cited that attaining an inflation target necessitates a long term horizon and often has an initial short term cost to the society, hence impatient politicians would be tempted to seek short-term gains at the expense of longer term benefits[12]. They proposed that central banks need independence both from the government and from financial markets.

A number of studies have conducted several tests using a set of indicators based on survey information to determine the degree of CBI. Fry et al (1992) employed a quantitative

[12] Maxwell Fry, Key Issues in the choice of monetary framework, page 14

measure of institutional characteristics of central banks, such as issues of independence, accountability, credibility and transparency. They constructed a weighted index of independence based on responses from five survey questions relating to the importance of price stability, the role and policy instrument of the central bank in choosing the target, the extent of government reliance on central bank financing and the term of office of the governor. There results showed that independence was negatively correlated with average inflation but not statistically different from zero even at the 10.0 percent level. Ironically, the authors also found that credibility was virtually uncorrelated with measures of independence and accountability.

Cukierman et al (1992) developed a more comprehensive survey approach to measuring CBI. They constructed 16 qualitative and quantitative indicators of independence, with the former ranging from the turnover ratio of central bank governors to the quality of the research department.[13] Each of these indicators was given a value of 1.00 for complete independence and 0.00 for complete dependence. Central bank independence indicators were calculated for 21 countries and the figures ranged from a high of 0.66 for the Bundesbank, Germany to a low of 0.14 for Norway. Cukierman et al found that legal independence was statistically significant in determining price stability in developed economies but not in developing economies.

Although the work of Cukierman (1992) is commendable, this paper utilizes a survey approach employed by Elgie (1995) to test the degree of CBI in Jamaica. Elgie's (1995) set of CBI indicators is similar to Cukierman (1992) but refined to include a greater number of indicators. The indicators are classified under two headings: political independence, which includes 29 indicators and economic independence, 7 indicators. In contrast to Cukierman et al, equal weights are ascribed to both political and economic independence to allow for a more meaningful comparison of two or more central banks.

As defined by Elgie (1995), political independence represents the central bank's ability to make policy decisions without the interference from the board members. The indicators of political independence broadly include the relationship between board members and the governor and the extent of board members intervention in the internal decision making

[13] See Cukeirman et al (1992)

process (see survey questions and methodology in Appendix 1). Economic independence represents the ability of the central bank to use monetary policy instruments without restrictions from the board members. Therefore, a fully independent central bank would be free of political interference and would have no restrictions in the use of monetary policy instruments. The reverse holds true for a fully dependent central bank. Studies have shown however, that the degree of independence is likely to fall in between these two extremes.

Table 3 presents a comparison of the results on CBI for the BOJ[14] and Banque de France. As shown in the table, the BOJ enjoys a higher degree of independence in its ability to use monetary policy instruments without restrictions from the board, relative to its political independence. Although the precise figures have no meaning in themselves, comparatively speaking, it is also reasonable to state that the Bank of Jamaica is relatively more independent than the Banque de France.

Table 2
Measurement of Central Bank Independence

	Jamaica[1]	France[2]
Political Independence	0.20	0.29
Economic Independence	0.36	0.32
Total	0.56	0.62

1/ Authors calculation: See Appendix for details
2/ Source: Elgie (1995)

With regards to political independence, the BOJ is managed by an executive board, which consists of the Governor, as the chairman and chief executive officer. The Governor is appointed by the Cabinet, and the majority of the members of the Board nominated by the Minister of Finance. This arrangement makes it possible to spread political influence over the decision-making entity of the Bank, and removes the independence of the central bank from taking instructions from government or any other political authority with regards to monetary policy. On the issue of the terms of the Governor's office, this falls between 5 and 8 years

[14] The indicators of CBI for Jamaica are based on the response from the questionnaire sent to a senior official at the Bank of Jamaica.

and almost twice as long as the terms of office of any political government. This augurs well for central bank independence, as the incentive for partisanship between the Governor and members of the political directorate is limited.

With regards to the dismissal and/or renewabillity of the Governor's contract, the fact that the cabinet members decide on this issue, the governor may be concerned for his job, when the BOJ's policies do not conform to the governments' political interest. All of these elements are consistent with a dependent central bank. The results for the members of the board and the Bank's decision-making process are similar to the results mentioned above. Although, the collective decision-making process among the board members augurs well for a more independent central bank, the presence of government representatives on the board, with no staggering of appointments and no requirements for professional qualifications further reinforces the already limited degree of political independence at BOJ.

With regards to economic independence of the BOJ, the Bank's clearly stated objective of maintaining price stability, its autonomy over monetary policy and interest rates, the market determined exchange rate and its regulation over the wider financial institutions are all consistent with economic independence. However, important changes to the BOJ law in 1976 and 1977 have significantly limited the degree of economic independence of the Bank. In particular, the 1976 amendment to the Bank of Jamaica Act empowered the bank to make temporary advances to the government from 15.0 percent to 30.0 percent of the government's estimated revenue. The 1977 act was also amended to permit the Bank to take securities issued or guaranteed by the government up to 40.0 percent of the expenditure budget for that year or such other percentage as the House might approve.[15] Hence the bank's functional independence is limited because its legal framework does not prohibit the bank from lending to the government, a condition consistent with a dependent central bank. Overall, the bank's total independence of 0.56 is comparable to other developing countries that have adopted IT as a monetary policy framework.

For the more developed economies, Mangano (1998) reconstructed two of the widely used CBI indices, Grilli, Masciandaro and Tabellini, (GMT) (1991) and Cukierman et al (1992). His paper addresses the issue of measurement errors and subjectivity of the weights used in the

[15] 'Bank of Jamaica, The First 40 Years 1961 – 2000'

construction of the questionnaires. In this context, Table 3 presents CBI results and relative rankings for 10 countries obtained from Mangano's paper. The rankings are given a value of 1.00 for the most autonomous central bank. As shown in the table, Germany has the most autonomous central bank based on the Cukierman and GMT rankings.

Table 3
Qualitative Indexes of Central Bank Independence
For the period 1980 - 1989

Country	Cukierman[1]	Rankings	GMT[2]	Rankings
Austrialia	0.44	5	0.47	6
Canada	0.56	2	0.47	11
Denmark	0.44	5	0.40	9
Germany	0.69	1	0.73	1
Ireland	0.44	5	0.47	6
Japan	0.13	15	0.33	11
New Zealand	0.27	10	0.20	16
Switzerland	0.56	2	0.73	1
United Kingdom	0.27	10	0.40	9
United States	0.44	5	0.73	1
France	0.27	10	0.33	11

1/ CBI from Cukierman et al (1992)
2/ CBI from Grilli et al (1991)

Source: Data from Paper by Gabriel Mangano (1998)

4b. Seigniorage and Indicators of Financial Market Depth

Masson et al (1997) emphasized that insights on CBI have limited scope in developing countries and for monetary policy if the presence of shallow capital markets, heavy reliance on seigniorage, and evidence of a fragile banking system exists. This problem is further compounded by the fact that developing countries face a wide range of experiences that differ significantly from advanced economies.

In this vein, the paper goes a step further by examining the depth of the Jamaica financial market and the existence of seigniorage activities relative to other selected countries. Seigniorage is generally defined as the opportunity cost of base money, or a form of tax (inflation tax) levied on the holders of currency. This tax is then redistributed to the

government as a source of revenue.[16] In high inflation countries, most seigniorage accrues as inflation tax.

Heavy use of seigniorage is perhaps one of the most common indicators of fiscal dominance, as government's reliance on seigniorage and the inflation tax often stems from their inability to raise and collect revenues from traditional sources. Studies have shown that developing countries are more likely to rely heavily on seigniorage due to a number of structural problems, such as poor tax collection procedures, unstable sources of tax revenues and evasion of taxes.

The depth of domestic capital markets in developing countries has also become a cause for concern. In particular, countries that have shallow markets and limited access to international capital markets restrict the governments' ability to raise debt to finance its expenditure. Hence, the limited fiscal flexibility may result in recourse to revenues from seigniorage and from the financial system through various forms of financial repression, such as interest rate ceilings, high reserve requirements and compulsory placement of public debt.[17] Studies have shown that the adverse effects of financial repression are highly correlated with the under-development of capital markets. Shallow capital markets are viewed as a common and subtle form of fiscal dominance, particularly in developing and low-income countries.

The fragility of the banking system becomes more critical after a prolonged period of financial repression. In the event of a banking crisis, the need to restore profitability to the financial system may necessitate the implementation of a number of reforms by the supervisory authority, in most cases the central bank. In this context, the central bank may be challenged to resolve the conflicts of attaining price stability on the one hand, and restoring banking sector profitability on the other. Thus the conduct of monetary policy may be rendered ineffective where severe financial repression becomes a quasi-fiscal activity.

Table 4 presents some evidence on seigniorage, inflation tax and three indicators of the degree of financial deepening for Jamaica and other selected countries. The indicators of

[16] Seigniorage can also be defined as the net revenue derived from the issuing of currency It arises from the difference between the face value of a coin or bank note and the cost of producing and distributing it.
[17] Masson et al (1997)

financial market depth are the average ratio of broad money to GDP, and the average and standard deviation of the real interest rate on domestic currency deposits in the banking system. Positive real interest rates reflect individuals' positive rate of time preference and the risk attributes of financial assets. Positive real rates on deposits are a fundamental pre-condition for substantial financial deepening. Additionally, with positive real interest rates, financial savings are greatly enhanced, which increases the monetisation and financial intermediation of the economy. The degree of monetisation in the economy is captured by the ratio of broad money to GDP.

The analysis of table 4 reveals several interesting results for Jamaica and other selected countries. A comparison of seigniorage is conducted relative to an acceptable threshold of 1.0 percent of GDP, and values above this figure provide a measure of excessive deficit financing by the central bank[18]. The findings for Jamaica indicate that central bank seigniorage for the period 1994 to 1998 was on average about 2.5 percent of GDP relative to a benchmark of 1.0 percent of GDP. For the period 1991 to 2002, government's reliance on seigniorage fell to negative 0.2 percent of GDP. The excessive reliance on seigniorage in the former period stemmed from the high inflation rate of 26.8 percent, 25.6 percent, 15.8 percent and 7.9 percent in 1994 to 1998, respectively. This provided a source of financing for the government particularly in light of the worsening state of the fiscal accounts, which moved from a surplus of 2.0 percent of GDP in 1994 to a deficit of 7.0 percent of GDP in both 1997 and 1998. The public sector balance worsened, partly reflecting higher wages and interest cost on domestic debt as well as, the government's efforts to 'bail out' financial institutions during the liquidity crisis of 1997. Within the context of declining GDP levels, the government was particularly challenged to raise additional financing from traditional sources and had to resort to the BOJ for financing through the issue of FINSAC[19] securities to the Bank during the period 1997 to 1998.

For the period 1999 to 2002, the reliance on seigniorage by the government was severely curtailed as the BOJ focused more sharply on achieving low single-digit inflation. Although the average fiscal balance as a percent of GDP rose sharply during this period, the government was able to finance a large part of its expenditure through increasing access to

[18] See Hochreiter et al (1996)

[19] The government effort to restructure and rehabilitate the banking system led to the establishment of the Financial Sector Adjustment Company (FINSAC) by the government.

Table 4
Seigniorage, Inflation,Government Balance and Indicators of Financial Deepening
In Selected Countries 1994 - 2002

	Advanced Countries		Latin America and the Caribbean			
	United States	Germany	Argentina	Brazil	Chile	Jamaica
***Seigniorage*[1]**						
1994 - 1998[2]	0.37	0.30	0.09	2.58	0.74	2.54
1999 - 2002	0.43	n.a	1.12	2.65	0.14	-0.20
CPI inflation						
1994 - 1998	2.45	1.74	1.83	433.32	7.66	19.93
1999 - 2002	2.49	1.58	5.67	6.80	3.31	7.04
***Government Balance (as%of GDP)*[3]**						
1994 - 1998	-1.08	-2.80	-1.22		1.63	-3.08
1999 - 2002	0.75	-1.03	-2.41		n.a	-5.27
***Inflation Tax*[4]**						
1994 - 2002	0.02	0.02	0.03	0.20	0.05	0.12
***Real Interest Rate on Deposits*[5]**						
Average (1994 - 2002)	2.39	1.50	8.77	25.97	4.78	3.03
Standard Deviation (1994 - 2002)	1.21	0.42	3.83	44.66	2.29	2.55
Broad Money*[6] *to GDP						
Average (1994 - 1998)	0.58	0.35	0.24	0.32	0.40	0.41
Average (1999 - 2002)	0.66	n.a	0.30	0.30	0.42	0.44

Source: Calculation based on IFS database, and the Statistical digest of the Bank of Jamaica
1/ Defined as the annual change in the monetary base divided by nominal GDP
2/ Period averages, in percent
3/ Central government balance divided by Nominal GDP
4/ Defined as: (CPI inflation/(100 + CPI inflation)), a measure of the real losses on holdings of money balances
the aveage is reported for the period 1994 - 2002
5/ Defined as: (((1 + nominal)/(1 + inflation rate)) - 1)*100
The mean and standard deviation are calculated from the series on annual real returns on domestic currency deposits in the banking system.
6/Broad money includes narrow money (M1) and Quasi-money

the international capital markets, which further reduced the reliance on seigniorage financing.

With regards to the depth of Jamaica's financial market, the increase in the broad money/GDP ratio for the period 1999 to 2002 relative to 1994 to 1998 shows the enhancement in the intermediation process that has taken place in Jamaica. However, the relatively small growth rate in this indicator may be due to the widening of the menu of savings and investment products offered by financial institutions but which are not classified as part of broad money supply. A comparison of relative country levels of this indicator

appears to suggest that the United States has a well-developed financial market and Jamaica's financial development surpasses those of the other selected developing countries.

The finding on real interest rate deposits enhances the result presented on the ratio of broad money to GDP. The table reveals the predominance of positive real rates for all countries. Jamaica has been able to maintain positive real interest rates on deposits over the period due to the progressively lower level of inflation that existed since 1996 as well as, the myriad of financial investment instruments offered by a number of institutions, which has forced banking institutions to offer relatively more attractive real rates to remain competitive. Another important issue of consideration is the real interest rate volatility, which is the responsiveness of real rates to changes in economic conditions. Excessive real interest rate volatility increases the risk of financial investments and is synonymous with a fragmented financial market. Jamaica's real interest rate volatility has been relative low over the period.

Overall, the analysis shows that Jamaica has a well functioning financial market, moderately low inflation levels and no signs of financial repression. Of concern to a successful implementation of IT in Jamaica however, is the operational independence of the central bank. The need to reform the legal framework governing the central bank to further limit or prohibit government financing still remains a critical issue. Nonetheless, the following section of the paper explores how IT could work for Jamaica. Issues relating to the choice of an appropriate price index, the monetary control lags and the inflation target horizon are explored within the framework of a vector auto regression (VAR) model.

5. Issues of Design and Implementation

5a. Definition of the Price Index

The choice of the appropriate price index is critical for countries under an IT regime because central banks are made accountable for achieving the inflation target. Several countries have favored targeting the rate of change in the CPI (headline inflation) relative to targeting 'underlying' or core inflation. The BOJ publishes both the CPI and the core inflation indices.

As noted by Allen (1997), the CPI measure used in Jamaica contains various measurement biases, and given the bank's mandate of price stability, it was imperative to develop a measure of inflation associated with changes in the money supply. In defining a measure of core inflation for Jamaica, the author examined six series, namely CPI excluding fuel sub-

category, CPI excluding food & drink sub-category, CPI excluding food & drink and fuel sub-categories, the weighted median, the trimmed mean and the CPI moving average seasonally adjusted series. Based on the standard deviation, the results showed that the core measure had the smallest variance. To determine the relationship between these series and monetary aggregates, such as base money, M1, M2 and M3 denominated in Jamaica dollars, a VAR model was estimated and the results obtained showed the trimmed mean as the appropriate core inflation series and base money, as the monetary series that was highly correlated with changes in the trimmed mean.

By using two additional measures of inflation, CPI without Agriculture and CPI without agriculture & fuel, this paper reexamined the choice of the appropriate price index for Jamaica. The test utilized five measures of inflation, namely CPI excluding food & drink, core inflation, CPI without fuel and the other two measures mentioned above. Consistent with the empirical approach used by Allen (1997), the results confirmed the core inflation measure as the appropriate index. However, the use of headline inflation has been more advantageous to emerging market economies because of the familiarity of this index to the public and the credibility it affords the monetary authorities. The most important drawback is that the CPI carries a higher weight for volatile components such as food.

With the ongoing debate on the choice of the appropriate index, the paper goes further by looking more closely at the horizon over which the monetary authorities would be indifferent between using core or headline inflation. To address this issue, an examination of the stylized properties of the nine components of the CPI as published by the BOJ is examined. The twelve-month percentage changes are calculated for all the subcomponents of the CPI.

Table 5: UNIT ROOT TEST

Augmented Dickey Fuller Test Results[1]

Variable	D-F with no constant or trend[2]	order of Integration	Significance
Headline	-3.29	I(1)	1%
Food	-2.98	I(1)	1%
Fuel	-2.63	I(1)	1%
Housing	-4.57	I(1)	1%
Furnishings	-1.98	I(1)	1%
Healthcare	-3.79	I(1)	1%
Personal	-3.76	I(1)	1%
Transport	-3.13	I(1)	1%
Misc	-2.73	I(1)	1%

1/ All variables are calculated at the 12-month average

2/ Lag length selection based on automatic Schwatz selection

Table 5 shows the results of the unit root test and displays the 1.0 percent to 10.0 percent McKinnon critical values and the order of difference stationary process. As shown in the table, all components of the CPI index are stationary in first difference.

Table 6 contains the results of the basic statistics for the nine components of the CPI and univariate Autoregressive (AR) models. The food price subcategory is heavily weighted in the index and food price volatility has the highest impact on headline inflation.

Price shocks from the fuel and housing sub-category as measured by the standard deviation are also significant but impact the CPI to a lesser extent given their relatively lower weight in the basket. Thus, the CPI is prone to supply shocks particularly from food prices and to a lesser extent, fuel prices. The high contemporaneous correlation between food prices and headline inflation also corroborates the evidence that food price volatility will have a significant impact on Headline inflation.

Although short-run volatilities in headline inflation exert a significant impact on inflation, of more importance however, is the effect of this volatility on inflation over the target horizon. Thus, to determine the choice of the index over the target horizon, the paper employs a similar method used by Hoffmaister (2001) to test the effect of food price shocks on headline and core inflation through the use of a reduced form equation.

Table 6: Selected Statistics for Main Categories of the CPI
Monthly data from 1991:12 - 2003:12
Observations - 145

	Headline	Food	Fuels	Housing	Furnishing	Heathcare	Clothing	Transport	Misc.
Weight in Headline Index	100	55.63	7.35	7.86	2.83	6.97	5.07	6.44	7.85
Annual Percent Change									
Average	21.89	21.13	21.76	22.61	18.74	21.46	22.01	21.75	27.61
Standard Deviation	20.98	22.6	23.32	17.41	18.63	21.86	24.98	15.52	18.07
Skewness	1.76	1.69	1.88	2.26	1.58	1.86	1.8	0.93	1.32
Kurtosis	5.36	5.11	5.6	7.7	4.82	5.66	5.46	3.62	4.04
Maximum	86.72	89.46	95.03	89.16	75.69	89.88	101.62	65.38	79.46
Minimum	5.88	2.11	3.01	9.18	3.46	5.16	2.83	1.83	7.97
Jacque-Bera Test of Normality	108.65	95.89	126.73	257.69	80.47	126.49	115.17	23.23	49.08
Autoregressive Models									
# of lags included	7	14	3	14	14	15	14	14	14
Adjusted R^2	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Inflation Innovation									
Standard error (SEE)	0.27	0.25	0.64	0.65	0.29	0.29	0.4	0.74	0.41
Correlation with Headline	1	0.99	0.95	0.92	0.98	0.98	0.94	0.91	0.97

Note: The 12-month percentage changes are calculated for the nine components of the CPI. The number of lags in AR model are determined using the Schwatz Information criteria (SIC), where the maximum lag tested was 18. The AR models contain monthly seasonal dummy variables. The categories as published are 1) Food and Drink, 2) Fuels & other household supplies, 3) Housing and other housing expenses, 4) Household furnishings & furniture, 5) Healthcare & personal expenses, 6) Personal clothing, footwear and accessories, 7) Transportation and 8) Miscellaneous expenses.

The Methodology

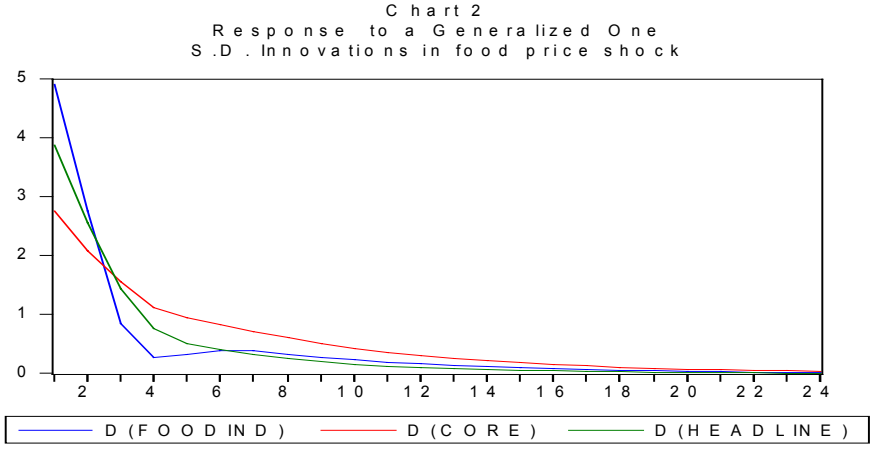
The VAR model used contains both measures of inflation, headline and core, and a measure of food price inflation[20]. The variables are integrated of order (1) and defined as such in the VAR. Consistent with the Hannan-Quinn and Scharwz criteria, two lags were specified for the model and the regression includes a full set of monthly seasonal dummy variables. The Generalized impulse response function[21] (GIRF) was used to calculate the impulse responses of core and headline inflation to a food price inflation shock.

[20] The food and drink category multiplied by its weight in the basket is used as a measure of food inflation

[21] The generalized impulse response function (GIRF) is an improvement over the usual standard impulse response. The impulse responses emerging from the GIRF are unique and invariant to the ordering of the variables in the VAR. The GIRF

The Results

Chart 2 gives the GIRF of a food inflation shock on headline inflation and core inflation. The historical effect of a unit shock to food prices translates on impact into a large response in headline inflation and a relatively smaller response in core inflation. The larger response in headline inflation reflects the heavily weighted food prices in the index and the high correlation among the variables. Core inflation by construction using the trimmed mean approach contains some elements of the food subcategory and hence its smaller response to a unit shock in food prices. It is interesting to note from the chart that although headline and core inflation begins to fall after the first month, the impact of food price shock on core inflation is larger than headline inflation after the third month. This reflects the persistence of price changes on core inflation, which by its definition represents the permanent aspect of the shock in food prices, which will take some time to dissipate. This essentially is the second round effect of a food price shock which results in a slower rate of decline in core relative to headline after the third month.



However, the more fundamental aspect of the results relates to the pace at which the difference between headline and core inflation disappears. Following from the unit shock in food prices, the difference between headline and core inflation moved from 1.12 percent in the first month to 0.30 percent in nine months. It dropped further to 0.24 percent, 0.20 percent and 0.03 percent in 11, 12 and 24 months respectively.

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is also not subject to the effects of choleski decomposition. Since the nature of the exercise is to gather the historical response of food price shock on inflation, the GIRF is far superior. The GIRF is defined as a random variable given by the difference between two conditional expectations, the first part is conditioned on history and the shocks, and the second part is based on the base line profile. See Panagiotidis et al (2003) for a detailed explanation

The results indicate that shocks in food prices tend to have short-run volatility effects on headline inflation in Jamaica. However, of importance to IT is that the difference in headline and core inflation from a unit shock from food prices is very small after 12 months. This result implies that if the inflation target is at least a year and beyond, the monetary authorities should be indifferent between using headline or core inflation as the relevant price index, as the shocks emanating from food prices would have dissipated by 12 months. However, because of the need to enhance credibility and transparency of monetary policy, it is arguably the best choice to define the target in terms of the index that is most widely used by the public to monitor price developments and inform expectations. The caveat to remember is that with an inflation target of at least a one-year horizon, using headline inflation or core inflation will essentially give the same results. The paper proceeds with the use of headline inflation.

5b. Monetary Control Lags and the Reduced Form Model

Following on the work of Hoffmaister (2001), this paper applies a reduced-form VAR model to determine the monetary control lags for Jamaica. The linkages from this model provide a measure of the lags of monetary transmission and the basis to stage a series of simulations that shows the potential effects of adopting IT.[22]

The Methodology

The variable selection in the VAR model specified below is guided by the work of Robinson (1999). The variables are specified in logs and defined below.

$$\begin{bmatrix} C_{1,1}(L) & C_{1,2}(L) & C_{1,3}(L) \\ C_{2,1}(L) & C_{2,2}(L) & C_{2,3}(L) \\ C_{3,1}(L) & C_{3,2}(L) & C_{3,3}(L) \\ C_{4,1}(L) & C_{4,2}(L) & C_{4,3}(L) \\ C_{5,1}(L) & C_{5,2}(L) & C_{5,3}(L) \\ C_{6,1}(L) & C_{6,2}(L) & C_{6,3}(L) \end{bmatrix} \begin{bmatrix} M_t \\ Tb_t \\ P_t \\ Bm_t \\ S_t \\ Y_t \end{bmatrix} = \begin{bmatrix} \mu_{mt} \\ \mu_{tb} \\ \mu_{pt} \\ \mu_{bm} \\ \mu_{st} \\ \mu_{yt} \end{bmatrix} \quad (1)$$

[22] See Hoffmaister (2001)

Where,

M_t is the growth rate in the value of imports

Tb_t is the 180-day Treasury bill rate

P_t is the Consumer price index

Bm_t is base money

S_t is the weighted average selling exchange rate

Y_t is the output gap

μ_i are the shocks from the VAR model

$C_{1,1}(L)$ are the lag polynomials

Details of the definition of these variables and sample period are included in Table 1 in the appendix. In equation 1, base money is included in the specification of the model as the aggregate the Bank of Jamaica uses to manage liquidity levels in the system. The 180-day Treasury bill rate reflects a representative measure of market interest rates, while the nominal exchange rate captures the linkages between the foreign exchange market and the domestic money market. Import prices are included to capture the importance of oil price volatility on CPI inflation. The output gap is used as a proxy measure of the business cycle[23].

Test for Stationarity

Table 7 presents the results of the unit root tests with the 1.0 percent and 5.0 percent McKinnon critical values. The table shows that with the exception of base money and output gap, all the other variables were non-stationary and had to be differenced once to become stationary.

Table 7: Unit Root Test
Augmented Dickey Fuller Results
Sample period 1991:02 - 2003:12

Variables	ADF	ADF[1]	ADF[2]	order of intergration	Critical Values
Lnbase	-2.61			I(1)	1%
lnCPI			-4.206	I(I)	1%
Lnoutputcycle	-2.069			I(0)	5%
Lnimports			-10.43	I(1)	1%
Lntbills	-9.93			I(1)	1%
Lnexch	-7.17			I(1)	1%

1/ with constant
2/ with constant and linear trend

The Results

The variables in the VAR model were specified in first difference with the inclusion of seasonal dummy variables. The data spans the period 1992:12 to 2003:01. To determine the lag length, VAR's of order 1 through 18 were examined and the Schwarz and Hannan Quinn criteria, achieved a distinct minimum at two lags and three lags, respectively. Although the parsimony principle suggests adopting a VAR (2), a VAR (3) was used instead due to the presence of serial correlation and heteroskedasticity at the second lag.

The paper utilizes the multivariate Johansen test (1991) to test for the existence of a stable long-run relationship between these variables. The null hypothesis under the Johansen test is no cointegration against the alternative of cointegration. As shown in table 1A in the appendix, there exist at most four cointegrating vectors.

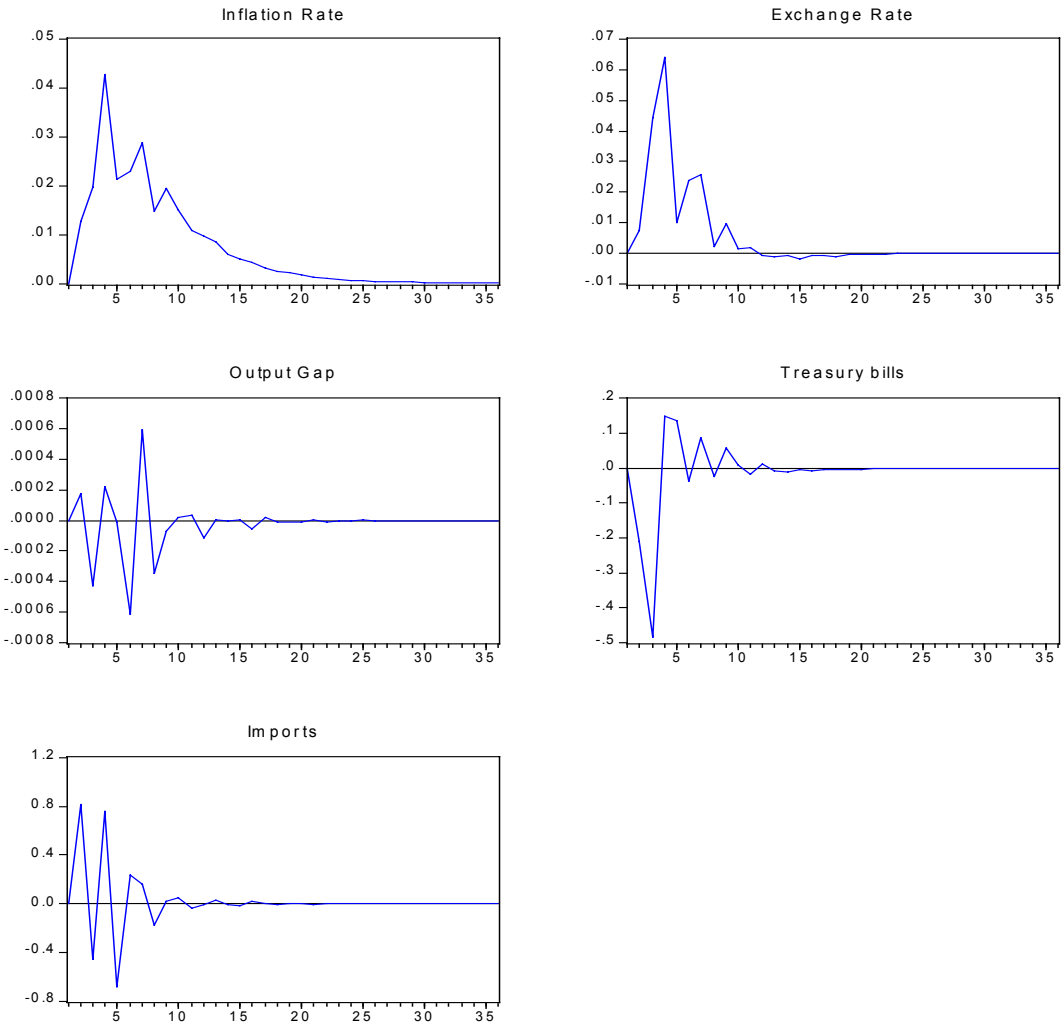
The results from the unrestricted VAR estimates showed an inverse and significant relationship between base money growth and changes in the Treasury bill rate at the second lag. There is also a positive and significant relationship between the growth in the value of imports and changes in base money at the first and second lag. The output gap is inversely and significantly related to inflation after the first month. This is expected given the inflationary impact of higher prices on the cost of production and the resultant lower demand for goods and services that arise from the erosion of purchasing power. Based on a priori expectations, there is a positive relationship between inflation and base money in the first month, while changes in the exchange rate does not exert any significant impact on inflation. This implies that the primary influence on price changes is the growth in base money. The results of the VAR are reported in Table 2A in the appendix.

The VAR model is used to generate the GIRF of an exogenous base money shock on the variables in the system. Chart 3 shows the GIRF of an exogenous base money shock on changes in the nominal exchange rate, changes in the output gap, changes in the Treasury bill rate, the inflation rate and changes in the value of imports. On impact, the increase in base money produces minimal effect on changes in the exchange rate in the first month, but

[23] The output gap is modeled as an ARMA (1,3) process and estimated as the difference between the actual log level and the trend level of output. Using the Beveridge-Nelson decomposition method, the trend used is the random walk portion of output.

the effect builds up significantly in the second month, peaking at approximately 0.07 percent from base level in three months, and then decays in a slow fashion by the fifth month.

Chart 3: Generalized Impulse Response to a Positive Base Money Shock



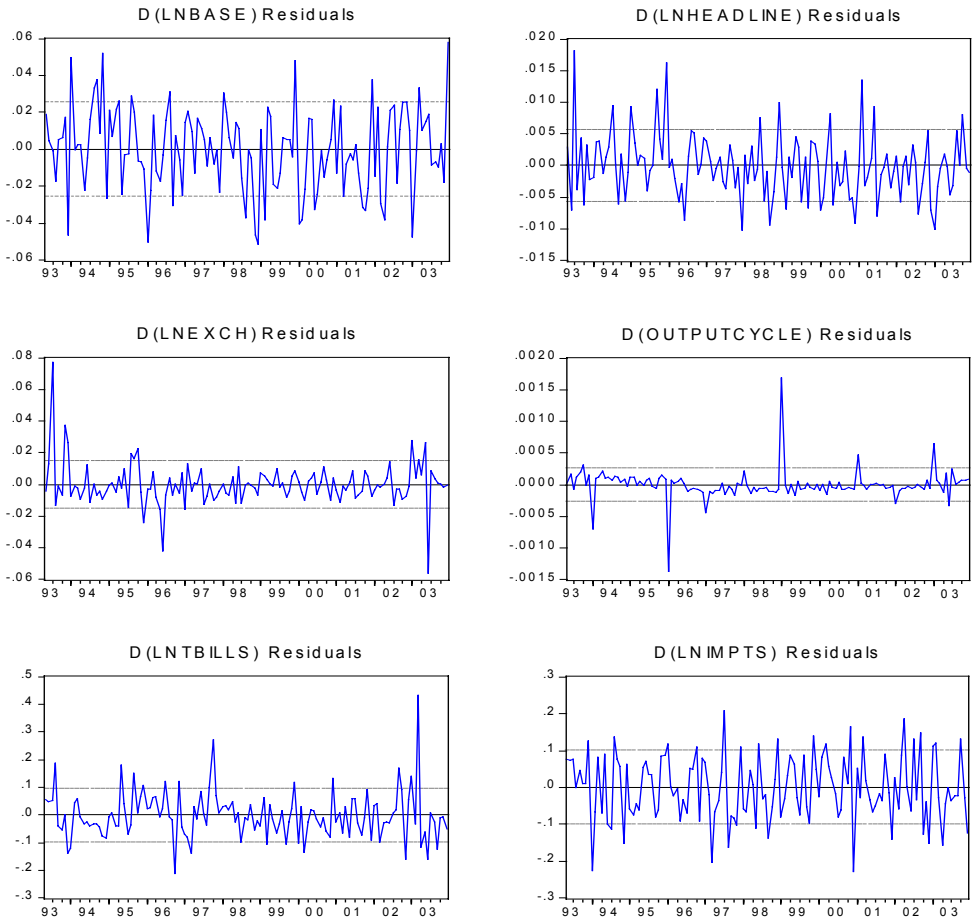
The impulse response meets a priori expectations suggesting that increases in the growth rate of base money, increases the value of the exchange rate (depreciation) as institutional investors seek to convert to foreign currency as a hedge against potential inflation.

Of note also is the pace at which the exchange rate depreciates which lasts for almost one quarter, reflecting the influence of expectations. Likewise, the impulse from base money changes has a small negative impact on changes in the Treasury bill rate in the first month. This phenomenon is plausible if expectations are formed adaptively and the shock in base money is unanticipated by institutional investors. In the second month however, the decline

in interest rates is sharper, and consistent with the depreciation of the currency, as foreign currency instruments appear more attractive to investors.

The effect of a unit increase in base money on changes in the output gap is quite small and becomes negative around the first month. This suggests that following a monetary expansion, output increases above trend for the first two months and falls below trend in the fourth month then continues to oscillate until it decays around the eleventh month. The impulse response of inflation from a monetary expansion rises sharply after the first month, peaks around the fifth month and then gradually falls around the seventh month. This lagged effect of base money on CPI is quite similar to results from other empirical work done at the BOJ.

Chart 4: Innovations of variables in the Vector Autoregressive model



Several diagnostics tests were conducted to determine the adequacy of the model and the error structure. In particular, the residual plot as indicated in chart 4 shows no evidence of serial correlation and appears to be white noise. The LM test for serial correlation failed to reject the null hypothesis of no serial correlation, while the White's test for heteroskedasticity also failed to reject the null hypothesis.

The monetary control lags derived from the impulse response of inflation to a unit shock in base money is shown in Table 8. The impact of an expansionary monetary policy takes six months for inflation to adjust 50.0 percent, thirteen months to adjust 90.0 percent and twenty-one months to adjust to approximately 100.0 percent. Hence, all of the adjustment in prices is completed in approximately twenty-one months.

Table 8: Monetary Control Lags

Lags	Inflation Response	Percent Completions
1	0.00000	0.0000
2	0.01285	0.0505
3	0.01976	0.1281
4	0.04282	0.2962
5	0.02145	0.3805
6	0.02290	0.4704
7	0.02877	0.5834
8	0.01477	0.6414
9	0.01956	0.7183
10	0.01506	0.7774
11	0.01098	0.8205
12	0.00981	0.8591
13	0.00848	0.8924
14	0.00595	0.9157
15	0.00503	0.9355
16	0.00428	0.9523
17	0.00322	0.9649
18	0.00248	0.9747
19	0.00225	0.9835
20	0.00168	0.9901
21	0.00135	0.9955

Inflation response is obtained from the Generalized impulse response table. The percent completed is the cumulative figure obtained from the percent of inflation response to total response

Therefore using an IT horizon of less than twenty-one months will result in the monetary control lags showing some evidence of instrument instability. In addition, the occurrences of supply side shocks may complicate monetary policy and extend the horizon further out. Hence the question arises of how long should the horizon be to address the potential of instrument instability on the one hand, against the relevance of a shorter horizon for IT to

have meaning. The results indicate that for IT to be successful in Jamaica, the target horizon has to be at least twenty-one months. However the issue of the longer horizon leads directly to the risk of the central bank missing its inflation target. To examine the appropriate inflation target horizon, the paper utilizes a Monte Carlo simulation and considers horizons of 12, 18 and 24 months to determine the success of keeping inflation within a targeted range.

5c. Inflation Target Horizon using Monte Carlo Simulation

Following from Hoffmaister (2001), this paper uses the VAR model discussed in section 5b to simulate how IT could work for Jamaica under different inflation target horizons of 12, 18 and 24 months given an inflation target band of 1.0 percentage points. The critical assumptions surrounding the simulation exercise are that the VAR model from equation 1 is assumed to be a true representation of the Jamaican economy and that the monetary transmission lags are stable. The general setup for the Monte Carlo simulation is as follows: the BOJ decides to adopt IT and meet monthly to update their inflation forecast from January 2001 to December 2003, the inflation forecast is the intermediate target of monetary policy, the inflation target is 5.0 percent, the inflation horizon is set between 12 to 24 months and the inflation target band is 1.0 percentage points.

The Methodology

The simulations are derived from subjecting the economy to external and domestic shocks. These historical shocks, μ_t obtained from the period May 1998 to December 2000[24] are drawn with equal probability with replacement from the reduced-form shocks in equation 1. The shocks apply to all variables in the model. Hence the central bank updates its inflation forecast each month in light of the shocks in the previous month. Specifically, the inflation forecast is defined as:

$$E_t \{\pi_{t+h}\} = e_\pi x [B^h x E_t \{\phi_t\}] \quad (2)$$

[24] The shocks used here are drawn from periods that appeared to be relatively stable over the entire sample period.

where the VAR (p) model is now expressed as a VAR (1) model. Expectations of inflation in the next period[25], $E_t\{\pi_{t+h}\}$ are dependent on $E_t\{\phi_t\}$ and ($\phi_t = m_t, tb_t, p_t, bm_t, s_t, y_t$), which is a vector of 6 variables and three lags. B^h contains the coefficient associated with the h^{th} lag of the variables in the model. The notation e_π denotes a unit row vector with a value of one in the position corresponding to the inflation rate.

The inflation forecast assumes the role of the intermediate target for monetary policy. Even though $E_t\{\mu_t\} = 0$ from equation 2, the fact that the economy is subject to shocks means that the realized μ_t are non-zero and unknown when the central bank decides on monetary policy. If revisions in the monetary policy stance are required, the BOJ first conducts an evaluation to determine whether their inflation forecast is consistent with the inflation target. To determine this, the monetary authorities use equation (5) to ascertain the growth in the money supply consistent with the inflation target such that the monetary policy rule is specified as:

$$Bm_t = \begin{cases} Bm_{t-1} + \alpha_h \times \{E_t\{\pi_{t+h}\} - \pi^*) + \mu(bm_t), & \text{if } | E_t\{\pi_{t+h}\} - \pi^* | > b \\ Bm_{t-1} + \mu(bm_t), & \textit{otherwise} \end{cases} \qquad (3)$$

where $\mu(bm_t)$, is the contemporaneous money growth innovation, π^* is the inflation target, α_h is a constant[26] at horizon h and b is the width of the inflation target band. Equation 3 states that the authorities adjust base money growth this period when the inflation forecast deviates from its target by more than the bandwidth, b. It is also clear from the equation that the authorities' control over base money is imprecise due to the error term. Hence the BOJ can only control the expected path of base money. In order words, monetary policy is forward looking and governed by the deviation of the inflation forecast from its targeted rate, π^*.

Essentially, the simulation exercise embodies the responsiveness of monetary policy to uncertainties arising in the macroeconomy. For instance, when the authorities face an unexpected shock (depreciation) in the exchange rate in January 2001. The unexpected

[25] The inflation forecast is calculated conditional on a constant money supply growth, i.e. $mt_{+S} = m_t$, for all S = 1, 2, 3…n.

[26] α_h is equal to the inflation response to base money changes in table 8 at different horizons.

shock, $\mu_{st\ 2001:m1}$ impacts monetary policy in February 2001 through its direct impact on the inflation forecast $E_t\ \{\pi_{m2+h,\ 2001}\}$. The impact on monetary policy from an exchange rate shock would necessitate a change in the monetary policy stance if the revised inflation forecast deviates from target by more than |b| in equation 3. Subsequent changes in base money growth operating through open market operations will depend on the extent to which shocks have an impact on the relevant inflation forecast.

The bootstrap simulation applies this setup to illustrate how monetary policy would evolve when the economy is subject to shocks. Repeating the bootstrap simulation a large number of times create 'pseudo-histories' that provide insights about the distribution of outcomes associated with IT.[27]

The Results

Table 9 shows the IT simulation for three different horizons, 12, 18 and 24 months. The inflation horizons are shown relative to a baseline simulation. This baseline simulation is determined by generating the h-period ahead (2001:M1 to 2003M: 12) inflation forecast and forecast for the rest of the variables. The average outcome and standard deviation are calculated for each of the variables in the VAR, stemming from 1000 Monte Carlo simulations. The path for base money in the baseline simulation is determined from the estimated VAR in equation 1 and not from the monetary policy rule equation.

The average outcome for the different inflation target horizons determines the path of the economy, while the volatility is measured by the standard deviation. The average outcome for the baseline simulation is consistent with a priori expectations of how monetary policy is expected to evolve under an IT framework. The baseline simulation results suggests that in order for the BOJ to meet its inflation target of 5.0 percent, the inflation rate will have to decline at the outset by 1.4 percent. This would necessitate a decline of 4.9 percent in base money through the use of open market operations, which would result in an increase of 1.8 percent in the Treasury bill rate. The contractionary monetary policy stance would reduce the output gap, but increase the value of the exchange rate. Not surprising, the value of imports would also increase, in tandem with the increase in the exchange rate.

Table 9: Inflation Target Horizon using Monte Carlo Simulations
For the period 2001:01 to 2003:12
(Inflation Target of 5 percent plus/minus 1.0 percentage point)

	Inflation Targeting Simulation						Baseline	
	Horizon 12 Months		Horizon 18 Months		Horizon 24 Months			
	Average	St. Deviation	Average	St.Deviation	Average	St.Deviation	Average	St. Deviation
Inflation								
2001M01	-1.2377897	0.0064873	-1.8546882	0.0063469	-2.4718575	0.0062944	-1.4147640	1.0094427
2001M03	0.6385553	0.0051573	0.9611326	0.0030497	1.2839664	0.0058816	0.7352543	0.5246084
2001M12	0.3308852	0.0037064	0.4980676	0.0045145	0.6651417	0.0061611	0.3807715	0.2716828
2002M01	0.8310985	0.0049154	1.2469496	0.0047715	1.6629829	0.0047815	0.9549621	0.6813712
2002M03	-0.5141293	0.0036838	-0.7716626	0.0037980	-1.0302178	0.0048605	-0.5898656	0.4208727
2002M12	1.0716731	0.0039412	1.6074523	0.0044171	2.1448911	0.0032150	1.2291601	0.8770132
2003M01	0.6629675	0.0031467	0.9936413	0.0033628	1.3237007	0.0031038	0.7602112	0.5424153
2003M03	-0.5689195	0.0007845	-0.8529205	0.0007565	-1.1383386	0.0028567	-0.6509562	0.4644612
2003M12	0.1844572	0.0039205	0.2774871	0.0032265	0.3707140	0.0024080	0.2113608	0.1508072
Base Money								
2001M01	0.1147519	0.0000622	0.1426702	0.0000000	0.1426702	0.0000000	-4.9122326	3.5049078
2001M03	0.0250964	0.0000299	0.0346008	0.0000000	0.0346008	0.0000000	1.2496682	0.8916458
2001M12	0.0258554	0.0000443	0.0356234	0.0000112	0.0383841	0.0000000	1.7206194	1.2276724
2002M01	0.1529441	0.0000468	0.1605857	0.0000000	0.1605857	0.0000000	0.9278682	0.6620396
2002M03	0.0277108	0.0000000	0.0277108	0.0000000	0.0277108	0.0000000	-3.1643322	2.2577702
2002M12	0.0088711	0.0000433	0.0141507	0.0000000	0.0141507	0.0000000	3.9023667	2.7843623
2003M01	0.0878063	0.0000000	0.0878063	0.0000000	0.0878063	0.0000000	0.8030999	0.5730166
2003M03	-0.0054330	0.0000074	0.0159296	0.0000000	0.0159296	0.0000000	-3.4320774	2.4488080
2003M12	-0.0042101	0.0000000	-0.0075186	0.0000080	-0.0051262	0.0000024	0.9422899	0.6723296
Exchange Rate								
2001M01	0.3101082	0.0082377	0.4693920	0.0091262	0.6291954	0.0081006	0.3608230	0.2574494
2001M03	0.4613953	0.0057104	0.6917398	0.0051279	0.9249649	0.0040540	0.5289206	0.3773881
2001M12	0.5376567	0.0038189	0.8061079	0.0041585	1.0755256	0.0041668	0.6174034	0.4405211
2002M01	-0.1259448	0.0043617	-0.1887010	0.0037380	-0.2499418	0.0037762	-0.1402784	0.1000895
2002M03	0.0652541	0.0038866	0.0937546	0.0053373	0.1244115	0.0048044	0.0719384	0.0513285
2002M12	0.2722816	0.0071760	0.4077897	0.0053337	0.5457631	0.0059156	0.3136966	0.2238245
2003M01	0.4214753	0.0075338	0.6288751	0.0063772	0.8417352	0.0052431	0.4821661	0.3440285
2003M03	0.1914547	0.0070679	0.2868722	0.0067245	0.3836157	0.0070666	0.2193543	0.1565106
2003M12	0.1221924	0.0053990	0.1830585	0.0053431	0.2444602	0.0053608	0.1403315	0.1001274

[27] See Page 27.

Table 9 contd: Inflation Target Horizon using Monte Carlo Simulations
For the period 2001:01 to 2003:12
(Inflation Target of 5 percent plus/minus 1.0 percentage point)

	Inflation Targeting Simulation						Baseline	
	Horizon 12 Months		Horizon 18 Months		Horizon 24 Months			
	Average	St. Deviation	Average	St.Deviation	Average	St.Deviation	Average	St. Deviation
Output Gap								
2001M01	0.019967	0.000078	0.029941	0.000082	0.039930	0.000085	0.022909	0.016345
2001M03	-0.001723	0.000054	-0.002554	0.000057	-0.003396	0.000057	-0.001922	0.001372
2001M12	0.004268	0.000072	0.006435	0.000078	0.008595	0.000079	0.004961	0.003539
2002M01	-0.017245	0.000075	-0.025834	0.000069	-0.034379	0.000169	-0.019704	0.014059
2002M03	0.010966	0.000054	0.016503	0.000033	0.022017	0.000030	0.012650	0.009026
2002M12	-0.014533	0.000073	-0.021788	0.000072	-0.029052	0.000045	-0.016605	0.011848
2003M01	0.005221	0.000080	0.007842	0.000080	0.010469	0.000080	0.006004	0.004284
2003M03	0.007336	0.000048	0.011022	0.000049	0.014729	0.000023	0.008454	0.006032
2003M12	0.000187	0.000043	0.000331	0.000057	0.000473	0.000058	0.000295	0.000211
T billis								
2001M01	1.581982	0.043032	2.367290	0.047855	3.161678	0.047994	1.817501	1.296798
2001M03	-8.557505	0.044123	-12.837261	0.046027	-17.106641	0.039989	-9.796393	6.989786
2001M12	-2.151038	0.022895	-3.179600	0.099994	-4.226178	0.093259	-2.437268	1.739005
2002M01	-1.870069	0.058686	-2.770103	0.065887	-3.684464	0.074945	-2.080962	1.484779
2002M03	3.618522	0.046931	5.444298	0.041571	7.262810	0.041800	4.164656	2.971508
2002M12	-6.956159	0.065675	-10.361429	0.111777	-13.755128	0.088898	-7.873244	5.617607
2003M01	-3.221186	0.051532	-4.836074	0.063159	-6.442029	0.065117	-3.663733	2.614096
2003M03	2.358431	0.062063	3.597639	0.094875	4.828489	0.075203	2.773599	1.978980
2003M12	0.932052	0.023148	1.385998	0.027329	1.850420	0.027990	1.067234	0.761478
Imports								
2001M01	7.555499	0.117034	11.272756	0.083869	15.072330	0.074289	8.609083	6.142633
2001M03	2.699426	0.052490	4.022507	0.049783	5.369324	0.050291	3.089206	2.204167
2001M12	7.499761	0.066908	11.237641	0.072651	14.994631	0.072631	8.609669	6.143051
2002M01	-4.017350	0.083178	-6.002043	0.085183	-7.970686	0.070761	-4.566403	3.258156
2002M03	6.654185	0.062022	10.004133	0.057288	13.342165	0.060836	7.644680	5.454525
2002M12	-0.040623	0.121250	-0.092921	0.119646	-0.145574	0.123534	-0.105752	0.075455
2003M01	4.465878	0.061642	6.747922	0.022698	8.994093	0.026422	5.172229	3.690416
2003M03	3.695094	0.071001	5.496694	0.066452	7.285736	0.078387	4.161454	2.969223
2003M12	5.466035	0.142089	8.190096	0.143605	10.944754	0.154240	6.270050	4.473719

The path of the economy under the different inflation target horizons when compared to the baseline simulation shows quite interesting results. Consider the simulation results for inflation as the target horizon increases. For the forecast period January 2001 to December 2003, inflation declines very slowly towards its target as the horizon increases. The fact that

inflation does not decline in a monotonic fashion may be explained by the nature of the shocks, such as oil and weather related, that have affected the economy, which necessitates continuous revision of the monetary policy stance.

As expected, the reduction in the rate of growth of base money over the forecast horizon gets larger as the horizon increases, due to the fact that the rate of decline in inflation is also larger as the horizon increases. Relative to the baseline simulation, the results for base money also shows that when the horizon is 12 months, base money growth would need to decline by 4.79 percent relative to 4.76 percent for horizons of 18 and 24 months. It is also important to note that the path for changes in interest rates, exchange rate and imports are consistent with the contractionary monetary policy stance. The result for the output gap is quite interesting and seems to exhibit some form of mean reversion, with larger corrections in the average outcome as the horizon lengthens. However the output gap declines consistently with the decline in the inflation rate.

The volatility results from the simulation are quite small and show relatively small differences across the target horizon. The table shows that the volatility of inflation increases marginally as the horizon lengthens. This may be due to the fact that the monetary authorities are less likely to control inflationary events the longer the horizon. As such, the variability tends to increase at longer horizons. It is also important to note that when compared to the baseline simulation, the variability of inflation is significantly below the baseline, reflective of the fact that the monetary authorities are operating within an IT framework.

The volatility in base money growth varies inversely with the volatility from inflation. The values are quite small, and become progressively smaller as the horizon increases. This suggests that as the horizon increases, the monetary authorities focus their efforts on future inflation[28] where the bank is increasingly more effective in controlling monetary policy and where the shocks to inflation have worked themselves out[29].

Consistent with higher inflation variability, output volatility is slightly higher as the target horizon increases. This may imply that the Bank's effort in lowering inflation may result in a

[28] Recall from Table 8 that at h = 12, the inflation response is 85.0 percent complete and 97.0 percent and 100.0 percent complete in 18 and 21 months

[29] Hoffmaister (2001)

tradeoff with higher output variability. The exchange rate and the interest rate volatility also increase marginally over the target horizon, both reflective of the higher inflation volatility.

Overall, the results seem to show that lower volatility in macroeconomic variables is likely to occur over a shorter than a longer horizon. However, a shorter horizon leads to more variability in base money growth. Thus, the objective criterion of stability dictates that the optimal forecast horizon lies in the range of 12 to 18 months. The choice of the optimal point forecast depends on the monetary transmission lags, the nature of supply side shocks and the monetary authorities perception of an appropriate horizon that has relevance for the success of IT. A horizon of 12 months may be the preferred choice, as long as the monetary authorities are comfortable with a monetary transmission lag that is 85.0 percent complete. Otherwise, an 18 months horizon could be selected given the fact that the transmission lags at this horizon is 100.0 percent complete and supply side shocks would have worked themselves out. The simulation results ruled out a horizon of 24 months, as this would render monetary policy ineffective.

7. Policy Implications and Conclusion

The paper has sought to examine a number of practical issues in implementing an inflation-targeting regime for Jamaica. The issue of IT is of importance to the central bank given its mandate of price stability and its objective to return the economy on the path towards low sustainable single-digit inflation. The paper proposes that IT represents a feasible alternative for the bank to achieve its objective.

Over the years, the Bank has improved the quantitative framework of monetary policy. A core inflation index and a monetary transmission mechanism have been developed. A Monetary Policy Report is also published every quarter. All these initiatives augur well for an IT framework. Other elements of critical importance to an IT process are the independence of the central bank and the depth of the financial market. These conditions which were explored in great detail, showed that BOJ's instrument independence and financial market depth is comparable to other developing countries that have implemented IT with success.

The only remaining prerequisite for a successful IT regime for Jamaica is the reform of the legal framework governing the central bank in an effort to limit or prohibit government financing. The legal framework of Central banks in all emerging market countries that target

inflation explicitly limit or prohibit financing of government expenditure. Hence, in addition to its instrument independence, the BOJ needs to gain operational independence, where the word independence means that no factor other than inflation should condition monetary policy decisions. Therefore, if *IT* is a desired monetary policy framework, the possible solutions available to the Bank in light of the fiscal burden are the pursuit of full central bank independence, eliminating the obligation to accommodate fiscal expansion, or restricting the possibility of fiscal dominance.

Other important results from the paper can be summarized as follows:

1. The definition of the price Index suggests that as long as the inflation target horizon is at least a year or beyond, targeting headline or core inflation will essentially yield the same results. However, headline inflation is the preferred choice.

2. For the monetary control lags, the VAR results revealed that it takes 21 months for inflation to return to baseline after a unit shock from base money. Therefore using an IT framework of less than 21 months may result in instrument instability.

3. The IT simulation suggests that the preferred inflation target horizon falls within the range of 12 to 18 months. However given the lags in monetary policy and the nature of supply side shocks, an 18 month horizon is the dominant choice.

Appendix 1

Appendix 1 - Questionnaire

Measuring the Independence of Bank of Jamaica
Political Independence
(**Overall weighting 0.50**)

The Governor
(Weighting 0.30)

(a) Appointment
1.00 Appointments are by the bank itself
0.75 Appointments are made with some bank involvement
0.50 Appointments are by the executive and legislature
0.25 Appointments are by the executive collectively
0.00 Appointments are by the chief executive personally

(b) Nomination
1.00 Nominations are by the bank itself
0.75 Nominations are made with some bank involvement
0.50 Nominations are by the executive and legislature
0.25 Nominations are by the executive collectively
0.00 Nominations are by the chief executive personally

(c) Qualifications
1.00 Some qualifications are necessary
0.00 No qualifications are necessary

(d) Term of office
1.00 Over eight years
0.50 Between five and eight years
0.00 Below five years

(e) Dismissal
1.00 Complete security of tenure
0.75 Dismissal with some bank involvement
0.50 Dismissal by the executive and legislature conjointly
0.25 Dismissal by the executive collectively
0.00 Dismissal by the chief executive personally

(f) Renewability
1.00 Not renewable
0.50 Renewable once
0.00 Renewable

(g) Other Posts
1.00 Other office holding not permitted
0.00 Other office holding permitted

Measuring the Independence of Bank of Jamaica
Political Independence

Deputy Governors
(Weightings 0.20)

(h) Appointment

1.00 Appointments are by the bank itself
0.75 Appointments are made with some bank involvement
0.50 Appointments are by the executive and legislature
0.25 Appointments are by the executive collectively
0.00 Appointments are by the chief executive personally

(i) Nomination

1.00 Nominations are by the bank itself
0.75 Nominations are made with some bank involvement
0.50 Nominations are by the executive and legislature
0.25 Nominations are by the executive collectively
0.00 Nominations are by the chief executive personally

(j) Qualifications

1.00 Some qualifications are necessary
0.00 No qualifications are necessary

(k) Term of office

1.00 Over eight years
0.50 Between five and eight years
0.00 Below five years

(l) Dismissal

1.00 Complete security of tenure
0.75 Dismissal with some bank involvement
0.50 Dismissal by the executive and legislature conjointly
0.25 Dismissal by the executive collectively
0.00 Dismissal by the chief executive personally

(m) Renewability

1.00 Not renewable
0.50 Renewable once
0.00 Renewable

(n) Other Posts

1.00 Other office holding not permitted
0.00 Other office holding permitted

(o) Staggering

1.00 Staggered Appointments
0.00 Appointments made simultaneously

Measuring the Independence of Bank of Jamaica
Members of the Board
(Weightings 0.20)

(p) Appointment
1.00 Appointments are by the bank itself
0.75 Appointments are made with some bank involvement
0.50 Appointments are by the executive and legislature
0.25 Appointments are by the executive collectively
0.00 Appointments are by the chief executive personally

(q) Nomination
1.00 Nominations are by the bank itself
0.75 Nominations are made with some bank involvement
0.50 Nominations are by the executive and legislature
0.25 Nominations are by the executive collectively
0.00 Nominations are by the chief executive personally

(r) Qualifications
1.00 Some qualifications are necessary
0.00 No qualifications are necessary

(s) Term of office
1.00 Over eight years
0.50 Between five and eight years
0.00 Below five years

(t) Dismissal
1.00 Complete security of tenure
0.75 Dismissal with some bank involvement
0.50 Dismissal by the executive and legislature conjointly
0.25 Dismissal by the executive collectively
0.00 Dismissal by the chief executive personally

(u) Renewability
1.00 Not renewable
0.50 Renewable once
0.00 Renewable

(v) Other Posts
1.00 Other office holding not permitted
0.00 Other office holding permitted

(w) Staggering
1.00 Staggered Appointments
0.00 Appointments made simultaneously

(x) Government Representatives
1.00 There are no representatives on the board
0.00 There are representatives on the board

Measuring the Independence of Bank of Jamaica
The Decision Making Process
Within the Central Bank
(Weightings 0.30)

(y) Policy Making
1.00 Collective
0.00 Not collective

(z) Instructions
1.00 The Bank accepts government instructions
0.00 The bank does not accept government instructions

(aa) Government Representatives
1.00 Representatives do not have a veto
0.00 Representatives do have a veto

(bb) Salary
1.00 The bank fixes its own salaries
0.00 The government fixes the members' salaries

(cc) Capital
1.00 100percent private capital
0.50 Some private capital
0.00 No private Capital

Measuring the Independence of Bank of Jamaica
Economic Independence
(**Overall weightings 0.50**)

(dd) Mission
1.00 A single stated mission to guarantee price stability
0.50 A plurality of conflicting mission
0.00 No mission statement at all

(ee) Monetary Policy
1.00 The bank determines monetary policy
0.50 Some degree of bank involvement in monetary policy
0.00 The government determines monetary policy

(ff) Interest Rates
1.00 The bank decides key interest rate movements
0.00 The government decides key interest rate movements

(gg) Exchange rates
1.00 The bank determines exchange rate parities
0.00 The government determines exchange rate parities

(hh) Bank Regulation

1.00 The BOJ regulates the wider banking sector
0.50 The BOJ is jointly responsible for regulation
0.00 The government is the chief regulator

(ii) Government lending

1.00 The bank is prohibited from lending to the government
0.00 The bank is obliged to lend to the government

(jj) Budget

1.00 The bank plays a part in the budgetary process
0.00 The budget is the government's sole responsibility

Appendix 1
Results

Independence of Bank of Jamaica

1996 - 2003

Political Independence

The Governor

Appointment	0.25
Nominations	0.25
Qualifications	1.00
Term	0.50
Dismissal	0.25
Rewenability	0.00
Other Posts	0.00
Total	***2.25***
Mean	***0.32***

Deputy Governors

Appointment	0.75
Nominations	0.25
Qualifications	1.00
Term	0.50
Dismissal	0.75
Rewenability	0.00
Other Posts	0.00
Staggering	1.00
Total	***4.25***
Mean	***0.53***

Appendix 1
Results

Independence of Bank of Jamaica
1996 - 2003

Political Independence

Members of the Board

Appointment	0.25
Nominations	0.25
Qualifications	0.00
Term	0.00
Dismissal	0.25
Rewenability	0.00
Other Posts	0.00
Staggering	0.00
Government Representatives	0.00
Total	***0.75***
Mean	***0.08***

Decision Making Process

Policy Decisions	1.00
Instructions	1.00
Government Representatives	1.00
Salary	0.00
Capital	0.00
Total	***3.00***
Mean	***0.60***

Sum of weighted means	**0.398**
Weighted Political Independence	**0.199**

Economic Independence

Missions	1.00
Monetary Policy	1.00
Interest Rates	1.00
Exchange Rates	1.00
Bank Regulation	1.00
Government Lending	0.00
Budget	0.00
Total	***5.00***
Mean	***0.71***

Sum of weighted means	**0.71**
Weighted Economic Independence	**0.36**

Table 1

Variable	Definition	Source
M_t	Value of imports	Balance of Payments statistics, BOJ
Tb_t	180-day treasury bill	Statistical Digest, BOJ
P_t	Consumer Price Index	Statistical Digest, BOJ
Bm_t	Base money, end of period	Statistical Digest, BOJ
S_t	Average weighted selling exchange rate	Statistical Digest, BOJ
Output	Quartlerly GDP interpolated to monthly GDP	Real sector statistics, BOJ
Y_t	Output gap, output minus random walk component from a Beveridge-Nelson decomposition	Author's calculation

Table 1A:

Johansen Cointegration Test

Sample (adjusted): 1993M05 2003M12
Included observations: 128 after adjustments
Trend assumption: Linear deterministic trend
Series: D(LNBASE) D(LNHEADLINE) D(LNEXCH) D(OUTPUTCYCLE) D(LNTBILLS) D(LNIMPTS)
Exogenous series: D11 D4 D5 D6 D7 D8 D9 D10 D12
Warning: Critical values assume no exogenous series
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.707236	422.5393	95.75366	0.0001
At most 1 *	0.626391	265.3057	69.81889	0
At most 2 *	0.43217	139.2837	47.85613	0
At most 3 *	0.23755	66.84425	29.79707	0
At most 4 *	0.15882	32.12832	15.49471	0.0001
At most 5 *	0.075085	9.9908	3.841466	0.0016

Trace test indicates 6 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.707236	157.2336	40.07757	0.0001
At most 1 *	0.626391	126.022	33.87687	0
At most 2 *	0.43217	72.43948	27.58434	0
At most 3 *	0.23755	34.71593	21.13162	0.0004
At most 4 *	0.15882	22.13752	14.2646	0.0023
At most 5 *	0.075085	9.9908	3.841466	0.0016

Max-eigenvalue test indicates 6 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

1 Cointegrating Equation(s): Log likelihood 2281.449

Normalized cointegrating coefficients (standard error in parentheses)

D(LNBASE)	D(LNHEADLINE)	D(LNEXCH)	D(OUTPUTCYCLE)	D(LNTBILLS)	D(LNIMPTS)
1.000000	-8.747221	2.319087	-2225.103	0.379021	1.705744
	-2.16465	-1.49509	-154.758	-0.28057	-0.36806

Table 2A
VAR Estimates, Monthly Observation from January 1993 to December 2003

	Base Money	CPI	Exchange rate	Output Cycle	Treasury Bills	Imports
Significant Lagged Regressors						
D(Base(-1))	-0.394367 *	0.012853	0.007576	0.000176	-0.208670	0.818090 *
D(Base(-2))	-0.018463	0.024666	0.047250	-0.00000142	-0.638346 *	0.610651
D(Base(-3))	0.107728	0.031952	0.069439	-0.00000355	-0.206113	1.173275 *
D(CPI(-1))	1.199040 *	0.428047 *	-0.076791	-0.008343	-1.580427	-2.843990
D(exchrate(-1))	0.202509	0.123553 *	0.591363 *	0.001652	2.536675 *	-0.696200
D(Output cycle(-1))	-6.588237	-4.644366 *	0.978673	-1.174662 *	-20.43142	-9.421973
D(Output Cycle(-2))	-2.937065	-1.609702	2.647592	-0.989038 *	23.49635	26.21059
D(Output Cycle(-3))	-1.260072	-1.230748	-0.146763	-0.505184 *	1.864751	21.28670
D(Tbills(-1))	-0.002095	0.004414	0.007536	-0.00000208	0.022451	0.263113 *
D(Tbills(-2))	-0.021082	0.005724	0.032049 *	-0.000388	0.055057	-0.413210 *
D(Tbills(-3))	-0.069741*	0.009942	-0.010767	0.000501	-0.025022	0.156168
D(lnimpts(-1))	-0.003619	-0.005543	-0.002318	-0.00000556	0.099746	-0.791991*
D(lnimpts(-2))	-0.007670	0.001710	-0.005717	-0.000184	0.135112	-0.680124*
D(lnimpts(-3))	-0.011250	0.009572	0.009807	0.00000701	0.084921	-0.198302*
R-squared	0.767333	0.732975	0.474041	0.679291	0.304449	0.719745
Adj. R-squared	0.704516	0.660878	0.332032	0.592699	0.11665	0.644076
Sum sq. resids	0.065097	0.003268	0.022025	7.27E-06	0.928293	1.002541
S.E. equation	0.025514	0.005717	0.014841	0.00027	0.096348	0.100127
Correlation Matrix						
D(LNBASE)	1.000	0.084	-0.030	0.055	0.027	-0.333
D(LNEXCH)	0.084	1.000	0.233	-0.036	-0.002	0.123
D(OUTPUTCYCLE)	-0.030	0.233	1.000	0.156	0.136	0.089
D(LNTBILLS)	0.055	-0.036	0.156	1.000	0.049	-0.028
D(LNCPI)	0.027	-0.002	0.136	0.049	1.000	-0.017
D(lnimpts)	-0.333	0.123	0.089	-0.028	-0.017	1.000

The VAR model is estimated with 3 lags and each equation contains a full set of monthly seasonal dummy variables. The asterisk (*) denotes variables that are significant.

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