THE USEFULNESS OF EVOLUTIONARY EARLY WARNING INDICATORS FOR EMERGING ECONOMIES AHEAD OF MACROECONOMIC CRISES: CONVENTIONAL METHODS

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ABSTRACT

This paper investigates the usefulness of early warning models in predicting macroeconomic crises such as the global crisis of 2009-2011. A general overview was taken of the key variables identified in the literature, and the most current methods of investigation were used to test the consistency of those variables. Thirteen variables were regressed on crisis incidence variables which measured growth in the Nominal Exchange Rate, the equity market, Net Official Reserves and the Fiscal Balance. The results of bi-variate and multivariate regressions showed that Interest Rate Spreads and the Real Interest Rate have proven to be the two most useful leading indicators that can explain the incidence of a macroecomic crisis in Trinidad and Tobago. The consistency of interest rates as a leading indicator is a unique finding, as it describes the Trinidad and Tobago crisis incidence differently from what was seen in the literature on the US and other advanced economies. The results of this paper show, most importantly, that even in a relatively insulated economy during a global economic crisis, internal dynamics driving confidence in investment markets can precipitate macroeconomic crises.

Keywords: Leading indicators, Early warning signals, Exchange market pressure index.

1.0 Introduction

The contemporary world economy is characterised by a significant increase in macroeconomic volatility relative to the past. In addition to the heightened frequency of different crises (e.g. currency, banking and simultaneous currency and banking crises), the frequency of the succession of large-scale crises simultaneously occurring in many different sectors of the macroeconomy allude to an emerging pattern of volatility clustering in the global macroeconomic system. Macroeconomic crises of the 2000s present a new ontology of volatility, since, compared to the Bretton Woods period, twin and multiple crises have become more frequent, and arguably more destructive.

This increase in global economic instability has led to a re-emergence of theoretical and empirical work surrounding the question of whether leading macroeconomic indicators are useful as early warning signals of crises. This line of research was first pioneered by Mitchell and Burns (1938) and has been pursued by various authors since (see Bukart et al. 2000, Stock and Watson 1992 and Frankel and Sarvelos 2010). Initial attempts to develop early warning systems based on leading indicators were problematic; having only academic value at best but little practical value at worst. In the new literature, the question of pragmatism (and relevance) is mainly addressed through revised and more robust methodologies for testing the trans-crisis, trans-period performance of variables and by testing out-of-sample performance. Additionally, the evolutionary approach to conceptualising macroeconomic crises is an improvement on static approaches, since it treats crises as inherent events instigated by internal market and non-market forces, which can be traced through an overall evolutionary pattern. This also implies an improvement in the policy approach to resolving crises, as the evolutionary approach calls for an overall behavioural change in the system, rather than merely implementing good macro-prudential and financial buffers.

The 2008-09 crisis (in the US), the subsequent global fallout, the brief ostensible recovery in 2010, and the present day relapse into crisis provide an interesting - if serendipitous - environment in which to re-

open the case for the usefulness of leading indicators as early warning signals. The usual dilemma faced by economists investigating crises is that it must always be done in hindsight, and often without the best information that would help the analysis. However, new approaches are being developed to constantly update both the repository of variables under scrutiny for early warning signals and the toolbox of models used to study their behaviour (both before and after the incidence of a specified "crisis").

This subject area should also generate great interest, particularly among policy makers, because of the fact that at the individual country level, risk is a function of exogenous and endogenous macroeconomic and microeconomic factors, rather than only external financial and economic equilibrium. The search for early warning indicators of financial and economic crises among academic economists is aligned with efforts by central banks and multilaterals to quantify risks and vulnerabilities and develop appropriate policy responses. Good predictions of crises have a strong resonance in emerging economies such as those in the Eastern Caribbean and Trinidad and Tobago because of the nature of their insertion into the world economy. However, one of the major problems encountered in using leading indicators for predictive purposes is that none of them is permanently a good indicator. Additionally, for the Caribbean, there are additional problems such as the availability and quality of data.

The purpose of this study is to analyse the usefulness of some of the leading indicators established as relevant in the literature on the US 2008-2009 crisis and apply them specifically to an empirical test of 1) Whether a macroeconomic crisis can be identified for Trinidad and Tobago during or following the US/global crisis and 2) Whether the analysis of evolutionary trajectories in specified leading indicators is useful for the identification of such a crisis. This paper will focus on the definition of macroeconomic crises and determining which leading indicators were useful in predicting a specified crisis period in Trinidad and Tobago between 2009 and 2011. At the moment, the focus is not on the number of variables, but the number of important combinations

possible between the most decisive variables that can lead to the development of a predictive model. While it may not be possible to predict precise magnitudes and points in time when real crises will occur, the general aim is to prove whether contemporary methodologies can accurately identify lending indicator variables relevant to a particular scenario.

This paper will lay the groundwork for further research into the methodology of forecasting and detecting crisis incidence covering the most prolific findings in recent literature and applying them appropriately for Trinidad and Tobago. The sequence of this paper hereafter will proceed as follows:

1. Review of Literature on Early Warning Indicators;
2. Definitions of Crisis and Crisis Incidence;
3. Modelling Approaches;
4. Variables and Defining the 2009-2010 Crisis in Trinidad and Tobago;
5. Empirical Analysis;
6. Implications of results and Policy Recommendations;
7. Conclusion.

2.0 Review of Literature on Early Warning Indicators (EWIs)

Although the body of empirical work has grown extensively since the Mexican and Asian economic crises in 1997, the problem of identifying broad lessons from the stylized facts remains a great challenge. The main reason is that while the literature has converged on a narrow set of dependent variables that measure the intensity and occurrence of a crisis, there is still a wide variation in the way crises are defined. Another reason is that different types of crises are investigated in different countries at different time periods, creating a wealth of disparate findings with no generality in the lessons learnt from one crisis and country to the next. A third and perhaps the most important reason is that empirical work on leading indicators is subject to selection bias. Since the variables used as indicators are selected in hindsight, then in spite of the economic

reasoning governing the selection and their being statistically significant, the usefulness of these variables cannot be ascertained beyond reasonable doubt if they have been identified after the crisis has occurred.

The approach taken by Frankel and Sarvelos (2010) to overcome these limitations is to identify the causes and symptoms of financial crises that have been most consistent over time, country and crisis. By engaging in an extensive review of the literature (surveying over 80 studies of pre-2008 crises), they were able to rank the indicators that were statistically significant and that demonstrated consistency across definitions of "crisis" and time periods. Their crisis measures were:

1. Percentage changes in nominal local currencies;
2. Equity Market Returns;
3. Percentage changes in levels of Real GDP;
4. Percentage changes in industrial production; and
5 Recourse to IMF financing.

However, in compiling and categorically ranking the early warning indicators analysed in the studies, they found that indicators such as Reserves, the Real Exchange Rate, GDP, Credit, The Current Account Balance, Money Supply, and Exports or Imports were the most frequently statistically significant. Interestingly, other indicators such as Contagion (dummies for contemporary crises occurring elsewhere), External Debt, Budget Balance and Capital Flows were among the least statistically significant. However, they were also the least featured out of all the studies. Other well established theoretical leading indicators such as the Real Interest Rate and Inflation were moderately featured and their statistical significance was more inconclusive. It is safe to say then that the literature points to the fundamental macro-economic variables that are most likely to be useful for developing EWI models.

2.1 Definitions of "Crisis" and "Crisis Incidence"

A quick scan of different definitions of "crisis" is informative, since the range of definitions spanned those observing multi-sector measures of crisis incidence and narrower measures of breaches occurring

in one particular sector – e.g. a currency crisis, or a banking system crisis - holding all other sectors constant. In the case of the latter, it is assumed that breaches occurring in a specific sector pose significant systemic risks, and therefore presage an overall macroeconomic crisis. A recent example of a narrow definition was found in Obstfeld et al. (2009), which measured crisis incidence as the *"percentage depreciation of local currencies against the US dollar over 2008"*. They found that the excess of reserves (as a proportion of M2) over the values predicted by their model of reserve demand is a statistically significant predictor of currency depreciation over 2008. However, the unadjusted level of reserves/M2 was not statistically significant. Frankel and Sarvelos (2010) also noted that the sample size was limited, and statistical robustness across different country samples was lacking.

Rose and Spiegel (2009) provided a broader-based definition of crisis incidence as a combination of 2008 changes in real GDP, the stock market, country credit ratings and the exchange rate. However, they failed to identify any consistent statistically significant variables of crisis incidence, except possibly stock market returns, inspite of the fact that the authors extensively investigated over sixty potential variables that could explain cross-country crisis incidence as well as country specific contagion effects. Additionally, the 2008 calendar year period over which the authors measure crisis incidence remains somewhat arbitrary.

Many studies took the angle that macroeconomic crises were best defined in terms of events in currency markets. The earliest attempts at these definitions relied on the development of market indices, which combined the variations in currency markets, reserves and interest rates. Eichengreen et al.'s (1995) Exchange Market Pressure Index (EMPI) was the best early example of this approach. This index is usually a weighted average of the rate of depreciation of the local currency (mostly against the US dollar in either nominal or real level), the monthly percentage changes in international reserves, and the monthly change in the interest rate. In general, a period of currency crisis is identified when the EMPI

exceeds a particular threshold, such as two or three standard deviations above its mean. In its standard mathematical form:

$$EMPI_t = \Delta s_t + w_1 \Delta i_t + w_2 \Delta r_t \quad (1)$$

where s is the exchange rate in natural logarithm, i_t is the home interest rate, such that $\Delta i_t = i_t - i_t^*$, and r is the international reserves *(R)* adjusted by base money *(B)* , such that

$$\Delta r_t = (R_t - R_{t-1})/B_{t-1} \quad (2)$$

If the index is below zero, the home currency is facing appreciation pressure;
otherwise, the currency is facing depreciation pressure.
The weights of interest rate changes and reserve changes are 1 w and $2\ w$, respectively.

Eichengreen et al. (1995) defined a crisis as:

EMP is greater in value than 1.5 S.D. of the entire sample's average value. Formally:

Crisis = 1 ; if $t\ EMPI > \mu_{EMP} + 1.5\sigma_{EMP}$

Crisis = 0 otherwise,

Where μ_{EMP} *and* σ_{EMP} denote the respective mean and the standard deviation for the entire sample of the EMP index. However, there are two major pitfalls of the EMPI approach, namely its sensitivity to 1) the weighting scheme for each component of the EMPI and 2) the statistical parametric assumption used in the construction of crisis thresholds.

Alternatives to the EMPI emerged earlier in the decade (circa 2001-2003) in the form of the Market Pressure Index (MPI) or, alternatively, Speculative Pressure Index (SPI). The MPI is defined as a "weighted average of changes in the exchange rate, the international

reserve and the interest rate" (Gunsel et al. 2010). Mathematically (in standard form) it is represented as:

$$MPI_{i,t} = (\alpha\%\Delta e_{i,t}) + (\beta\Delta i_{i,t}) - (\gamma\%\Delta r_{i,t}) \quad (3)$$

Where:

e denotes the nominal exchange rate vis-à-vis the USA.

i denotes short-term interest rates.

r denotes foreign exchange reserves.

α, β and γ, are weights which equalize the conditional volatilities of each component.

The decision criteria for a crisis here is similar:

Crisis = 1 ; if $t\ MPI > \mu_{MPI} + 1.5\sigma_{MPI}$

Crisis = 0 otherwise,

Where μ_{MPI} *and* σ_{MPI} denote the respective mean and the standard deviation for the entire sample of the EMP index.

A higher index is reflected in higher values of these three variables. Therefore, this indicates greater pressure on the exchange market depending on the nature of the intervention of the respective central banks. That is, speculative pressures are either accommodated by a loss of reserves or can be prevented by the monetary authorities through an increase in interest rates. As with Eichengreen et al. (1996), a crisis episode is defined as a month in which the MPI exceeds its overall mean of the index by 1.5 times the pooled standard deviation of the calculated index.

Abiad (2003) surveyed more than 30 studies which used the MPI which consisted of a weighted average of nominal exchange rates and reserve and interest rate changes; they then converted this into a binary crisis variable using a threshold specified by using a sample-dependent standard deviation. However, even with the commonalities in the use of this methodology, there is considerable variation with regard to the inclusion of interest rate changes, the weighting of various components, the threshold used to define the binary variable and the analysis of high-inflation episodes. Among the studies which Abiad (2003) surveyed which

used the MPI, Burkart and Coudert (2000) focused solely on large and accelerating interest rate depreciations and combined crises dates from other "expert estimations" to predict crisis dates. Ghosh and Ghosh (2003) focused solely on "deep currency crises" which they defined as crises resulting in a decline in GDP growth rates of at least three percentage points. Zhang (2001) used exchange rates and reserve changes separately and identified crises when either of the two crossed a sample-dependent threshold.

However, a major limitation to the EMPI approach is the calculation of the weights attaching each component. Eichengreen et al. (1996) argue that, ideally, the weights should be derived from the excess demand for foreign exchange from an empirical model of the exchange rate. That is, by determining the slope coefficient that reflects how much official intervention would be required to avoid a one percentage point change in the exchange rate. However, there is little agreement within the practice about the most appropriate theoretical model of the foreign exchange market and none of the models is a good fit. An alternative that they suggest is precision weighting, which involves computing the weights from the inverse of each component's variance from the entire sample.

Some studies relied on far more intuitive approaches: mostly on the forecasts of professional economists before and after the incidence of the crisis. Berkmen et al. (2009) was one such study. They found that countries with more leveraged domestic financial systems and more rapid credit growth tended to suffer larger downward revisions to their growth outlooks, while exchange-rate flexibility helped reduce the impact of the shock. Interestingly, Rose and Spiegel (2009) and Blanchard et al. (2009), found little evidence that international reserves played a significant role in explaining crisis incidence. While this approach was simpler and relied on the anticipation of imminent crises, the downside to them was that they had to focus on revisions to growth forecasts by professional economists rather than actual growth outturns because data on actual economic performance was not available at the time.

Ironically, the most pragmatic definition had been one of the earliest, by Stock and Watson (1992), who simply asserted that a crisis was

a period of recession. Their basic argument was to define recessions and expansions as different patterns of economic activity, derive the quantitative definitions of those two patterns and calculate the probability that the economy would exhibit particular patterns in future months using the stochastic simulation of a model that forecasts future economic activity. However, their definition of recessionary and expansionary patterns was nebulous, having more assertions about what they define (i.e. the growth of the unobserved state of the economy, with the requirement that either pattern be economy-wide, rather than sector specific) rather than what they were definitively. Burns and Mitchell (1946) also gave a somewhat vague, but admittedly useful, definition of recessions - in which they assert that it is a substantial prolonged decline in economic activity that occurs broadly across various sectors of the economy. Unfortunately, time parameters and value thresholds of variables were not explicitly specified in either definition.

2.2 Modelling Approaches

Much of the earlier literature featured linear models for forecasting. However, these models have not been able to account for asymmetries often associated with business cycles. Linear leading indicator models that incorporated nonlinear models included models which used a bi-variate smooth transition error correction model. Other studies which featured nonlinear techniques were Estrella and Mishkin (1998) and Birchenhall et al. (1999), which used leading indicators in probit and logit models to forecast recessions. Estrella and Mishkin found that interest rate variables were better predictors of real activity than direct measures of money.

Finally, Anderson and Wahid (2000) used a univariate nonlinear model that emphasized the ability of interest rate spreads to predict output. Anderson and Wahid made a profound distinction between the performance of nonlinear univariate models and multivariate nonlinear models. They found that univariate nonlinear models do not predict recessions any better than autoregressive (AR) models, but multivariate nonlinear models do outperform VAR models. They also found that

nonlinear models of output and spread increased in predictive ability as they moved from univariate to multivariate models. However, using variables such as money instead of spread did not improve forecasts.

Other methodological approaches included the non-parametric indicators or signals approach, popularised by Kamisnky et al. (1998), and advanced by Bruggeman and Linne (2000). This approach consists of selecting a number of variables as leading indicators of a crisis and determining threshold values beyond which a crisis signal is considered to be given. While the statistical significance of the indicators used cannot be determined directly because the thresholds are determined within-sample, statistical tests can be undertaken to investigate the out-of-sample performance of these indicators. Tests of the out-of-sample significance of the Kaminsky et al. and other signal-based models have been undertaken by, among others, Berg and Patillo (1999), Bussiere and Mulder (1999) and Berg et al. (2004), who have shown these models to be moderately successful in predicting financial crises (Frankel and Sarvelos 2010).

More innovative techniques have recently been introduced by adapting a biological view of the evolution of variables towards critical crisis regions. Among the more interesting of these attempts were the use of binary recursive trees to determine leading indicator crisis thresholds (Ghosh and Ghosh 2003), the training of artificial neural networks (ANN) and fuzzy logic forecasting, Markov switching models (Abiad 2003) and the unconventional non-theoretical approach of Apoteker et al. (2000) in applying genetic algorithms.

3.0 The Variables

The data used consisted of 18 annual macroeconomic and financial variables for Trinidad and Tobago, culled from the Central Bank of Trinidad and Tobago's data centre. (see Table 1). Stylized facts based on comparisons of macroeconomic data for countries in the Caribbean region were sourced from the IMF's World Economic Outlook database. For comparisons between Caribbean countries, there was great variability

in the availability of data. Most data points were available to provide an even dataset for the level and growth rate of GDP, whereas the dataset containing the least data and more irregular reporting was seen for measures of debt. Regional and international data were analysed in a descriptive scan of the pre-crisis and current periods, while high frequency data for Trinidad and Tobago were used to define crisis incidence from the beginning of January 2009 to an ostensible end date of June 2011.

Table 1: List of Variables Used in Study

Measure	Variables
Reserves	Reserves as % of GDP, Total External Debt, M2 to total Reserves
REER	% Change in REER
GDP	% Change in GDP
Credit	Rise in Domestic Credit as % of GDP
Current Account	Current Account Balance, Net national Savings as % of GNI
Money Supply	Growth Rates of M2& M3
Exports/ Imports	X, M and Trade Balance as % of GDP
Inflation	% Changes in Inflation
Interest Rate	Real Interest Rates and Deposit Rates
Debt Composition	Short Term Debt, Multilateral Debt Service
Capital Flows	FDI, Portfolio Flows as % of GDP
Debt	Total Debt Service as % of GDP

3.1 Defining a macroeconomic crisis: What would one look like in Trinidad and Tobago?

Using a definition inspired by the work done by Frankel and Sarvelos (2010), a macroeconomic crisis in Trinidad and Tobago's macroeconomic was conceptualised as breaches in key leading indicators in the macroeconomy, the currency market and the capital market, followed by a loss of confidence in the country's currency and financial assets. The latter part of the definition is a departure from the norms seen in the literature, where the focus was on defining crisis thresholds alone. Measures of loss of confidence in Trinidad and Tobago's macroeconomy were mainly established by observing exchange rate trends and any simultaneous loss of investor confidence, mirrored by oscillations in stock market indices. It would have enriched the analysis to add an overall view of confidence in the macroeconomy, mirrored by consumer expectations. However, the lack of a national consumer expectations index presents another dimension that could be explored in further research.

A crisis time marker for Trinidad and Tobago is specified as January 2009, the period within which "bad news" about CL Financial emerged in the public domain. This period was significant, because of CL Financial's systemic importance and the current of uncertainty that suddenly (and subsequently) rippled throughout both the Trinidad and Tobago economy and the regional economy.[1] In Frankel and Sarvelos (2010), the crisis date was specified as September 15th 2008, the period in which Lehman Brothers collapsed under bankruptcy. The result of the announcement of Lehman Brother's "bad news" created a ripple of revelations of systemic risks in the US financial market. Although asset prices peaked and many measures of financial market risk started to rise prior to September 2008, the financial market dislocations became

[1] CL Financial is the largest conglomerate in Trinidad and Tobago, having subsidiaries in insurance, banking, real estate, manufacturing and energy industries. It also has large arms across the Caribbean, which meant that the systemic risk was spread across the region particularly in Guyana, Grenada and Barbados.

particularly synchronised and abrupt after this date. We would hope to test for similar evolutionary trends in the indicators in Trinidad and Tobago following the approximate "CL event".

Although, based on the data, the end period of Trinidad and Tobago's crisis would presumably fall between January and June 2011, identifying the end date of the crisis is less straightforward, since the recovery of certain variables remains unclear, while other variables seem to be still erratic. In Trinidad and Tobago, the ability to observe a crisis was made a bit more difficult, since in May 2010, there was an unexpected change in political regime[2]. This added an interesting but troubling dimension; with the sudden change in government and policy directives, there was a heightened sense of both optimism and pessimism, stemming from the popularity of the newly elected government by the majority of the population, while the still large faction of supporters of the outgoing administration drove an undercurrent of fear, suspicion and pessimism about the economy. More than a year later, public opinion is of a far different tenor - one seemingly more united in general uncertainty due to the number of unresolved issues (some relating to CL Financial) influencing the country's economic prospects and the added effect of a State of Emergency[3], whose economic impact requires separate study. So, for example, could this uncertainty have been responsible for capital flight before January 2011, when the US-TT exchange rate uncharacteristically rose by 2.5 per cent (compared to January 2010), or was this merely a coincidence, having to do with the previously weaker comparative value of the US in mid-2010 and speculation about it strengthening in 2011 following announcements of a more robust recovery towards the end of 2010? The relapse of the US and Euro area into possibly larger financial crises in August 2011 raise the question of how insulated Trinidad and

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[2] The then incumbent PNM was ousted in a 2 ½ year early snap election by the newly formed People's Partnership, a coalition of opposition parties which had a meteoric surge of popularity after public discontentment with the PNM had peaked during the 2009 crisis.

[3] A State of Emergency was imposed on August 21st 2011.

Tobago is from those events, while internally, loss of confidence and growing uncertainty about the macroeconomic outlook could be driving crisis dynamics that could be detected using conventional methods to analyse the evolution of leading indicators.

3.1.1 Defining the Parameters of a crisis

Important in defining the parameters of a "crisis" is the identification of dependent variables. The crisis measures used were:

1. Nominal Local Currency Percentage Change versus the US dollar from January 2009 to January 2011.
2. The Composite Stock Price Index.
3. Percentage change in Trade.
4. Changes in Net Official Reserves from January 2009 to January 2011.
5. Changes in the Fiscal Balance.

The decision to use percentage changes in Trade (the Balance of Payments, Net Exports) was as a result of the lack of a reliable Industrial Production index for Trinidad and Tobago and the general lag in the release of other production-specific series. It was assumed that speculation in commodity markets would be more reliably detected in the export markets, making the foreign trade series an ostensibly better leading indicator for Trinidad and Tobago.

Many studies have combined exchange rate moves with losses in international reserves as a measure of crisis incidence. The inclusion of reserves as a measure of crisis incidence is important, because it allows for observation of movements in market pressure that may not be captured through exchange rate moves. In Trinidad and Tobago, there is a managed floating exchange rate regime, which means that a crisis could be observed through larger drops in reserves and in exchange rate weakness. To test whether this is of any merit, Section 4.2 will include construction and analysis of an Exchange Market Pressure index which includes reserves.

3.1.2 Independent Variables

The explanatory variables selected are based on indicators identified in the literature. For an analysis of the Trinidad and Tobago situation, all independent variables were analysed over a 17 year period from January 1995, and an out-of-sample experiment between September 2008 and January 2009, the period just before the conceptual beginning of the local crisis precipitated by the US/global economic crisis. The explanatory variables were categorised into the following groups:

i. Money and Credit

This included the percentage change in domestic credit provided by the banking sector, percentage changes in money and quasi money, and percentage changes in liquid liabilities (M3).

ii Trade

Variables in this category included percentage changes net exports and growth in the balance of payments.

iii. Inflation

The series contained changes in inflation over the last 21 years.

iv. Interest rates

This included the interest rate spread (lending rate minus deposit rate), and the real interest rate over the reference period.

v. Fiscal Balance

This was measured as the current account balance (the difference between current expenditure and capital expenditure) as a percentage of GDP.

vi. Foreign Investment

Foreign investment was measured as external investment, measured by changes in gross foreign assets, and inflows of investment, measured by changes in the inflow of foreign direct investment.

vii. Real Effective Exchange Rate

Since a rise in the REER represents a stronger local currency, the REER was also included in the analysis.

viii. Debt

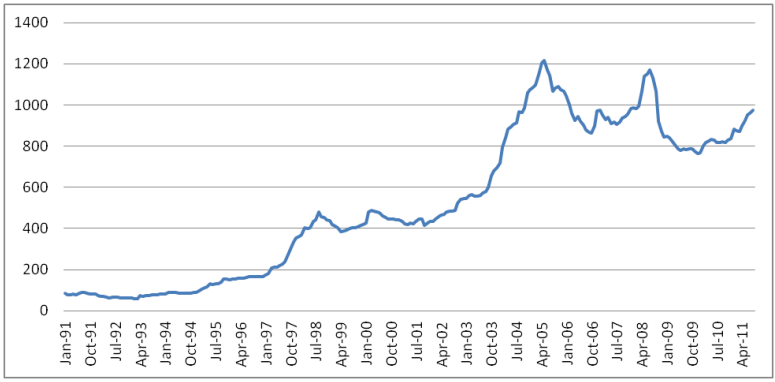
The debt-to-GDP ratio was specified as the debt variable.

4.0 Evidence from the Data - Did Trinidad and Tobago Experience a Crisis?

A cursory glance at some output indicators and asset prices before and during the crisis revealed patterns that could have suggested an imminent crisis. In the US there was a protracted downward movement in equity markets and the US trade-weighted dollar prior to September 15th 2008, then their subsequent plunge following that date. Measures of market risk such as the VIX (the "fear" or volatility indicator) began to trend upwards around July 2008 and sustained record highs between October 2009 and April 2009 (see Appendix 1).

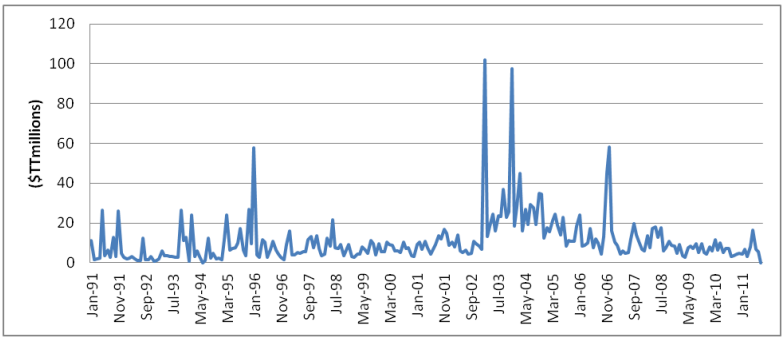
In Trinidad and Tobago, the behaviour of equity markets was similarly interesting prior to January 2009. In July 2008, there was an unusual peak in the composite stock price index (CSPI), following a steady upward trend since January that year (see Figure 1).

Figure 1: Composite Stock Index Price, Trinidad and Tobago



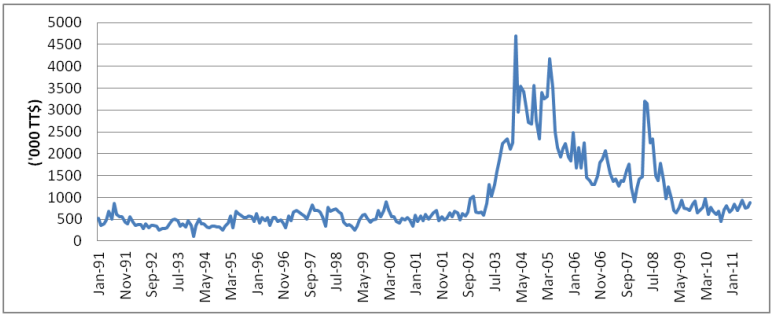
By January 2009, the CSPI had been on a steady decline, maintaining a lower level throughout 2010 than pre-2008 levels. However, in terms of volume of shares traded, there was no discernibly unusual deviation (see Figure 2).

Figure 2: Volume of Shares Traded, Trinidad and Tobago Stock Exchange



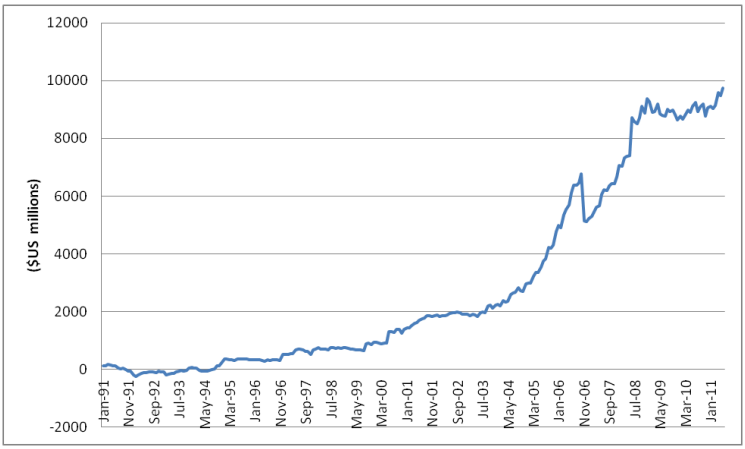
The number of transactions on the Trinidad and Tobago Stock Exchange also peaked around July 2008 (see Figure 3). While these trends are of interest, due caution is necessary before any conclusions can be formed, since it is difficult to establish *a priori* whether there is any link between the stock market behaviour and a subsequent crisis in Trinidad and Tobago since this period coincided with the US crisis, and the unusual activity in the Trinidad and Tobago equity market may have been due to speculation about foreign equity markets, rather than knowledge of an imminent local crisis.

Figure 3: Number of Transactions ('000), Trinidad and Tobago Stock Exchange



Net official reserves had been on a steady increase from January 2006 to January 2010, with only one severe trough in January 2007. After July 2008, net official reserves seemed to plateau off into 2010 (see Figure 4). However, reserves oscillated on an upswing toward the end of the series.

Figure 4: Net Official Reserves in $US millions (T&T)



Some stylised facts about the regional effects of 2008-2009 crisis were also deduced from the data. A global cross-section of Real GDP growth between 2007 and 2010 is presented in Appendix 2. Between 2007 and 2008, some of the Eastern Caribbean islands (most notably Grenada, St. Vincent and the Grenadines) and Jamaica suffered the worst loss of Real GDP growth. Their exchange rate pegs to the US meant that their currencies also suffered from some depreciation during 2010. The differences in economic performance across the world, and across the Caribbean in particular, points to the fact that a crisis could be defined differently and for different periods, reinforcing the need to use

definitions of crisis incidence specific to the economy being studied, particularly for the purpose of testing the predictive power of various leading indicators.

More descriptive statistics are presented in Table 2. In the correlations matrix of our key crisis indicators (Nominal Exchange Rate, Growth in the Composite Stock Index, Growth in Net Official Reserves, Growth in the Fiscal Balance) we find some mixed results. Net Official Reserves was shown to be negatively correlated with the Composite Stock Index and even more strongly negatively correlated with the Nominal Exchange Rate. More surprisingly, there seemed to be zero correlation between Net Exports and the Nominal Exchange Rate, a finding that seems counter-intuitive, but that could be explained by the managed float exchange rate regime upheld by the Central Bank. A weak but positive correlation was found between Net Official Reserves and the Fiscal Balance.

4.1 Bi-variate Regressions

The first stage of statistical analysis involved running bi-variate regressions of the crisis incidence indicators on the outlined independent variables. Ordinary Least Squares (OLS) estimation was used since the variables included were all continuous and this was the most basic starting point seen in the literature. Sixty five bi-variate regressions were conducted in which thirteen variables were selected to be regressed upon the five dependent variables outlined in section 3.1.1. The bi-variate tests were meant to be an exploratory method of selecting the best performing indicators to determine if crisis incidence could be uniquely specified in Trinidad and Tobago.

Table 2: Cross Correlations of Possible Crisis Indicators Trinidad & Tobago

	% Change in the Nominal Exchange Rate	% Change in the Composite Stock Price Index	% Change in Net Exports	% Change in Net Official Reserves	% Change in The Current Balance
% Change in the Nominal Exchange Rate	1.00	-	-	-	-
% Change in the Composite Stock Price Index	0.41	1.00	-	-	-
% Change in Net Exports	0.00	-0.09	1.00	-	-
% Change in Net Official Reserves	-0.79	-0.39	0.25	1.00	-
% Change in the Current Balance	-0.02	-0.29	0.02	0.12	1.00

The results are reported in Appendix 3. The money and credit block performed quite poorly as effective determinants of leading indicators, as none of the variables were significant. The fact that some of the coefficients were negative possibly indicates that Trinidad and Tobago's economy is highly leveraged (and that there was a higher level of credit growth before the crisis). However, this did not seem to affect Trinidad and Tobago as negatively as other highly leveraged economies. When compared to economies such as the US, relatively more conservative banking policies in Trinidad and Tobago might have been responsible for averting the level of risk faced in Trinidad and Tobago.

There was mixed performance in the trade block, as only Net Exports was significant when regressed against the growth rate of the Nominal Exchange Rate and growth in the Composite Price Index. The signs of the coefficients in both regressions adhered to *a priori* assumptions, reflecting positive interrelationships. The performance of Trade as a possible (if weak) leading indicator probably highlights the high

dependence of Trinidad and Tobago's economy on its linkages to regional and international economies, and the fact that it is more interlinked with international productive sectors than with its domestic productive sectors.

Inflation showed relatively stronger consistency across the dependent variables; the only specifications in which it proved not to be significant were against growth in Net Exports and growth in the Current Account Balance. The signs of the coefficients also adhered to *a priori* expectations of being positive in relation to growth in the Nominal Exchange Rate and growth in the Composite Stock Price Index. The interest rate block performed the best in terms of general consistency and the expected signs. Both the interest rate spread and the real rate of interest proved to be significant in all specifications except against growth in Net Exports.

However, the Real Effective Exchange Rate did not appear to be an effective indicator for Trinidad and Tobago, a result which is fairly at odds with most other studies surveyed. The implication may be that there was no local currency weakness in the early period of the US crisis. However, as recently as in June 2011, the Trinidad and Tobago dollar exhibited a weakening position against the US, in spite of the US dollar's weakening position globally at the time. The Debt to GDP Ratio was another relatively strong performing block in terms of signs of coefficients, significance and consistency.

Other variables that appeared as significant in most of the literature but were found not significant in the bi-variate regressions included investment flows and the fiscal balance, both categories performing poorly in terms of levels of significance and coefficient signs.

The results so far show that for Trinidad and Tobago, only a few variables identified in the literature apply as possible crisis indicators. The difference between these results and those found for other countries further suggests that each crisis is driven by different independent variables. Identifying and studying those other variables may be beyond the scope of this paper; however, other qualitative variables and symbolic modelling techniques may be used to give further depth to the analysis.

The variables identified as the strongest performing here (i.e. Inflation, Interest Rates and Debt to GDP) were tested further for consistency against another key crisis measure in the literature: the Exchange Market Pressure Index.

4.2 Constructing an Exchange Market Pressure Index for Trinidad and Tobago

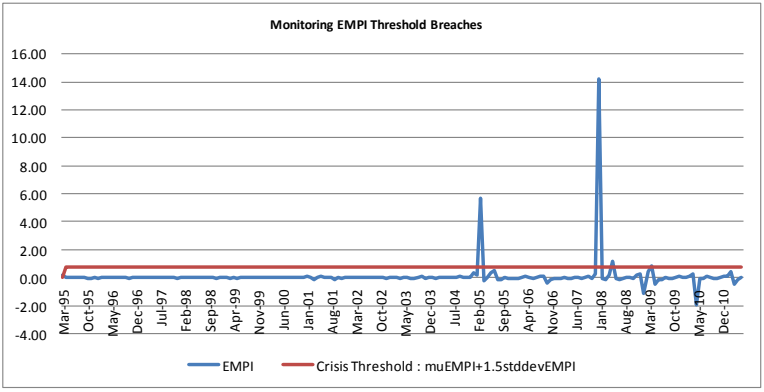
Following the approaches gleaned from Eichengreen et al. (1996) and more recently in Frankel and Sarvelos (2010), the bi-variate regressions were supplemented by the construction of an Exchange Market Pressure Index (EMPI). Methods of correcting for some of the short-comings in using the EMPI are informed by Frankel and Sarvelos (2010). In the case of Trinidad and Tobago, the only adjustment needed was one to possible valuation distortions due to large exchange rate movements, which could lead to mis-statements of true market pressure. To correct for this, Trinidad and Tobago's currency reserves were measured in terms of US dollars, since the Trinidad and Tobago dollar is pegged to the US dollar and the majority of currency reserves are denominated in US dollars.

Following the authoritative methodology of Eichengreen et al. (1996), an Exchange Rate Market Pressure Index was created, using a weighted average of exchange rate and reserve changes. The weights are determined by the inverse of the relative standard deviations of each series[4], as a measure to compensate for the different volatilities in each series. The index was then regressed against a number of leading indicators.

Figure 5 displays the values of the EMPI constructed for Trinidad and Tobago against the crisis threshold that was found (specifically, 0.77). It can clearly be seen that over the long series, while there were two clear breaches of the EMPI crisis threshold in 2004-2005 and again in 2007, the

[4] As seen in Frankel and Sarvelos (2010), and Eichengreen et al. (1996).

Figure 5: Monitoring Breaches in the EMPI Crisis Threshold



EMPI was consistently below its crisis threshold, and in particular, it had periodically moved further away from the critical level during the conceptualised crisis period between January 2009 and June 2011. This confirms the results of the bivariate regression using the REER in the foregoing section, and provides further definitive proof that there was at least no currency crisis in Trinidad and Tobago contemporaneous with those occurring in the advanced economies during the reference period. However, the fact that the EMPI demonstrated low speculative pressure on the local currency could signal a crisis of low investor confidence in the Trinidad and Tobago dollar, and a possible indication of capital flight during the crisis reference period.

Appendix 4 reports the results of those regressions. Based on the empirical results yielded from the bi-variate regressions and on conventional methods seen in the literature, the baseline specification included Inflation, the Interest Rate Spread, the Real Interest Rate and the Debt to GDP Ratio. Two additional experimental specifications were run, to test each category of leading indicators reported in Appendix 4.

In the first specification:

$$EMPI_1 = \alpha + \beta_1(\text{Inflation}) + \beta_2\,(\text{Interest Rate Spread}) + \beta_3\,(\text{Real interest rate}) + \beta_5(\text{Debt to GDP Ratio}) + \epsilon \quad (4)$$

the coefficients of Inflation and the Debt to GDP ratio did not retain their significance, although in the case of Inflation, the inverse relationship between the coefficient and the EMPI seemed intuitive. Both the Interest Rate Spread and the Real Interest Rate maintained significance and were consistently so in the second and third specifications. The first specification was modified to drop Debt to GDP. This seemed to have no overall effect on the performance of the model, but the interest rate variables maintained significance well below the 10 per cent level. In the third specification, the Inflation variable was also dropped. This had little effect on the overall performance of the model, but proved once again the consistency of the Interest rate variables as strong explanatory variables in an early warning regime for Trinidad and Tobago. It is interesting to note the signs of the coefficients of both variables. The implication from all three specifications is that while interest rate spread is directly related to the EMPI, the real interest rate is inversely related to the EMPI. An increase in real interest rates in advance of the conceptual crisis period could signal downward pressure in the EMPI, and indicate a possible crisis in local investment markets.

4.3 Robustness Testing

In this section, the findings of the foregoing bi-variate and multivariate regressions are tested for robustness by introducing an alternative crisis incidence measure: Real GDP between 1995 and 2009. The bi-variate analysis of section 4.1 is repeated by now regressing the EMPI and the modified crisis incidence measure on all independent variables while controlling for the previously specified crisis incidence outcome variables. In comparing the performance of the independent variables against the modified crisis incidence variables, the Interest rate variables maintain their consistency in being significant, although the sign

of the interest rate spread coefficient has now changed to suggest an inverse relationship with the EMPI. Both interest rate spread and the real interest rate showed an inverse relationship with Real GDP. While one criterion for robustness is clearly and unequivocally satisfied, the other is less definitively not satisfied.

Another interesting result is that Trade, and in particular, Net Exports, proved to be significant in the Real GDP specification, while growth in the balance of payments was not significant. The consistency of the performance of Net Exports confirms earlier findings that Trinidad and Tobago's linkages to the region through its exports could be one vital channel through which crises in export markets could be signalled.

The coefficients on the foreign investment variables remained consistent in significance and sign. However, the performance of Debt, the Real Effective Exchange Rate and the money and credit variables differed from what obtained in the original results generated by the first series of bi-variate regressions. With these results, an overall conclusion can be made that while the performance of the Interest Rate variables has been identified as robust, and possibly the best leading indicator variables for a conceptual crisis in Trinidad and Tobago, the performance of the other variables tested is far more inconclusive.

5.0 Implications of Results and Recommendations

This study has established, through a conceptual experiment using an EMPI constructed for Trinidad and Tobago that no contemporaneous currency crisis existed in Trinidad and Tobago during the US/global macroeconomic crisis. However, contemporaneous measures at the time of the US/global crisis and current data suggest that a crisis of confidence in the investment market in Trinidad and Tobago is more plausible. This crisis is manifested in indications of capital flight, which can have more severe macroeconomic implications.

Up to this point, econometric analysis has also shown that only two of the identified indicators have been confirmed as leading indicators for a conceptual macroeconomic crisis in Trinidad and Tobago. These are

Interest Rate Spread and the Real Interest Rate. While interest rates did not feature prominently in the literature[5] as a leading indicator, it stands to reason that this study has established a preliminary methodology for selecting useful leading indicators for predicting the latest crisis incidence in Trinidad and Tobago, despite the lack of more intuitive results from other seemingly relevant variables such as Debt, and Foreign Direct Investment, and yet other economy-neutral variables such as inflation. The performance of Trade, despite not being consistent across specifications, also warrants further study, since the bi-variate robustness regressions of Appendix 5 gave a sense of the relative impact of Trade in explaining crisis incidence.

The first policy implication that emerges from the analysis is that since interest rates stood out as a useful leading indicator, this is an indication that crises can be generated internally in a situation of relative insulation from global economic shocks. The performance of the EMPI and the implications it presents for the currency and investment markets confirm that the possibility of an internal dynamic driving macroeconomic crises in Trinidad and Tobago is reasonable and worth studying in greater depth. As a result, a direct policy recommendation stemming from this study would be to manage interest rate spreads and real interest rate through fiscal policy, as a means of maintaining confidence in investment markets. However, given that inflation dynamics are partly externally driven in Trinidad and Tobago, the challenge of managing interest rates to maintain incentives for savings and investment is formidable.

The performance of Trade as a possible leading indicator and the insignificance of the Real Effective Exchange Rate in the models also point to the need to intensify linkages between local productive sectors as a means of increasing the country's internal and external competitiveness -

[5] It is also worth noting that all of the literature surveyed studied crisis incidences occurring in developed economies with more internally integrated sectors and far more complex structures. The findings here serve to re-enforce the point that crisis measures for an economy such as Trinidad and Tobago should be at great variance with those developed for advanced economies.

another measure that can reduce vulnerability to fluctuations in demand during a crisis. Since Trinidad and Tobago's main exports are in the petrochemicals sector, a further policy recommendation would be to improve the competitiveness of other tradable sectors (agriculture and manufacturing in particular) and integrate them to reduce dependence on foreign trade, particularly imports.

As was the case in all other studies on the subject, the approaches used here to identify leading indicators of crises do not provide an unequivocal standard that can be used to verify the incidence of past or future crises. The painstaking nature of crisis episodes also presents a further challenge to researchers trying to identify past crises and predict future ones using the best early warning signals available. While the findings cast an optimistic light on the usefulness of leading indicators in explaining and predicting crises, much more is required to reach an ideal model for generating early warning indicators - the most work has to be done in the estimation of model parameters based on past crises in order to do better out-of-sample assessments. Far more research in this area needs to be done in particular for Trinidad and Tobago, but there are already a few insightful studies that have established some baseline methodologies, such as Berg and Patillo (1999) and Berg et al. (2004).

6.0 Conclusion

This paper analyses early warning indicators and methods of selecting variables which are consistently useful in predicting economic crises. Using conventional methods gleaned from recent literature on the 2008-2009 US and world crises, a number of variables were identified and subsequently included in a conceptual experiment of the incidence of macroeconomic crisis in Trinidad and Tobago between 2009 and 2011. Interest rate spreads and the Real Interest Rate were found to be the most consistent leading indicators of the specified conceptual crisis. Robustness tests also signalled the possible importance of Trade as a leading indicator variable in explaining macroeconomic crises in Trinidad and Tobago.

A number of other variables appeared as potentially useful leading indicators during the specified crisis period, but their robustness across different crisis incidence measures and specifications was less compelling. A number of yet unknown factors could have affected the performance of other variables that were anticipated to be useful leading indicators based on the literature but was not supported by the data from Trinidad and Tobago.

The completion of this empirical exercise for Trinidad and Tobago sets the stage for more advanced analysis of early warning indicators, and in particular their evolutionary patterns towards crisis episodes. The results of this study can now be juxtaposed with non-theoretical approaches; such as employing genetic algorithms, which is a proposal for continuing research from this paper.

REFERENCES

Abiad, Abdul. "Early Warning Systems, A Survey and a Regime Switching Approach". IMF Working Paper 03./32. 2003.

Anderson, Heather, M. Wahid, Farshid. "Predicting the Probability of a Recession with Nonlinear Autoregressive Leading Indicator Models". Monash University, Australia, Working Paper 3/2000. 2000.

Apotheker, Theirry, Barthelemy, Sylvain. "Genetic Algorithms and Financial Crises in Emerging Markets". TAC-Financial. 2000.

Berg, Andrew., Borensztein, Eduardo., Patillo, Catherine. " Assessing Early Warning Systems: How Have they Worked in Practice?". IMF Working Paper, 04/52. 2004.

Berg, A. and Pattillo, C., 1999, "Predicting Currency Crises: The Indicators Approach and an Alternative", Journal of International Money and Finance; Vol. 18(4), August 1999.

Berkmen, Pelin, et. al., 2009, "The Global Financial Crisis: Explaining Cross-Country Differences in the Output Impact," IMF Working Papers 09/280, International Monetary Fund.

Blanchard, Olivier, Hamid Faruqee, and Vladimir Klyuev, 2009. "Did Foreign Reserves Help Weather the Crisis", IMF Survey Magazine, IMF, Oct. 8th. http://www.imf.org/external/pubs/ft/survey/so/2009/num100809a.htm.

Bruggeman, Axel, and Thomas, Linne. "Are the Central and Eastern European Transition Countries Still Vulnerable to a Financial Crisis? Results from the Signals Approach", Bank of Finland Institute for Economies in Transition Discussion Paper, 2000.

Burkart, Olivier, Virginie Coudert., "Leading Indicators of Currency Crises in Emerging Economies." Notes D'Etudes et de Recherche, Banque de France, 2000.

Burns, Arthur F., and Wesley C. Mitchell, Measuring Business Cycles (New York, New York: National Bureau of Economic Research, 1946).

Eichengreen, Barry, et. al., 1995. "Exchange Market Mayhem: The Antecedents and Aftermath of Speculative Attacks", Economic Policy, Blackwell Publishing, Vol.10, No. 21, pp. 249-312, October.

Eichengreen B, Rose A, Wyplosz C., Contagious currency crises: first test. The Scandinavian J. Econ., 98(4): 463-484. 1996.

Estrella, A, F Mishkin., "Prediciting US Recessions: Financial Variables as Leading Indicators," Review of Economics and Statistics 80, pp 45-61. 1998.

Ghosh, Swati R., and Atish R. Ghosh, 2003. "Structural Vulnerabilities and Currency Crises," IMF Staff Papers, Palgrave Macmillan Journals, vol. 50(3), pages 7.

Gunsel, Nil, R., Tursoy, Turgut., Rjoub, Husam. "An empirical analysis of currency crises, fundamentals and speculative pressure". African Journal of Business Management, Vol. 4(6) pp 972-978. 2010. Available online at - http://www.academicjournals.org/AJBM.

Frankel, Jeffrey, A., Sarvelos, George., "Are Leading Indicators of Financial Crises Useful For Assessing Country Vulnerabilty? Evidence From the 2008-2009 Global Crisis". NBER Working Paper 16047. 2010.

Klucik, Miroslav, Juriova, Jana, Klucik, Marian. "Time Series Modelling with Genetic Programming Relative to ARIMA Models". Slovak University of Technology, Slovakia. 2010.

Mitchell, Wesley C. and Arthur F. Burns. 1938. Statistical Indicators of Cyclical Revivals, NBER Bulletin 69, New York. Reprinted as Chapter 6 of G.H. Moore (ed.), Business Cycle Indicators, Princeton: Princeton University Press, 1961.

Obstfeld, Maurice, Jay Shambaugh, and Alan Taylor, 2009, "Financial Instability, Reserves, and Central Bank Swap Lines in the Panic of 2008," American Economic Review, 99, no.2, May, 480-86.

Rose, Andrew, and Mark Spiegel, 2009a. "The Causes and Consequences of the 2008 Crisis: Early Warning" (with Mark Spiegel), Global Journal of Economics, forthcoming. NBER Working Papers 15357.

Rose, Andrew, and Mark Spiegel, 2009b, "The Causes and Consequences of the 2008 Crisis: International Linkages and American Exposure," Pacific Economic Review.

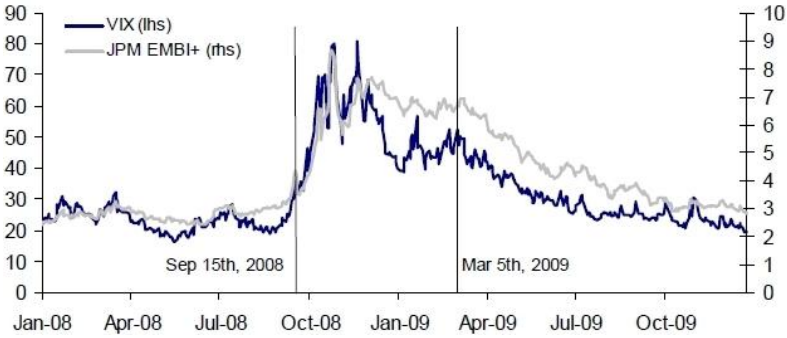
Stock, James, H. Watson, Mark, W. "A Procedure for Predicting Recessions with Leading Indicators: Econometric Issues and Recent Experience" NBER Working Papers no. 4014. 1992.

Zhang, Zhiwei, 2001. "Speculative Attacks in the Asian Crisis," IMF Working Papers 1/189, International Monetary Fund.

APPENDIX I

Equity Market Volatility in the US 2008-2009

Figure 1: Equity Market Volatility and Bond Spreads

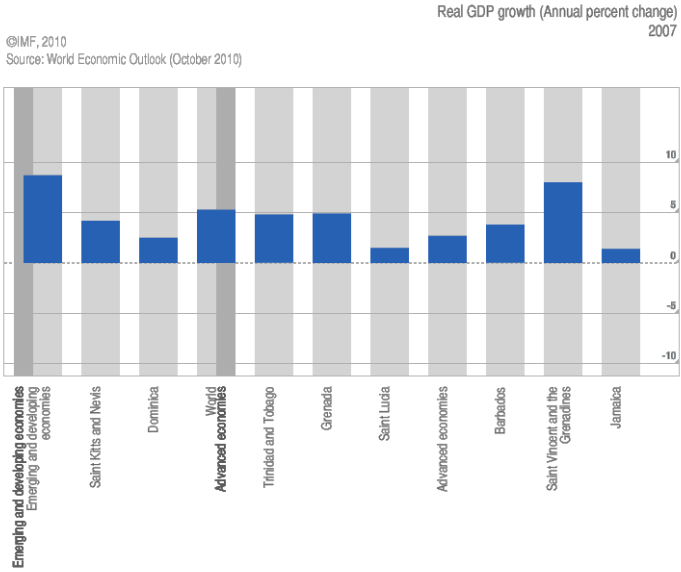


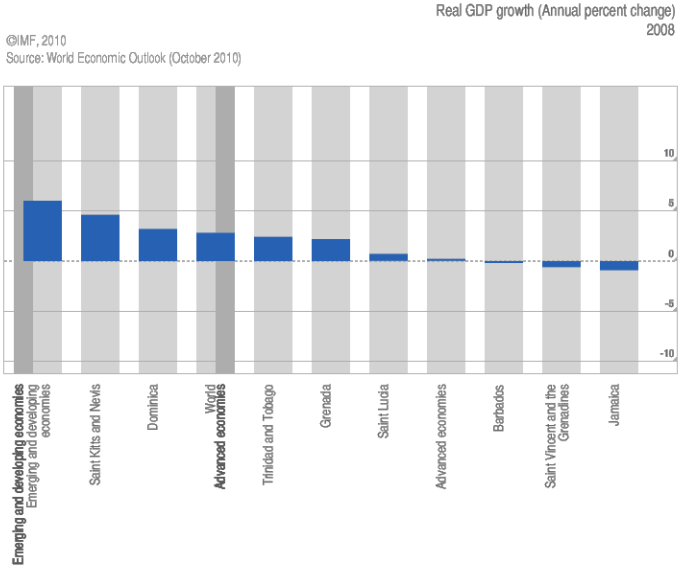
Source: Frankel and Sarvelos, 2010

Figure 2: Equity Markets and US Trade Weighted Dollar

Source: Frankel and Sarvelos, 2010

APPENDIX II


Real GDP growth (Annual percent change)
2007
©IMF, 2010
Source: World Economic Outlook (October 2010)
10
5
0
-5
-10
Emerging and developing economies
Emerging and developing economies
Saint Kitts and Nevis
Dominica
World
Advanced economies
Trinidad and Tobago
Grenada
Saint Lucia
Advanced economies
Barbados
Saint Vincent and the Grenadines
Jamaica


Real GDP growth (Annual percent change)
2008
©IMF, 2010
Source: World Economic Outlook (October 2010)
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Emerging and developing economies
Emerging and developing economies
Saint Kitts and Nevis
Dominica
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Advanced economies
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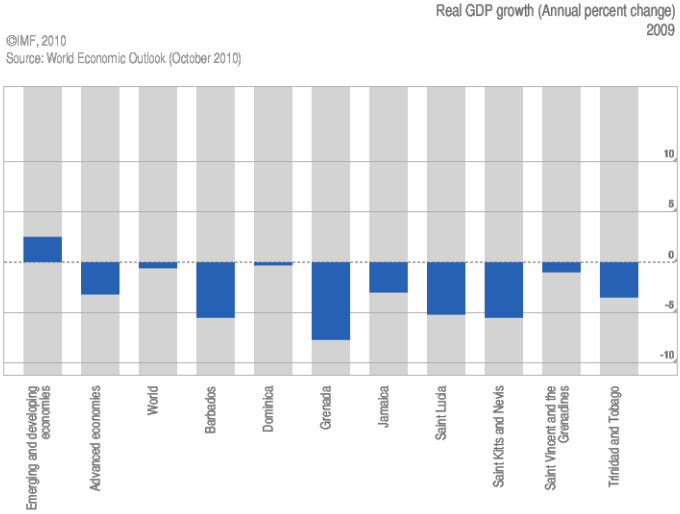
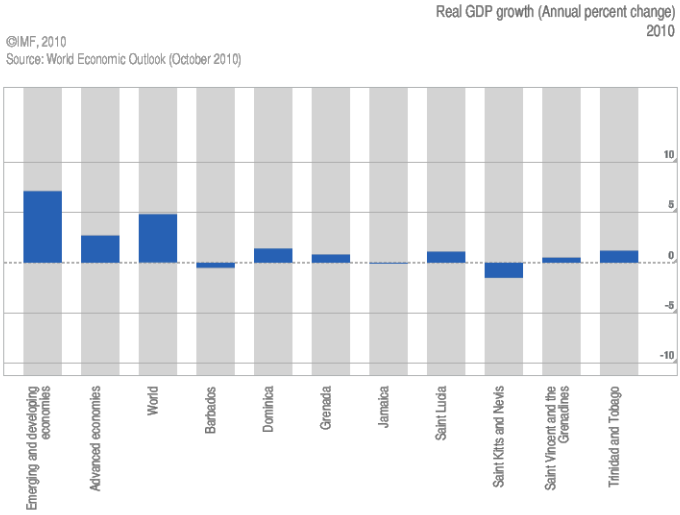
Saint Vincent and the Grenadines
Jamaica

Appendix II (Con't)





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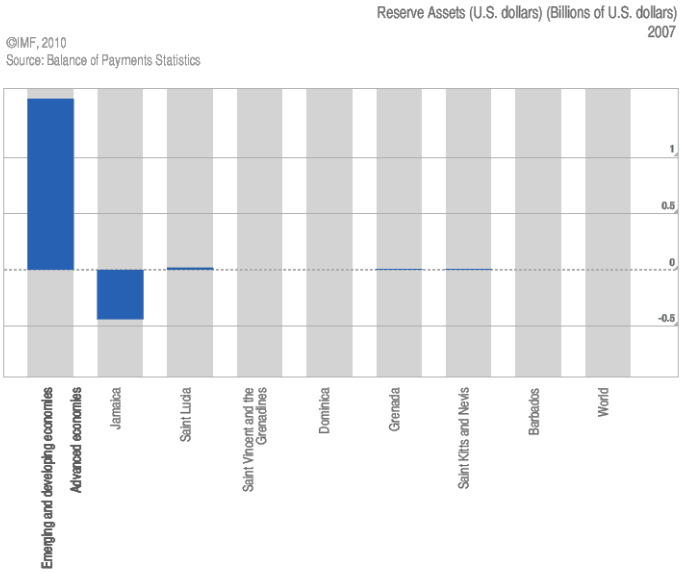

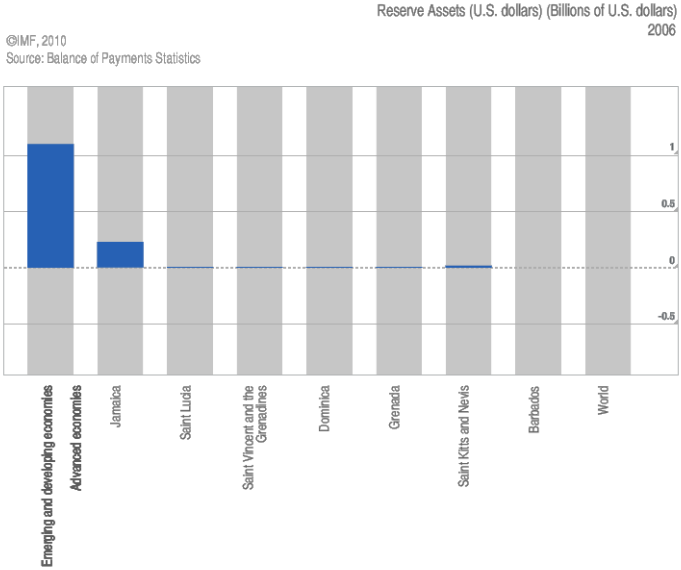

APPENDIX III

Results of Bivariate Regressions on Crisis Variables							
Categories	**Independent Variable**	**% Change in the Nominal Exchange Rate**	**% Change in The Composite Stock Price Index**	**% Change in Net Exports**	**% Change in Net Official Reserves**	**% Change in The Current Balance**	**Decision Criteria**
Money and Credit	*% Change in Domestic Credit Provided by the Banking Sector*	0.58	1.78	5.56	-0.18	0.14	**Coefficient**
		0.09	**0.21**	**0.68**	**0.17**	**0.98**	**P-value**
	% Change in Money and Quasi Money (M2)	0.62	-1.34	-9.7	0.4	16.56	**Coefficient**
		0.68	**0.81**	**0.86**	**0.49**	**0.56**	**P-value**
	% Change in Liquid Liabilities (M3)	0.28	0.71	30.45	0.01	-6.44	**Coefficient**
		0.76	**0.84**	**0.39**	**0.96**	**0.72**	**P-value**
Trade	*Net Exports*	5.18	0.0002	0.0002	-1.49	-0.0002	**Coefficient**
		0.13	**0.03**	**0.85**	**0.28**	**0.69**	**P-value**
	% Change in BOP	0.003	0.004	-0.106	-0.003	-0.27	**Coefficient**
		0.8	**0.93**	**0.83**	**0.45**	**0.28**	**P-value**
Inflation	*Inflation (Annual %)*	1.58	6.3	6.65	-0.53	-10.14	**Coefficient**
		0.06	**0.04**	**0.84**	**0.11**	**0.55**	**P-value**

Appendix III (Con't)

Categories	Independent Variable	% Change in the Nominal Exchange Rate	% Change in The Composite Stock Price Index	% Change in Net Exports	% Change in Net Official Reserves	% Change in The Current Balance	Decision Criteria
Interest Rates	Interest Rate Spread (lending rate minus deposit rate,%)	-3.59	-10.85	15.68	1.108	47.86	**Coefficient**
		0.01	**0.07**	**0.79**	**0.06**	**0.104**	**P-value**
	Real Interest Rate(%)	-1.13	-4.15	-4.74	0..34	17.87	**Coefficient**
		0.04	**0.063**	**0.83**	**0.13**	**0.11**	**P-value**
Fiscal Balance	Current Account Balance as a % of GDP	2.53	17.37	-53.31	-0.51	-57.14	**Coefficient**
		0.46	**0.22**	**0.68**	**0.7**	**0.38**	**P-value**
Foreign Investment	% Change in Gross Foreign Assets	-0.54	-4.74	-5.29	0.26	-3.66	**Coefficient**
		0.56	**0.18**	**0.88**	**0.47**	**0.83**	**P-value**
	% Change in Foreign Direct Investment	-0.07	0.07	-6.81	0.008	-13.36	**Coefficient**
		0.84	**0.95**	**0.64**	**0.95**	**0.05**	**P-value**
Debt	Debt as a % of GDP	-0.68	-3.34	4.94	0.22	8.63	**Coefficient**
		0.05	**0.007**	**0.72**	**0.103**	**0.22**	**P-value**
REER	Real Effective Exchange Rate Index (2005=100)	0.004	0.013	0.02	-0.001	-0.06	**Coefficient**
		0.03	0.11	0.809	0.19	0.14	**P-value**

APPENDIX IV

Multivariate Regressions on the EMPI				
	Regression Specification			
	1	**2**	**3**	
Independent Variables				Decision Criteria
Inflation	-1.87	-1.4	-	Coefficient
	0.91	***0.93***	-	P-value
Interest Rate Spread	125.97	124.38	125.89	Coefficient
	0.04	***0.03***	***0.02***	P-value
Real Interest Rate	-54.64	-56.92	-56.79	Coefficient
	0.02	***0.01***	***0.007***	P-value
Debt To GDP Ratio	-2.29	-	-	Coefficient
	0.8	-	-	Coefficient
C-intercept	-4.94	-5.5	-5.7	P-value
	0.28	**0.15**	0.04	Coefficient
Number of Observations	16	16	16	
R-squared	44%	44%	44%	

APPENDIX V

Results of Bivariate Regressions on Crisis Variables

Categories	*Independent Variable*	EMPI	REAL GDP	Decision Criteria
Money and Credit	*% Change in Domestic Credit Provided by the Banking Sector*	-1.62	1.16	**Coefficient**
		0.77	**0.13**	**P-value**
	% Change in Money and Quasi Money(M2)	-6.43	5.14	**Coefficient**
		0.78	**0.1**	**P-value**
	% Change in Liquid Liabilities(M3)	-6.87	-4.25	**Coefficient**
		0.65	**0.98**	**P-value**
Trade	*Net Exports*	0.0003	24.72	**Coefficient**
		0.55	**0**	**P-value**
	% Change in BOP	-0.1	1.82	**Coefficient**
		0.61	**0.54**	**P-value**
Inflation	*Inflation (Annual %)*	5.29	5.59	**Coefficient**
		0.71	**0**	**P-value**
Interest Rates	*Interest Rate Spread (lending rate minus deposit rate,%)*	-9.35	-1.26	**Coefficient**
		0.71	**0**	**P-value**
	Real Interest Rate(%)	-13.01	-4.8	**Coefficient**
		0.16	0	**P-value**

Appendix V (Con't)

Categories	Independent Variable	EMPI	REAL GDP	Decision Criteria
Fiscal Balance	Current Account Balance as a % of GDP	-79.23	1.34	**Coefficient**
		0.13	**0.06**	**P-value**
Foreign Investment	% Change in Gross Foreign Assets	7.31	-9.38	**Coefficient**
		0.62	**0.65**	**P-value**
	% Change in Foreign Direct Investment	4.17	1.24	**Coefficient**
		0.5	**0.13**	**P-value**
Debt	Debt as a % of GDP	-6.2	-2.64	**Coefficient**
		0.29	**0**	**P-value**
REER	Real Effective Exchange Rate Index (2005=100)	0.002	1.64	**Coefficient**
		0.95	0	**P-value**