2002

MONEY AFFAIRS

VOLUME XV, NUMBER 1, JANUARY-JUNE 2002

CEMLA

ASSEMBLY

Associated Central Banks *(vox et votum)* and Collaborating Members *(vox).*

GOVERNING BOARD, 2001-2003

President: Banco de México □ **Members:** Banco Central de la República Argentina □ Banco Central de Brasil □ Banco de la República (Colombia) □ Banco Central de la República Dominicana □ Central Bank of Trinidad and Tobago □ Banco Central de Venezuela.

EXTERNAL AUDITING
Banco de México

EXECUTIVE PERSONNEL

Director General: Kenneth Coates □ **Deputy Director General:** Carlos-Alberto R. Queiroz □ *International Relations Director:* Juan-Manuel Rodríguez Sierra □ *Studies Director:* Flavia Rodríguez Torres □ *Training Director:* Jimena Carretero Gordon.

MONEY AFFAIRS is a bi-yearly publication of the Centre for Latin American Monetary Studies (CEMLA), Durango nº 54, Mexico City, D. F., 06700. ISSN-0187-7615.

MONEY AFFAIRS is regularly listed in the International Current Awareness Service: Economics. Selected material is indexed in the International Bibliography of Economics.

MONEY AFFAIRS

VOLUME XV, NUMBER 1, JANUARY-JUNE 2002

Francisco Marcos Rodrigues Figueiredo
Roberta Blass Staub

Evaluation and combination of core inflation measures for Brazil

1. INTRODUCTION

The objective of this paper is to discuss and compare some results of alternative methodology to calculate core inflation indicators for the Brazilian IPCA.[1]

In order to assess the trend component of inflation, Central Banks have developed measures known as core inflation indicators. This tool aims to eliminate or reduce temporary fluctuations from price indices allowing monetary authorities to identify shocks hitting the inflation rate that do not affect the trend infla-

[1] IPCA, calculated by the *Instituto Brasileiro de Geografia e Estatística* (IBGE), is a comprehensive statistic measuring price changes to families with monetary income from any sources ranging between 1 and 40 minimum wages and includes nine metropolitan areas of the country, besides the municipality of Goiânia and Brasília.

Paper prepared by F. M. Rodrigues Figueiredo and R. Blass Staub, Research Department of the Central Bank of Brazil. The paper was presented at the VI Meeting of the Network of America Central Banks Researchers, organized by the Banco Central del Uruguay, in Montevideo, Uruguay, October 17-18, 2001.The views expressed in this paper do not necessarily reflect those of the Central Bank of Brazil.

tion. Temporary shocks, despite impacting the headline index, are quickly reversed without affecting expectations and, therefore, do not demand a policy response from the monetary authority.

The first attempts to develop a measure that captures the permanent component of inflation date back to the 70´s decade and consisted of purging the most volatile components from the headline index. Hence, this methodology of core inflation excludes the elements whose short-term behavior mostly differs from the underlying price trends. In general, food and energy are excluded from the core indices on these grounds.

During the 1990´s, the literature presented other methods for compute core. The use of limited influence estimators due to Bryan and Pike (1991) and Bryan and Cecchetti (1994) is an example of alternative methods. The papers of Wynne (1999) and Roger (1998) are excellent examples of surveys that describe several methods for the calculation of core inflation, as well as the advantages and shortcomings of each one.

There has been a surge in the literature about core inflation in recent years, as more countries adopt explicit inflation targeting regimes or single out low and stable inflation rate as the main goal of monetary policy. That growing interest was unequivocally illustrated in the BIS seminar, *Measures of Underlying Inflation and Their Role in the Conduct of Monetary Policy* (BIS, 1999) held in February 1999. In addition, several Central Banks such as the Bank of England, the Reserve Bank of New Zealand and the Federal Reserve Bank of the United States disclose regularly inflation trend measures. Table A1 in Appendix shows the different measures of core inflation used by several Central Banks.

Remarkable information from the table mentioned above is that in a sample of 22 Central Banks that regularly disclose core inflation figures, just two of them do not use some indicator based on a kind of exclusion method. A possible explanation to this widespread use is that the public can easily understand this measure.

Regarding Brazil, estimation of core inflation has been a recent topic and has gained importance after the introduction of the inflation targeting regime in July 1999. The first measures of core inflation were published in the beginning of 2000. Since March of that year, *Fundação Getúlio Vargas* (FGV) has been releasing a monthly measure of core inflation for the IPC-Br, using the trimmed mean technique, whose methodology is briefly described in Gonçalves *et al.* (2000). *Instituto de Pesquisa Econômica*

Aplicada (IPEA), in its January 2000 Bulletin, presented some preliminary results for the IPCA core inflation using smoothing trimmed mean. The description of the methodologies can be found in Moreira and Carvalho (2000). Furthermore, Monetary Policy Committee (COPOM) has divulged a symmetric trimmed-mean since September 2000. This last indicator is described in the next section.

The outline of this paper is as follows: next section describes a set of alternative core inflation indicators computed. In Section 3, Granger causality tests and impulse responses from a bivariate VAR are analyzed to assess attractor properties. In the fourth section the results of a combination of core inflation indicators are evaluated. Concluding remarks and issues that should be explored follow this.

2. CORE INFLATION MEASURES

In this section, the core inflation measures employed along this paper are described. First, a measure based on exclusion of items corresponding to *foods at home* and *administered prices*. Second, the 20% symmetric trimmed mean disclosed by COPOM. The two last indicators are an asymmetric trimmed mean proposed by Bryan and Cecchetti (2001) and a double weighted measure.

2.1 Exclusion measure of core

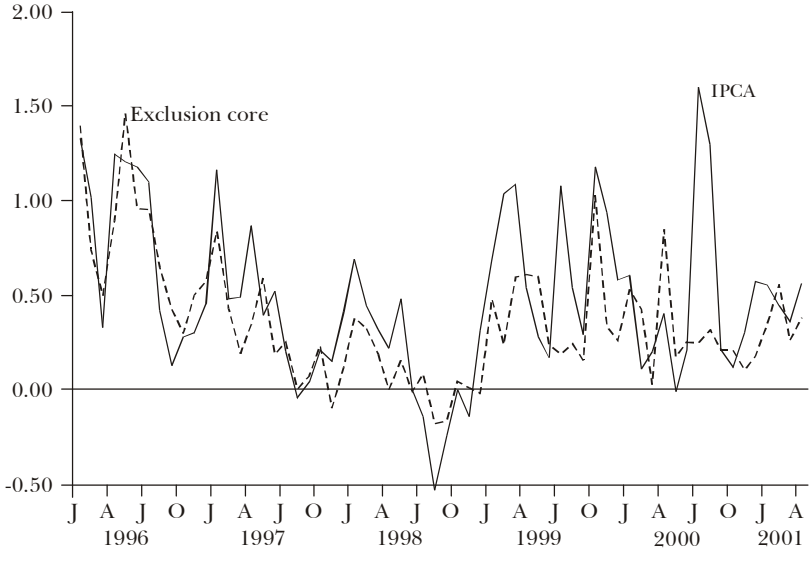
The first indicator of core inflation is one based on the traditional approach of excluding the items that historically present the highest volatilities. To compute this estimator, the items of *food at home* and *administered prices* are excluded from the headline IPCA. The items whose prices are considered wholly or partially controlled by government are basically public transportation, motor and household fuel and lubricants, land, water and sewage taxes and telephone services. The excluded items amounted approximately 43% of the total basket of the IPCA in April 2001. Chart 1 shows the core series from January 1996 through April 2001.

2.2 A symmetric trimmed-mean with smoothing items

An alternative method for estimating the core is the use of limited influence estimators (LIE). These are order statistics in which

the influence of the values located on the tails of the distribution is reduced. The weighted median and trimmed-mean are examples of LIE.

CHART 1. IPCA AND EXCLUSION CORE, JANUARY 1996 THROUGH APRIL 2001



The trimmed mean consists of the computation of the mean of a distribution where tail portions are removed. The weighted median is a particular case of trimmed mean, in which nearly 50% is removed from both tails.

In order to calculate the trimmed mean with α%, the sample of the variations of the IPCA components is ordered $\{x_1, \ldots, x_n\}$ with its respective weights $\{w_1, \ldots, w_n\}$. The symmetric trimmed mean is obtained from:

$$\bar{x}_\alpha = \frac{1}{1 - 2\frac{\alpha}{100}} \sum_{i \in I_\alpha} w_i x_i$$

where

$$I_\alpha = \left\{ i \mid \frac{\alpha}{100} < W_i < (1 - \frac{\alpha}{100}) \right\}$$

I_α is the set of the components to be considered in the computation of the trimmed mean with α% and W_i is the accumulated weight up to i-th component.

When estimating a trimmed-mean, the choice of the section to be trimmed is not a trivial subject. In this paper, α was chosen in order to minimize the root mean square error (RMSE) relative to a benchmark measure of core inflation, a 13-month centered moving average of the headline inflation rate. Such method is quite frequent in the core inflation literature. Bryan and Cecchetti (2001), for example, use a 24-month centered moving average to compute an optimal trim for the IPCA.

The trimming point chosen was 30%, that is to say the new inflation figure is computed with 40% of central section of the price changes distribution.

The 30% trimmed mean for the IPCA from January 1996 to May 2000 was mostly below the overall inflation as shown in Figueiredo (2001). This underestimation of the inflation path when the tail cuts are symmetric was also noticed by Laflèche (1997), Roger (1998) and Marques *et al.* (2000). Statistically, this behavior results from a positive asymmetry in the distribution of the changes of the price components.

The asymmetry of the price distribution could be explained by the existence of certain prices that suffer changes from time to time. The discontinuous price changes are larger than the variations of other prices that present more regular behavior, thus leading to a systematic exclusion of the former from the computation of the trimmed mean, causing a downward bias in the core measure.

In the core inflation literature, there are two possible solutions to this shortcoming. First, an asymmetric core inflation could be computed as Bryan and Cecchetti (2001) and Picchetti and Toledo (2001) did.

The methodology used by Bryan and Cecchetti (2001) is summarized in the next subsection. Picchetti and Toledo (2001), using a dynamic factor index indicator as benchmark to minimize the RMSE function, found 30% for the inferior trimmed and 40% for superior trimmed. Both author performed these computations for IPCA.

Another solution suggested by Laflèche (1997) and implemented by Gonçalves *et al.* (2000) for the IPC-Br is the smoothing the series that present less frequent changes.

In this paper, the second approach was chosen. The employed method consists of distributing the price variation of some items for the period and the following eleven months. The smoothed items were the following: communication, electricity, household and motor fuels, household services, public transportation, to-

bacco products and tuition and other school fees. The observed and smoothed series are showed in Figueiredo (2001). After including the smoothed series in the price components, the new core measure was computed and the optimal trim chosen was 20%.

Chart 2 displays the monthly percent changes for the IPCA and the trimmed mean. This new statistic does not present a downward bias.

CHART 2. IPCA AND 20% TRIMMED-MEAN CORE, JANUARY 19996THROUGH APRIL 2001

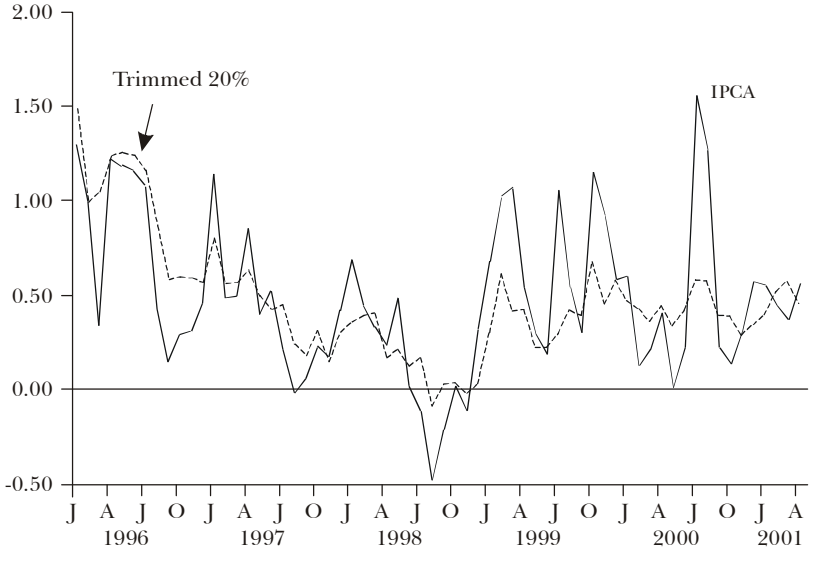


Table A2 in Appendix shows the frequency in which a component is trimmed in the lower and the upper tail. 12 up to 16 items with a frequency trimmed larger than 60% are food. In spite of being smoothed items, motor and household fuel were excluded 74% and 61% of the whole sample period, respectively.

2.2.1 Bootstraping

Another approach to determine the trimming point is to use a bootstrap methodology developed by Efron (1982). The procedure used here is similar to the one applied in Cechetti (1998) and Andrade and O´Brien (2000). First of all, the 13-month centered moving average is substracted from the monthly price

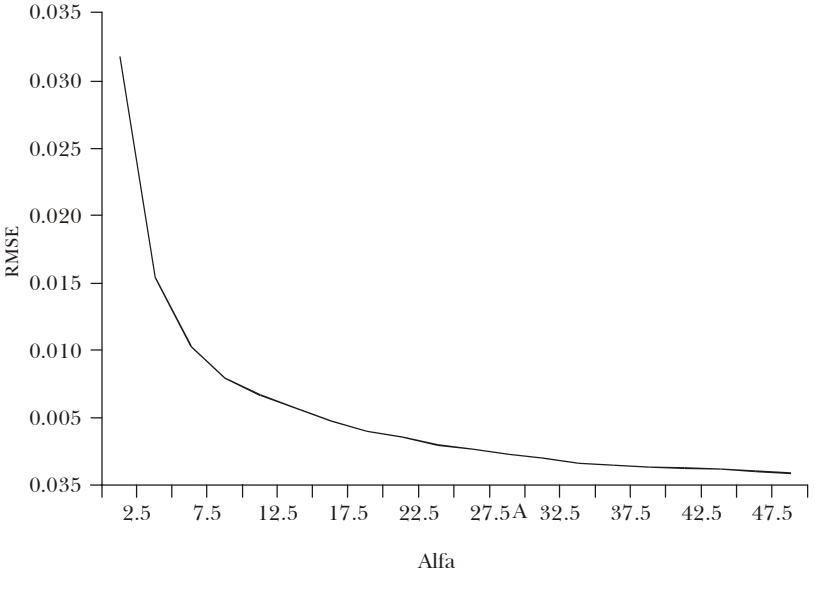
variation of each item (totalizing 52 itens). The sample period ranges from January 1996 to October 2000. Consequently, there is a 52 x 58 matrix from which random samples were drawn. Each sample consists of 52 items resulting from a drawn from each line of the matrix.

The goal of this exercise is to find an α (how much of the distribution is excluded from each side) that minimizes the root mean square error (RMSE) of the price variations relatively to the 13-month centered moving average. The RMSE was calculated for each sample with $\alpha = 0$ to 47.5 (step = 2.5). We used the weights recalculated so as to add to 100. Finally, the bootstrap estimate was reached.

According to Neter *et al.* (1996), the number of bootstrap samples necessary for evaluating the precision of an estimate depends on each particular application. They suggest to look at the variability of the bootstrap estimate calculated, in this case the RMSE. If the variability stabilizes reasonably, the process should be stopped. Based on this criterion 400 samples for each alpha were drawn. The values of RMSE obtained for $\alpha = 0$ to 47.5 (step = 2.5) are showed below.

As we can verify, the RMSE decreases as α increases. But it must be taken into consideration that the gain in trimming can be

CHART 3. RMSE FOR THE BOOTSTRAPPING PROCEDURE



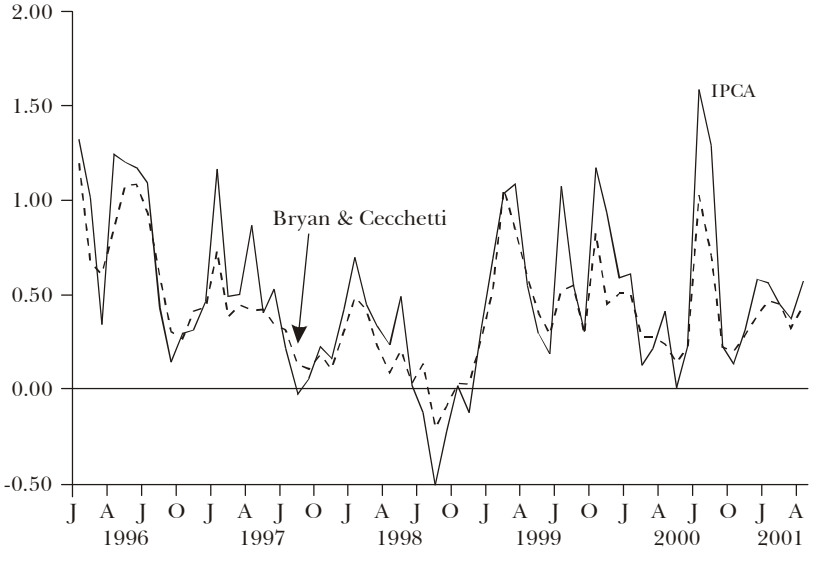
very small, suggesting that to trim more or not does not provide much additional efficiency gain in tracking the trend of inflation. For example, trimming 20% from each side reduces the RMSE in almost 93%.

Thus, the chosen indicator was the 20%-trimmed mean which was obtained using historical data.

2.3 Bryan & Cecchetti indicator

Bryan and Cecchetti (2001) proposed an unbiased measure of core inflation for the IPCA based on an asymmetric trimmed mean. To do this, they chose the percentile of the distribution of the price changes that on the average represents the headline inflation measured by the IPCA for a sample ranging from August 1994 to May 2000. The value was slight above the 60th percentile. Then the authors built trimmed means centered in the 60th percentile and found out the most efficient indicator in terms of RMSE when compared with a 24-month centered moving average. The most efficient estimator was an 24%-trimmed indicator, being 14,4% in the lower tail and 9,6% in the upper tail. Chart 4 shows the core measure from January 1996 to April 2001.

CHART 4. IPCA E BRYAN & CECCHETTI CORE, JANUARY 1996 THROUGH APRIL 2001 (Monthly percent change)



2.4 DoubleWeighting Core

A core measure using the double weighting method (π^{dw}) was calculated as well. The methodology used is a combination of methods shown by Laflèche (1997) and Marques et al. (2000). With *N* price components, the formula is:

$$\pi_t^{dw} = \frac{\sum_i^N c_i w_i \pi_{it}}{\sum_i^N c_i w_i} \text{ with } w_i = \frac{\frac{1}{\sigma_{it}}}{\sum_{i=1}^N \frac{1}{\sigma_{it}}}$$

Where c_i is the expenditure weight for *i*-th component and w_i is the volatility weight for component *i* based on the standard deviation of this component in the period *t* (σ_{it}). This standard deviation is calculated using the volatility of each component in relation to the average variability of the overall IPCA. In order to perform this computation it is required to choose a certain time window (*m*) as shown in the formulae below. In this paper, it was used a five-month window. Chart 5 displays the series obtained from this methodology.

$$\text{where } \sigma_{it} = \sqrt{\frac{\sum_{j=t-m+1}^{t} \left[\left(\pi_{ij} - \pi_j\right) - \left(\overline{\pi_{it} - \pi_j}\right)\right]^2}{m}} \text{ for i = 1,2,..., N and}$$

$$\left(\overline{\pi_{it} - \pi_j}\right) = \sum_{j=t-m+1}^{t} \frac{\left(\pi_{ij} - \pi_j\right)}{m}$$

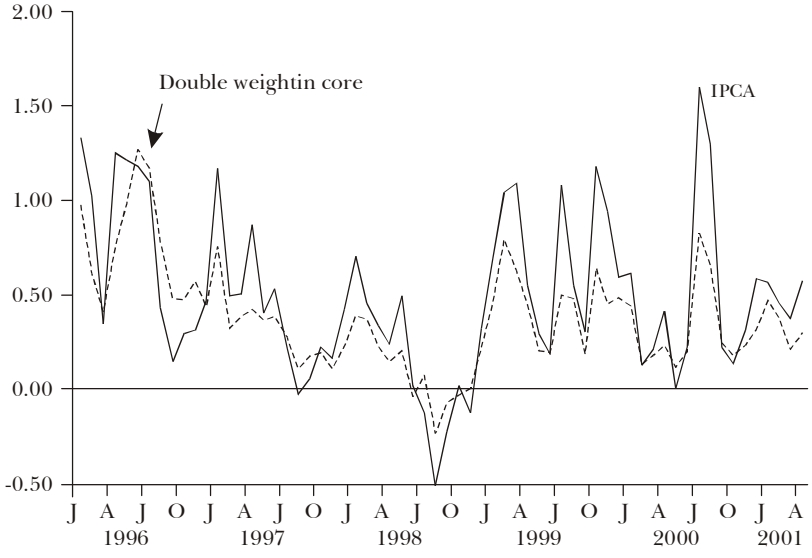
In the next section, all measures for core inflation are evaluated in according to their capacity to fulfill some desired properties.

3. EVALUATION OF CORE ESTIMATORS

According to the core inflation literature, the procedure to select the appropriate indicator of the core inflation still remains a challenging question. Roger (1998) suggested that a good measure of core inflation should satisfy four properties: timeliness, robustness, unbiasedness, and verifiability. Furthermore, Wynne (1999) added to this list the following conditions: forward looking nature, theoretical basis and easy understanding by the public.

Marques *et al.* (2000) assert that the above conditions are vague

CHART 5. IPCA AND DOUBLE WEIGHT CORE, JANUARY 1996 THROUGH APRIL 2001 (Monthly percent change)



and little selective despite being important. Besides, some conditions seem to be just pre-requisites. In order to overcome these questions some authors evaluate core inflation indicators by means of some statistical properties.

A basic test is to verify if the core inflation indicator shows lower variability than the headline index. Intuitively, a measure of core inflation should be less volatile than the headline inflation, because this statistic seeks to retain only lasting movements in prices excluding transient noise. According to the standard deviations figures in Table 1, the four indicators present lower volatilities than the headline index.

Other method to compare is to compute a RMSE of each measure and a core inflation reference (a centered moving aver-

TABLE 1. STATISTICS OF CORE INFLATION INDICATORS - JAN/96 TO APR/2001

Statistics	*IPCA*	*Exclusion*	*Trimmed 20*	*B & C*	*Double weight*
Acumul. Change	37.22	27.19	35.43	30.94	27.19
Standard-deviation	0.44	0.34	0.31	0.30	0.27
RMSE*	0.40	0.27	0.19	0.26	0.27
RMSE**	0.36	0.29	0.17	0.26	0.27

* The benchmark is a 13-month centered moving average of IPCA. ** The benchmark is a 24-month centered moving average of IPCA.

age). According to Wynne (2001), this procedure tests the ability of a potential core estimator to track trend inflation.

In this paper, using a 13-month and a 24-month centered moving average of the IPCA, all of indicators presented lower RMSE than the headline index. This result means that using whichever core measure evaluated, the Central Bank can improve upon the high-frequency signal to assess the IPCA trend. Furthermore, the 20%-trimmed mean indicator performed better than the other, producing an efficiency gain of 52% (13-month) and 54% (24-month) over the monthly change of the IPCA. The efficiency gains from the other methods are similar (ranging 32% to 34% for a 13-month moving average).

In order to systematize a set of required properties, Marques *et al.* (2000) introduced statistical conditions that have to be met by any core inflation indicator. The first condition is the existence of stable long-run relationship between core measure and inflation. Also, the trend measure should behave as an *attractor* of the inflation, in the sense that, in the long run, inflation tends to converge to the measure. However, this condition should not apply in the opposite direction, that is, the core measure should not be *attracted* by inflation. Thus, it is expected that, under normal conditions, when inflation is above the core, it tends to drop in the future.

If the attraction condition applies, changes in the core precede temporarily changes in the inflation headline and the converse is not true. Thus, a granger causality test might be performed between core inflation and the headline index in both directions to assess these features.

The results of the traditional Granger causality tests are valid only if the series are stationary. To verify if the core inflation series are stationary Augmented Dickey-Fuller tests were used. Statistical tests results are shown in Table 2 below, the unit root hypothesis are rejected in a significance level of 1% for each indicator except to the double weighted core that the null hypothesis is rejected in a level of 5%.

Granger causality tests were applied to assess the attraction conditions described earlier. The results obtained are showed in Table 3.

Based on the levels of significance of an F test, the indicator suggested by Bryan and Cecchetti outperformed the other attending both hypotheses with one and two lags: the core statistic is not Granger-caused by the IPCA and Granger-causes the IPCA.

For the 20% trimmed mean core, considering one lag in the mo-

TABLE 2. AUGMENTED DICKEY-FULLER TESTS

Index	*Lags*	*Intercept*	*Trend*	*ADF*
IPCA	0	yes	no	-4.64*
Exclusion	0	yes	no	-4.06*
Trimmed 20	5	yes	no	-3.88*
B&C	0	yes	no	-4.06*
Double	0	yes	no	-3.53**

* Unit root hypothesis rejected for 1% level of significance * Unit root hypothesis rejected for 5% level of significance

del, the null hypothesis that the indicator does not cause inflation is not rejected, but with two lags the null hypothesis is rejected. Changing the model specification we have the desired properties. The other condition is satisfied for both lags.

For the double weighted indicator, the tests show that the hypotheses of not Granger causality are not rejected in both directions.

At last, the exclusion core indicator performed poorly. This indicator does not cause the IPCA and is caused by the IPCA for both lags.

In order to verify the impact of changes in the core measure to headline inflation, impulse responses of a bivariate vector autoregression with the monthly changes of the IPCA and each core in-

TABLE 3. GRANGER CAUSALITY TESTS

Index	*Null hypothesis*	*Lags*	*F*
Exclusion	IPCA does not causes Exclusion	1	4.95**
		2	2.94***
	Exclusion does not causes IPCA	1	0.13
		2	1.65
Trimmed 20	IPCA does not causes Trimmed 20	1	0.00
		2	0.95
	Trimmed 20 does not causes IPCA	1	2.45
		2	3.88**
B&C	IPCA does not causes Trimmed 20	1	0.02
		2	1.15
	Trimmed 20 does not causes IPCA	1	5.01*
		2	4.72*
Double	IPCA does not causes Double	1	0.22
		2	0.57
	Double does not causes IPCA	1	0.54
		2	1.13

* Null hypothesis rejected for 1% level of significance. ** Null hypothesis rejected for 5% level of significance. *** Null hypothesis rejected for 10% level of significance.

dicator were estimated. The lag length of VAR is selected using the Akaike Information Criteria.

The diagonal graphs of impulse responses give the amount of persistence contained in the core measure and in headline inflation. The most important part for the impulse response graphs are those displayed on the off diagonal. The upper right graph gives the impact on the core inflation measure from a standard-deviation shock in the headline inflation. As discussed above, it is expected that the core inflation will not react systematically to changes in inflation. Meanwhile, the lower left chart shows the headline inflation response to one standard-deviation shock in core measure. The attractor properties of core measure would lead to a significant positive impact in the first months that vanishes after some periods.

The four sets of graphs show similar results, however a couple of points are worth to remark. The impulse response of the exclusion core for a shock in the IPCA is significantly positive in the first two periods. This pattern suggests time precedence for the IPCA in relation to core statistics.

When the upper left graph of the three sets of impulse are compared, the persistence of Trimmed 20 core seems to be larger than the other. This behavior is the consequence of the smoothing procedure used in this approach.

4. CORE INDICATOR COMBINATION

The need for an accurate and reliable measure of core inflation is practically a consensus among Central Banks authorities, mainly in those countries that follow an inflation targeting regime for monetary policy. Not only the core permits detecting particular movements in prices, but it also helps Central Banks communicate with the public in a more transparent way. However, there is some vagueness related to the best method for the calculation of such indicator.

The best choice for the core measure depends on its objective. If the Central Bank objective is to anchor expectations, the core inflation estimation should be disclosed to the public. In this context, an alternative to enhance credibility should be a verifiable and timely computed measure, easily understandable by the public in general. On the other hand, if the core is used as an intermediate target, for instance, the Central Bank can choose an indicator calculated by more sophisticated methods.

According to Laflèche (1997), as an accurate measure of trend inflation is a controversial subject, a preferred procedure should be to use a set of available core indicators provided by distinct methods. When this group points to the same direction, it should be considered a reliable instrument for monetary policy decisions. However, if the estimates conflict, larger attention is required to examine the reasons of the divergence and to ensure which road the monetary policy must follow.

Cogley (1998) goes further in this line and suggests that the alternative measures of core inflation could be combined in a weighted average with the aim of assessing the different information on trend inflation contained in different methods. Banco de La Republica from Colombia, for example, discloses the average of four core inflation measures.

In order to verify if a combination of core measures produces a better indicator for tracking trend inflation, a simple arithmetic average and a weighted average whose weights were defined on inverse of the variability of each measure were computed and evaluated. Both RMSE for 13- and 24-month moving averages for the two ways of combinations display results worse than 20%-trimmed mean. This outcome is possible due to the employment of biased indicators of core inflation in the set of core inflation measures.

5. CONCLUSION

In this paper, a set of core inflation indicators were estimated and evaluated. All estimators seem to reveal the trend of inflation better than the headline inflation does. However, the symmetric 20%-trimmed mean with smoothed items and the asymmetric indicator proposed by Bryan and Cecchetti (2001) performed better. Based on the causality tests, this two indicators help to anticipate the changes of the headline inflation.

Using an approach suggested by Cogley (1998), a combination of the indicators were computed and this new indicator does not improve the capacity of revealing the persistent movement of inflation given by centered moving averages.

The further research on core inflation includes the computation of trimmed mean with smoothed sub items rather than items and the evaluation of the predictive capacity of core inflation statistics for different forecast horizons.

Appendix

TABLE A1. CORE INFLATION MEASURES USED BY CENTRAL BANKS

Country	*Core measure*
Australia	CPI less mortgage interest payments, government controlled prices and energy prices
Belgium	CPI less potatoes, fruit and vegetables
Canada	CPI less indirect taxes, food and energy items
Chile	CPI excluding perishable goods and energy
Colombia	An average of four measures (CPI excluding food and three limited influence estimator)
Czech	CPI less fees and controlled and regulated prices
Finland	CPI less housing capital costs, indirect taxes, and government subsidies
France	CPI less change in taxes, energy prices, food prices and regulated prices
Greece	CPI less food and fuel
Israel	CPI less govenrment goods, housing, fruit and vegetables
Japan	CPI less fresh foods
Netherlands	CPI less vegetables, fruit, and energy
New Zealand	CPI less commodity prices, government controlled prices, interest and credit charges
Norway	CPI less electricity prices and indirect taxes
Phillipines	A statistical trend line
Poland	A set of three measures (CPI less officialy controlled prices, CPI less prices with highest volatilities and a 15% trimmed-mean)
Portugal	10% trimmed mean of the CPI
Singapore	CPI less cost of private road transportation and accommodation
Spain	CPI less mortgage interest payments
Sweden	CPI less housing mortgage interest and effects of taxes and subsidies
United Kingdom	Retail price index less mortgage interest payment
United States	CPI less food and energy items weighted median (FRB of Cleveland)

SOURCES: Bryan & Cecchetti (1999), and several Central Banks publications.

TABLE A2. THE TRIMMED FREQUENCY – JANUARY 1996 THROUGH JANUARY 2001

Items	*Inferior*	*Superior*	*Total*
More frequent trimmed			
Potatoes	52.46	39.34	91.80
Vegetables	52.46	37.70	90.16
Fish	45.90	40.98	86.89
Cereals	45.90	36.07	81.97
Fruits	62.30	18.03	80.33
Sugar and sweets	42.62	32.79	75.41
Fats and oils	54.10	21.31	75.41
Household fuel	*1.64*	*72.13*	*73.77*
Poultry and eggs	40.98	31.15	72.13
Meat	36.07	34.43	70.49
Dairy products	39.34	29.51	68.85
Flour and prepared flour mixes	42.62	21.31	63.93
Television, sound equipment	45.90	16.39	62.30
Motor fuel	*4.92*	*55.74*	*60.66*
Bedding and bath clothes	36.07	24.59	60.66
Beverages	44.26	16.39	60.66
Less frequent trimmed			
Maintanance and repair commodities	14.75	14.75	29.51
Decorator items	16.39	13.11	29.51
Tuition, other school fees and childcare	*0.00*	*27.87*	*27.87*
Reading materials	16.39	9.84	26.23
Vehicles	14.75	8.20	22.95
Personal care services	16.39	6.56	22.95
Hospital and other medical care services	14.75	6.56	21.31
Prepared food	9.84	9.84	19.67
Professional services	13.11	3.28	16.39
Domestic services	*3.28*	*4.92*	*8.20*

Obs. The smoothed items are in boldface.

CHART A.1. IMPULSE RESPONSES FROM A BIVARIATE VAR

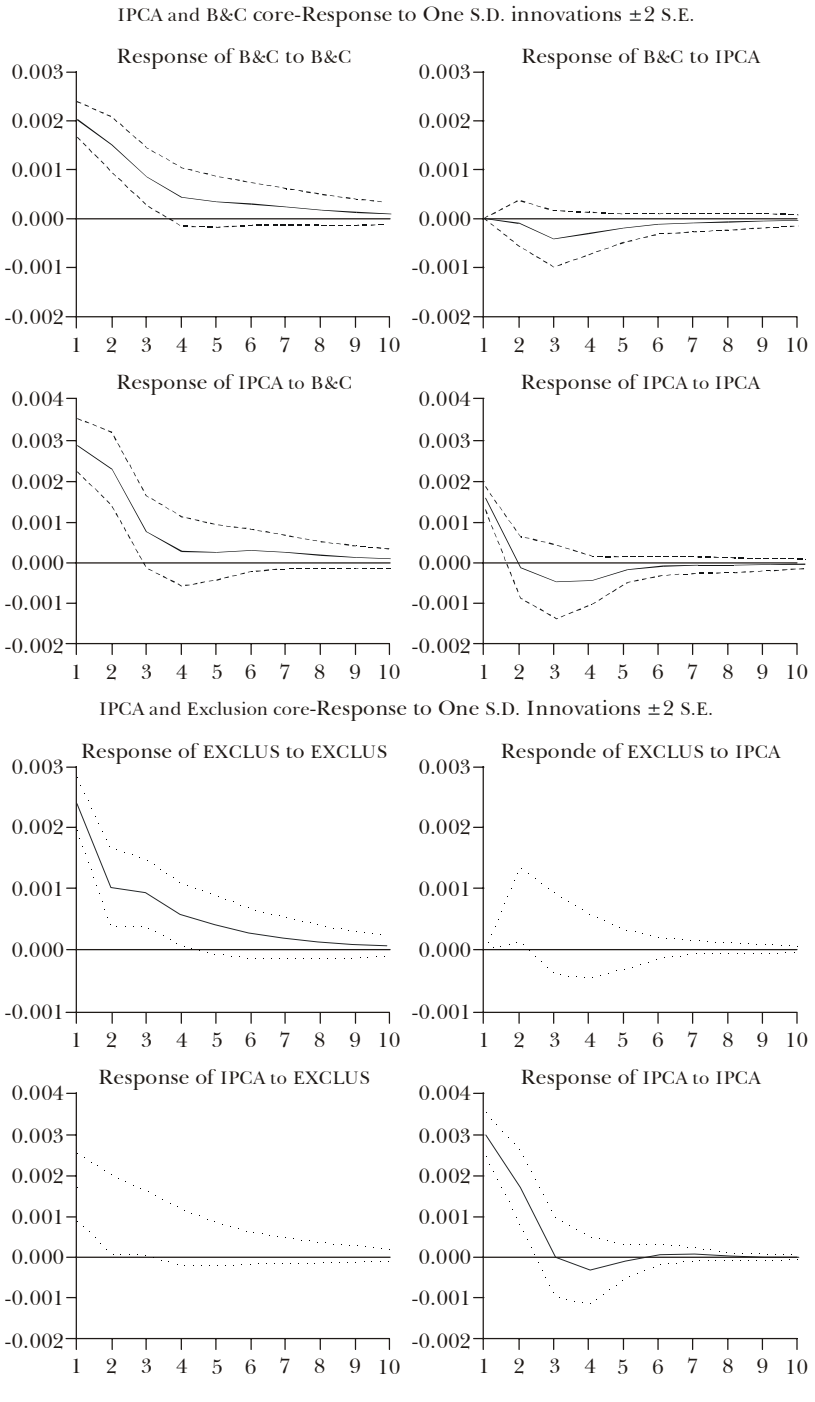
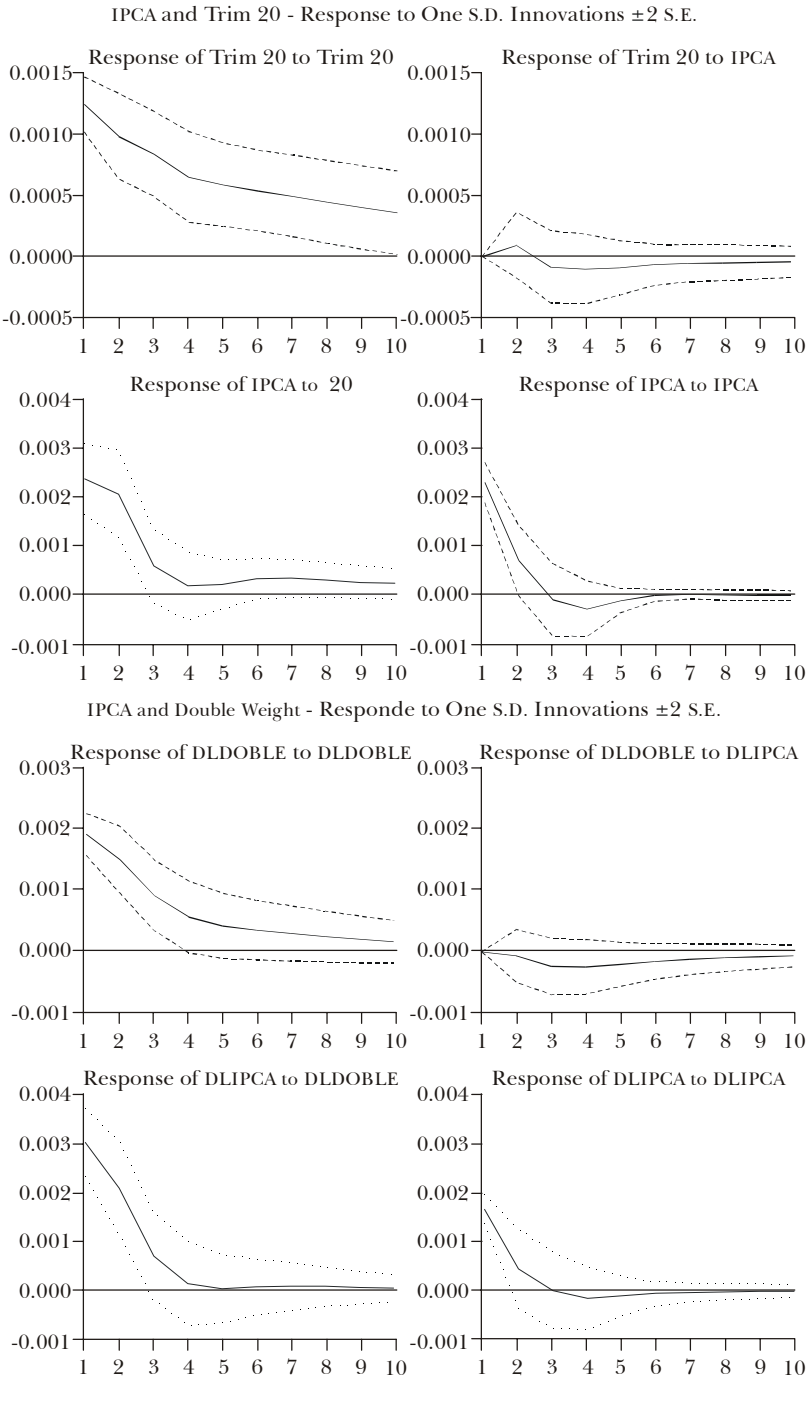


CHART A.I *(conclude)*



REFERENCES

Andrade, Isabel C. and O'Brien, Raymond J. (2000). "A Measure of Core Inflation in the UK". Mimeo.

Bryan, Michael and Cecchetti, Stephen G. (1994). "Measuring core inflation". Chapter 6 in N. G. Mankiw (ed.) *Monetary Policy,* University of Chicago Press.

Bryan, Michael and Cecchetti, Stephen G. (1999). "The monthly measurement of core inflation in Japan". *Discussion Paper Nº. 99-E-4, Institute for Monetary and Economic Studies, Bank of Japan*.

Bryan, Michael and Cecchetti, Stephen G. (2001). "A Note on Efficient Estimation of Inflation in Brazil". *Working Paper Series 11*, Banco Central do Brasil, March.

Bryan, Michael and Pyke, Christopher (1991). "Median price changes: an alternative approach to measuring curent monetary inflation". *Federal Reserve of Cleveland Economic Comentary*, December.

Cecchetti, Stephen G. (1997). "Measuring Short-Run Inflation for Central Bankers". *Economic Review,* Federal Reserve Bank of St. Louis.

Cogley, T. (1998). "A simple adaptive measure of core inflation" Federal Reserve Bank of San Francisco Working Paper, November.

Efron, B. (1982). "The Jackknife, The Bootstrap, and Other Resampling Plans". Philadelphia, Penn.: Society for Industrial and Applied Mathematics.

Figueiredo, Francisco (2001). "Evaluating Core Inflation Measures for Brazil". *Working Paper Series 14*, Banco Central do Brasil, March.

Gonçalves, Antônio C. P.; Schechtman, Jack and Barros, Rebecca (2000) "Núcleo de inflação". Conjuntura Econômica, March.

Laflèche, Thérèse (1997). "Statistical measures of trend rate of inflation". *Bank of Canada Review,* autumn.

Marques, Carlos R.; Neves, Pedro D. and Sarmento, Luís M. (2000). "Evaluating core inflation indicators". *Working Paper 3-00, Economics Research Department, Banco de Portugal*, April.

Moreira, Ajax R. B. and Carvalho, L. (2000). "Indicadores IPEA de tendência da inflação no Brasil". *Boletim Conjuntural do IPEA*, January.

Neter, J.; Kutner, M.H.; Nachtsheim C. J. and Wasserman, W. (1986). Applied Linear Statistical Models. Irwin, 4th ed.

Picchetti, Paulo and Toledo, Celso (2001). "How much to trim? A methodology for calculating core inflation, with an application for Brazil". *Revista de Economia Aplicada*.

Roger, Scott (1998). "Core inflation: concepts, uses and measurement". *Central Bank of New Zealand Working Paper 98/9*.

Wynne, Mark A. (1999). "Core inflation: a review of some conceptual issues". *European Central Bank Working Paper # 5*, may.

Bosede Nelson-Douglas

Estimation of speculative attack models and the implications for macroeconomic policy: Jamaica 1991-2000

INTRODUCTION

In recent years, a number of articles on exchange rate management have emphasized the importance of implementing sustainable exchange rate policies. The effectiveness of exchange rate policies require the harmonization of monetary and fiscal policies, and the maintenance of a high degree of credibility in the foreign exchange market. Since exchange rates are strongly influenced by expectations, the behaviour of monetary authorities, in particular, is of critical importance for exchange rate behaviour. If monetary policy objectives are inconsistent with fiscal policy for a prolonged period of time, an exchange rate crisis may ultimately materialize. This crisis is often characterized by continuous defi-

Paper prepared by Bosede Nelson-Douglas, economist, Research and Economic Programming Division from the Bank of Jamaica, and presented at the VI Meeting of the Network of America Central Bank Researchers, organized by the Banco Central del Uruguay, in Montevideo, Uruguay, October 17-18, 2001. 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 Research Services Department and the REPD Division at the Bank of Jamaica as well as three anonymous referees for their valuable and insightful comments.

cits on the current account of the balance of payments, leading to a gradual erosion of central bank's reserves, which is followed by a sharp speculative attack on the currency.[1]

In addition to acknowledging the importance of monetary and fiscal discipline in pursuing a sustainable exchange rate regime, the contribution of some random shocks to the domestic money market, most notably shocks from external credit and changes relative prices are also important. The unexpected availability of external credit supplies may avoid, at least temporarily, the depreciation of the currency and make the depletion of central bank reserves by a speculative attack more difficult to accomplish. Relative price shocks on the other hand randomizes the demand for nominal money balances and therefore may also have a strong direct influence on the probability of a currency depreciation.

Within the context of the Jamaican economy, recurrent depreciation of the currency has been one of the realities of the economy, particularly after the liberalization of the foreign exchange market in 1990. During the period 1991 to 1993, the economy experienced notable macroeconomic instability, characterized by sharp downward movements in the exchange rate, continuous deficits on the current account and unprecedented inflation rates. Consequently, the authorities had to tighten monetary policy in an effort to stabilize the exchange rate and moderate the movements in the inflation rate. For the period 1994 to 1999, relative stability in the Jamaican economy was restored, particularly to domestic prices and, to a lesser extent, the exchange rate. The relatively high real rates that prevailed during this period attracted strong private capital inflows, which contributed to the rapid accumulation of the NIR and led to relative stability in the foreign exchange market. However, to the extent that interest rates remained relatively high, the fiscal imbalance widened due in part, to higher interest costs on domestic debt. The increase in the overall public sector debt pointed to the need for fiscal adjustment, the postponement of which added further impetus for speculative pressures in the market. In response, the authorities intensified open market operations, which led to the attainment of relative economic stability, albeit at a cost to economic growth and the country's debt position.

The interest in the ability of the authorities to support the current managed exchange rate policy in light of recurring foreign

[1] The reserves of the central bank are eroded when official and private foreign borrowing to finance the current account deficit does not materialize.

exchange instability has been a source of motivation for this paper. The objective, therefore, is to generate a model aimed at predicting the timing and magnitude of a currency depreciation forced by speculative attacks on the exchange rate system, and to provide an 'early warning' of regime fragility. While this approach has been applied exclusively to fixed and pegged exchange rate regimes, with some modification the empirical model can be applied to managed exchange rate systems. In this context, the paper develops a monetary model of speculative attacks under a managed exchange rate regime, which is then used to assess the probability that the exchange rate will depreciate, by a speculative attack on the currency.[2] This should allow policymakers to anticipate the destabilizing impact of future currency depreciation and redirect policy targets towards the attainment of macroeconomic stability and growth.

The paper is divided into six sections. Section 1 presents a literature survey on speculative attack models. Section 2 gives an historical overview of Jamaica's exchange rate policies during the period 1991 to 2000. Section 3 develops a monetary model of the Jamaican economy as an extension of some of the models in the literature. Data analysis and estimation procedures are detailed in section 4. In section 5, the estimates of the model for the Jamaican sample are presented and section 6 summarizes the findings of the paper and draws together the major policy implications for Jamaica.

1. LITERATURE REVIEW

The literature on currency crises has not embraced a standard definition of a currency crisis. Most of the studies on exchange rate crises have focused exclusively on devaluation episodes as a definition of 'crises'. Frankel and Rose (1996) examined large and infrequent devaluation, while others such as Collins (1995) include in their sample, small and infrequent devaluation that are not full-blown currency crises. A few studies adopt a broader definition of crises, which includes, in addition to devaluation,

[2] Variants of speculative attack models have examined the collapse of the fixed exchange rate into a permanent float, the attack on the fixed exchange rate leading to a devalued post-attack fixed exchange rate, or the pre-attack regime may be a crawling peg rather than a pure fixed exchange rate, as in Connolly and Taylor (1984) and Goldberg (1994).

episodes of unsuccessful speculative attacks with sharp increases in domestic interest rates and /or sizable losses of international reserves. These definitions have been applied exclusively to fixed and pegged exchange rate systems. However for the purposes of a managed exchange rate system there is a conceptual issue of the definition of a currency attack. The term 'managed' is used here to describe systems where official intervention is practiced to smooth erratic fluctuations in the exchange rate that is not planned according to any pre-considered strategy or agreed in advance and whose parameters are unannounced to the market and sometimes not even known to the authorities. A useful definition of a currency attack was used by Kamisky's (1998): which can be summarized as follows:

> A situation in which an attack on the currency leads to a sharp depreciation of the exchange rate, a large decline in international reserves, or a combination of the two. The definition is also comprehensive enough to include not only currency attacks under a fixed exchange rate but also attacks under other exchange rate regimes.[3]

One strand of the literature on currency crises originated from the 'fundamentals approach', which has flourished following Krugman's (1979) seminal paper, which showed that under a fixed exchange rate regime, crises were caused by weak 'economic fundamentals'. Krugman emphasized that rapid domestic credit expansion in excess of money demand growth, leading to a persistent loss of reserves, would ultimately force the authorities to abandon the peg. His model suggested that the period preceding a crisis would be characterized by a gradual but persistent decline in international reserves and rapid domestic credit growth, which increases the money supply relative to the demand for money. In addition, Krugman's model highlights that excessive money creation may result from the need to finance the public sector, and in this regard, fiscal imbalances and credit to the public sector may serve as indicators of a looming crisis.

A number of papers have extended Krugman's basic model in various directions. For instance, using quarterly data from 1973 through 1982, Blanco and Garber (1986) adapted the model to a regime of recurring discontinuous devaluation to interpret the dynamics of the Mexican exchange rate system. They emphasized

[3] See Graciela Kaminsky et al. (1998), Leading Indicators of Currency Crises, page 15.

that the recurrence of currency devaluation in Mexico implied that the exchange rate regime pursued by the authorities was a secondary goal, conditional on fulfillment of other primary goals, such as the government's fiscal position. They also viewed excessive domestic credit growth as a catalyst for currency crises. Blanco and Garber estimated the value of the fixed minimum reserve level and the parameters governing the devaluation policy rule. To generate the probability of an attack, they minimized the deviations of the one-quarter ahead-expected exchange rates from observed forward exchange rates. It was found that the estimated probabilities of devaluation jumped to peaks of 20 percent just prior to the major devaluation in 1976 and 1982 and fell to low levels immediately after devaluation.

Cumby and van Wijnbergen (1989) also applied the speculative attack model to the Argentine crawling peg between 1979 to 1981. A similar principle for determining the timing of an attack under a fixed exchange rate regime was extended to the crawling peg system i.e. when the shadow exchange rate exceeds the official rate, speculators will attack the currency.[4] The post-attack regime may be a floating exchange rate or a crawling peg with an increased rate of depreciation. Cumby and van Wijnbergen found that the probability of a speculative attack was driven primarily by domestic credit creation and the probabilities reached its highest level of about 80 percent just prior to the attack that led to the abandonment of the Argentine policy in 1981.

Goldberg (1994) used Mexican data from 1980 through 1986 to study the influence of both fiscal and monetary shocks on speculative attacks on the peso, in both the fixed exchange rate and in the ensuing crawling peg regime. Goldberg added to the list of forces contributing to an attack by explicitly modeling real exchange rate movements and foreign credit disturbances. She found that the one step-ahead probability generally reached levels of 100 percent in the period before a crisis and that at such times, the realized shadow exchange rate significantly exceeded the official rate. She also found that domestic credit creation, not external credit disturbances, drove the timing of speculative attacks in the Mexican situation.

The general consensus in the literature based on the 'fundamentals approach' therefore indicates that speculative attacks on

[4] The shadow exchange rate is defined as the rate that clears the money market, and the exchange rate that prevails once an attack has taken place.

exchange rate systems are driven primarily by excessive domestic credit creation. This may be in response to the need to finance the public sector or the extension of credit by central banks to domestic financial institutions in difficulty, which may inevitably lead to the collapse of the exchange rate system. It was also recognized in some of the literature that the availability of external credit in supplementing the reserves of the central bank could make speculative attacks more difficult to accomplish and can, in practice avoid a regime collapse. Flood (1984) stressed however "*… that ultimately, if the underlying fiscal and monetary policy process are inconsistent with the exchange rate regime, there will be a need for a new exchange rate because there is a limit to borrowing reserves on the international market*".[5]

Over the past few years, attention has shifted towards studying the usefulness of several variables in signaling an impending crisis, generally known as the '*signals approach*' or '*Second Generation approach*'. This approach involves monitoring the evolution of a number of economic variables whose behaviour usually departs from 'normal' in the period preceding a currency crisis. The method compares the behavior of variables in periods preceding a crisis with the behavior of the same variables in periods of tranquility. Deviations of these variables from their normal levels beyond a certain threshold value are taken as 'warning signals' of a currency crisis within a specified period of time. Some of the indicators that provided good signals were the real effective exchange rate, a proxy for political violence, errors and omissions plus short-term capital in the balance of payments, stock prices, proxies for elections and receipt and variability of multilateral development bank loans.

Most research papers that utilize the '*signals approach*' have also acknowledged the importance of monetary and fiscal discipline, but view government fiscal policies as partial catalysts for speculative attack on a currency.

> Obstfeld (1994) summarizes the focal point of the literature appropriately by recognizing "*…that typically, exchange rate crisis situations arise when the central bank does not have sufficient instruments at hand to attain both its internal and external policy goals. Devaluation forced by speculative attacks thus allows for the reconciliation of these conflicting objectives*".[6]

[5] Flood (1984), Collapsing exchange rate regimes: some linear examples, page 3.

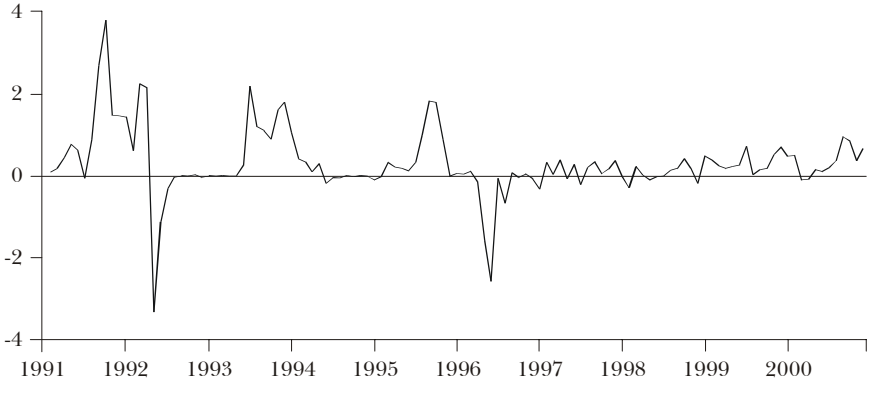
[6] Obstfeld (1986a), Rational and Self fulfilling balance of payments crises, page 74.

2. JAMAICA'S EXCHANGE RATE EXPERIENCE (1991 TO 2000)

The Jamaican economy has been transformed since the 1980s by a wide range of structural reforms aimed at increasing the role of market forces in resource allocation and creating a stable macroeconomic environment for the achievement of growth and development. The liberalization of the foreign exchange market in 1990 and the capital account in 1991 represented the continuation of such reforms. Following liberalization, the economy experienced severe macroeconomic instability, evidenced by substantial depreciation in the external value of the currency, unprecedented levels of inflation and a sharp decline in real interest rates. During the latter part of the 1990's, relative stability in the Jamaican economy was restored, particularly to domestic prices and to a lesser extent, the exchange rate. However, this stability was attained at a cost to economic growth and the country's debt position.

Chart 1 portrays movements in the exchange rate over the period1 1991 to 2000.

CHART 1. MONTHLY CHANGES IN THE EXCHANGE RATE JANUARY 1991-DECEMBER 2000 (J$ per US$)



With the operation of a managed floating exchange rate system in September 1991, the Jamaican dollar depreciated considerably from J$13.67 per US$ to J$20.91 per US$ (or 53% depreciation) by end-December 1991. This contributed significantly to inflation (point-to-point) reaching the record level of 80.2 percent for the year. Influenced by the expansion in banking system credit, the demand for liquid assets increased, signaled by a 95.3 percent growth in narrow money (M1), and a 54.6 percent increase in

broad money (M2). With further expectations of devaluation, the monetary authorities relied heavily on open market operations to constrain liquidity and reduce demand pressures. In addition, the fiscal authorities implemented measures aimed at constraining liquidity and limiting domestic borrowing, such as the reduction in expenditure on selected public entities and further price liberalization. By the end of 1991, the six-month treasury bill rate, a prime indicator of market interest rates, rose sharply to 35.1 percent, while the rate on Bank of Jamaica (BOJ) certificates of deposit increased to 40.1 per cent. Concurrently, the net international reserves fell by US$54.1 million between September and December 1991.

For the first half of 1992, the Jamaican dollar depreciated further before it stabilized at J$22.20 per US$ 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 of the authorities slowed the growth in money supply considerably. This contributed to a lower level of foreign exchange demand and accounted for a deceleration in the inflation rate. These factors, 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.

By mid 1993, the Jamaican dollar came under pressure again and depreciated to J$32.70 per US$ by the end of 1993. Reduced foreign exchange inflows to 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 fueled further expectations of devaluation. The determination by the authorities to maintain tight monetary policy was underlined by more aggressive open market operations. Consequently, interest rates, which had begun to decline since the latter half of 1992 (23.22 percent in December 1992), increased sharply during the second half of 1993 (39.36 in December in 1993). The rate of money growth slowed considerably, while inflation rates moderated to 30.1 percent from 40.2 percent in 1992.

By early 1994, relative stability in the exchange rate was achieved at approximately J$33.5 per US$, which helped to temper the rate of growth in domestic prices to 26.7 percent by the end of 1994. The stability in the foreign exchange market was attained by continued tight monetary policy, which invariably pushed interest rates to unprecedented levels. The high interest rate regime contracted the growth in domestic credit and con-

tributed to an expansion in the net foreign assets of the banking system, which in turn, contributed to the rapid growth in money supply (M3) from 30.2 percent in 1993 to 35.2 percent by the end of 1994. Over the period however, the growth in narrow money contracted from 40.0 percent in 1993 to 24.3 percent in 1994, induced mainly by portfolios shifts in response to the widening interest rate differential between savings deposits, time deposits, and government securities. 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.

By 1995, the contractionary monetary policy stance was relaxed slightly to facilitate increased investment. Treasury bill rates declined to 20.3 percent in April 1995, while M2 grew at a rate of 38.5 percent relative to the 36.6 percent in 1994. By July 1995, the ensuing growth in consumer credit arising from rapid wage increases and lower bank lending rates accelerated inflationary and foreign exchange pressures in the market. By mid-November 1995, the currency depreciated to J$40 per US$. In response, monetary policy was tightened sharply and domestic treasury bill rates rose from 23 percent in July 1995 to 36 percent in October 1995. Between August and November 1995, the BOJ sold over US$95.0 million of foreign exchange reserves to slow down the depreciation of the currency.

Following a substantial depreciation of the dollar in 1995, a loss of international reserves and high inflation rates, the authorities focused more sharply on achieving a reduction in inflation. During the period 1996 to 2000, monetary policy was tightened substantially, resulting in a marked reduction in the inflation rate. However, over the same period, the public sector balance shifted from a surplus to a deficit, 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 and more recently demand pressures in the foreign exchange market have resulted in more extensive open market operations by the monetary authorities.

3. THE MONETARY MODEL & PROBABILITY OF DEPRECIATION

This section of the paper applies the monetary model of exchange rate determination used by Goldberg (1994) and Flood et

al. (1992) to Jamaica's managed exchange rate system for the period 1991 to 1999. The monetary model relies on the money market equilibrium condition, which determines the equilibrium exchange rate under a freely flexible exchange rate system. The model is specified in logarithms in equation (1) – (9) below:

$$Md_t - Q_t = a_0 - a_1 i_t + a_2 y_t - a_3 \{E_t S_{t+1} - S_t\} \quad (1)$$

$$Q_t = \alpha P_t + \{1 - \alpha\}\{S_t + P_t^*\} \quad (2)$$

$$P_t = S_t + P_t^* + \Omega_t \quad (3)$$

$$\Omega_t = \rho \Omega_{t-1} + \delta_t \quad (4)$$

$$i_t = i_t^* + \{E_t S_{t+1} - S_t\} \quad (5)$$

$$MS_t = R_t + D_t \quad (6)$$

$$D_t = D_{t-1} + \mu_t + \ell_t \quad (7)$$

$$\ell_t = \gamma_t + \phi_t \quad (8)$$

$$Ms_t = Md_t \quad (9)$$

Where,

Md_t = money supply (M2),

Q_t = aggregate price index,

i_t = nominal monthly treasury bill rate (derived from six-months t-bills)

i_t^* = nominal monthly treasury bill rate for the United States

y_t = monthly real interpolated GDP

S_t = weighted average exchange rate vis-à-vis the US$

P_t = domestic goods prices

P_t^* = foreign goods prices

Ω_t = the deviation from PPP which follows an AR(1) process

R_t = the level of foreign reserves (valued in domestic currency)

D_t = the level of domestic credit to the public and private sectors.

ℓ_t = domestic credit shock

γ_t = shocks that are induced domestically by the monetary authorities

ϕ_t = external credit shocks

Equation (1) shows that the demand for real money balances in Jamaica is a function of domestic interest rate, the level of income and a currency substitution motive. The aggregate price index in equation (2) is defined as the weighted sum of domestic goods prices (P_t) and traded goods prices ($S_t + P_t^*$). The weight α corresponds to the share of domestic goods in the aggregate price index. The model assumes that purchasing power parity as well as interest parity holds. Thus, purchasing power parity (PPP) is determined according to equation (3), where domestic and foreign good prices differ due to medium-term systematic deviations (Ω_t) from PPP, and follows a first-order autoregressive process in equation (4). Equation (5) is the interest parity condition, where i_t^* is the exogenously given world market interest rate and equation (6) defines the supply of money as the sum of the stock of central bank reserves R_t, and the stock of domestic credit D_t.

Following Goldberg's (1994) specification, domestic credit is modeled in equation (7) as evolving according to a trend rate μ_t, and a stochastic random disturbance component ℓ_t with the former mirroring trend fiscal deficits or expected monetary financing of government deficits. The random disturbance ℓ_t is then decomposed into two components. The first component γ_t relates to the need to monetize government deficits due to unanticipated expenditures for which no revenues are currently available, and ϕ_t shocks stem from the uncertain availability of external credit flows to cover domestic deficits. According to Goldberg (1994), unanticipated domestic credit creation could arise when the government had expected to finance domestic deficits by borrowing on the international market. If external credit does not materialize, a greater share of basic government deficit will be monetized.

The money market equilibrium condition is specified In equation (9), which will be used to determine the path of a freely floating exchange rate, which is compared to rates that exist under a managed system. The difference between the actual managed

rate and the market-clearing rate derived from the fundamental approach is considered as the misalignment gap, which may be temporary or permanent in nature. If there is a persistent gap between actual and generated exchange rates, then it suggests that the 'managed ' official exchange rate is severely misaligned relative to the market's perception of what it should be. This situation can arise, for example when there are changes in fundamentals that trigger a change in the equilibrium exchange rate, but that are not reflected in changes in the actual rate.[7] In such a situation where the rates diverge persistently, a speculative attack is likely to occur as rational agents may doubt the ability of the central bank to continue to support the managed rate. Economic agents will exploit the opportunity and drive the central bank's reserves to a critical level in an effort to force the realignment of the currency.

The timing of such an attack depends on the policies agents expect the central bank to adopt in response to a run on its reserves. Most of the papers on exchange rate crises have assumed that the central bank will simply withdraw from the market when reserves are driven to a critical level. Melick (1996) assumed that the authorities would sterilize the loss of reserves at the time of the collapse, leading to a discrete jump in the money supply. For simplicity, this paper assumes that the central bank will withdraw from defending the currency once the attack has driven foreign reserves to a critical level. This is followed by a depreciation of the exchange rate.

The post-attack permanently floating exchange rate that prevails once an attack has taken place is known as the 'shadow floating exchange rate' S^*_t, which is defined as the rate that clears the money market. The shadow floating rate which reflects market fundamentals is the exchange rate that would prevail in period t, if reserves R_t are driven to their critical level R_c and the exchange rate was allowed to float freely. Alternatively, the shadow rate can be interpreted as the minimum bound for the rate that would prevail if speculators attacked central bank reserves and depleted reserves to a critical level.

Using the money market clearing condition, the shadow exchange rate in period t is determined by substituting equation (2) – (8) into (1) and solving for the shadow rate, S^*_t:

[7] From a theoretical approach, the concept of misalignment requires assuming that there exist institutional or other type of rigidities the prevent the actual rate from adjusting rapidly towards its medium to long run equilibrium level.

$$S_t^* = \frac{1}{(1 + a_1 + a_3)} \sum_{j=0}^{\infty} \left[\frac{a_1 + a_3}{1 + a_1 + a_3} \right]^j E_t H_{t+j} \qquad (10)$$

$$H_{t+1} = D_t - P^*_{t+1} + \mu_{t+1} + \gamma_{t+1} - \phi_{t+1} - \alpha\rho\Omega_t - \alpha\delta_{t+1} - a_0 - a\, i^*_{t+1} - a_2 y_{t+1} + R_c$$

Equation (10) has two important characteristics. First, the current exchange rate depends on the future path of the $H_{t+1,}$ variables, which are known as the 'fundamentals' plus shocks from external credit supplies and relative prices. Second, while all expected future variables included in $H_{t+1,}$ influences the equilibrium exchange rate, the quantitative importance of each period's influence varies directly with how close it is to the present. That is, the influence of say, period t+j's expected relative outcome on the fundamentals is discounted by the factor $\frac{(a_1 + a_3)^j}{(1 + a_1 + a_3)^{j+1}}$ which since $a_1 > 0$ approaches zero as j approaches infinity.[8]

While the work of Blanco and Garber (1986), focused on assessing the probability of devaluation in the context of a pegged exchanged rate system, applying models of collapse probabilities to managed regimes require minor modification to their construct. In a pegged exchange rate system, the central bank's optimization strategy after an attack has occurred involves setting a rate that is equal to or greater than S^*_t such that

$$\overset{t}{S}_t = S_t^* + \nu_t$$

and ν_t has a normal density function $g(\nu_t)$,[9] and $\overset{t}{S}_t$ is the new post-attack depreciated pegged exchange rate. Hence in a pegged system, the central bank will select a new rate equal to the minimum viable rate plus a random quantity depending on the magnitude of the disturbance that forced the attack.

In the case of managed exchange rate systems, particularly the system in operation in Jamaica, the aim of the central bank is to achieve "relative stability" in the foreign exchange market. Whilst this strategy does not suggest an explicit intervention rule, it

[8] Where a_1 is the coefficient on domestic interest rates, that captures the sensitivity of interest rates to money demand holdings.

[9] With zero mean and standard deviation σ .

seems clear that the central bank is averse to large swings in the exchange rate in the face of significant changes in foreign exchange flows. Prior to a speculative attack the Bank's plausible optimization strategy may involve setting a rate in the market $\overset{\iota}{S}_t$ such that:

$$\overset{\iota}{S}_t = S_{t-1} + v_t \tag{11}$$

where S_{t-1} is the rate realized in the market in the previous period, with or without the explicit intervention of the central bank, and $V_t \geq 0$. Adjusting the magnitude of V_t can incorporate different degrees of tolerance for exchange rate slippages**.** As such if an attack on the currency is initiated, the central bank will intervene in the market to prevent its rapid slide. When the requirement to reduce large fluctuations in the currency drives reserves to their critical level, the central bank will withdraw from the foreign exchange market. The rate that would prevail in a post-attack period will then become the shadow exchange rate S_t^* and the subsequent intervention rule will then seek to "stabilise" the movements in this new exchange rate level.

Using this framework, the probability that a speculative attack on the Jamaican dollar will occur at the beginning of period $t+1$ is the probability that the shadow rate will exceed the managed exchange rate. Therefore, the probability of depreciation at time $t+1$ based on information available at time t is defined as β_t, where:

$$\beta_t = \Pr\left[S_{t+1}^* - \overset{\iota}{S}_{t+1} > 0 \mid \varepsilon_t \right] \tag{12}$$

$\overset{\iota}{S}_{t+1}$ is the managed exchange rate in period t+1 and ε_t is all the the information available in period t. Based on equation (12), the solution procedure entails minimizing the deviation of the shadow exchange rate from the observed managed exchange rate, and computing the probability density function over the range of the deviation. The probability of depreciation is expected to peak prior to or at the period when a depreciation occurs and fall to low levels immediately after the currency depreciation. Estimating the probability using this approach attempts to capture the systematic relationship between the realized depreciation, economic fundamentals and the contribution of important shocks, and to evaluate whether speculative pressures on the exchange rate can be accounted for by these factors.

4. DATA ANALYSIS AND ESTIMATION PROCEDURE

The implementation of a speculative attack model requires as a fundamental prerequisite, the absence of exchange rate controls. In this context, monthly analysis of the exchange rate regime spans the period October 1991 – December 1999. Out-of-sample forecasts are generated for the period January to December 2000.

A description of the data set used in the paper is provided in Table 1a in the appendix. The identification of the appropriate time series that closely represents the theoretical constructs of the model was not entirely straightforward, particularly so for real GDP data (y_t). In the context where real GDP data is not available on a monthly or quarterly basis, a quarterly series was interpolated using the weighted quarterly variation in major exports of goods and services[10] and major imports. The imputed GDP series was seasonally adjusted and smoothed using a four-period moving average representation to generate the quarterly series, and subsequently a three-period moving average to derive the monthly GDP data series.

With regard to the procedure used to estimate the model, the focal point was to derive the probability of a speculative attack on Jamaica's managed exchange rate system. To make this approach operational, a working definition of speculative attack was required.

> A speculative attack is defined as periods in which the level of reserves falls by more than 10 percent relative to the previous month and/or the domestic interest rate rises by more than 5 percent, which precipitates or responds to a currency depreciation of over 1 per cent during any given month.[11]

This definition is based on the notion that the monetary authorities can successfully prevent an attack on the currency, up to a point, by drawing down on their reserves, or by simply raising interest rates. It is also important that the fall in the level of reserves or the increase in the interest rate be significantly large to rule out routine changes.

[10] These include the major traditional exports and tourism arrivals.

[11] Sensitivity analysis was employed for reserve changes that were higher and lower than the 10% specified. For values higher than 10%, there were some reductions in the number of crisis periods, but very little change in the overall results. A 10% fall in the value of reserves is deemed to be significantly high over a given month.

The next step was to derive the probabilities of a speculative attack on the currency. In order to estimate the probability of a speculative attack, the shadow exchange rate in period *t+1* was computed. These required estimates of the money demand function (egn. 1), the stochastic process governing domestic credit creation (egn. 7 & 8), deviations from PPP (egn. 3 & 4) and an assumption about the critical reserve floor. Also, forecasts were required to update the expectations of the non-stochastic variables in $H_{t+1,}$ (the fundamentals) that is, foreign interest rate (i^*_{t+1}), US wholesale prices (P^*_{t+1}), GDP (y_{t+1}) and the calculated weights in the aggregate price index (α_{t+1}).

The series on domestic credit was regressed on domestic credit lagged once and a trend component $\mu_{t.}$ The trend component was calculated by using a four-period moving average of the seasonally adjusted domestic credit. The residual $\ell_{t.}$ was collected, which defined the domestic credit shock and then decomposed into its source components γ_t, which captures the domestic induced shock and ϕ_t which relates to external shocks. The method of decomposition to obtain external credit shocks was to regress external supply credit F(t) on the residual from the domestic credit equation.[12] The residual from this regression gives an estimate of the component of domestic credit shocks linked in any way to the supply of net external credit to Jamaica, consistent with Goldberg (1994). The shocks that are domestically induced by the monetary authority γ_t, were derived by subtracting ℓ_t from ϕ_t.

To generate forecast for the shocks to domestic credit, γ_{t+1} and ϕ_{t+1}, an ARIMA process was fitted over 18 months rolling sample, beginning at period t and going back 17 additional months.[13] The standard deviation was computed and fitted over the sample range 1991:10 to 2000:12. Forecast of expected systematic departures from PPP were also generated using the same procedure above. The relative PPP shock $\Omega_{t.}$ was then decomposed into its medium term systematic departures from PPP, Ω_{t-1} and its random shocks $\delta_{t,}$ by the following regression, $\Omega_t = \rho\Omega_{t-1} + \delta_t$

For the specification of the critical reserve floor, we note that Blanco and Garber (1986) modeled the reserve floor as a constant multiplied by an index of US import prices. Melick (1996) and

[12] F(t) is net foreign assets of monetary authorities and deposit banks. F(t) was used in levels and difference twice because negative values were recorded for earlier periods. F(t) was then regress on domestic credit residuals such that, $\phi t = -F(t)$. This approach induces data biases as recognized by Goldberg (1994).

[13] The data set for domestic credit goes back to March 1990.

Grilli (1990) adopted the simplifying assumption that the authorities will defend the regime until reserves are completely exhausted. Goldberg (1994) used an ad hoc approach and estimated the complete model for a range of reserve floors. The specification of the critical reserve level used in this paper is consistent with Goldberg's approach, with the exception that a constant reserve floor was not maintained for the entire sample. The model was estimated using a range of reserve floors beginning at US$400.00mn, (the mean of the NIR from 1993 to 1998),[14] and gradually adjusting downwards according to the following rule: Over the period 1991 to 1993, when the NIR was negative, the critical reserve floor was taken to be US$0.50mn; for the period 1994 to 1995, when reserves were positive and below US$200mn, the reserve floor was specified as US$10.0mn, for the period 1996 to 1998, the reserve floor used was US$50mn and US$80mn for 1999 to 2000.[15] To obtain a well-defined series, the specified reserve floor was smoothed using the Hodrick-Prescott filter. This approach is justifiable given the sensitivity of the model to reserve floor changes, and the fact that it allows for an adequate representation of growth in the NIR and the concurrent changes, we believe, in the authorities view of R_c .

For the other variables for which forecasts were required, the autocorrelation and partial correlation functions were examined to determine the structure of the ARIMA process. A unique ARIMA process was then selected based on the Akaike Information Criteria, and fitted to the variables to be forecasted over the entire sample period, inclusive of period t.[16] (see Table 2a in appendix for Akaike results) Forecast for period t+12 was then estimated over rolling sub-samples of 18 months of data.[17] The forecasted values for period t+12 were collected and tested for model adequacy[18] and where appropriate, the standard deviation of the forecast residuals were calculated.

[14] The NIR was negative for the period 1991 to November 1993.

[15] The reserve level was converted to domestic currency using the end of period average weighted exchange rate.

[16] Table 3a in the appendix shows the results of the ARIMA processes, including the r-squared, D-W and AKAIKE results for the variables for which forecast is required.

[17] The sample was broken up in 18 equal periods and forecast were generated using an 18-month rolling samples with an interval of 6 months.

[18] Tests were carried out for stationarity, serial correlation and heteroskedasticity.

Finally, the estimation procedure applied to the set of structural equations takes the form of an iterative process that estimates the money demand function in equation (15):

$$Md_t - Q_t = a_0 - a_1 i_t + a_2 y_t - a_3 \{S_{t+1} - S_t\} \quad (15)$$

The parameters from this money demand model were used to generate start up values to compute the shadow exchange rate in equation (11) and to provide first pass estimates of probabilities of depreciation in equations (12) and (13). The probabilities obtained from these estimates were then used in the estimation of equation (16) below, where the currency substitution term is now weighted by the probability of depreciation.

$$Md_t - Q_t = a_0 - a_1 i_t + a_2 y_t - a_3 \left\{ 1 - \beta_t \{S_{t+1} - S_t\} + \beta_t \left\{ S^*_{t+1} - S_t \right\} \right\} \quad (16)$$

5. ESTIMATION RESULTS

This section of the paper detail the results generated from applying the monetary model to derive the shadow exchange rate and the probability of a speculative attack on the managed exchange rate. In the analysis that follows, the predicted probability is used in determining the consistency of the model by seeing how well it compares with known events during the sample period. A similar procedure is adopted for the out-of-sample forecasts. In this instance, the last year (January - December 2000) is used in determining the probability of the occurrence of speculative attack on the Jamaican dollar.

5.1 Test for Stationarity

The first step in estimating the components of the monetary model was to examine the stylized properties of the macroeconomic data series used in the model specified in section 3 above. Table 3a in the appendix shows the results of the unit root test and displays the 1.0% to 10.0% McKinnon critical values and the order of difference stationary processes. The variables, domestic interest rate, real money supply, income (GDP), currency substitution/expected depreciation, domestic prices were integrated of order (1). The other variables, such as the domestic credit and inflation were integrated of order (0). As shown, all the variables in the money demand equation are *I (*1) and hence potentially cointegrated.

5.2 Money demand

The paper utilizes the multivariate Johansen test (1991) to test for the existence of a stable long-run money demand and cointegrating relationship. The null hypothesis under the Johansen test is no cointegration against the alternative of cointegration. As shown in table 4a in the appendix, there exists one cointegrating vector for the set of variables, real money supply, domestic interest rates, expected depreciation and income. The results from the first pass estimates show that in the long run, the decision to hold broad money appear to be driven by movements in domestic interest rate, the level of income and the expected depreciation of the currency. The currency substitution variable/expected depreciation reflects the notion that devaluation expectations result in a substitution out of broad money holdings to foreign currency. As such, instruments such as foreign assets and treasury bills are used to hedge against the impact of high inflation and expected devaluation on money holdings. Since, to a large extent treasury bills are outside of the deposit money banks, this may imply that the non-bank public may have expected that nominal interest rates on deposits have not been adjusting quickly enough to compensate for higher inflation and devaluation expectations.

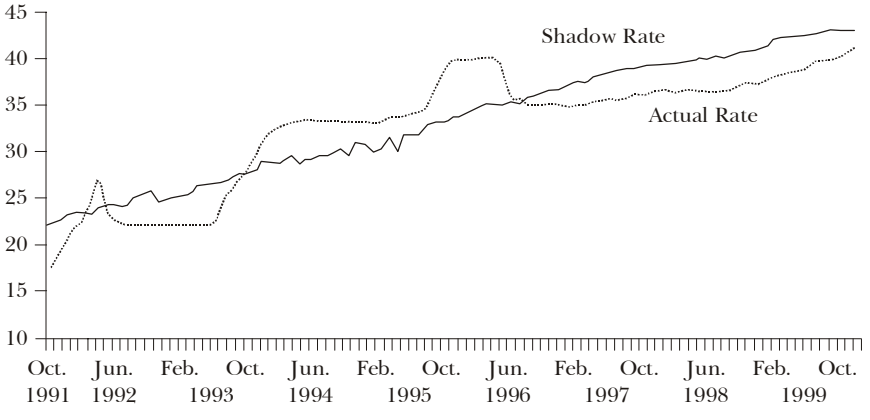
Table 5a shows the second-pass estimates of the long run money demand function with the currency substitution variable now weighted by the probability of depreciation. All things considered, the money demand function with the inclusion of monthly seasonal dummies showed evidence of parameter stability.

5.3 Shadow Exchange Rates & Collapse Probabilities – In-Sample Results

The shadow exchange rate is defined as the rate that would prevail if speculators attacked the central bank reserves and forced the depreciation of the currency. Thus the computed shadow rate is consistent with the contemporaneous state of monetary and fiscal conditions in the economy. The difference at any moment in time, between the shadow/equilibrium rate and the managed exchange rate indicates the degree of misalignment. If the shadow rate is greater than the actual rate, the theory indicates that the currency is overvalued, conversely if the shadow rate is less than the actual rate, the currency is undervalued. For the entire sample period, it would appear that the Jamaican dollar was overvalued during the periods October 1991 – February

1992; May 1992 – September 1993 and August 1996 – December 1999. Chart 2 gives a comparative view of the computed shadow exchange rates and the observed managed exchange rates.

CHART 2. SHADOW EXCHANGE RATE VS. ACTUAL EXCHANGE RATE, 1991-1999 (J$ per US$)

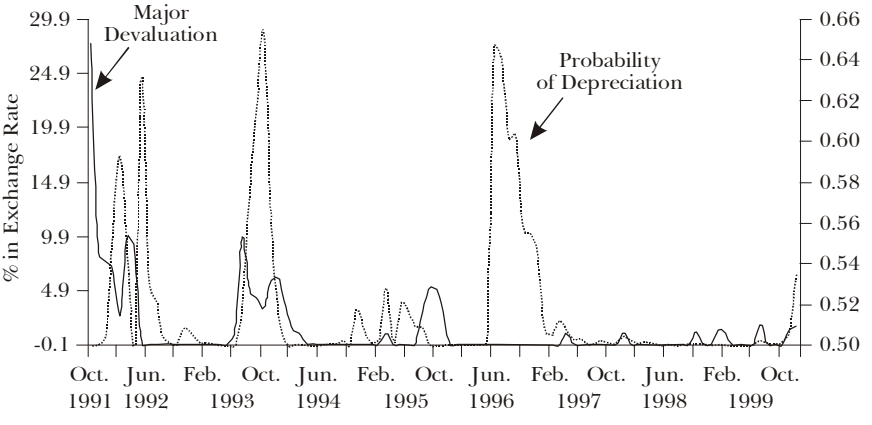


The misalignment gap and the overvaluation of the currency reveals the extent to which the market has persistently factored in an expected depreciation which may be driven by factors that are not related to economic fundamentals.

Chart 3 gives a graphical representation of the probabilities of depreciation measured against major depreciation episodes for the in-sample period while Table 1 gives the selected probabilities of depreciation for Jamaica measured against the percentage change in the currency, the treasury bills and the net international reserves of the Bank. A major depreciation episode is identified as one that is symptomatic of a depreciation of over 1 percent during a given month. The probabilities of depreciation are indicative of the profitable arbitrage that could be gained by speculative activities in the foreign exchange market. These probabilities are expected to peak prior to or during an episode of currency attack. For the purposes of this paper, a probability value greater than 0.5, which represents the mean of the data is used to determine the occurrence of a speculative attack. Obviously, the higher the probability value, the more severe the incidence of an attack on the currency. However, it is quite interesting to note that the probability of depreciation may be high during a particular period but the severity of the actual depreciation itself may be compressed by the central bank's intervention in the market.

It is worthy of note that other articles have used probability values that are close to 1.0 to determine the occurrence of a crisis, while some have estimated probability values of 0.5 and less. For instance Blanco and Garber (1986) in applying the speculative attack model to Mexico found that the estimated probabilities jumped to peaks of 20 percent just prior to a major devaluation, while Goldberg (1994) found that collapse probabilities reached a 100 percent prior to the exchange rate crises.

CHART 3. PROBABILITY OF DEPRECIATION VS. MAJOR DEPRECIATION EPISODES, 1991-1999



Overall, the collapse probabilities were able to accurately predict the major attack episodes particularly in the immediate post-liberalization period, and the depreciation of the currency during July 93 to January 94 and September and October 95. In the periods identified, the exchange rate depreciated by over 3.0 percent in any given month. During the months following the liberalization of the currency in September 1991, the exchange rate depreciated by over 27 percent in October 91 (see table 1), this depreciation continued with the second largest fall in the value of the currency noted in March 92. Although the probabilities were at 0.5 percent for October 91, the probabilities began to rise in November 91 and remained high during the period, attaining a value of 0.59 percent, a month prior to the sharp depreciation in March 92. During these months, Jamaica experienced significant depreciation, which manifested itself in an unprecedented rise in the inflation rate, and without the cushion of reserves to halt the slide of the currency, the monetary authorities were forced to increase interest rates sharply.

TABLE 1. SELECTED COLLAPSE PROBABILITIES MEASURED AGAINST THE PERCENTAGE CHANGE IN THE CURRENCY, THE SIX-MONTHS TREASURY BILL AND THE NET INTERNATIONAL RESERVES OF THE BANK OF JAMAICA

			Percentage Changes	
	Prob. Of depreciation	*NIR*	*Exchange Rate*	*Treasury-Bills (6-Mths)*
Oct-91	0.500003		-27.67	
Nov-91	0.500266		-8.45	13.27
Dec-91	0.503673		-7.67	13.13
Jan-92	0.553423		-7.04	13.03
Feb-92	0.594629		-2.77	3.43
Mar-92	0.547289		-10.00	8.15
Apr-92	0.501664		-8.69	-7.78
Jun-93	0.500014		-1.19	-0.41
Jul-93	0.520296		-9.78	7.32
Aug-93	0.574052		-4.87	43.33
Sep-93	0.618092		-4.28	14.24
Oct-93	0.653136		-3.33	-3.77
Nov-93	0.558633		-5.81	6.81
Dec-93	0.513789	139.94	-6.12	-0.35
Jan-94	0.500265	-32.13	-3.37	1.50
Feb-94	0.500053	48.17	-1.30	3.80
Mar-94	0.500340	345.55	-1.03	-3.64
Aug-95	0.509170	-6.61	-2.92	-1.03
Sep-95	0.500062	13.82	-5.19	16.14
Oct-95	0.500000	-11.03	-4.85	22.17
Nov-95	0.500000	-10.37	-2.31	1.17
Apr-97	0.507386	-1.75	-1.11	-9.45
Dec-97	0.504650	-4.03	-1.02	1.23
Oct-98	0.500314	-2.28	-1.14	4.62
Jan-99	0.500227	-0.54	-1.29	-4.60
Feb-99	0.500076	-0.05	-1.04	-3.10
Jul-99	0.501988	-17.91	-1.85	-0.60
Nov-99	0.506941	2.99	-1.30	5.14
Dec-99	0.535873	-11.20	-1.73	1.47

NOTE: Criteria: 10% fall in Reserves, 5% rise in interest rates and a 1% depreciation of the currency. NIR was negative prior to 1993.

For the second period, July 93 to January 1994, the currency depreciated by 9.78 percent in July with the rate of depreciation gradually falling to 6.1 percent in December and 3.4 percent in January 1994. From table 1, the probabilities started to rise in June of 1993 and gave a strong indication of the imminent sharp depreciation of the currency in July and subsequently after. It is interesting to note however that the probabilities were relative low when compared to the sharp depreciation that occurred in July. Also in October, when the rate of depreciation was at its

lowest, the probability of an attack reached its peak of 0.65 percent. This explanation may lie in the fact that the money supply (M2) growth of 4.0 percent in October 1993 was in excess of the monthly growth rates recorded in 1993, implying an increased probability of depreciation. From the table, it was obvious that the monetary authorities had to increase interest rates subsequently to reduce demand pressures in the market.

During the months of September and October 1995, the exchange rate depreciated by 5.2 percent and 4.9 percent respectively. The probabilities peaked prior to this depreciation episode, remained high and then declined precipitously to its base value of 0.5 percent. One can observe from table 1 that the monetary authorities were forced to intervene in the market, with reserves falling by 11 percent on average and interest rates rising by 16 percent and 22 percent in the respective months. This policy response helped to reduce demand pressures in the foreign exchange market.

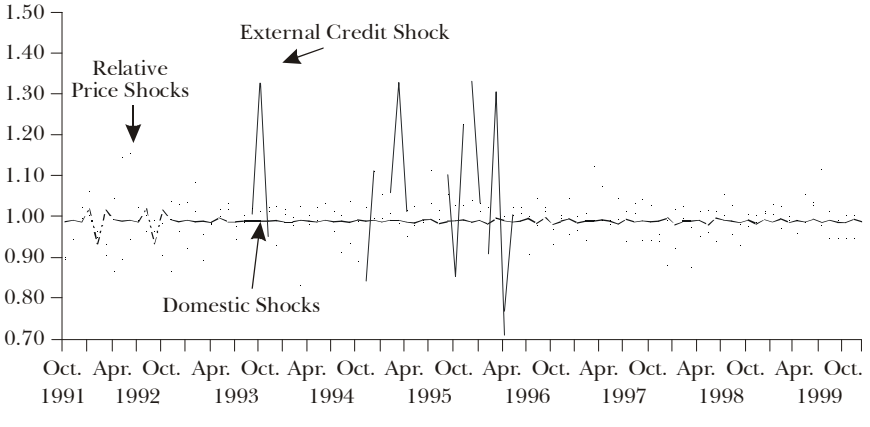
From May to December 1996, the model generated high probabilities of an attack, when the exchange rate had achieved relative stability. The high probabilities can in fact be interpreted as a reflection of the inconsistency between fiscal and exchange rate policies. The collapse probabilities signaled the opportunity for profitable arbitrage during these periods, due to the expansionary credit growth relative to the movements in the exchange rate. Connolly (1986) highlighted that to avoid a speculative attack, the exchange rate needed to be devalued by an amount no less than the rate of growth of domestic credit, and an attack is risked when domestic credit growth exceeds the rate of currency depreciation. Within this period, the monthly average rate of domestic credit growth was 5.1 percent higher than the rate of currency depreciation. However, the market rate was affected by substantial sales of foreign exchange to the market, which resulted in a substantial loss of approximately US$168.0 million in international reserves. Concurrently, the authorities also had access to significant external credit to cushion the fall in the reserve level. Therefore the availability of external credit in the context of intervention sales to the market allowed the Central Bank to compress the size/extent of speculative demand pressures in the foreign exchange market.

For the period January to December 1999, the probabilities hovered around their mean value of 0.5 percent. However, the probabilities began to rise in October 1999 and attained a value of 0.54 percent in December 1999. The shadow exchange rate,

which reflects underlying economic conditions, suggested that the currency was overvalued, yet the probabilities did not adequately track the build-up in demand pressures experienced in 1999. Although pressures in the market emanated from the difficulties the country experienced in raising external credit on a timely basis to cover its fiscal operations and the role of such news on the market, the market rate was again affected by substantial sales of foreign exchange by the central bank. Given the high level of net international reserves during the period and the subsequent receipt of external credit during the latter part of 1999, the central bank was able to compress the rate of currency depreciation, substantially.

Chart 4 examines the role of external credit shocks, relative prices and domestic credit shocks in influencing the probabilities of an attack on the currency. The uncertainty surrounding the ability of the government to obtain external credit was more pronounced in earlier periods relative to the period 1997 and 1998, while in July 1999, the variability surrounding external credit shocks increased marginally. It is likely that the impact of governments unsuccessful bond offer during the period of June to July 1999 could have influenced this outcome. However, this paper finds that the variability of these shocks do not significantly alter the direction of the collapse probabilities.

CHART 4. EXPECTED VOLATILITY OF DOMESTIC CREDIT CREATION, EXTERNAL CREDIT AVAILABILITY, AND RELATIVE PRICES, 1991-1999



5.4 Collapse Probabilities – Out-of-Sample Results

For the out-of-sample period January to December 2000, the probabilities indicated that there would have been an attack on

the currency, with the probability values attaining an average of 0.65 percent between January and August 2000 and falling to an average value of 0.55 percent subsequently after. As shown in table 2, with the exception of April to July 2000 were the currency was overvalued, it is evident that the exchange rate was undervalued at most points during the out-of-sample period.

TABLE 2. ACTUAL EXCHANGE RATE VS SHADOW EXCHANGE RATE, OUT-OF-SAMPLE RESULTS, JANUARY – DECEMBER 2000

Months	*Actual rate*	*Shadow rate*	*Deviation*
Jan	41.75	41.6778	-0.0722
Feb	42.25	41.8557	-0.3943
Mar	42.15	41.9319	-0.2181
Apr	42.07	42.2906	0.2206
May	42.22	42.4064	0.1864
Jun	42.33	42.4389	0.1089
Jul	42.53	42.5709	0.0409
Aug	42.89	42.6841	-0.2059
Sep	43.85	42.6812	-1.1688
Oct	44.71	43.0897	-1.6203
Nov	45.08	43.2119	-1.8681
Dec	45.75	43.3110	-2.4390

These results are rather interesting and somewhat puzzling. In a context of significant access to foreign inflows in 2000,[19] which helped to boost the NIR to record levels during the period, expectations for depreciation were not dampened as evidenced by the high probabilities. In fact the probabilities peaked prior to the overvaluation of the currency in April to July and remained high in August, when significant demand pressures on the exchange rate ensued stemming from the relative attractiveness of a Eurobond offer that was floated on the international market. The central bank was forced to intervene heavily to reduce the pressures on the exchange rate. To the extent however, that the country benefited from significant external credit, the level of intervention in the market by the central bank was not reflected in the change in the NIR.

In addition to foreign exchange intervention, the Bank drastically increased its 270-day and 365-day instruments to constrain liquidity in the money market in the latter part of 2000. In the context where the changes in the NIR was not adequately cap-

[19] Foreign exchange flows from the receipt of cellular license, proceeds of Eurobond flows and IADB/World Bank flows.

tured by the model and the six-month interest rate instrument used in the model did not represent the fundamental change in the interest rate structure during the period, the model did not appear to have performed well. For the latter reason only, the equilibrium exchange rate did not reflect the changes in the fundamentals that trigger the changes in the actual rate. However, the high probabilities in fact signaled the underlying changes in the fundamentals and gave strong evidence of speculative pressures on the currency. Towards the end of 2000, the high interest rate regime enabled the restoration of some level of confidence in the foreign exchange market and invariably compressed the probability of further depreciation of the currency.

TABLE 3. SELECTED COLLAPSE PROBABILITIES MEASURED AGAINST THE PERCENTAGE CHANGE IN THE CURRENCY, THE TREASURY BILLS AND THE NET INTERNATIONAL RESERVES OF THE BANK OF JAMAICA

			Percentage Changes	
	Prob. Of Depreciation	*NIR*	*Exchange Rate*	*Treasury Bill*
Jan-00	0.654649	0.92	-1.16	-0.27
Feb-00	0.643974	30.62	-1.20	0.43
Mar-00	0.651571	19.12	0.24	-11.92
Apr-00	0.651492	6.06	0.19	-1.94
May-00	0.652498	4.26	-0.36	0.31
Jun-00	0.654162	-2.70	-0.26	-0.93
Jul-00	0.654909	4.26	-0.47	-0.68
Aug-00	0.651945	18.52	-0.85	-1.57
Sep-00	0.579843	0.06	-2.24	0.51
Oct-00	0.542744	-9.77	-1.96	0.00
Nov-00	0.527778	-9.87	-0.83	0.82
Dec-00	0.508128	27.86	-1.49	15.15

6. POLICY IMPLICATIONS & CONCLUSION

So far, the attempt by this paper to predict the depreciation of the exchange rate has been relatively successful. The in-sample results based on probability estimates predicted the depreciation of the currency following the liberalization period, and prior to and during other major depreciation episodes. The paper finds that the most important influence on the probabilities was the pattern of domestic credit creation and monetary financing of government's deficit. The paper highlights that in order to achieve stability in the foreign exchange market, in the presence of normal demand for credit by the private sector, governments

borrowing needs should be covered by non-bank financing methods, foreign borrowing and grants.

This kind of research is useful in the following respects: Firstly, the computed shadow exchange rate based on economic fundamentals and the probabilities are capable of generating an early warning system of regime fragility. If the model predicts a high probability of depreciation, then the monetary authorities can be proactive in their policy approach in reducing future demand pressures. The policy options at their disposal may either lead to higher intervention sales to the market, contractionary monetary and fiscal policy, or a combination of both.

One of the limitations of using this model to calculate the probabilities is that to derive the forecast of these probabilities, a forward exchange rate market must exist. To the extent that Jamaica does not have a forward market, this may pose some difficulties. However, an alternative option may be to utilize the financial program generated by the Bank, which assumes relative fixity in the exchange rate over the forecast horizon.

Overall, the paper finds that the credibility and sustainability of the managed exchange rate system can be achieved by influencing the pattern of credit creation in financing governments operation. The fiscal imbalance must be addressed if monetary policy is to be effective in curtailing demand pressures over the medium term. The point must therefore be emphasized that exchange rate stability can only be achieved by stabilizing exchange rate expectations, and the policy instruments to be used are fundamental fiscal adjustments. As such, fiscal adjustments in conjunction with the stance of monetary policy, can restore credibility in the market, maintain low inflation, provide an avenue for declining interest rates, increased investment and ultimately growth.

Interesting areas for further research work could examine the 'signals approach' to speculative attack in the foreign exchange market by examining the evolution of macroeconomic variables that may have influenced speculative activities. This model requires the construction of an exchange rate crisis index as an indicator of a looming crisis. This line of research should be potentially useful to the central bank. Another area of interesting research work could also examine the role of central bank intervention and the impact of their operation in stabilizing the foreign exchange market.

Appendix

TABLE 1A. DATA SOURCES AND DEFINITION

$F(t)$	Net foreign asset of monetary authorities and commercial banks, obtained from various issues of the BOJ statistical digest
P^*_t	United states wholesale prices, obtained from various issues of the International Financial Statistics
S_t	End of period monthly weighted average exchange rate, obtained from the Statistical Digest
α_t	Jamaica exports plus imports of goods converted to local currency using the monthly weighted average exchange rate and expressed as a ratio of real GDP interpolated
S^*_t	The author's calculation of the shadow exchange rate
i_t	Domestic nominal six-month treasury bills, obtained by using the treasury bill rate provided in various issues of Statistical Digest and adjusted to obtain monthly series
i_t *	US treasury bills, from various issues of the IFS
P_t	The consumer price index, from the Statistical Digest
Y_t	Interpolated monthly real GDP, using an index of exports, imports and Tourism
D_t	Credit to the public sector, the private sector and to other financial institutions on a net basis. Obtained from the Statistical Digest, various issues
R_t	Net Foreign assets of the Bank of Jamaica.

TABLE 2A. RESULTS FROM ARIMA PROCESS 1991 TO 1999

	ARIMA Tests results			
Variable	*Order of Arima Process*	*R-squared*	*Durbin-Watson Statistics*	*Akaike Criterion*
log i_t*	(1,1,1)	0.17	1.86	-3.52
log P_t*	(1,0,1)	0.98	2.05	-8.37
log D_t	(1,1,0)	0.14	2.05	-1.75
log α_t	(2,0,2)	0.46	1.9	-2.61
Δ log P_t	(2,0,1)	0.75	2.08	-0.8
log Y_t	(2,1,2)	0.4	2.01	-7.22

TABLE 3A. UNIT ROOT TESTS

	ADF Test Results			
Variable	*Lags*	*Levels*	*Ist Difference*	*Significance*
Log i_t	4		-4.247	1%
Log real m2	8		-3.463	5%
Log P_t	3		-3.445	10%
log D_t	6	-2.500		
Δ log P_t	4	-3.035		
log Y_t	3		-6.522	5%
Log (S_{t+1} - S_t)	3		-8.286	1%

TABLE 4A. $Md_t - Q_t = a_0 - a_1 i_t + a_2 y_t - a_3\{S_{t+1} - S_t\}$

Results from JOHANSEN COINTEGRATION TEST

Sample: 1991:01 2000:12
Included observations: 105
Test assumption: No Deterministic trend in the data
Series: LRM2 CURRSUB LMONTBILLS LGDPINTER 1/
Lags interval: 1 to 1

Eigenvalue	*Likelihood Ratio*	*5 Percent Critical Value*	*1 Percent Critical Value*	*Hypothesized No. of CE(s)*
0.441885	80.26950	39.89	45.58	None **
0.143373	19.03458	24.31	29.75	At most 1
0.025019	2.785577	12.53	16.31	At most 2
0.001191	0.125172	3.84	6.51	At most 3

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

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

Unnormalized Cointegrating Coefficients:

LRM2	*CURRSUB*	*LMONTBILLS*	*LGDPINTER*
-0.287609	-2.785860	-0.121805	0.085243
0.701608	-0.306427	0.512912	-0.126214
-0.849760	0.164138	-0.083171	0.326994
0.007136	0.064146	-0.013156	0.002667

Normalized Cointegrating Coefficients: 1 Cointegrating Equation(s)

LRM2	*CURRSUB*	*LMONTBILLS*	*LGDPINTER*
1.000000	9.686291	0.423511	-0.296386
	(4.19339)	(0.13395)	(0.04238)
Log likelihood	882.5736		

1/ LRM2 = log $(Md_t - Q_t)$; Currsub = Log $(S_{t+1} - S_t)$; Lmontbills = Log i_t; LGDPinter = log Y_t.

TABLE 5A. $Md_t - Q_t = a_0 - a_1 i_t + a_2 y_t - a_3 \left\{ 1 - \beta_t \left\{ S_{t+1} - S_t \right\} + \beta_t \left\{ S^*_{t+1} - S_t \right\} \right\}$

Results from JOHANSEN COINTEGRATION TEST

Sample: 1991:01 2000:12
Included observations: 97
Test assumption: No deterministic trend in the data
Series: LRM2 LMONTBILLS PIE LGDPINTER 2/
Exogenous series: DUMMY1 DUMMY11 DUMMY12
Warning: Critical values were derived assuming no exogenous series
Lags interval: 1 to 1

Eigenvalue	*Likelihood Ratio*	*5 Percent Critical Value*	*1 Percent Critical Value*	*Hypothesized No. of CE(s)*
0.496947	83.66705	39.89	45.58	None **
0.120576	17.02232	24.31	29.75	At most 1
0.044626	4.558918	12.53	16.31	At most 2
0.001345	0.130591	3.84	6.51	At most 3

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

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

Unnormalized Cointegrating Coefficients:

LRM2	*LMONTBILLS*	*PIE*	*LGDPINTER*
-0.290084	-0.116379	-8.159606	0.504678
-0.711619	-0.559575	0.699464	0.081477
0.787823	0.109956	-0.465178	-0.274214
0.614375	0.134911	0.220692	-0.215015

Normalized Cointegrating Coefficients: 1 Cointegrating Equation(s)

LRM2	*LMONTBILLS*	*PIE*	*LGDPINTER*
1.000000	0.401191	28.12846	-1.739766
	(0.12700)	(12.3616)	(0.63671)
Log likelihood	944.3426		

2/ Pie = $1 - \beta_t \{S_{t+1} - S_t\} + \beta_t \{S^*_{t+1} - S_t\}$.

LIST OF REFERENCES

Agenor, Pierre-Richard, Jagdeep S. Bhandari and Robert P. Flood (1992); "Speculative Attacks and Models of Balance of Payments Crisis". *International Monetary Fund Staff Papers,* volume 39 (2), June, pages 357-394.

Bacchetta Philippe, (1990*); "Temporary Capital Controls in a Balance of Payments Crisis*". *Journal of International Money and Finance,* Volume 9, pages 246-257.

Bennett, Karl M., (1983); "Exchange Rate Policy and External Imbalance: The Jamaican Experience 1973-1982". *Social and Economic Studies,* volume 32 (4), pages 93-111.

Bennett, Karl M., (1986); "An Analysis of Jamaica's Foreign Exchange Auction". *Social and Economic Studies*, volume 35 (4), pages 93-111.

Berg, Andrew and Catherine Pattillo (1999); "Are Currency Crises Predictable: A Test." *IMF Staff Papers,* Vol. 46 No. 2, 107 – 138.

Blackburn Keith (1988); "Collapsing Exchange Rate Regimes and Exchange Rate Dynamics: Some Further Examples". *Journal of International Money and Finance,* volume 7, pages 373-385.

Blanco, Herminio and Peter M. Garber (1986): "Recurrent Devaluation and Speculative Attacks on the Mexican Peso". *Journal of Political Economy,* 94 (1), February, pages 148-166.

Campos, Isabel M and Zenon Jimenez-Ridruejo (2000); "Were the Peseta Exchange Rate Crises Forecastable During Target Zone Period?", Working Paper FAE 99/06, University of Valladolid, Spain.

Connolly Michael, (1986); "The Speculative Attack on the Peso and the Real Exchange Rate: Argentina, 1979-81". *Journal of International Money and Finance,* volume 5, pages S117-130.

Eichengreen Barry, and Andrew K. Rose, Charles Wyplosz (1994); "Speculative Attacks on Pegged Exchange Rates: An Empirical Exploration with Special Reference to the European Monetary System." NBER Working Paper # 4898.

Esquivel, Gerardo and Felipe Larrain (1999); "Currency Crises: Is Central America Different*?*", CID Working Paper # 26.

Fontaine, Thomson., "Currency Crises in Developed and Emerging Market Economies: A Comparative Empirical Treatment." P.h.d. Thesis, Clemson University, 1 – 97.

Goldberg Linda S., (1991); "Collapsing Exchange Rate Regimes: Shocks and Biases". *Journal of International Money and Finance,* volume 10, pages 252-263.

Goldberg, Linda S., (1994); "Predicting Exchange Rate Crises – Mexico revisited." *Journal of International Economics* 36, 413-430.

Grilli, Vittorio (1991); "Managing Exchange Rate crises: Evidence From the 1890's." *Journal of International Money and Finance,* 258 – 275.

Kaminsky, Graciela, Saul Lizondo and Carment M. Reinhart (1998); "Leading Indicators of Currency Crises." *IMF Staff Papers* 45 No.1 (March) 1 – 48.

Kohli, Renu (2000); "Real Exchange Rate Stabilization and Managed Floating: Exchange Rate Policy in India, 1993-99", Indian Council for Research on International Economic Relations, Working Paper no. 59.

Lim, Guay-Cheng (2000); "Misalignment and Managed Exchange Rates: An Application to the Thai Baht", *IMF Working Paper* 00/63.

Melick, William R.(1996); "Estimation of Speculative Attack Models: Mexico Yet Again". Bank For International Settlements, Working Paper no. 36.

Mussa, M., "The Exchange Rate, The Balance of Payments and Monetary and Fiscal Policy Under A Regime of Controlled Floating", in Flexible Exchange Rates and Stabilization Policy. Edited by Jan Herin, Assac Undbeck & Johan Myhrman. The Scandinavian Journal of Economics, 19976, 1977, Great Britain, Unwix Brothers Ltd.

Obstfeld, Maurice (1984): "Balance of Payments Crisis and Devaluation". *Journal of Money, Credit and Banking,* volume 16, May, pages 208-217.

Rangvid, Jesper and Carsten Sorensen (1998); "Determinants of the Implied Shadow Exchange Rates from a Target Zone", Copenhagen Business School, Denmark.

Witter Michael (1983): "Exchange Rate Policy in Jamaica: A critical Assessment". *Social and Economic Studies,* volume 32, number 4, pages 1-48.

Wyplosz Charles, (1986): "Capital Controls and Balance of Payments Crises". *Journal of International Money and Finance,* volume 5, pages 167-179.

Sergio Clavijo

Towards multibanking in Colombia: from 'patchwork' to financial holdings

I. INTRODUCTION

During the last two decades, the financial system in Colombia has been evolving towards a system that has some features of multibanking. In the early 1980s, lending activities were deregulated so that commercial banks could operate with different sectors of the economy. However, some saving instruments continued to operate according to their specialization by economic sectors: those indexed to inflation (UPAC) were the monopoly of mortgage institutions (CAVs), while consumer activities had to be funded through CDs denominated in pesos, offered by commercial banks and the near-banks (CFCs). Demand deposits remained the monopoly of the commercial banks. The result over

Paper prepared by S. Clavijo, Member of the Board of Directors of the Banco de la República (Central Bank of Colombia). *This paper was prepared for the ASOBANCARIA's Convention, June 8-9th, 2000, Bogotá. The views contained herein are personal and not necessarily are shared by the Board of Directors of the Bank. The author is indebted to Lorena Silvani and Lucía Cuevas, for helping with financial data, and to Nicolás Torres for able discussions regarding legal issues.* *E-Mail: sclavive@banrep.gov.co.* *JEL Classification: Financial Markets (E-440), Financial Institutions (G-280), Economic Development (O-160).*

the 1980s was a hybrid system, which pointed to a "universal treatment" in the asset side of the balance sheet, while maintaining a certain degree of "specialization" in the liability side.

In the early 1990s, crucial reforms were approved (Laws 45 in 1990 and 35 in 1993) aiming at a gradual movement towards multibanking by recurring to the scheme of subsidiaries and financial holdings. Unfortunately, the fear of cross-operations and improper financial leverage led the authorities to strongly regulate the operations of near-bank dealing with mutual funds, leasing and consumer credit. This setting impaired an adequate exploitation of the existing economies of scale and scope.

The financial system in Colombia experienced a credit boom over the 1993-97 period, which ended-up with a financial crisis during 1998-2000. The over-expansion of the financial system through subsidiaries and branch-outs resulted in a costly scheme, which combined with real asset depreciation resulted in capital losses of about -32% for mortgage institutions and 21% for banks. The average overhead of the banking system was close to 8% over the years 1988-95, maintaining undue pressure on the financial wedge. In turn, the average banking wedge was 6%, significantly higher than the 2.7% observed in developed countries. As the crisis erupted, the financial wedge had to be compressed and the operational costs made several institutions non-viable.

New regulations have been implemented (Laws 510 and 546 in 1999) to cope with this crisis, particularly in the mortgage system. As a result, commercial banks are in the process of absorbing all mortgage institutions, while a significant number of near-banks have gone out of business. From 1997-2000, a total of 70 financial institutions (about one third of total bank/non-bank financial institutions) have been closed, merged or taken over, generating a better possibility of reaching and optimal size.

In spite of these recent reforms, the system remains impaired to consolidate a real multibanking structure. Further changes in regulation will be required to overcome the current "patchwork quilt of rules and exceptions," to use the expression of Mr. Brady (1990 p. 5) when referring to the American financial system. If implemented, it will be possible to reduce excessive financial wedges and to promote higher competition among better-capitalized financial holdings that could exploit "economies of scale and scope."

In this paper, we propose that commercial banks further absorb the tasks currently being performed by mortgage institutions (CAVs), near-banks (CFCs) that deal with consumer credit and

leasing operations, and mutual funds (Fiduciaries). Financial holdings would consolidate around multibanks, insurance and broker companies, while the investment banks (CFs) and the pension funds administrators (AFPs) focus on medium and long-term projects and portfolios. Stronger prudential regulations and a proper setting of a "fire-wall" will then be required, as well as higher solvency indicators.

In section II we explore the current structure of the Colombian financial system and some of the implications of recent legislation. Section III is devoted to analyzing the economies of scale and scope in Colombia and the rationale for multibanking. Finally, section IV provides concluding remarks.

II. "CROSS-ROADS" IN THE COLOMBIAN FINANCIAL SYSTEM

A. Subsidiaries and Branch-outs: The Exhaustion of the early 1990s Scheme

During 1996, the Colombian government explored the possibility of introducing legal changes that aimed at expanding the opportunities of multibanking. At that stage, it was not yet evident the "speculative bubble" that was being inflated through rapid credit expansion since 1993. Later, it became evident that actions taken by the Central Bank resulted insufficient to avoid a deep crisis (Banco de la República, 1999 p. 32; Urrutia, 1999 p. 5). The crisis first hit the near-banks in 1996, extended towards savings and loans in 1997, and generated systemic effects on the banking system in the period 1998-2000. It is now clear that stringent supervision is required, particularly over the mortgage system, where financing should not surpass 75% of the commercial value or committing more than 25% of the personal monthly income (Ministerio de Hacienda, 1998; Urrutia, 2000 p. 20).

In the mid-1990s, the perception of the financial system in Colombia was that it lacked the degree of competition required to spur better and cheaper services. The owners of financial institutions were aware of these problems, but were confident that foreign investment would help to promote more competition and technological progress. However, the system of subsidiaries and branches had topped its expanding capabilities and operational costs were mounting. In the early 1990s, the rationale for not going directly towards multibanking was the following:

"(This system of subsidiaries) is a more fortunate development than multibanking, given the fact that it provides the benefits of universal banking (like the one developed in Germany) and avoids the structural problems of supervision and regulation that 'full-financial-services' have shown." See Martínez (1994, p. 56).

In short, the system of subsidiaries adopted in Colombia brought some confidence regarding "cross-operations" and "vested interest," but at the cost of not being able to fully exploit the existing economies of scale. The regulators pointed out three main difficulties with multibanking in Colombia:

1. Possible "moral hazard" problems between owners of financial institutions and owners of firms. Only a proper setting of a 'firewall' between the financial and the real sector would have precluded this problem, and authorities felt they were not ready for such a task.

2. Avoiding financial contagion problems. The system of subsidiaries was certainly a good device for the early 1990s. Regulators, however, were aware that financial holdings and group operations were difficult to track. In the future, supervision had to be built-up at the level of the financial holdings, to be in a good position of understanding systemic risks.

3. Avoiding excessive financial leverage. This had been a serious problem during the early 1980s crisis, when the financial cost amounted to almost 6% of GDP. In fact, Law 510 in 1999 aims at increasing the autonomy of the Superintendency of Banks, so that better *in-situ* surveillance can be performed.

The financial crisis of 1998-2000 has revealed that subsidiaries and branch-outs adopted in Colombia induced over-costs and relatively high overheads. For example, over the period 1988-95, the net interest margin for banks (=Net interest income/Assets) was 6% in Colombia (Demirgüc-Kunt and Huizinga, 1999 p. 384-88; ASOBANCARIA, 2000 p. 27). Such a margin resulted similar to that of Latin America (6.2%), but it is significantly higher than the 2.7% observed in developed economies. Additionally, high net interest margins coincided with high operational costs in Colombia (an overhead of 8.3% with respect to a 6.2% observed in the region). When the crisis exploded, there was not financial room left for increasing provisions as required; in fact, provisions were only 0.9% of total assets, about half of what international standards would advise, and even below the regional average (1.1%).

More recently (1998-99), net interest margins declined slightly to 5% of total assets as a result of deterioration in non-performing loans. Financial expenditures also declined as a result of lower reserve requirements and some efforts in downsizing the banking system (Urrutia, 2000b). In fact, the number of banking offices (excluding 'Banco Agrario') had reached a pick of 2,800, while mortgage offices (CAVs) numbered about 1,000 by end-1997. Due to take-overs, mergers and foreclosures, banking and mortgages offices had been reduced by 350 as of March 2000. Many institutions have announced between 20-50% operational cost-reductions for the coming years. Public financial entities are minimizing losses, while getting ready to bring them all upto the point of sale during the next two years. It is estimated that net costs of divesting public financial entities could reach about 4% of GDP.

As recently expressed by the Banking Association of Colombia, "it is urgent to continue this process of cost-reduction in order to minimize losses resulting from a fall in the net interest margins and increases in non-performing loans portfolio … In spite of the efficiency gains over the 1990s, last year saw some setbacks" (ASOBANCARIA, 2000a p. 3). In fact, such setbacks are happening at a time when the quasi-fiscal burden has been reduced from 25% to 12% of the liabilities during the 1990s. The transaction tax has represented about 2 percentage points of the 12% quasi-fiscal burden experienced over the years 1998-99. These figures imply that the reduction in the reserve requirements and the lowering to one digit inflation over the 1990s (Clavijo, 1991; Fernández, 1994 p. 203) has more than compensated the cost-effect of such transaction tax.

Another reason to continue an effort in streamlining the financial system has to do with the fragility that arises from capital flows volatility (Catáo and Rodríguez, 2000 p. 4). In fact, recent economic literature emphasizes how the "credit transmission mechanism" is particularly acute when financial wedges are being pressured by high overhead costs. The "Tequila effect" and the "Asian Crisis" illustrate how coping with globalization requires to water-out financial wedges and avoid using them as a cushion in times of financial turbulence.

In synthesis, the structure of the financial system in Colombia needs to be revisited in order to find its optimal size. The current crisis began in 1996 with a significant downsizing of the near-banks (CFCs), and continued during 1997 by redirecting leasing and mutual fund operations, and took a drastic change in 1999 when the fusion/merger of mortgage institutions with commercial

banks took place. It has been estimated that losses in the financial system along with the need to recapitalize private institutions will entail investments representing about 4% of GDP over the years 1997-2000.

The structure and legal framework in which such investments take place will dictate the possibility of reinstating profits for private investors in the near future. In the following section we will briefly discuss the performance of the financial sector over the 1990s and propose a new institutional framework for the new decade.

B. The Financial Framework and the Crisis

Even before the crisis of 1998-2000, there existed some concerns about the characteristics of the financial system:

- It was a rather small financial sector, where banking and mortgage assets amounted only to 45% of GDP;
- Financial wedges were, on average, high in relative terms (6% of financial assets);
- Operational costs were also high, representing 8% of overhead;
- Basic financial transactions were difficult to perform and time-consuming. This was aggravated by the imposition of the transaction tax of 0.2% over the years 1998-99. However, the government has insisted that such a tax (representing about 0.7% of GDP) avoided systemic risks that otherwise would have triggered a wide spread financial crisis (Restrepo, 1999). In spite of a 4.5% GDP contraction and serious problems of public order, financial panics or run-offs in the Colombian financial system have not taken place.

Foreign Direct Investment (FDI) in Colombia's financial system now represents about 18% of total assets. The so-called "reconquista" has generated new concerns about the difficulties in effectively adopting cost-saving technology in Colombia and the effects of "collusion." It has also spurred a debate about ownership concentration. In fact, as of March 2000, two economic groups represented about 37% of financial assets and the aggregation of other two groups explained almost 47% of total assets. The remaining 22% belong to governmental institutions and only 31% of the assets belong to private institutions no associated with any particular economic group.

The issue of ownership concentration somehow has been surpassed by historical events, as near-banks and mortgage institutions quickly resort to mergers and take-overs as the only way to survive in the system. With the benefit of hindsight, it is now clear that such a process could have been more orderly, reported better efficiency gains, and caused less capital concentration, if needed legal changes had been adopted in 1996. Some of those changes took place in late 1999, when the process was almost completed.

During the 1990s, several private institutions purported the image of "multibanks," while having to operate behind wooden-boards ("triplex"). The system of subsidiaries impaired the operation of "centralized treasuries" and ended-up duplicating operational costs. The knowledge of customers was poor, disperse, and costly.

Politicians sacked public banks and their administrators violated legal codes for providing loans, particularly during 1995-98. BANCAFE, Banco del Estado, BCH, Caja Agraria, la Previsora, and Fondo Nacional del Ahorro have all generated significant losses for the public budget. The idea of divestiture of all financial public entities (except for second-tier banks that operate at no direct risk) is now a national purpose and should be a reality by end-2001.

As shown in table 1, in the years 1995-99, there were foreclosures, mergers and take-overs of 7 Banks, 5 mortgage institutions (CAVs), 14 Financial Corporations (CFs), 10 near-banks (CFCs), 24 leasing y 10 fiduciaries. Although late, the financial system has sensed that it is oversized and has taken the decision to reduce by 70 the number of institutions in these areas. When considering other financial institutions, the reduction is from 438 in 1995 down to 349 in 1999. Assets in the financial system increased significantly during the first half of the 1990s, passing from 52% of GDP in 1991 to 70% in 1995. However, by end-1999 there has been some stagnation at the level of 72% of GDP.

It is now clear that the financial system requires further grouping in order to be able to exploit the existing "economies of scale and scope." Additional legal changes are required to move swiftly towards a multibanking system that would take advantage of synergies in the system. Currently, it is difficult to imagine the existence of more than, say, 15 multibanks competing in a dynamic market (after absorbing the tasks of the near-banks, plus the mortgage business). This could well imply that the total number of financial entities could be reduced from the current 350 down

TABLE 1. INDICATORS OF THE FINANCIAL SYSTEM OF COLOMBIA, 1991-FUTURE

	Number of entities				*Assets/GDP*				*Solvency indicator*[a]			
	1991	*1995*	*1999*	*Future*	*1991*	*1995*	*1999*	*Future*	*1991*	*1995*	*1999*	*Future*
Banks	26	32	26	15	24.1	28.5	35.8	60.0	13.3	13.4	10.9	15.0
Mortgage	10	10	5	0	9.7	13.3	10.3	0	10.2	10.2	9.1	0
Finan. corp.	22	24	10	5	4.4	6.9	6.3	10.0	18.1	18.1	15.6	15.0
Near-banks	73	74	40	0	3.3	5.9	2.6	0	na.	na.	na.	na.
Generals	30	31	21	0	2.8	3.3	1.4	0	15.4	12.4	17.6	na.
Leasing	43	43	19	0	0.5	2.7	1.2	0	na.	na.	na.	na.
Other entities	240	298	268	130	10.5	15	16.7	21.0	na.	17.4	20.7	na.
Pension (AFPs)	0	14	8	5	0	0.1	0.2	1.0	na	na.	na.	na.
Fiduciar-ies	20	47	37	0	0.1	0.2	0.3	0.0	na	na.	na.	na.
Other[b]	220	237	223	125	10.4	14.7	16.1	20.0	na	na.	na.	na.
Total	371	438	349	150	51.9	69.7	71.7	91.0	na	na.	na.	na.

SOURCES: Super-Intendency of Banks and own computations.

NOTE: na.: Not available.

[a] Technical Capital/Assets weighted by Risk. [b] Includes Insurance and Brokers, Credit Unions, and other minor institutions, but excludes the Central Bank, Exchange houses, and Foreign Banks representations.

to, say, no more than 150. This consolidation of financial institutions should imply a capital strengthening of the remaining entities.

We imagine that a good mark to strive for is that by the end of the current decade total assets in the financial system in Colombia should be heading towards 92% of GDP. This would imply a capital deepening of about 20 points of GDP, similar to the gain attained over the 1990s. Only then would be the Colombian financial system in a position to compete on equal footing with the emerging markets of Southeast Asia, where prudential regulations also need to be improved. Current solvency indicators also need to be increased, say to 15%, taking into account that larger business opportunities also entail bigger risks.

Table 2 shows three phases of the financial system in Colombia over the 1990s. During the years 1990-92, the banks reported profits over capital of 20.2% and of 2.2% with respect to assets (almost double the average figure reported by Spaniard banks). During the period of consolidation (1993-97), the banks maintained their good performance, reporting capital profits of 12.2% y and 1.8% with respect to assets. In the meantime, mortgage institutions (CAVs) reported similar figures (20% and 1.5%, respectively). During all these years, solvency indicators for banks were close to 13%, almost five percentage points above the 8% required by the Basle Agreement, and mortgage institutions reported around 11%.

The speculative bubble created over the years 1993-97 finally exploded in 1998, reverting most of the above mentioned indicators. Banks reported capital losses of 21% and 2.4% with respect to

TABLE 2. FINANCIAL SYSTEM PERFORMANCE INDICATORS (ANNUAL AVERAGES)

	1990-92	*1993 –97*	*1998-2000(I)*
Banks (exc. Caja Agraria)			
Profits / Capital	20.2	12.2	-21.2
Profits / Assets	2.2	1.8	-2.4
Solvency Indicator[a]	12.5	13.0	10.3
Mortgage Inst. (CAVs)			
Profits / Capital	24.6	21.5	-32.1
Profits / Assets	1.4	1.6	-2.5
Solvency Indicator[a]	10.3	10.6	9.8

SOURCE: Superintendency of Banks, Colombia

[a] Technical Capital / Assets Weighted by Risk.

assets during the period 1998-2000(I). Mortgage institutions lost about 32% of their capital or 2.5% of their assets. Furthermore, solvency indicators declined to an average of just 9.8% for mortgage institutions and to 10.3% for banks.

The trend of the financial system has not been a good one in the last five years, as the downturn in economic activity cut most financial institutions oversized and with limited capacity for reaction over the business cycle (details in Clavijo, 2000). It is then useful to revisit the current structure of financial businesses in Colombia and to sketch possible reforms that aim at reducing costs and increasing solvency indicators.

III. BRIEF HISTORY OF MULTIBANKING AND THE CASE OF COLOMBIA

A. Multibanking in the Developed World

In the early years of the XXth Century and before the great depression (1929-33), the developed world exhibited cohabitation of multibanking and specialized banking. However, regulators reacted to the great depression by curtailing the possibilities of multibanking, particularly in the Anglo-Saxon world.

The so-called Anglo-Saxon model had a history of specialized banking services, as a result of links between internal and external trade, based on short-term financing. Barriers erected over the 1940-50s were firmly maintained up to the early 1970s, when a deregulation process was re-ignited. In the case of the United States, the lagging in financial services had many legal explanations (Fry, 1988 p. 281ss):

- Demand deposits were not allowed to recognized explicit interest yields.
- McFadden's Law had limited, since 1927, inter-state mortgage operations; additionally, geographical barriers were erected which hampered branching developments of the financial services.
- Glass-Steagall's Law had segmented, since 1933, developments of financial services with respect to stock markets.
- Regulations of bank holdings had limited, since 1956, the development of insurance services and futures markets.

By contrast, the German Model of multibanking was a historical result of strategic alliances between the industry and the financial sector, servicing different economic sectors and at different horizons. It has been said that the great economist Schumpeter emphasized that the "innovative entrepreneur" was the perfect blending of a "banker with vision for industrial business." Several historians concluded that the industrial development of Germany was induced by this symbiosis between the bankers and the multipurpose vision of the firms. The latter, without the opportunity for concretion with the former, would have not generated such an immense industrial wealth in Germany (Mülhaupt, 1976).

There has been a historical link between non-innovative industrial processes and specialized banking in less developed countries, with the notable exception of Japan. Vernon's theory about "product-life-cycle theory" fits quite well with this evidence, particularly in Latin America, whereas "research & development" processes require tight relations between industry and banking that multibanking tends to provide with better results (Khatkhate and Riechel, 1980).

In the case of Japan, specialized banking also coincided with high State intervention, including administrative controls on interest rates and government lead-projects. However, the 1997-98 crisis made evident that such a system was not only inefficient but also prone to crony schemes and lacked minimum standards of supervision and prudential regulations.

During the 1970s and early 1980s, multilateral agencies supported general schemes that aimed at consolidating multibanking in emerging markets. However, due to unwanted effects on financial property concentration and difficulties in the surveillance of financial conglomerates, by mid-1980s priority was giving to prudential regulations, ending-up in the adoption of the Basle Agreement in 1988.

Financial deregulation continued in the early 1990s and received special support from Europe, after the EU approved in 1992 a global scheme for modernizing financial services in that continent. The United States reacted quickly, but in a disorganized manner, ending-up in a "patchwork" scheme (Brady, 1990). Multibanking has encountered several difficulties in the United States, but the most demanding problem arises from concentrating risks around a deposit insurance (FDIC) which is too generous (Breeden, 1990). At present stage, American megabanks are "reading" market forces to gauge a proper balance between re-

tailing, investment banking, and securities. Most banking strategists are betting on a consolidation of multibanking, where specifics would depend on regulations around the "H.R.10" system, approved in November of 1999. The Fed and the Treasury have yet to strike a good balance between their regulatory and supervision tasks to expedite this movement towards multibanking in the United States (The Economist, 1999).

Table 3 summarizes the systems that have so far prevailed in some developed economies, where United States and Japan have been important exceptions regarding multibanking. In Europe, some countries are re-directing and re-sizing their financial services, after learning that "cross-subsidies" are not paying their rapid expansions. Outsourcing is in fashion, but there is a clear tendency to consolidate financial groups. In the meantime, the United States keeps moving towards "underwriting," as a way of adopting innovative schemes that point towards multibanking.

TABLE 3. BANKING ARRANGEMENTS IN SOME DEVELOPED COUNTRIES

	Banking Services	*Non-Banking*
A. Specialized:		
U.S.A.-Japan	Subsidiaries	Non-Financial Subsidiaries
B. Semi-Specialized:		
U.K. – Canada	Banks	Subsidiaries-Subsidiaries
C. Multibanking:		
Germany-Switzerland	Universal Banking	Universal Banking (Dpts.)

SOURCE: Based on Fry (1988), and Brady (1990).

In the following section we will discuss how recent trends in the Colombian banking structure, particularly in light of recent reforms (Law 510 in 1999), can be ascribed within the world tendency towards multibanking.

B. Financial Structure in Colombia: Changes Towards Multibanking

It has been said that since the origins of the financial system, rooted in Law 45 in 1923, the banking system in Colombia was flexible enough to allow for universal banking (ASOBANCARIA, 1997). In fact, commercial banks and mortgage operations could operate jointly. However, the lack of dynamic markets and different group interest generated segmented markets which repre-

sented a hybrid system, with elements of competition in the liability side, but with specialization by sectors in the lending side of the balance sheet (Clavijo, 1992; Melo, 1993). In this regard, Colombia was not an exception with respect to the Anglo-Saxon tendency to avoid multibanking up to the early 1990s.

Law 45 in 1990 opened the possibility of operating through financial conglomerates based on expanding financial services by means of creating subsidiaries. Law 35 in1993 further extended consumer credit towards mortgage institutions (CAVs) and also permitted these institutions to turn into mortgage banks (allowing them operate demand deposits).

However, near-banks (CFCs) were over-regulated and forced to undergo additional specialization in order to deal with leasing operations. This had negative effects on the financial structure and distorted reserve requirements regulations. Additionally, Law 454 in 1998 allowed special treatment for "credit unions" entering the financial system, which latter proved to be another factor of weakness and financial contagion during the crisis.

Some new regulations approved through Law 510 in 1999 were aimed at further promoting competition in the financial system:

- The use of branch offices was further flexibilized to cover fiduciaries and broker operations, allowing the exploitation of some "economies of scope."
- Investments in real sector assets by the Financial Corporations were deregulated and the "notion of the firm" became more general.
- Complementary, Law 546 in 1999 linked mortgage-indexation to recent CPI-performance and opened the use of such unit of account to any financial instrument. This law also reinstated the mandate to turn mortgage institutions into banks before end-2003 (in practical terms this conversion should be over before end-2001).

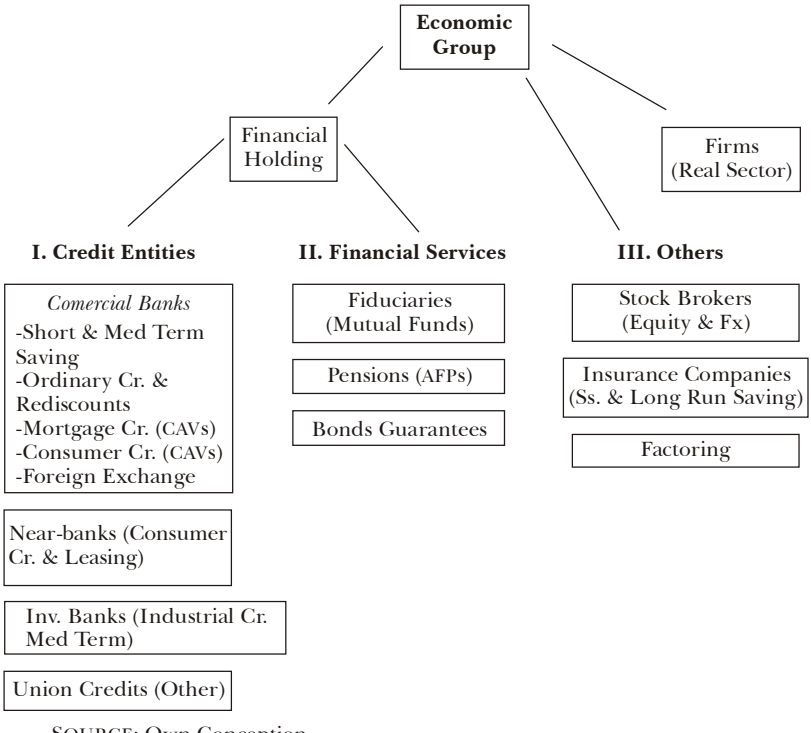
However, several obstacles remain so as to be able move further into multibanking in Colombia:

- There is no proper legal separation between "own" and "delegated" operations, so mutual funds and fiduciary operations can not be passed onto banks.
- Leasing operations are limited to near-banks (CFCs) and their consumer credit continues to be artificially separated from those offered by commercial banks.

- Stringent regulations are required to attain a proper setting of a 'firewall' between financial entities and real sector firms.

Graph 1 illustrates the current structure of the financial system under Law 510 in 1999. It is clear that, in spite of the conversion of mortgage institutions into banks, the market continues to be segmented regarding near-banks and fiduciaries, generating operational over-costs.

GRAPH 1. CURRENT STRUCTURE OF THE FINANCIAL SYSTEM UNDER LAW 510/99



SOURCE: Own Conception.

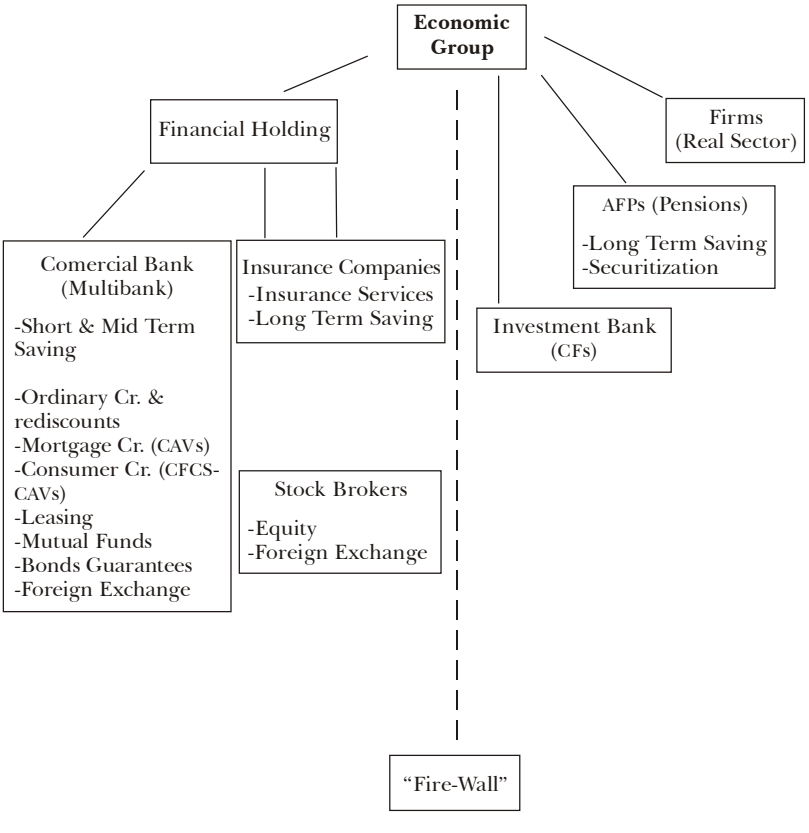
Graph 2 depicts how the system could be turned to operate under a multibanking system, with better possibilities of exploiting existing economies of scale and scope. Besides absorbing operations of mortgage institutions, the idea is to also bring all consumer credit, leasing, mutual funds and some broker operations "under the same roof." This should permit significant reductions in net margins and lower real costs for consumers.

However, such agglomeration of financial services would also

entail a concentration of risks. Consequently, banking supervision and prudential regulations should be enhanced, particularly at the level of the financial holdings (centered in the new multibanks). From the perspective of the regulator, it is better to have dynamic financial competition among a few multibanks, than continue to struggle for additional capitalization in an atomized and small system. A crucial issue in allowing the consolidation of financial holdings is the proper setting of a firewall between the real and the financial system, in order to avoid contamination at times from economic recessions.

Another key element in the case of Colombia is to further enhance the role of Financial Corporations as investment banks, while pension funds concentrate on medium and long-term port-

GRAPH 2. FINANCIAL SYSTEM OF COLOMBIA UNDER A MULTIBANKING PROPOSAL



SOURCE: Own Conception.

folios (including their crucial role in public assets divesting). In this regard, the recent example of the AFPs in Argentina deserves attention, while some useful lessons could be learnt from difficulties arising in Mexico and Brazil with respect to the short-term role-played by banks and mutual funds.

In the following section, we briefly discuss the empirical findings regarding the "economies of scale and scope" in Colombia, which seem to be significant.

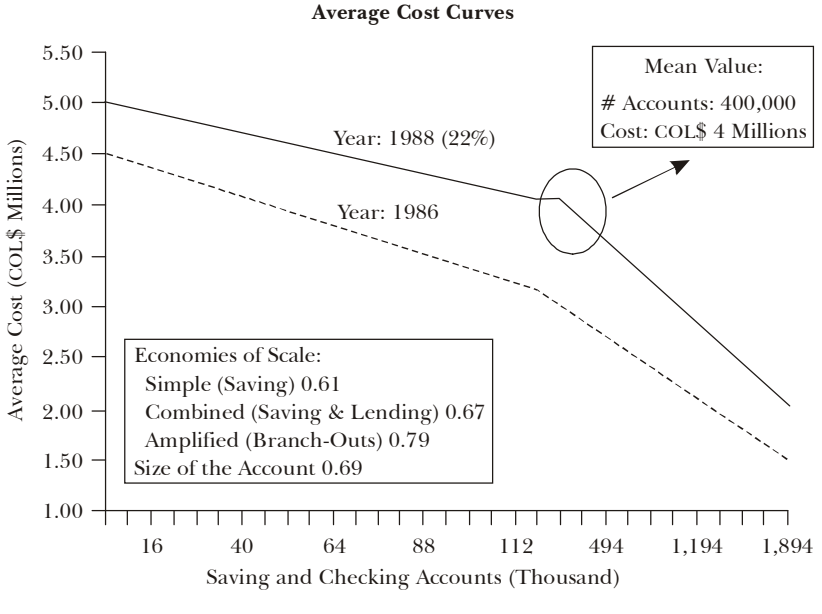
IV. ECONOMIES OF SCALE AND FINANCIAL STRUCTURE IN COLOMBIA

A. *Economies* of Scale and Scope

One necessary condition (although not sufficient) for the existence of economies of scale is that the average cost curve exhibit a descendent shape. A practical difficulty arises, however, when attempting to define the banking product relevant for such an average cost.

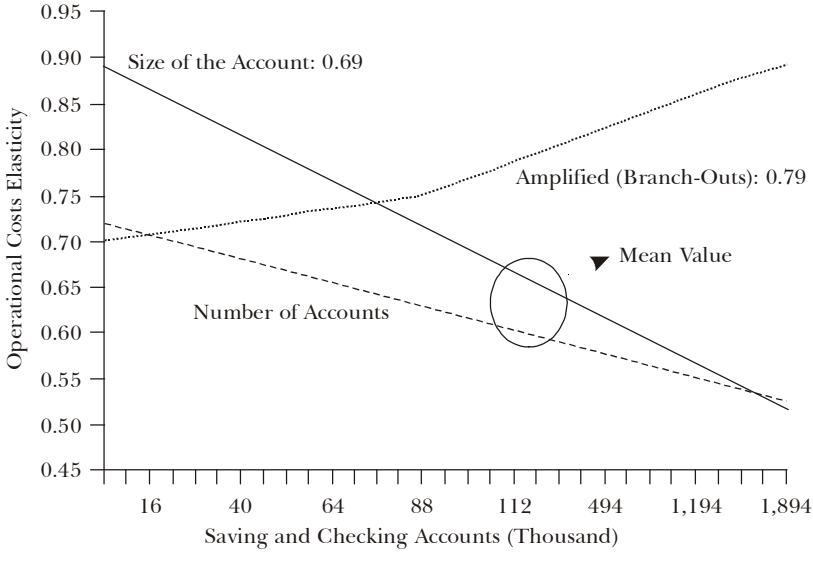
Ferrufino (1991) found an average descending cost curve for the

GRAPH 3. ECONOMIES OF SCALES: BANKS, OPERATIONAL COSTS IN TERMS OF SAVING AND CHECKING ACCOUNTS, 1988



banking system, for 1986 and 1988, when the product was defined in terms of the number of checking and savings accounts (see graph 3). The average cost for the bank was of the order of COL$4 million per-annum (equivalent to COL$32 million or US$16,000 per-annum at current prices), when the banks operated in the range of 150,000-400,000 accounts. She also found that simple economies of scale with respect to the number of savings accounts (0.61) was not much different from combined (savings and lending) economies of scale (0.67). When considering the average size of the savings accounts, the result increased to 0.69 (maintaining average costs savings close to 30% when expanding savings and/or lending). Finally, if expansion took place through branch-outs, the "amplified" economies of scale were reduce to 20%, with a rapid decrease in savings above 500,000 savings accounts.

GRAPH 4. EVOLUTION OF ECONOMIES OF SCALES: BANKS, IN TERMS OF SAVING AND CHECKING ACCOUNTS, 1988



Graph 4 shows the different results that banks obtained in cost-savings if the expansion occurred "under the same roof" (about 40%) or through branching (between 10-35%).

These figures illustrate that in the early 1990s there was an ample scope for exploiting economies scale, which could only be partially used by the system due to the adoption of subsidiaries.

Although these studies need to be revisited in line with recent events, particularly with the conversion of mortgage institutions into banks, our intuition is that significant overheads could be further reduced if changes were introduced in the financial system to expedite the consolidation of multibanking in Colombia. Additional estimates for the years 1994-96, carried out by Avendaño (1997), also give support to the existence of significant economies of scale that could be used by the system.

B. The Debate about "Financial Inefficiencies"

Maurer (1993) has criticized the above-mentioned results on grounds of deficiencies in econometric procedures. However, this seems to be a general difficulty when dealing with economies of scale. More recently, Suescun and Misas (1996) adopted an alternative methodology by attempting to distinguish between the "financial environment" and the self-reaction of banks to those business conditions. The efficiency-X framework adopted by these authors led them to conclude that administrators of Colombian banks were not able to reduce costs, although the "environment" permitted them to do so. Using panel-data for the period 1989-95, they found inefficiencies that represented about 31% of operational costs (representing about 4 percentage points of the financial wedge), where nearly 27 points (85% of the total inefficiency) was explained by lack of effective administrative controls.

This evidence would support the idea that there has been some "collusion" for not operating at the efficient banking-production-frontier in Colombia during those years. This X-inefficiency approach would then be recommending the adoption structural changes to foster better competition. Moving towards multibanking certainly seems to be a superior alternative than maintaining the current scheme that hampers the exploitation of economies of scale and scope.

In short, the main objectives of the financial reforms over the last decade have not yet been accomplished in Colombia (Carrasquilla and Zarate 1997, p. 66), namely:

i) Increasing real savings in the economy;

ii) Reducing net financial margins in order to reduce the cost of credit;

iii) Increasing the selection of investment projects based on real returns and their low risks.

Moving towards multibanking would certainly increase the probability of reaching such objectives by the end of this decade, while promoting capital deepening. The regulator, however, has an immense task in terms of increasing surveillance and prudential regulations to cope with the concentration of risks that this new optimal size of the financial system implies.

V. CONCLUSIONS

In this paper, we have proposed that commercial banks further absorb the tasks currently being performed by mortgage institutions (CAVs), near-banks (CFCs) that deal with consumer credit and leasing operations, and mutual funds (Fiduciaries). Financial holdings would consolidate around multibanks, insurance and broker companies, while the investment banks (CFs) and the pension funds administrators (AFPs) focus on medium and long term projects and portfolios. Stronger prudential regulations and a proper setting of a "fire-wall" will then be required, as well as higher solvency indicators.

As discussed, the financial system of Colombia experienced a credit boom over the years 1993-97, which ended-up with a financial crisis during 1998-2000. The over-expansion of the financial system through subsidiaries and branch-outs resulted in a costly scheme, which combined with real asset depreciation resulted in capital losses of about -32% for mortgage institutions and 21% for banks. The average overhead of the banking system was close to 8% over the years 1988-95, maintaining undue pressure on the financial wedge. In turn, the average banking wedge was 6%, significantly higher than the 2.7% observed in developed countries. As the crisis erupted, the financial wedge had to be compressed and the operational costs made several institutions non-viable.

New regulations were implemented (Laws 510 and 546 in 1999) to cope with this crisis, particularly concerning the mortgage system. As a result, commercial banks are in the process of absorbing all mortgage institutions, while a significant number of near-banks have gone out of business. During the 1997-2000 period, a total of 70 financial institutions (about one third of total bank/non-bank financial institutions) have been either closed, merged or taken over, generating a better possibility of reaching and optimal size.

In spite of these recent reforms, the system remains impaired

to consolidate a real multibanking system. Further changes in regulation will be required to overcome the current "patchwork quilt of rules and exceptions." If implemented, it will be possible to reduce excessive financial wedges and to promote higher competition among better-capitalized financial holdings that could exploit "economies of scale and scope."

REFERENCES

ASOBANCARIA (1997), *Especialización de la Entidades Financieras en Colombia* (Doc. de Trabajo, Abril).

ASOBANCARIA (2000), *La Medición del Margen de Intermediación en el Sector Financiero* (Febrero).

ASOBANCARIA (2000a), "La Crisis de Rentabilidad", *La Semana Económica* (No. 256, Mayo).

Avendaño, H. (1997), "Eficiencia y Economías de Escala en el Sistema Financiero Colombiano", en *El Mercado de Capitales de Colombia, XV Simposio,* Marzo.

Banco de la República (1999), "Informe de la Junta Directiva al Congreso de la República-Marzo de 1999", *Revista del Banco de la República* (Marzo).

Barajas, A., R. Steiner and N. Salazar (1998), *Interest Spreads in Banking: Costs, Financial Taxation, Market Power, and Loan Quality in the Colombian Case 1974-96,* IMF-Working Paper (WP/98/110, August).

Brady, N. (1990), "Global Competition: A Catalyst for Restructuring U.S. Financial Services", *Issues in Bank Regulations* (Summer).

Breeden, R. C. (1990), "Concerning Financial Services Modernization", *Issues in Bank Regulations* (Summer).

Carrasquilla, A., y J. P. Zarate (1997), "Reforma del Sector Financiero en Colombia: ¿Dónde Estamos?", en *El Mercado de Capitales de Colombia, XV Simposio,* Marzo.

Catào, L., y S. L. Rodríguez (2000), *Banks and Monetary Shocks in Emerging Markets: How Far Can We Go With the 'Credit View?*, IMF-Working Paper (WP/00/68, March).

Clavijo, S. (1991), "El Margen de la Intermediación Financiera en Colombia", *Banca y Finanzas* (Marzo).

Clavijo, S. (1992), "Overcoming a Financial Crisis during Transition from a Repressed to a Market-based System: Colombia

1970-89", in *The Colombian Economy* (edited by A. Cohen and F. R. Gunter (Westview).
Clavijo, S. (2000), "Reflexiones sobre Política Monetaria e 'Inflación Objetivo' en Colombia", *Borradores de Economía* (No. 141, Banco de la República, Febrero).
Demigüc-Kunt, A., and H. Huizinga (1999), "Determinants of Commercial Bank Interest Margins and Profitability: Some International Evidence", *The World Bank Economic Review* (Vol. 13, No. 2).
Fernández, J. (1994), *Sector Financiero: Motor del Desarrollo* (Asociación Nacional de Instituciones Financieras, ANIF).
Ferrufino, A. (1991), "Reestimación y Ampliación de la Evidencia sobre Economías de Escala en el Sistema Financiero Colombiano", *Ensayos Sobre Política Económica,* (No. 19, Diciembre).
Fry, M. J. (1988), *Money, Interest, and Banking in Economic Development* (John Hopkins U. Press).
Khatkhate, D., and K. W. Riechel (1980), "Multipurpose Banking: Its Nature, Scope, and Relevance for Less Developed Countries", *IMF-Staff Papers* (September).
Martínez, N. H. (1994), "La Ley 45 de 1990 o la Definición de un Nuevo Modelo Bancario", en *Las Reformas Económicas del Gobierno del Presidente Gaviria: Una Visión desde Adentro* (Compiladores O. L. Acosta e I. Fainboim, Ministerio de Hacienda y Credito Público de Colombia).
Maurer, M. (1993), "La Multibanca y la Evidencia sobre las Economías de Escala en la Banca Colombiana", *Ensayos Sobre Política Económica* (Diciembre).
Melo, J. E. (1993), *Las Reformas al Sistema Financiero* (Superintendencia Bancaria, Marzo).
Ministerio de Hacienda y Crédito Público (1998), *La Corrección Monetaria y la Deuda Hipotecaria* (Vice-Ministerio Técnico, Noviembre).
Mülhaupt, L. (1976), "In Defense of Universal Banks", *The Banker* (July).
Restrepo, J. C. (1999), *Memorias de Hacienda 1998-99* (Ministerio de Hacienda y Crédito Público, varios tomos).
Suescun, R., y M. Misas (1996), "Cambio Tecnológico, Ineficiencia de Escala e Ineficiencia-X en la Banca Colombiana", *Borradores Semanales de Economía* (No. 59).
Urrutia, M. (1996), "Primeros Efectos de las Reformas al Sector Financiero", *Revista del Banco de la República* (Enero).
Urrutia, M. (1999), "Antecedentes de la Recesión y Estrategia de Reactivación", *Revista del Banco de la República* (Mayo).

Urrutia, M. (2000a), "Políticas para Evitar Burbujas Especulativas en Finca Raíz", *Revista del Banco de la República* (Enero).
Urrutia, M. (2000b), "El Margen de Intermediación y la Importancia de su Medición", *Revista del Banco de la República* (Mayo).
"The Wall Falls" (1999), *The Economist* (October 30th).

Tracy Polius
Wendell Samuel

Banking efficiency in the Eastern Caribbean Currency Union: an examination of the structure-conduct-performance paradigm and the efficiency hypothesis

INTRODUCTION

The relationship between market structure and performance in banking remains a much-studied and controversial area of the analysis of firms in the industry. The application of theories of industrial organization developed in other industries suffers from several weaknesses as a result of the peculiarities of banking. Not least of these is the identification and measurement of the output of the banking firm.

The analysis of banking efficiency in the small island economies that constitute the Eastern Caribbean Currency Union (ECCU)[1]

[1] The member countries The Eastern Caribbean Currency Union are Anguilla, Antigua and Barbuda, Dominica, Grenada, Montserrat, St. Kitts-Nevis, St. Lucia and St. Vincent and the Grenadines.

Paper prepared by Tracy Polius, economist, and Wendell Samuel, Senior director, Research and Information Department of the Eastern Caribbean Central Bank. The paper was presented at the VI Meeting of the Network of America Central Banks Researchers, organized by the Banco Central del Uruguay, in Montevideo, Uruguay, October 17-18, 2001.

poses some even more intractable difficulties. The small size of the combined market - 550 thousand persons - serviced by 44 banking entity results in an average population of 12500 per bank. In most jurisdictions such a ratio would be classified over banked. The size of the territories also limits the number of banks that would be viable. This means that the traditional measures of concentration would be inapplicable.

There is less than perfect movement of financial resources within the currency union due to the existence of several restrictions that limit the movement of capital (Augustine, Samuel and Sandiford, 1994; World Bank (1998). The fragmentation of the financial markets within the ECCU suggests that local concentration is more important than market share at the regional level. This also complicates the definition of the competition as empirical studies of the US market, which suggest that area over which customers shop for different banking services vary with the banking product. Hence while information intensive banking services may be confined within the country some value added financial services like investment services and credit cards may be sought further afield. Identification of the competition is further complicated by non-bank financial institutions like credit unions and insurance companies that provide near banking services.[2]

The mixture of foreign branch banks (which do not have capital) and indigenous commercial banks also complicates the use of capital-based measures of performance.

The paper seeks to assess the relevance of the Structure-Conduct-Performance (SCP) and relative efficiency hypotheses in explaining the performance of the banking industry in the ECCU. As a first step the standard estimation procedures are used taking into consideration the peculiarities of the small island economies that are being studied. The structure of the paper is as follows: After the introduction the theoretical foundations of the SCP and Relative Efficiency hypotheses are discussed in Section I. Section II discusses the estimation procedures used in the study, while Section III describes the characteristics of data. The results of the estimation procedures are discussed in Section IV and the final section consists of some concluding remarks and identifies some areas for further research.

[2] The influence of credit unions can be very significant in at least one country where their total deposits represents xx% of the deposits of commercial banks.

I. THEORETICAL FOUNDATIONS

The literature on bank performance is not conclusive on all the factors that contribute to bank profitability. However the literature points to factors such as market concentration, market power, ownership, efficiency and market growth as influencing the performance of banks. The literature is also inconclusive about the nature of the influence of these variables on bank performance. This section presents a discussion of the competing thesis and highlights some issues regarding bank performance from the literature.

Structure-Performance Conduct (SCP) Hypothesis

The SCP paradigm is the most used framework for the analysis of the performance of the banking industry. While its theoretical foundations are well established in the industrial organization literature (Stigler, 1964; Scherer, 1989), its applicability to the banking firm has not always been rigorously justified.[3] The SCP theory predicts that profits and output prices would be higher the greater the level of concentration in a given market. This is due to the greater ease of collusion in a more concentrated market. When applied to the baking industry it predicts that profits, interest rates on each type of loan and services charges would be higher in a more concentrated market. On the other hand deposit rates offered would vary inversely with concentration (Gilbert 1984).

Following Ruthenberg (1994), the link between concentration and profits can be derived from the Cournot model of oligopolistic behaviour. Assuming and industry with N firms producing a homogenous product Q. The profit maximization function facing the individual firm is [QP(Q) - C(Q)]. The firms are assumed to have identical cost functions and assume that the other firms output decisions are unaffected by their own output decisions. Market equilibrium is attained when:

$$\frac{P(Q) - C(\frac{Q}{N})}{P(Q)} = \frac{1}{N}\frac{1}{\eta}$$

Where η is the price elasticity of demand.

[3] Hannan (1991) is one significant exception.

If the assumption of identical cost functions is dropped in favour of a an element λ which measures the expectations of any firm in the industry concerning the response of rivals (including potential entrants) to its own output decisions, then market equilibrium can be rewritten as:

$$L = \frac{P(Q) - MC}{P(Q)} = H(1 + \lambda)\frac{1}{N}$$

Where L is the market Lerner index and H is the Herfindahl index of concentration, measured as the sum or squared market shares of firms in the industry.

Empirical studies of the SCP have estimated the relationship between market structure and performance by regressing measures of performance against a variety of variables. Ruthenberg (1994) suggests the following general specification of the relationship:

$$\pi_i = f(H_i, PC_i, NNI_i, R_i, V_i)$$

Where:

- π_{ij} is a measure of performance of commercial banks in country i during year j;
- H_{ij} is a measure of the concentration of the banking industry in the county i in year j;
- PC_{ij} is a proxy for potential competition or the level of barriers to entry in county i in year j. Potential competition should compete profits away and hence profits are a decreasing function of the level of potential entry;
- NNI_{ij} is a measure of non-interest interest income calculated as fees and commissions less overhead expenses as a percentage of total assets incurred by commercial banks in country i during the year j. A positive relationship between performance on NNI is predicted by SCP;
- R_{ij} is a measure of overall risk than banks in country I are exposed to in year j. The coefficient of this variable is expected to be positive give the positive relationship between risk and return;
- V_{ij} is a vector of control variables representing market and country specific characteristics.

Gilbert (1984) reviewed approximately 45 studies on the relationship between performance and market structure in the Bank-

ing industry. He concluded that about one half of the studies uncovered a statistically significant relationship between performance of the market structure. Of the studies that with statistically significant coefficients on market concentration, estimates of the effect of changes in the concentration ratio on the performance measures were economically very small.

A number of reasons have been advanced for the mixed empirical support for the SCP paradigm. These include the following:

Measurement errors

There are several sources of errors in the measurement of the performance variable. The most important is that the numerator usually interest income or operating income is an annual or quarterly flow but the denominator usually an asset measured at a point during the year is a stock. The latter may be substantially different from the average over the year (Heggestad, 1979; Vittas, 1991).

The R-squared for the equations in most of the studies of market structure are quite low ranging from 0.20 to 0.50 (Gilbert). This suggests that there may be several variables that are omitted from the equation. The estimated coefficients may be biased if the measure of market concentration is correlated the omitted variables.

Simultaneous equation bias

The measures of performance may not totally independent of the exogenous variable as in the case where non-interest income is included in the regressors of some measure of profit. The coefficient of the concentration ratio would then be biased towards zero. In such instances a reduced-from equation should be derived from the demand an supply relationships. In most cases the relationship used neither supply equations, demand equations or reduced forms.

Differences in Regulatory Regimes

The studies do not take account of the effect of regulation on bank performance. Banking is a highly regulated industry and differences in regulatory regime can have a non-trivial effect on performance (Gilbert, 1984). In particular ceilings and floors on

interest rates that arise from financial repression in developing countries may affect the rate of return. In the case of the ECCU the regulatory framework is identical, with the only restriction being a floor of 4 per cent on the rate of interest on savings deposits. The required reserve ratio is 6%, which is low by developing countries standard (Fry 1998).

Identification of the Competition

Most studies identify the local market, defined in terms of distance as the area for potential competition. However as noted earlier, the spatial delineation of the market may be inappropriate if customers' perception of the market for banking services varies with the particular banking product. For example in the ECCU customers have a choice of credit cards issued by local banks and those issued by banks abroad. The same holds for investment services and complex financial engineering products that are supplied by banks based in Trinidad and Tobago.

Contestability of Markets and Multi-products

The literature on the contestable markets suggest that performance is not so much determined by performance but by the nature of barriers to entry. Shaffer (1982) applies the insights from Baumol et al (1982) that combine the effects of barriers to entry and joint cost within a multi-product framework the banking industry.

The major threat to the theoretical foundations of the SCP paradigm though is the Efficiency Hypothesis, which is developed in the next sub-section.

The Efficiency Hypothesis

The efficiency hypothesis challenges the basic predictions of the SCP paradigm. The efficiency hypothesis posits that the relationship between market structure and performance of any firm is defined by the efficiency of that firm. In cases where a firm is highly efficient relative to the competitors, the firm can maximize profit by maintaining its current size and pricing strategy or by reducing prices and expanding its operations. If the firm chooses to expand its operations, it will eventually gain market share and thus, concentration will be a consequence of efficiency. The efficiency hypothesis is defined by a number of sub branches such as

the relative market power hypothesis and the efficient structure hypothesis.

The relative market power hypothesis argues that firm with large market shares and well-differentiated products will be able to able to exercise market power when pricing they products and earn super normal profits.

The efficient structure hypothesis states that only the efficiency of firms can explain the positive relationship between profits and concentration or profits and market share. The X-efficiency argument within this branch of literature states that those firms with superior management or production technologies have lower costs and therefore higher profits. By extension, those more efficient firms will gain greater market shares, which may result in a more concentrated market. In this context, efficiency influences the level of profit and market structure. The scale efficiency argument contends that firms may have comparable quality of management and technology, but some firms produce at a more efficient scale than other firms, thus they have lower unit costs and higher unit profits. Such firms are assumed to acquire larger market shares, which may result in higher levels of concentration. In this scenario, efficiency through an indirect process drives both profit and market structure.

Berger (1991) applied the relative efficiency hypothesis to US banking sector data. The results indicated that once efficiency issues related to individual firms are accounted for, levels of bank cost inefficiency exert greater influence on bank performance than market concentration. In another application of the relative efficiency hypothesis, Berger (1993) found that mergers and the degree of market overlap were generally statistically insignificant in explaining bank performance.

Other researchers such as Brozen (1982) and Gale and Branch (1982) have argued that the structure of an industry may be due to superior production efficiency of firms.[4] This is because production efficiency allows firms to increase their market share, thus leading to higher market concentration. This suggests that it not collusion or mergers that lead to higher than normal profits, but rather economies of scale and scope.

Demsetz (1973) argues that a positive relationship between profit rates and concentration may reflect different levels of pro-

[4] The following references were cited in; "The efficiency of financial institutions: areview and preview of research past, present and future." Allen Berger, et.al. Journal of Banking and finance 17 (1993): 221-249.

duction efficiency among firms, rather than more effective collusion, or higher concentration in the market.

An examination of studies that have been completed on banking sector data provides evidence to support both the SCP paradigm and the relative efficiency hypothesis. It is therefore not clear which factors have greater weight in terms of determining bank performance.

II. DATA AND METHODOLOGY

Data

A sample of forty-four banks was used to investigate the determinants of bank profitability in the Eastern Caribbean Currency Union. Statistics on bank profitability and the other variables were obtained directly from the Eastern Caribbean Central Bank. The model was estimated used semi-annual data for the period 1991 to 1999.

The ownership variable was defined as follows. International branch banks were assigned a value of 3, regional branch banks were assigned a value of 2, locally owned banks were assigned a value of 1, and government owned banks were assigned a value of 0. The concentration ratio was constructed using assets of the largest banks summing to approximately 70% of total commercial banking assets in the various countries. Due to the nature of the commercial banking market in the ECCU, this flexible approach had to be taken. In some instances, the largest three banks accounted for over 90 per cent of total assets. In other cases the largest three banks accounted for fewer than 60% of total assets. Thus, a flexible approach was utilized. The flexible approach may be limited in that it may not accurately reflect the level of concentration in each country, however, it is felt that it is the best approach given the underlying nature of the commercial banking market.

The size variable was constructed using total assets of the ECCB area banking system. Individual banks account for between 6 per cent and 1.2 per cent of the total assets of the commercial banking system. Commercial banks that account for between 6 per cent and 3.5% of total ECCB area banking assets were considered large and assigned a value of 2. Commercial banks with total assets that account for between 3.5% and 2 %were considered medium sized and assigned a value of 1. Banks

with assets representing less than 2 % of total ECCB area assets were considered to be small and assigned a value of 0.

Econometric Methodology

Ratio analysis was also in order to determine whether higher profitability of banks is associated with the size and ownership structure of banks. A fixed effect model using the pooled least squares approach will also be utilized to examine the influence of efficiency and structure variables on bank performance. The formulation of the model assumes that differences across individual banks can be captured in the constant term. In the fixed effect formulation can be defined as follows;

$$Y_t = i\alpha_{it} + \beta_{it} + \varepsilon_{it}$$

For i = 1,2 ……N cross sectional units and t = 1,2,……t.

This can be written in the following matrix format;

$$Y_1 = (I\ 0\ldots\ldots..0)\alpha_1 \ + \ X_1\beta$$

$$Y_2 = (\ I\ 0\ldots\ldots..0)\alpha_2 \ + \ X_2\beta$$

$$Y_n = (\ I\ 0\ldots\ldots..0)\alpha_n \ + \ X_n\beta$$

Or;

$$Y = [d_1, d_2\ldots\ldots\ldots\ldots d_n X]\begin{bmatrix}\alpha \\ \beta\end{bmatrix} + \varepsilon$$

Where d_1 is a dummy variable indicating the i^{th} unit. If we allow the nT *x* n matrix D = [d_1, d_2 …….. d_n]. Then putting together all nT rows gives;

$$Y = D\,\alpha + X\beta + \varepsilon$$

This is a classical regression model and in cases where n is small enough, the model can be estimated by ordinary least squares with K repressors in X and n columns in D.

The fixed effect model allows for the estimation of different intercept (α_i) coefficients for each for each bank within the pool. EVIEWS, the software package used for estimation, computes the fixed effects by subtracting the "within" mean for each variable and estimating ordinary least squares using the transformed data.

Model Formulation

The models were formulated in order to explore the tenets of the structure-conduct-performance hypothesis and the relative efficiency hypothesis. It has been hypothesized, that generally foreign branch banks perform better state owned banks and other indigenous banks. Performance, in this context includes factors such as efficiency, the level of unsatisfactory assets and profitability. This lends credence to the SCP hypothesis that the structure of the banking system does impact on the performance of banks within the system. The efficient structure hypothesis suggests that efficiency influences the level of profit and market structure. The following three models were estimated;

$$ROA = f\ (CON, OE, NI, SE, IN, SI, MD) \quad (1)$$

$$OE = f\ (CON, SI, MD, ROA) \quad (2)$$

$$CON = f\ (OE, NI, SE, MD, TA\ ROA) \quad (3)$$

Where, ROA is the return on assets ratio, CON is the level of market concentration in terms of assets, OE is the ratio of operating expenses to average assets, NI is the ratio of net interest income to average assets. The ratio of interest earned on loans to average total loans is defined as IN, SE is the ratio of staff expenses to total expenses. MD represents the market share of banks in terms of deposits, TA is the loans to deposit ratio and ML is market share in terms of loans.

In equation 1, profitability is explained as a function of the level of market concentration (CON) and the level of operating efficiency of individual banks. The ratio of operating expenses to average assets is a measure of the efficiency with which expenses generate increased assets in the individual banks. This ratio is expected to be negatively related to bank profitability. The ratio of staff expenses to total expenses is a measure of operating efficiency. The coefficient on the ratio of net interest income to average assets is expected to be positive. The coefficient of the ratio of interest earned on loans to average total loans (IN) is expected to carry a positive sign.

Concentration (CON) and market share in terms of deposits (MD) and size of a bank relative to other banks in the ECCB area (SI) were included in equation I in an attempt to test the validity of the SCP hypothesis in the context of the OECS. The market share in terms of deposits was included as banks in the ECCB area are predominantly involved in traditional banking business.

The SCP paradigm predicts that banks that operate in a more concentrated market, or have greater market shares are most likely to be able to use market power in order to increase their profitability. Thus, the SCP hypothesis will be validated if the coefficients associated with these variables are significant and positively related to profitability.

In equation 2, the efficiency of banks is represented as a function of market concentration in terms of assets (CON), size of the bank (SI), market share in terms of deposits and profitability in the last year. This equation was specified in order to determine whether the structure of the market has any influence on the efficiency of individual banks. It was also important to ascertain the influence of size on the efficiency of banks. The coefficient on the size variable is expected to positive as economic theory predicts that larger banks become more efficient as they benefit from economies of scale and scope.

Equation 3 was specified in order to test the relevance of the efficiency hypothesis. The efficient hypothesis predicts that, efficiency influences the level of profit and market structure. Thus, concentration is specified as a function of the ratio of operating expenses to average assets, the ratio of staff expenses to total expenses, the ratio of net interest income to average assets, the ratio of interest earned on loans to average total loans, and the loans to deposit ratio.

III. DISCUSSION AND RESULTS

Ratio Analysis

The profitability of banks classified as small, medium and large were examined and the results are presented in table 1 below.

The analysis reveals a positive relationship between profitability and size of commercial banks within the ECCU. The average return on assets for small banks over the period 1991 to 1999 stood at about 54% compared to a return of 130% and 147% for

TABLE 1. PROFITABILITY OF COMMERCIAL BANKS BY SIZE

	Mean Profit	*Var. Profit*	*No. of Banks*
Small Banks	0.54	1.94	19
Medium Banks	1.30	0.14	9
Large Banks	1.47	0.67	11

medium and large banks respectively. This positive linear relationship confirms the view that the performance of banks is partly determined by factors relating to the structure of the market within which banks operate. It should also be noted that small banks experience relatively high variability of profit when compared to medium and large banks. This may be due to the fact that smaller banks are not able to benefit from economies of scale, thus producing services at higher cost and reducing profit. Of the nineteen small banks within the sample, fifteen of these banks recorded less than 100% return on assets and five banks recorded losses over the relevant period. In contrast, medium and large banks did not record losses over the period.

TABLE 2. PROFITABILITY OF BANKS BY OWNERSHIP

	Mean Profit	*Var. Profit*	*No. of Banks*
Int'l branch	1.44	2.41	23
Reg. branch	0.66	1.20	8
Local banks	0.44	0.59	10
Gov't banks	0.93	0.10	3

The profitability of banks was also examined in relation to the ownership structure of the banks. Commercial banks were divided in four groups: international branch banks, regional branch banks, locally owned banks and government owned banks. International branch banks recorded the largest profits during the period 1999 to 1999. However, they also recorded very high variability in profits. This result is consistent with expectations as international branch banks can draw on the expertise and resources of their parent companies. Government owned banks are second in terms of profitability and experience the lowest variability of profits. This result is surprising as it is expected that government intervention in the banking sector may reduce the profitability of banks. However, this depends on the extent of government involvement in the activities of commercial banks. It must be noted that only three banks were examined and none of these banks are wholly government owned.

Low average profit and low variability of profits characterize locally owned banks. This may be due to the fact that these banks have used interest rate competition in an order to compete with the international branch banks. In addition, some local banks have not succeeded in increasing the range of services available to the customers, while other local banks have increased their costs

by setting up a number of branches. Regional branch banks rank third in terms of profitability and they experience high profit variability over the period. Most of regional branch banks were incorporated after 1992 and therefore they may be still at the gestation stage where interest costs are high in order to achieve a wider customer base.

Fixed Effect Models

The equations were estimated using the econometric package EVIEWS. The results from the pooled least squares estimation of the fixed effects model are presented in Table 3 below.

TABLE 3. POOLED FIXED EFFECTS MODELS

Explanatory Variables	*Dependent Variable*		
	ROA	*CON*	*OE*
CON	0.01		0.01***
SI	0.10		-0.22**
SE	0.74*	-0.05***	
NI	0.06**	-0.22**	
OE	-1.45*	0.31*	
IN	0.21***		
MD	-0.04	0.40**	-0.06**
ROA		0.05**	
ROA(-1)			-0.05
TA		1.50**	
R^2	*0.50*	*98.4*	*0.40*
F Statistic	*109.6**	*840.4**	*140.6**

NOTE: Intercept coefficients are not reported.
* Denotes significance at 1%. ** Denotes significance at 5%. *** Denotes significance at 10%.

The results from equation 1 reveal that the variables that were used as proxy structure variables were not significant in terms of explaining the level of profitability in the commercial banks in the ECCB area. The variables, size, market shares in terms of deposits and market concentration were all found to be insignificant. This may be due to the fact that it is difficult to determine whether size will influence profitability. Since there is heterogeneity in services provided across banks, it becomes difficult to define economies of scale or scope. This result does not confirm the lin-

ear relationship that was observed between bank size and profitability using ratio analysis. However, the variable size and concentration carried the correct sign. The market share in terms of deposits is negatively related to profitability. This may not be an unusual result, as the relationship will depend on how efficiently deposits are converted into loans, and the cost of holding deposits. The results suggest that the SCP hypothesis does not hold in the context of commercial banks in the ECCB area.

In equation 1 the efficiency related variables were all found to be significant. The operating expense to average assets (OE) was negatively related to profitability. This indicates that as the proportion of costs to productive assets becomes smaller banks can become more profitable. The ratio of personnel expenses to total expenses was positively related to profitability. This result is consistent if we assume that productivity increases as personnel expenses increase. The ratio net interest income to average assets is positively related to profitability. As banks become more efficient in terms of generating income from their assets, profits should increase. The sign on the coefficient of the ratio of interest earned on loans to average total loans is positive and this confirms the view that profitability should increase as the interest earned on loans increases. Thus, these results lend support the view that efficiency drives profitability.

In equation 2, market concentration is significant and positively related to operational efficiency, as proxied by the ratio of operating costs to average assets (OE). This suggests that cost inefficiencies are more likely in concentrated markets, as banks are better positioned to pass on these costs to customers. Size is significant and negatively related to operational efficiency, indicating that smaller banks are more cost efficient. This finding is inconsistent with the theory the larger banks tend to be more efficient as they benefit from economies of scale and scope. Market share in terms of deposits is significant and negatively related to operational efficiency. This suggests that as market share in terms of deposits increases operational efficiency falls. This result is consistent with the fact that operating costs increase as deposits grow. Thus, if deposits are not being converted into productive assets efficiently, this negative relationship will hold. Profitability in the last year was found to be insignificant in terms of determining market concentration. Thus, the market structure variables were found to be important in terms of explaining efficiency.

In equation 3 the ratio of operating costs to average assets is positively related to the concentration ratio. Is expected that cus-

tomers will bear a higher proportion of operational costs as market concentration increases. The personnel expense to total expenses (SE) is significant and negatively related to market concentration. The loans to deposits ratio is significant and positively related to concentration. Thus as banks become more efficient in providing their traditional banking services, market concentration increases. The ratio of net interest income to average assets is significant and negatively related to market concentration. As banks become more efficient in terms generating revenue from their assets, they may be able to expand their market share. However, if higher net interest income is due to non-competitive pricing polices, banks may not be able to increase market shares and concentration. The results from equation 3 lend support to the predictions of the efficiency hypothesis. The results suggest that the efficiency of commercial banks impact significantly on the market structure that is likely to emerge.

Estimation of the following pooled common effect models yielded the results presented in table 4;

$$\text{ROA} = f\,(\text{CON, OE, NI, SE, IN, SI, MD, OW}) \tag{4}$$

$$\text{OE} = f\,(\text{CON, TA, SI, ML, NP, OW}) \tag{5}$$

$$\text{CON} = f\,(\text{OE, NI, SE, TA, MD}) \tag{6}$$

The common effect formulation allows for the estimation of identical intercept coefficients for all pool members. The ownership variable was included in these models as it could not be included in the fixed effect models due to difficulty in calculating the covariance matrices.

Of particular interest, is that the ownership variable was significant and positively related to the proxy measure for operating efficiency. This suggests that foreign branch banks are more efficient than state owned and locally incorporated banks. However, the ownership variable was not significant in terms of explaining changes in profitability of banks. The efficiency variables were important determinants of the level of market concentration, thus lending support to the efficiency hypothesis.

IV. CONCLUSION

The paper sought to assess the relevance of the structure-conduct-performance (SCP) and relative efficiency hypotheses in

explaining the performance of the banking industry in the ECCU. Equations were specified in an effort to determine whether variables relating to the structure of the banking system exert greater influence on profitability, or whether it is the efficiency of the banking firm that drives profits and ultimately market structure.

TABLE 4. POOLED COMMON EFFECTS MODELS

Explanatory Variables	*Dependent Variable*		
	ROA	*CON*	*OE*
CON	-0.01*		-0.01**
SI	-0.03		-0.13**
SE	0.06**	-0.10**	
NI	0.60*	0.25	
OE	-1.45*	-0.81**	
IN	0.32*		
MD	0.09***	2.48*	-0.06**
ML			-0.01**
OW	0.01		0.14*
TA		-11.9*	
R^2	*0.44*	*72.9*	*0.24*
F Statistic	*69.3**	*397.8**	*38.32**

NOTE: Intercept coefficients are not reported.

* Denotes significance at 1%. ** Denotes significance at 5%. *** Denotes significance at 10%.

The results from the exercise are strongly biased towards the efficiency hypothesis. In examining the factors that determine profitability the proxy measures for market structure; size, market concentration, market share of deposits and ownership were insignificant. In contrast the efficiency variables such as the proxy for operational management, and efficiency in terms of generating revenue from assets were significant determinants of profitability. Thus, when one examines profitability as a measure of performance, the results lends little support to the SCP paradigm. When operational efficiency was used as a proxy for performance the market structure variables, such as ownership and market concentration were significant in determining performance. In that regard, the SCP hypothesis receives some measure of support.

In examining the impact of the efficiency variables on the level of market concentration, the results confirm the predictions of the relative efficiency hypothesis. The evidence therefore suggests that efficiency of commercial banks is more important in terms of determining profitability. One can therefore conclude from the results, that the relative efficiency hypothesis is more relevant in the context of the ECCU.

Further research should involve the dis-aggregation of the data set into smaller groups according to structural factors such as size and ownership, in an effort to determine whether the results vary across groups. The use of cost functions in other to calculate measures of economies of scale and scope and cost efficiency among banks, may also be useful approach.

REFERENCES

Berger, Allen, and Loretta Mester. "Inside the Black Box: What Explains Differences in the Efficiencies of Financial Institutions." *Journal of Banking and Finance* 21(1997): 895-947.

Berger, Allen, "Profit Structure Relationship in Banking Tests of Market Power." *Journal of Money Credit and Banking* 27(1995): 404-431.

Berger, Allen, "The Relationship between Capital and Earnings in Banking." *Journal of Money Credit and Banking* 27(1995): 432-455.

Berger, Allen, William Hunter and Stephen Timme. "The Efficiency of Financial Institutions." *Journal of Banking and Finance* 17 (1993): 221-249.

Bhattacharya, Sudipto "Contemporary Banking Theory." *Journal of Financial Intermediation* 3(1993):3-50.

Ferrier, G. and K. Lovell. "Measuring Cost Efficiency in Banking: Econometric and Linear Programming Evidence." *Journal of Econometrics* 46 (1990): 229-245.

Joseph Fields, Neil B. Murphy and Dogan Tirtiroglu. "An International Comparison of Scale Economies in Banking: Evidence from Turkey." *Journal of Financial Services Research* 7(1993): 111-125.

Greene, William. *Econometric Analysis*. Macmillan Publishing Company, New York, 1993.

Grliches, Zvi. *Output Measurement in the Service Sectors*. University of Chicago Press, 1992.

Gollinger, Terri, and John Morgan "Calculation of an Efficient Frontier for a Commercial Loan Portfolio." *Journal of Portfolio Management* Winter (1993): 39-46

Hunter, William and Stephen Timme. "International Comparison of Bank Production Characteristics and Technological Change." *Applied Economics* 24(1992): 45-57.

Nathan, Ali and Edwin H. Neave. "Operating Efficiency of Canadian Banks." *Journal of Financial Services Research* 6(1992): 265-276.

Ruthernberg, David. " Structure Performance and Economies of Scale in Banking in a Unified Europe." *Bank of Israel Review* 4(1994): 95-114.

Sherrill Shaffer "A Test of Competition in Canadian Banking." *Journal of Money Credit and Banking* 25(1993): 49-61.

Stanhouse, Bryan. "Credit Evaluation, Information Production and Financial Intermediaion." *Journal of Financial Services Research* (1993): 217-233.

Tobin, James. "The Commercial Banking Firm." *Scandinavian Journal of Economics* 4 (1982): 495-530.

Vittas, Dimitri. *Measuring Commercial Bank Efficiency*. Policy Research Working Paper 806, World Bank, November 1991.

Williams, A. "Factors Affecting the Performance of Foreign Owned Banks in Australia: A Cross-sectional Study." *Journal of Banking and Finance* 22(1998): 197-219.

Worrell, DeLisle. *Bank Behavior in Small Open Economies*. Central Bank of Barbados, 1996.

Rudolph Matthias
Allisha Abraham

The impact of cash flow on corporate investment in Trinidad and Tobago

INTRODUCTION

The role of finance in economic development has been debated over the years. These discussions were joined by Adam Smith (1776) and later Joseph Schumpeter (1912). An early view was that the availability of finance was crucial to economic growth. Support for this view was provided by Tinbergen (1939, pp. 49) in one of the earliest studies on investment. Tinbergen (1939) found "that the fluctuations in investment activity are in the main determined by the fluctuations in profits …some months later". In a later study Meyer and Kuh (1957, pp. 192) support this view noting that "the investment decision is subject to a multiplicity of influences…" but that there was a "clear tendency for liquidity and financial considerations to dominate the investment decision in the short run".[1]

Firms that rely heavily on internal sources of funds to finance

[1] Quoted in Chirinko and Schaller (1995).

Paper prepared by R. Matthias and A. Abraham, from the Research Department of the Central Bank of Trinidad and Tobago.

their new investments may find that investment is highly correlated with profits. Business cycles can be exacerbated in countries where large numbers of firms rely heavily on internally generated cash flow to finance their investments. For example, in periods of recession when profits are likely to be low, aggregate investment is also likely to be low if firms in general rely on profits to finance investments. However, in countries with well functioning capital markets, firms' investment spending need not be tied to internally generated funds.

In the perfect capital markets of Modigliani and Miller (1958), firms may access any amount of funds externally, either in the form of debt or new equity. In such environments, the investment spending of profit maximising firms will be constrained only by the availability of positive net present value projects. In practice, however, capital markets are not perfect in the way Modigliani and Miller assume.

While Modigliani and Miller (1958) also argue that firms operating in perfect capital markets would be indifferent between financing by debt or equity, in practice, firms do appear to target a capital structure that comprises a certain proportion of debt and equity. One advantage of using debt is that the interest cost of debt provides a tax shield. However, firms have to limit the amount of debt they issue to avoid bankruptcy. To achieve the desired capital structure or to gain new capacity for borrowing, firms must issue new equity or retain internal funds. However, because firms tend to incur high transaction costs (especially small ones)[2] and pay a significant "lemon's" premium (especially those firms that are of good quality) for new shares,[3] these factors tend to act as a deterrent to firms that wish to issue new shares.

Whether firms can secure the funds they need to undertake profitable investment projects is an important consideration for economic policy making, mainly because firms are the engines of growth. In Trinidad and Tobago, two surveys on this issue were conducted in recent years. The first study was done by Farrell *et al.* (1986) and later updated by Clarke *et al.* (1992), using a larger and more representative sample of firms.

In their study, Farrell *et al.* investigated, among other things,

[2] Since transaction cost tend to have a fixed component, the cost per dollar of fund raised tend to be highest on small issues, which are more likely to be issued by small and medium sized firms.

[3] The Akerlof (1970) lemon problem always operates against the best quality and most efficient firms.

the constraints to growth that firms faced. The results reported in Table 1 show that of the sixty-nine sample firms, availability of finance was ranked third, after market size and management talent, as one of the most important factors that constrained firms' investment and growth. They also found that, on average, firms financed 51 percent of their investments from internally-generated resources, a ratio which is only slightly lower than that of more developed countries like the US and the UK (see Table 2).

TABLE 1. SIGNIFICANCE ATTRIBUTED BY FIRMS TO VARIOUS CONSTRAINTS ON THEIR OPERATIONS, LEVEL SIGNIFICANCE (in percentage distribution)

Type of constraint	*Very important*	*Important*	*Of minimal importance*	*Non response*		*Total*
Market size	73.9	17.4	2.9	5.8	-	100
Availability of finance	53.6	29.0	4.3	5.8	7.3	100
Availability of management	42.0	45.0	7.2	4.3	1.5	100
Availability of technical staff	42.0	43.6	5.8	4.3	4.3	100
Cost of finance	31.9	47.6	8.7	5.8	5.8	100

SOURCE: Corporate Financing and Bank Credit.

TABLE 2. RELATIVE IMPORTANCE OF INTERNAL AND EXTERNAL SOURCES OF FUNDS IN SELECTED COUNTRIES

Country	*Period*	*Internal funds/total funds*
United Kingdom	1970's	60
Germany	1970's	60
USA	1981	66
Japan	1967-1971	38
Guyana	1971	44
Trinidad & Tobago	1981/82	51 (Mean)
Trinidad & Tobago	1981/82	32 ((Median)

SOURCE: Corporate Financing and Bank Credit.

With respect to external sources of funds, the results show a strong preference for bank finance. Table 3 shows that financing comprised of overdraft facilities and bank loans accounted for 60 percent of total external funds. Other borrowing accounted for 33.7 percent while reliance on the stock market through the issuance of new shares was minimal, with new share issues accounting for 2.9 percent of total external funds.

TABLE 3. SOURCES OF FUND*

	Sources	% Distribution
i)	Cash & Bank balances	49.8
ii)	Trade Credit	17.2
iii)	Bank Loans	10.2
iv)	Other Loans	5.7
v)	Issue Of Shares	2.9
vi)	Other sources**	13.6
	Memo: External funds ratio	49.0 (mean) 68.0 (median)

SOURCE: Corporate Financing and Bank Credit.

* 47 firms supplied data for 1982, 14 for 1981 and 2 for 1980. ** Includes decreases in trade debtors, decreases in inventories and other working capital changes as web as decreases in financial investments and sales of fixed assets.

Internal funds as a source of investment financing has been growing in importance over the years (Table 4). In the 1982 survey, 26 percent of the respondents said that over 80 percent of their fixed assets were financed from internal resources. In the 1990-92 survey, 38 percent of them said that over 80 percent of their investment were financed internally.[4]

TABLE 4. INTERNAL FINANCING OF INVESTMENT IN FIXED ASETS, 1975-80, 1981 AND 1982

Percentage distribution	*1975-80*	*1981*	*1982*
Non-response	27.5	10.0	11.6
Not applicable	1.4	5.8	7.2
Nil	31.9	42.0	31.9
1-29	8.7	8.7	11.6
30-49	2.9	5.8	2.9
50-79	7.2	7.2	8.6
80-100	20.2	20.3	26.0
Total	*100.0*	*100.0*	*100.0*

These surveys have provided useful insights into corporate financing decisions and apparent constraints on firms' investment and growth. This study extends the work of these two surveys in

[4] Clarke *et al.* (1992).

some respects. It does so by examining the issue of investment financing constraints among listed companies in Trinidad and Tobago over the period 1986 to 2000. Before examining the data and results, a literature review is presented.

LITERATURE REVIEW

The work of Modigliani and Miller (1958) provides the mainstream position on the investment-finance nexus. They show that in perfect capital markets, there will be no cost differential between internal and external sources of finance. Internal and external finance will be perfect substitutes. Firms will therefore be indifferent between internal and external funds for their investments. Consequently, investment decisions will depend only on the expected future profitability of the project. Many have argued, however, that in the real world, capital markets are imperfect. There are market frictions, taxes and information asymmetry, which have led to agency problems among other things. And because of these problems, internal and external finance may not be perfect substitutes.

In imperfect markets, some firms may face difficulty accessing external funds. With respect to debt financing, Jensen and Meckling (1976) argue that agency problems—an example of which is conflict between owners and creditors—could arise in the presence of asymmetric information and these problems could lead to an increase in the marginal cost of debt finance to the firm. The Akerlof (1970) lemon's argument—when investors are unable to discern differences in the quality of borrowers—has also been used to show that in the presence of asymmetric information, good companies may have to pay a relatively high premium to raise new shares. Transaction costs (underwriting discounts, registration fees, taxes, selling and other administration expenses) associated with new share issues also make stock market financing more expensive than internal finance.

Myers and Majluf (1984) put forward a different argument based on asymmetric information. They point out that when the premium on external financing is high, the firm might refuse even those projects, which yield positive net present values (NPV). Firms that cannot convince existing shareholders to buy and hold the new issue of shares may undertake the positive NPV projects only if debt securities can be issued. Firms in this situation with sufficient retained earnings may undertake all positive

NPV projects. Retained earnings therefore help avoid the under pricing associated with new share issues and pricey debt. Myers (1984) refers to this as the pecking order of financing where firms prefer retained earnings than risky debt and as a last resort, new share issues.

Several empirical studies have attempted to test the relationship between financial factors and firms' investment behaviour. The Q (the ratio of a firm's assets relative to the cost of producing those assets) model is one approach that is commonly employed. Neo-classicals have also used both structural investment models (see, Jorgenson and Siebert, 1968) and sales accelerator models to measure investment-cashflow sensitivity.

Many of the studies have examined this issue by classifying firms according to some segmenting variables, which is thought to distinguish firms that are constrained from those which are not. The idea is to classify firms based on some exogenous variable, some of which include maturity, concentration of ownership, membership of an industrial group, manufacturing/non-manufacturing and credit rating (Kadapakkam *et al.*, 1997).

Fazarri, Hubbard and Petersen (1988), (FHP), is one of the earliest and best-known studies of investment and cash flow constraints. FHP used data on a wide cross-section of manufacturing firms and classified these firms based on dividend payout. They argue that firms with average low payout ratios are more likely to be financially constrained than those with average high payout. While they found that cashflow was positively correlated with the investment spending of all firms, they also found that the sensitivity of cashflow to investment was much greater for firms with low dividend payout ratios. They interpret this high cashflow-investment sensitivity as evidence of financial constraint.

Gilchrist and Himmelberg (1995) and Chirinko and Schaller (1995) provide support for the cashflow-investment sensitivity. Chirinko and Schaller (1995) found that information asymmetry and transaction costs were possible sources of financing constraints for over 200 Canadian firms in their analysis. They considered their results as strong evidence that firms in a weaker information position had higher liquidity-investment sensitivities.

However, the link between cashflow and investment, and in particular the interpretation of these findings as financing constraints have generated widespread debate. Kaplan and Zingales (1995) (KZ) are perhaps the best known critique of the cashflow-investment sensitivity and cashflow constraint argument. In their study, which analyzes the same firms identified in FHP's 1988

work, they found that only a small percentage of these firms had actual difficulty financing their investment whether from internal or external sources. For this reason, they criticized FHP for not sufficiently addressing the question whether higher cashflow-investment sensitivity was related to financing constraints.

In an attempt to answer this question, KZ used previously unexplored data sources to assess which firms faced financing constraints. They relied to some extent on qualitative data such as annual reports, management's discussion of liquidity conditions and future investment plans, as well as other public news to complement quantitative data collected. This was done for each firm year. The idea was to gauge whether the firm could be correctly classified as financially constrained by the availability of internal and/or external funds.

KZ found that in only 15 percent of firm-years was there genuine indication that firms had difficulty accessing investment funds. More surprisingly, those firms classified as less financially constrained according to KZ's classification exhibited far greater investment-cash flow sensitivity than those categorized as financially constrained. KZ used agency cost arguments to explain these surprising results suggesting that managers choose to rely primarily on internal cash flow for investment despite the availability of additional low cost external finance.

KZ's findings suggest a less than one-to-one relationship between investment-cash flow sensitivity and financial constraints. This prompted them to ask what then is the source of firms' investment-cash flow sensitivity, and why do financially constrained firms demonstrate lower sensitivities, while companies facing no identifiable constraints exhibit higher sensitivities. Some possible reasons they put forward for these apparent anomalies are: a) financially constrained firms are in fact financially distressed, so that any excess cash is directed to servicing loans rather than for investment purposes. b) Seemingly financially unconstrained firms are in fact financially constrained. c) Firms that are unconstrained engage in precautionary savings to compensate for future shortages of cash. d) The cost of modifying capital expenditure due to cash flow shocks is high.

Kaplan and Zingales conclude that their research points to several telling implications: a) greater cash flow-investment sensitivity does not provide ample evidence of financing constraints. b) If high sensitivity among unconstrained firms is due to managers choosing to rely mainly on internal funds despite the availability of low cost external financing this may be symptomatic of agency

problems caused by overly risk-averse managers. If however, managers' decisions are based on justifiable caution, then their policies are in fact sound and not irrational. Whatever the reason for firms' investment decisions, KZ's results suggest that policies designed to make credit more readily available in periods of recession, for example, may not necessarily lead to increased investment as expected.

Since their work was published, other studies have found evidence to corroborate the findings of KZ. Kaddapakam, Kumar and Riddick (1998) examined the degree to which cash flow availability influences investment in six OECD countries. Much of their empirical work attempt to ascertain the extent to which reliance on internal funds was influenced by firm size based on the view that smaller firms have less access to external capital markets and as a result may be more dependent on internal funds. Larger firms, on the other hand, are thought to have better access to external finance since they face comparatively lower transaction costs, are less susceptible to the effects of information asymmetries and are less affected by agency problems because of greater monitoring by large institutional shareholders who can in some respects constrain managerial actions.

Kaddapakam *et al.* (1998) results indicate that, in general, all firms regardless of size were affected by the availability of internal financing. However, after segmenting the sample according to size, they found that, contrary to a priori expectations, the highest cash flow-investment sensitivity was exhibited among the largest firms and the lowest sensitivity among the smallest firms. Like KZ, Kaddapakam *et al.* (1998) explain these findings by appealing to managerial agency factors as well as the likelihood that larger firms may have enjoyed greater flexibility with respect to their investment timing decisions and therefore were better able to adjust capital expenditure in response to cash flow shocks. Hence, they too conclude that the degree of sensitivity between cash flow and investment cannot accurately measure corporate financing constraint or ease of access to capital markets.

In his critique of research done by Lamont (1997), Schnure's (2000) findings also support those of KZ. Lamont found high cash flow-investment sensitivity for 26 large oil-dependent firms whose oil revenues fell around 1986 and interpreted this sensitivity as evidence of financial constraints and capital market imperfections. However, after careful re-examination of both quantitative and qualitative firm data, Schnure (2000) conclude that many of the large firms identified as financially constrained by Lamont

were by no means cash or investment constrained. Schnure (2000) therefore agrees with KZ on two grounds. Firstly, that in this kind of investigative work, the measurement of cash flow and liquidity condition is important. Secondly, that caution should be exercised in interpreting high investment-cash flow sensitivities as evidence of financing constraints.

There has also been some debate between FHP and KZ. In subsequent work FHP (1996) criticised KZ pointing out that KZ's determination of financial constraint is complex and judgmental. For instance, FHP argue that statements by managers, which KZ used in their analysis, might not always reflect economic reality. Nevertheless, FHP goes on to argue that the overall results of the study done by KZ lend support to their main findings that a firm's investment decisions may in fact be affected by financial factors.

The present study extends this kind of work to listed companies in Trinidad and Tobago. The study employs a standard econometric model to examine the effects of cash flow on corporate investment. The objective is to identify the extent to which, if any, financial factors constrain firms' investment. The next section of this paper presents a discussion of the data and methodology. This is followed by the results of the study and some concluding remarks and discussion.

DATA AND METHODOLOGY

Data description

The data for this analysis came from the Trinidad and Tobago Stock Exchange (TTSE) company dataset. At the end of 2000, twenty-eight (28) companies were listed on the TTSE. Since the analysis focuses on firms making physical investment and generating sales in the product market, six (6) listed financial companies were excluded. Three (3) regional companies, which are cross-listed on the TTSE were also excluded since their centre of economic activity is outside of Trinidad and Tobago. Finally, one (1) company was omitted as it has only two years of published data available. This leaves us with a sample of eighteen (18) non-financial listed companies.

Table 5 gives a list of sample companies and data availability. Twelve (12) of the companies included in the study are manufacturing firm. The remaining six (6) are non-manufacturing firms.

TABLE 5. SAMPLE COMPANIES DATA AVAILABILITY, 1986 -2000

Company	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*Years of data available*
Non-Manufacturing																
Agostini	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*15*
ANSA McAL	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*15*
Furness	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*15*
LJ Williams	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*15*
Neal & Massy	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*15*
Valpark	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*15*
Manufacturing																
Angostura Holdings	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*15*
Berger	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*15*
CCN	N/A	N/A	N/A	N/A	N/A	1	1	1	1	1	1	1	1	1	1	*10*
Flavourite	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*15*
Lever Brothers	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*15*
MoraVen Holdings	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	1	1	1	1	*5*
National Flour Mills	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	1	1	1	1	1	*6*
Point Lisas	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*15*
ReadyMix	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*15*
Trinidad Cement	N/A	N/A	N/A	1	1	1	1	1	1	1	1	1	1	1	1	*12*
Trinidad Publishing	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*15*
West India Tobacco	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*15*
	14	*14*	*14*	*15*	*15*	*16*	*16*	*16*	*16*	*17*	*18*	*18*	*18*	*18*	*18*	*243*

As the table shows, sample companies have data ranging from five (5) years to fifteen (15) years between period 1986 and 2000. The sample is unbalanced, with a total panel of two hundred and forty three (243) firm years of data.

Descriptive statistics for the full sample and variables used in the regressions are given in Table 6. The smallest company in any year had capital stock of TT$1.8 million and the largest TT$1.7 billion, with a median of TT$48.9 million. The median firm had an investment to capital stock ratio of 9 percent, cash flow to capital of 10 percent and a Q ratio of 0.75. Over the period 1986 to 2000, the median firm also paid out 46 percent of its earnings as dividends.[5] However, as indicated by the large standard deviation for each variable, our sample includes a broad range of firms with regard to size, investment behavior, and financial health.

TABLE 6. DESCRIPTIVE STATISTICS OF THE FULL SAMPLE, 1986-2000

	Mean	*Std. Dev.*	*Median*	*Minimum*	*Maximum*
Capital stock	182,459	302,306	48,957	1,805	1,759,382
Investment to capital stock	0.18	0.40	10	-0.65	3.64
Cash stock to capital	0.13	0.18	0.08	0.00	1.17
Cash flow to capital	0.14	0.18	0.10	-0.23	1.83
Sales growth	10.52	25.80	7.24	-61.18	209.94
Sales to capital	2.46	3.16	1.48	0.08	26.11
Dividend payout*	0.49	0.33	0.46	0.00	1.00
Tobin Q	1.11	0.96	0.75	0.03	4.51

* Maximum dividend payout in any year was constrained to +100%.

Table 7 provides means and standard deviations for firms segmented by size, dividend policy and industry classification. Given the small size of the sample, we divide the sample into tertiles to maintain sufficient observations in each category. With respect to size, the smallest firms (those in the first tertile) have average capital stock of $23.8 million. Firms in the second tertile are, on average, twice as large as small firms, and those in the third tertile are twenty times as large as the smallest firms. Firms in the second tertile have the lowest internally generated cash for

[5] In any year in which dividend payment exceeded net earnings or in cases were dividends were paid but current profits were negative, the dividend payout ratio was taken as 100 percent.

TABLE 7. MEAN AND STANDARD DEVIATION (I N BRACKETS) FOR FIRMS BY SIZE, DIVIDEND PAYOUT AND INDUSTRY

Firms size is based on the average value of capital stock over sample period. Firms in the first tertile are the smallest firms or have the lowest dividend payout ratios. Those in the third tertil e are the largest firms or have the highest dividend payout ratio.

	Firm size 1st Tertile	*Firm size 2nd Tertile*	*Firm size 3rd Tertile*	*Dividend payout 1st Tertile*	*Dividend payout 2nd Te rtile*	*Dividend payout 3rd Tertile*	*Manufactur-ing firms*	*Non-Manufac-turing firms*
Capital stock	23,813 [16,697]	52,994 [19,586]	489,996 [380,764]	146,815 [251,627]	224,104 [379,610]	172,640 [248,656]	100,087 [196,644]	290,719 [375,341]
Investment to capital stock	0.18 [0.42]	0.17 [0.46]	0.18 [0.30]	0.22 [0.61]	0.21 [0.28]	0.11 [0.18]	0.23 [0.49]	0.11 [0.20]
Cash stock to capital	0.11 [0.20]	0.12 [0.17]	0.16 [0.16]	0.12 [0.21]	0.13 [0.17]	0.16 [0.17]	0.18 [0.22]	0.08 [0.08]
Cash flow to capital	0.19 [0.26]	0.10 [0.09]	0.12 [0.09]	0.15 [0.28]	0.15 [0.11]	0.12 [0.09]	0.19 [0.22]	0.08 [0.07]
Sales growth	8.26 [21.11]	10.52 [31.05]	13.13 [25.25]	14.76 [37.33]	11.12 [18.35]	5.87 [17.23]	13.16 [27.82]	7.06 [22.55]
Sales to capital	3.37 [4.56]	2.49 [2.03]	1.39 [1.10]	2.59 [5.10]	1.97 [1.24]	2.86 [1.87]	3.25 [3.89]	1.43 [1.17]
Dividend payout*	0.33 [0.27]	0.72 [0.34]	0.45 [0.26]	0.21 [0.23]	0.49 [0.22]	0.76 [0.29]	0.49 [0.32]	0.48 [0.34]
Tobin Q	0.82 [0.65]	1.54 [1.31]	1.03 [0.70]	0.79 [0.74]	1.08 [0.64]	1.43 [1.28]	1.45 [1.10]	0.65 [0.40]

* Maximum dividend payout in any year was constrained to +100%.

flow (10%), investors clearly believe that they had the most valuable investment opportunities as evidenced by their Q (1.54) ratio, the highest of the three categories. Even so, their investment rates did not exceed that of the overall sample, and these firms paid out the highest rate of dividends (72%) of all sample firms.

Segmenting the sample by dividend payout ratios, we find that firms with high dividend payout ratios have the highest Q and cash stock. However, among the three categories, these firms also have the lowest rates of investment and internal cash flow generated. While the average manufacturing and non-manufacturing firms have similar payout ratios, the similarities appear to end there. The average manufacturing firm has cash resources (cash stock and cash flow) that are at least twice as large as that of non-manufacturing firms. And with Q and sales growth rates that are more than twice as large as their counterparts, manufacturing firms achieved investment rates that are twice as large. Manufacturing firms appear to have outperformed non-manufacturing firms.

Model

To examine the possible financial constraints on firms' investment spending, we employ a variant of the Q-model of investment. The Q theory of investment was introduced by Keynes (1936) and developed by Brainard and Tobin (1968), Tobin (1969). In this theory, a forward looking firm faced with costs in adjusting its capital stock will have its investment expenditures determined by Marginal Q, the ratio of the discounted future revenues from an additional unit of capital to its purchase price. In the absence of taxes and capital market imperfections, a value-maximizing firm will invest as long as the shadow price of an additional unit of capital, marginal Q, exceeds unity.

Since Marginal Q is unobservable, empirical studies employ Tobin's average Q, defined as the market value of the firm to the replacement cost of its existing capital stock. Tobin's average Q therefore incorporates information about future conditions and how these are likely to affect firms' investment. In effect, average Q incorporates the capital market's evaluation of the firm's investment opportunities. The basic Q model is:

$$I_{it}/K_{it} = \mu_i + \mu_1 Q_{j,t-1} + \mu_{it}$$

Where μ_i is the normal value of investment scaled by capital stock (I_{it}/K_{it}) for the ith firm and μ_{it} is the error term.

Using the Q model and assuming perfect capital markets, there is no reason to expect fluctuations in internal finance (cash flow) to have a significant impact on investment, unless firms must pay a premium to access external funds for their projects. To examine whether our sample firms face these financing constraints, we follow other studies and use the following Q model, which is augmented by internal finance, cash stock and sales.

$$I_{it}/K_{i,t-1} = \beta_1 Q_{j,t-1} + \beta_2 CF_{it}/K_{i,t-1} + \beta_3 CS_{it}/K_{i,t-1} + \beta_4 S_{i,t-1}/K_{i,t-2} + \varepsilon_{it}$$

The dependent variable is investment to capital stock (I_{it}/K_{it-1}), I_{it} is investment in plant, equipment, and long-term investments. We focus on spending on fixed assets and long term assets as these reflect management's deliberate decision to use corporate resources. In contrast, changes in current assets occur in the normal course of business. Capital stock K_{it-1} is the beginning-of-period capital stock, defined as the net book value of plant, equipment, and long-term investments.

Tobin's Q ($Q_{j,t-1}$), is calculated as the ratio of firm market value to firm book value at the beginning of the period. Market value is the sum of market value of outstanding common equity, book value of long-term debt and preferred stock at the beginning of the year. Firm book value is the book value of common equity plus the book value of long-term debt and preferred stock. Cash-flow to capital (CF_{it}/K_{it-1}) is cash flow generated during the year, measured as the sum of net income plus depreciation, amortized intangibles and deferred taxes, less dividends divided by beginning-of-period capital stock. Cash stock to capital stock (CS_{it}/K_{it-1}) is the sum of cash and marketable securities at the beginning of the year divided by beginning-of-year capital stock. Sales to capital stock (S_{it-1}/K_{it-2}) is the value of net sales to beginning of period capital, each variable being lagged one period.

We estimate the above model, using the "within estimators" approach, which requires suppression of the intercept term. Fixed time effects capture aggregate business-cycle influences and other unobserved time-invariant links between a firm's investment and explanatory variables. For example, problems of high values of Tobin's average Q, stemming from monopoly rents not captured by our simple model are likely to be eliminated by using fixed-effects methods.[6] We run several variations of this model,

[6] Lindenberg E.B. and Ross, S.A. (1981), "Tobin's Q ratio and industrial organisation", Journal of Business, Vol. 54, pp. 1-32; Salinger, M.A. (1984),

dropping one or more of the explanatory variables at times, and including an explanatory variable with a lagged term. Given the relatively small size of the sample, we try where possible to run a parsimonious model. For this reason, we include only one lagged term.

RESULTS

Tables 8 to 13 present OLS estimates for the full sample and for the sample segmented by dividend payout, industry and a measure of firm size. Regressions were run for the full sample period 1986 to 2000 and for shorter time periods within this sample period to gauge whether the importance of cash flow changes over time.

Full sample results

Panel A of Table 8 reports estimates for the most basic model. In these models, we regress investment on internally generated cash flow and Q after controlling for firm time invariant effects. Our results show a strong positive relationship between investment and internally generated funds. The coefficients on the cash flow variable range from 0.511, in the five-year period 1986 to 1990, to 1.169, in the five-year period 1996 to 2000. All coefficients are statistically significant at the 10 percent level or better. These results suggest that investment is affected by the availability of internal finance.

As is typically found the coefficient on Tobin's Q is positive and close to zero, but unlike most studies, the coefficients are not statistically significant in our study. For example, in their model, which regresses investment on Q and cash flow, Kaplan and Zingales (1995) report statistically significant Q ranging from 0.021 to 0.039 over various time periods between 1970 and 1984. In the present study, the Q coefficient range from 0.08 to 0.239 and only the coefficient in time period 1986 to 2000 is statistically significant.

Since Q is based on asset prices which are determined in markets where investors are supposed to take a forward-looking

---

"Tobin's Q, unionization and the concentration-profits relationship", Rand Journal of Economics, Vol. 15, pp. 159-70.

TABLE 8. EFFECTS OF CASHFLOW AND Q ON INVESTMENT, 1986-2000

Dependent variable is investment to capital stock (I_{it}/K_{it-1}), where I_{it} is investment in plant, equipment, and long-term investments, and K_{it-1} is the beginning-of-period capital stock. Independent variables are defined as follows: Tobin Q ($Q_{i,t-1}$) is the ratio of firm market value to firm book value. Market value is the sum of market value of outstanding common equity and book value of long-term debt and preferred stock at the beginning of the year. Firm book value is the book value of common equity plus the book value of long-term debt and preferred stock. Cashflow to capital (CF_{it}/K_{it-1}) is cash flow generated during the year, measured as the sum of net income plus depreciation, amortized intangibles and deferred taxes, less dividends divide by beginning of period capital stock.

Panel A	*1986-2000*	*1991-2000*	*1986-1995*	*1986-1990*	*1991-1995*	*1996-2000*
CF_{it}/K_{it-1}	1.072**	1.090**	1.015*	0.511***	0.797*	1.169***
	[0.481]	[0.534]	[0.288]	[0.275]	[0.307]	[0.619]
Q_{it-1}	0.080	0.081	0.084	0.054	0.043	0.239***
	[0.074]	[0.086]	[0.057]	[0.071]	[0.117]	[0.142]
Adjusted R^2	0.27	0.23	0.20	0.08	0.17	0.22
No of observations	241	170	151	71	80	90
Panel B	*1987-2000*	*1991-2000*	*1987-1995*	*1987-1990*	*1991-1995*	*1996-2000*
CF_{it}/K_{it-1}	0.952**	0.962***	0.981*	0.490	1.023*	1.121***
	[0.464]	[0.503]	[0.242]	[0.351]	[0.339]	[0.637]
CF_{it-1}/K_{t-2}	0.266	0.286	0.976*	-0.483	1.153*	0.129
	[0.298]	[0.340]	[0.333]	[0.520]	[0.412]	[0.502]
Q_{it-1}	0.063	0.065	0.016	0.061	0.034	0.222
	[0.083]	[0.093]	[0.073]	[0.109]	[0.110]	[0.170]
Adjusted R^2	0.28	0.24	0.27	0.06	0.25	0.21
No of observations	225	168	136	57	79	89

* Indicate significance at 0.01. ** Indicate significance at 0.05. *** Indicate significance at 0.10.

stance and prices should reflect expected profitability of the company, it should help to capture the profitability of new investment spending and hence should be highly correlated with investment spending decisions. The low explanatory power of Q in our results appear to indicate that earnings expectations captured by Q do not convey much useful information about firms' investment spending.

Panel B of Table 8 reports estimates for the model, which in-

cludes cash flow, lagged one period. The results are similar to those of Panel A of the table. Although the size of the coefficient reduces in absolute terms, the cash flow coefficients remain positive and statistically significant in five of the six regressions, and the lagged term is also positive in five of the six regressions and statistically significant in two. These results suggest that the firm's cashflow and profitability from past years also have significant impact on investment spending in the current period. Although the adjusted R^2 improves slightly with the inclusion of the lagged cash flow term, the Q coefficient while remaining positive lacks significant explanatory power.

TABLE 9. EFFECTS OF CASH FLOW, CASH STOCK AND Q ON INVESTMENT, 1987-2000

Dependent variable is investment to capital stock (I_{it}/K_{it-1}), as described in Table 8. Independent variables are cash stock to capital stock (CS_{it}/K_{it-1}) which is the sum of cash and marketable securities at the beginning of the year divide by beginning of year capital stock. The other independent variables are as defined in Table 2.

Panel A	*1987-2000*	*1991-2000*	*1987-1995*	*1987-1990*	*1991-1995*	*1996-2000*
CF_{it}/K_{it-1}	1.069**	1.051***	1.077*	0.499	0.803*	1.130***
	[0.500]	[0.553]	[0.314]	[0.357]	[0.314]	[0.673]
Q_{it-1}	0.112	0.117	0.103	0.058	0.049	0.235
	[0.136]	[0.152]	[0.069]	[0.103]	[0.115]	[0.203]
Q_{it-2}	-0.052	-0.057	-0.078	-0.101	-0.194***	-0.002
	[0.127]	[0.142]	[0.058]	[0.084]	[0.113]	[0.155]
Adjusted R^2	0.28	0.24	0.20	0.06	0.19	0.21
Observations	223	167	134	56	78	89
Panel B	*1986-2000*	*1991-2000*	*1986-1995*	*1986-1990*	*1991-1995*	*1996-2000*
CF_{it}/K_{it-1}	1.028**	1.020**	1.000*	0.510***	0.849*	1.050***
	[0.464]	[0.511]	[0.295]	[0.276]	[0.330]	[0.589]
Q_{it-1}	0.077	0.077	0.084	0.054	0.044	0.240***
	[0.073]	[0.084]	[0.057]	[0.072]	[0.116]	[0.141]
CS_{it}/K_{it-1}	0.157	0.219	0.044	0.041	-0.123	0.376
	[0.211]	[0.275]	[0.140]	[0.274]	[0.176]	[0.510]
Adjusted R^2	0.27	0.23	0.20	0.06	0.15	0.22
Observations	241	170	151	71	80	90

* Indicate significance at 0.01. ** Indicate significance at 0.05. *** Indicate significance at 0.10.

Table 9 provides additional results for the full sample. Here we replaced lagged cash flow with lagged Q (Panel A) and cash stock (Panel B). Even so, the results remain broadly similar to those reported above. The cash flow coefficients remain strongly positive in all regressions. However, in Panel A, while the Q remains positive, the lagged Q is consistently negative although not statistically significant. In Panel B, the cash stock coefficients are positive in most regression, but are not significant.

Table 10 reports results from the model which includes sales to test whether cash flow effects still has significant explanatory power when account is taken of output levels. The justification for including sales is that the firm's investment spending may be related to the level of or change in output or sales. The model includes cash flow, Q and sales, lagged one period. Although in several cases cash flow looses significance when sales are included, it remains strongly positively correlated with investment in two equations.

TABLE 10. EFFECTS OF CASH FLOW, Q AND SALES ON INVESTMENT, 1987-2000

Dependent variable is investment to capital stock (I_{it}/K_{it-1}), and independent variables are lagged sales to capital stock (S_{it-1}/Kit_{-2}), Q and cash flow. All other variables are as defined in Table 8.

	1987-2000	*1991-2000*	*1987-1995*	*1987-1990*	*1991-1995*	*1996-2000*
CF_{it}/K_{it-1}	0.769	0.738	0.940*	0.177	0.801**	0.803
	[0.479]	[0.497]	[0.292]	[0.479]	[0.320]	[0.676]
Q_{it-1}	0.074	0.070	0.071	0.000	0.053	0.220***
	[0.074]	[0.082]	[0.068]	[0.112]	[0.116]	[0.131]
S_{it-1}/ K_{it-2}	0.032	0.042	0.026	0.066	0.043	0.049
	[0.022]	[0.029]	[0.021]	[0.077]	[0.042]	[0.037]
Adjusted R^2	0.28	0.25	0.21	0.07	0.17	0.23
Observations	225	168	136	57	79	89

* Indicate significance at 0.01, ** Indicate significance at 0.05, *** Indicate significance at 0.10.

Results from Table 10 can be interpreted in several ways. One might argue that with Q in the model with sales, cash flow should *not* have significant explanatory power. In this model, Q is expected to serve as a signal of the profitability of investment not captured by sales. But it is also known that internal cash flow is highly correlated with current and therefore future output levels. However, with sales explicitly included in the model, cash flow

(internally generated funds) should not have significant explanatory power. Therefore if one argues that Q captures the effects of future profitability on the demand for investment, this lends credibility to the argument that any positive significant coefficients on the cash flow variable is likely to indicate an additional supply of low cost investment funds for firms that must pay a premium to access external financing. A strong positive coefficient on cashflow in this model could indicate financing constraints.

Results for firms segmented by dividend payout

Our next results are those from the sample segmented by dividend policy. As discussed above, FHP and a number of other studies argue that firms that pay low dividends on average over a period of time are more likely to be financially constrained than those that pay high dividends. Firms in the first third have dividend payout ratios that average 0 to 35 per cent; that for firms in the second third averages 36 to 55 per cent and for firms in the third tertile, the average is 56 to 92 percent.

Results for the model with cash flow and Q as explanatory terms are reported in Table 7. They show that while the cash flow terms are positive and significant in many cases, the effect of cash flow on investment is greatest for firms with the lowest and highest dividend payout ratios. Over the entire sample period, 1986 to 2000, the coefficient on cash flow for firms with the lowest payout ratio (1.162) is larger than that of firms with the highest payout ratio (0.910). This is also the case for the period 1991 to 2000. However, for the 1986 to 1995 period, the cash flow coefficients are strongly positive and largest for the highest payout firms and declines with dividend payout in the next two groups. Although it is not clear how to interpret the largest cash flow coefficient for the highest dividend payout firms, as we found for the entire period, FHP and others provide supporting evidence that cash flow coefficients are largest for low payout firms.

Results for firms segmented by size

We follow Kadapakkam *et al.* (1998) and segment the sample based on firm size. The rationale here is that the cost of external funds to small firms is likely to be higher than that for large firms. Typically, smaller firms are followed by fewer analysts than larger firms are. Hence, there is likely to be greater and more costly in-

TABLE 11. EFFECTS OF CASH FLOW AND Q ON INVESTMENT FOR FIRMS CLASSIFIED BY DIVIDEND PAYOUT

Dependent variable is investment to capital stock (I_{it}/K_{it-1}). All variables are as defined in Table 8.

	1986-2000	*1991-2000*	*1986-1995*	*1986-1990*	*1991-1995*	*1996-2000*
*Panel A: Sample firms with dividend payout ratios in the **first tertile** (average dividend payout 0-55 percent)*						
CF_{it}/K_{it-1}	1.162**	1.236**	0.715**	-0.209	0.438***	1.514*
	[0.508]	[0.539]	[0.300]	[0.330]	[0.227]	[0.496]
Q_{it-1}	0.209	0.235	0.200	0.301	-0.310	0.603***
	[0.169]	[0.212]	[0.122]	[0.200]	[0.365]	[0.337]
Adjusted R^2	0.36	0.30	0.17	-0.10	0.12	0.41
Observations	77	55	47	22	25	30
*Panel B: Sample firms with dividend payout ratios in the **second tertile** (average dividend payout 35-55 percent)*						
CF_{it}/K_{it-1}	0.128	-0.226	1.004*	0.808***	0.786	-0.562
	[0.522]	[0.679]	[0.385]	[0.456]	[0.513]	[1.005]
Q_{it-1}	0.112	0.123	0.200	0.105	0.349	0.137
	[0.085]	[0.084]	[0.161]	[0.303]	[0.255]	[0.093]
Adjusted R^2	0.09	0.09	0.25	-0.10	0.41	-0.09
Observations	84	59	54	25	29	30
*Panel C: Sample firms with dividend payout ratios in the **third tertile** (average dividend payout 55-92 percent)*						
CF_{it}/K_{it-1}	0.910***	0.850	2.913*	1.328***	3.409**	0.481
	[0.528]	[0.602]	[1.106]	[0.770]	[1.435]	[0.588]
Q_{it-1}	-0.018	-0.025	-0.017	0.001	-0.027	0.027
	[0.054]	[0.063]	[0.051]	[0.076]	[0.099]	[0.081]
Adjusted R^2	0.07	0.02	0.33	-0.04	0.30	-0.15
Observations	80	56	50	24	26	30

* Indicate significance at 0.01. ** Indicate significance at 0.05. *** Indicate significance at 0.10.

formation asymmetry between insiders and outsiders of small firms. Furthermore, small firms are likely to incur higher transaction costs per dollar of new shares than large firms do. Both factors are likely to lead to small firms having greater difficulty accessing capital markets, becoming more cash constrained and ex-

hibiting a higher degree of cash flow-investment sensitivity than large firms.

To identify firms, which are likely to suffer more because of size, we use the average over 1986 to 2000 beginning-of-period capital stock as a measure of size to place firms in three groups. We

TABLE 12. EFFECTS OF CASH FLOW AND Q ON INVESTMENT FOR FIRMS CLASSIFIED BY SIZE

Dependent variable is investment to capital stock (I_{it}/K_{it-1}). All variables are as defined in Table 8.

	1986-2000	*1991-2000*	*1986-1995*	*1986-1990*	*1991-1995*	*1996-2000*
*Panel A: Sample firms with capital stock in the **first tertile** (average capital stock TT$4.3 million to TT$44.5 million)*						
CF_{it}/K_{it-1}	1.363*	1.451*	0.669*	0.211	0.522***	1.847*
	[0.481]	[0.529]	[0.254]	[0.323]	[0.265]	[0.510]
Q_{it-1}	-0.006	-0.022	0.347*	0.336	0.145	0.173
	[0.072]	[0.085]	[0.120]	[0.257]	[0.330]	[0.111]
Adjusted R^2	0.55	0.52	0.31	0.12	0.23	0.68
Observations	90	60	60	30	30	30
*Panel B: Sample firms with capital stock in the **second tertile** (average capital stock TT$46.3 million to TT$63.9 million)*						
CF_{it}/K_{it-1}	-0.372	-0.592	2.705**	1.648***	3.017**	-1.527
	[1.003]	[1.130]	[1.148]	[0.873]	[1.374]	[1.249]
Q_{it-1}	0.248	0.286	-0.016	-0.007	0.028	0.682***
	[0.184]	[0.212]	[0.047]	[0.077]	[0.087]	[0.364]
Adjusted R^2	0.20	0.17	0.33	0.00	0.25	0.28
Observations	74	54	44	20	24	30
*Panel C: Sample firms with capital stock in the **third tertile** (average capital stock TT$169.2 million to TT$938.2 million)*						
CF_{it}/K_{it-1}	-0.179	-0.289	1.210	0.579	1.086	-0.636
	[0.650]	[0.689]	[0.834]	[0.929]	[0.982]	[0.840]
Q_{it-1}	0.117	0.109	0.106	0.089	-0.013	0.159
	[0.087]	[0.094]	[0.146]	[0.226]	[0.285]	[0.102]
Adjusted R^2	0.06	0.03	0.09	-0.12	0.05	-0.09
Observations	77	56	47	21	26	30

* Indicate significance at 0.01, ** Indicate significance at 0.05, *** Indicate significance at 0.10.

regress investment on cash flow and Q for each group separately. The results, which are reported in Table 12, are consistent with our a priori expectations. The coefficients on the cash flow variable for the smallest firms in the sample is consistently positive and highly statistically significant over the full sample period and all other sub-periods, except the earliest five-year period, 1986 to 1990.

TABLE 13. EFFECTS OF CASH FLOW AND Q ON INVESTMENT FOR FIRMS CLASSIFIED BY INDUSTRY

Dependent variable is investment to capital stock (I_{it}/K_{it-1}). All variables are as defined in Table 8.

	1986-2000	*1991-2000*	*1986-1995*	*1986-1990*	*1991-1995*	*1996-2000*
			Panel A: Manufacturing Firms			
CF_{it}/K_{it-1}	1.031**	1.047***	0.865*	0.260	0.640**	1.109***
	[0.511]	[0.567]	[0.257]	[0.254]	[0.265]	[0.659]
Q_{it-1}	0.098	0.098	0.081	0.049	0.005	0.271***
	[0.084]	[0.096]	[0.059]	[0.073]	[0.131]	[0.159]
Adjusted R^2	0.27	0.21	0.21	0.09	0.15	0.20
Observations	137	100	82	37	45	55
			Panel B: Non-Manufacturing Firms			
CF_{it}/K_{it-1}	2.076*	2.158**	3.166**	3.806**	3.550***	2.514*
	[0.746]	[0.881]	[1.388]	[1.871]	[2.083]	[0.942]
Q_{it-1}	-0.095	-0.110	0.136	0.149	0.312	-0.052
	[0.095]	[0.104]	[0.156]	[0.212]	[0.271]	[0.073]
Adjusted R^2	0.22	0.21	0.26	0.17	0.23	0.28
Observations	104	70	69	34	35	35

* Indicate significance at 0.01. ** Indicate significance at 0.05. *** Indicate significance at 0.10.

In contrast, the sign on the cash flow coefficient for the largest firms is inconsistent but not statistically different from zero. Interestingly, coefficients on the cash flow variable for firms in the middle group is positive and strongly correlated with investment in two time periods, 1986 to 1990 and 1991 to 1995. Indeed, during these periods, the cash flow coefficients for medium-sized firms are 4.0 and 7.8 times as large as those for the smallest firms.

In summary cash flow effect is sensitive to investment for small and medium sized firms, but not large firms. This result suggests that while we make a distinction between small and medium-sized firms, this distinction does not appear to hold in the market. One reason for this is that there is not much difference in size of firms in these groups. As Table 7 shows, small firms have an average capital stock (size) of $24 million, medium sized firms $53 million, and large firms $490 million. What this shows is that large firms are much larger than medium-sized firms, but medium-sized firms are not much larger than small firms in our sample, which probably explains the sensitivity of cash flow for small and medium-sized firms.

Results for firms based on industry classification

We also segmented our sample based on whether a firm is a manufacturing or non-manufacturing concern. Poterba (1988) argues that because of the highly specialized nature of manufacturing firms' fixed assets, these firms are likely to encounter greater liquidity constraints than non-manufacturing firms in providing acceptable and marketable collateral in support of their debts. However, one can also argue that non-manufacturing firms may also have high levels of intangible assets, which could not be used as collateral for debt financing, and may be liquidity constrained just as much or even more. Notwithstanding these arguments, we divide our sample into manufacturing and non-manufacturing firms to see whether cash flow investment sensitivity is different for firms in these two different industry classes.

The results for manufacturing and non-manufacturing firms from the Q model augmented by the cash flow variable are reported in Table 13. These results show that the cashflow coefficients for non-manufacturing firms are 2 times to 14 times as large as those for their manufacturing counterparts over the entire sample period and various sub-periods. The greater cash-flow-investment sensitivity for non-manufacturing firms appears to support the argument that these firms might have assets that do not support external financing. However, the results may also be reflecting the impact of cash flow on size. As Table 3 shows, non-manufacturing firms are also twice as large, on average, as manufacturing firms. And as we find above, cash flow is strongly correlated with investment for firms in the smallest and largest categories.

CONCLUSION

This study examined the effect of cash flow on corporate investment. We employed the Q model of investment with an unbalanced panel dataset of 18 companies over 1986 to 2000. We ran several augmented versions of the Q model. These regressions regress investment on Q, internally generated cash flow, cash stock and sales, after controlling for time invariant effects.

The results for our full sample show a strong positive relationship between investment and internally generated funds (cashflow), suggesting that the financial and real decisions of Trinidad and Tobago listed firms are not independent. When we segment the sample based on a measure of firm size, we find that the effect of cashflow on investment is strongly positive, but only for small and medium sized firms. When the sample is segmented by dividend payout ratios, the effect of cash flow on investment is positive and strongly correlated with investment for firms with the lowest payout and highest dividend payout ratios. When we segment the sample based on industrial classification, the cashflow coefficients on manufacturing and non-manufacturing firms are positive and highly correlated, but the coefficients for non-manufacturing are more than 2 times that of their manufacturing counterparts.

Given the sizable positive and statistically significant cash-flow coefficients, there appears to be a *prima facie* case of financial constraints among firms in Trinidad and Tobago. However, in light of the work of KZ, we cannot unambiguously conclude that these findings are evidence of financial constraints. And as KZ also showed, the size of our cashflow coefficients in the various regressions need not have a monotonic relation with the severity of financial constraints. It is quite possible that the liquidity term in our regressions serves as a proxy for omitted variables or some other specification problems. What these preliminary results do, however, is provide a basis for more investigation into whether firms identified in our sample as financially constrained are indeed so, and what might be some of the associated factors that affect firms ability to efficiently raise investment finance in the local capital market.

REFERENCES

Akerlof, G. A. (1970), "The market for 'lemons': Quality and the market mechanism", *Quarterly Journal of Economics*, 84, 488-500.

Bond, Stephen, *et al.* "Financial Factors and Investment in Belgium, France, Germany and the UK: A Comparison Using Company Panel Data". Working Paper No. 5900. National Bureau of Economic Research. January 1997.

Brainard, William C., and James Tobin. "Pitfalls in Financial Model Building," *American Economic Review* 58 (May 1969), 99-122.

Chirinko, R. S. and H. Schaller. "Why Does Liquidity Matter in Investment Equations?" *Journal of Money, Credit and Banking,* Vol. 27, No. 2 (May 1995).

Clarke, C., D. Stoddard and V. Shield. "Corporate Financing Revisited", *Insights into an Emerging Financial Structure: The Experience of Trinidad and Tobago*. Ramesh Ramsran (ed.) 1995.

Cummins, Jason G., *et al.* "Investment Behaviour, Observable Expectations and Internal Funds". *Finance and Economics Discussion Series,* Federal Reserve Board, 1997-27.

Fazzari, Steven, R. Glenn Hubbard and Bruce C. Petersen. "Financing Constraints and Corporate Investment: Response to Kaplan and Zingales". Working Paper No. 5462, National Bureau of Economic Research. July 2000.

_____. "Financing Constraints and Corporate Investment", *Brookings Papers on Economic Activity,* 141-195, 1988.

Fumio, Hayashi. "Tobin's Marginal q and Average q: A Neoclassical Interpretation," Econometrica, Vol. 50 (January 1982), pp. 213-24.

Gilchrist, Simon and Charles Himmelberg. "Investment, Fundamentals and Finance". Working Paper No. 6652, National Bureau of Economic Research. July 1998.

Graham, J. R. and C. R. Harvey. "The Theory and Practice of Corporate Finance: Evidence from the Field", *Journal of Financial Economics,* Volume 60, No. 2-3 (May/June 2001) 187-243.

Jensen, M. C. and Meckling, W. H. (1976), "Theory of the firm: Managerial behaviour, agency costs and ownership structure", *Journal of Financial Economics,* 3, 305-60.

Jorgenson, D. W. and C. D. Siebert. "A Comparison of Alternative Theories of Corporate Investment Behaviour", *American Economic Review,* Vol. 58 (September 1968) 681-712.

Kadapakkam, P., P. C. Kumar and L .A. Riddick." The Impact of Cash Flows and Firm Size on Investment: the International Evidence", *Journal of Banking and Finance,* Vol. 22 (1998), 293-320.

Kaplan, Steven and Luigi Zingales. "Do Financing constraints Explain Why Investment in Correlated with Cash Flow?"

Working Paper No. 5267, National Bureau of Economic Research. September 1995.

_____. "Investment-Cash Flow Sensitivities Are Not Valid Measures of Financing Constraints". Working Paper No. 7659, National Bureau of Economic Research. April 2000.

Keynes, J. M., (1936) *The General Theory of Employment, Interest and Money,* New York: Harcourt Brace.

Lamont, Owen. "Cash Flow and Investment: Evidence from Internal Capital Markets". Working Paper No. 5499, National Bureau of Economic Research. March 1996.

Modigliani, F., and M. Miller. "The Cost of Capital, Corporate Finance and the Theory of Investments", *American Economic Review* 48 (June 1958) 261-297.

Meyer, J. R. and E. Kuh (1957), *The Investment Decision,* Cambridge, Mass: Harvard University Press.

Myers, S. C. and N. S. Majluf. "Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not Have", *Journal of Financial Economics,* Volume 13, No. 2 (June 1984) 187-221.

Opler, T., *et al.* "The Determinants and Implications of Corporate Cash Holdings". Working Paper No. 6234, National Bureau of Economic Research. October 1997.

Poterba, James M. "Financing Constraints and Corporate Investment: Comment," *Brookings Papers on Economic Activity* (1988:1), 200-4.

Schnure, Calvin. "Internal Capital Markets and Investment: Do the Cash Flow Constrints Really Bind?" *Finance and Economic Discussion Series,* Federal Reserve Board 1997-39.

Smith, A. (1776), "An Inquiry into the Nature and Causes of the Wealth of Nations", London: W. Strahan and T. Cadell.

Stein, J.C. "Agency Information and Corporate Investment". Working Paper No. 8342, National Bureau of Economic Research. June 2001.

Terrence, F., A. Najjar and H. Marcelle. "Corporate Financing and Use of Bank Credit in Trinidad and Tobago", *Social and Economic Studies,* Volume 35, No. 4, (1996).

Tinbergen, Jan. "A Method and Its Application to Investment Activity." In *Statistical Testing of Business Cycle Theories,* Vol. 1 Geneva: League of Nations, 1939.

Tobin, J. (1984), "On the efficiency of the financial system", *Lloyds Bank Review,* No. 153, July, 1-15.

The **CENTRE FOR LATIN AMERICAN MONETARY STUDIES** (**CEMLA**) was founded in 1952, by the following seven Latin American central banks: Banco Central de Chile, Banco de la República (Colombia), Banco Nacional de Cuba, Banco Central del Ecuador, Banco de Guatemala, Banco Central de Honduras, and Banco de México, S. A. Nowadays, all the central banks of Latin America and the Caribbean, as well as some extraregional central banks and other regional entities of the financial sector are members of the Centre. The complete list of CEMLA's members is published in the last page of this review. **CEMLA** focuses its activities on the monetary, financial and banking fields, where it promotes research, organizes international meetings and seminars about operative and technical problems, and analyzes experiences that are sistematized through the design and administration of technical assistance and training programs oriented to capacity-building and up dating of the staff of its associated and collaborating members.

One of its main aims is to inform about the evolution of economics thought inside and outside the Latin American and Caribbean region, as well as to publish the main international and regional facts in monetary, banking, and exchange policies. Its books, reviews and bulletins contain a wide stock of information for analysis and represent a permanent source of data for people interested in these matters.

MONEY AFFAIRS

Annual subscription: 30.00 dollars (students and teachers in the Caribbean and Latin American countries: 16.00 dollars). Single copy: 18.00 dollars (students and teachers in the Caribbean and Latin American countries: 9.00 dollars). Financial institutions, Universities, Libraries and other institutions in the Caribbean and Latin American countries: 20.00 dollars. Single copy: 12.00 dollars.

Subscription and requests:
Claudio Antonovich *Phone: (5255) 55-33-0300, ext. 255*
CEMLA, Public Relations Department *Fax: (5255) 55-25-4432*
Durango nº 54, Mexico City, 06700, Mexico *E-mail: antonovich@cemla.org*