August 2009

(DRAFT)

Firm Investment and Monetary Transmission in Jamaica: An Investigation of the Balance Sheet Channel with Micro-Level Firm Data.

Taffi Bryson[1]
Research Department
Research and Economic Programming Division
Bank of Jamaica

Abstract

This paper investigates the existence of a balance sheet channel in Jamaica. In this context, the study assesses the impact of monetary policy on firms' investment behaviour through its financial position. Utilizing firm level data for publicly listed non-financial firms, the paper finds evidence of an operative balance sheet channel albeit small. Further, the cash flow to capital ratio, a proxy for firms' financial liquidity is found to be a significant determinant of investment. The study also examines the difference in investment behaviour between small and large firms and finds that large firms' investment only reacts to growth in sales while small firms' investment is sensitive to both fluctuations in sales as well as the user cost of capital. The analysis shows that manufacturing firms' investment decisions are highly sensitivity to market interest rate while non manufacturing firms' decisions are not. Therefore, there is evidence to conclude that monetary policy as an asymmetric impact on firm investment.

JEL classification: C23, E22, E52

Keywords: Panel Data, Investment, Monetary Policy, Balance Sheet channel

[1] The author would like to thank all the staff of the Research Department of the Bank of Jamaica for their invaluable comments and contributions to the development of this paper. All errors are, however, my own. The views expressed in this paper are those of the author and do not necessarily reflect those of the Bank of Jamaica

1.0 Introduction

A sound understanding of the dynamics of the transmission mechanism is a critical component of monetary policy formulation. One of the important areas of the transmission mechanism is the effect of monetary policy on firm investment decision. Generally, monetary policy impacts business investment through two main channels, the interest rate channel and the balance sheet channel. The traditional interest rate channel is defined as the case where changes in market interest rates results in changes in the user cost of capital, which in turn affect investment decisions. The balance sheet channel is defined as the case where fluctuations in market interest rates affect the financial position of firms. The latter channel, which relies on the assumption of imperfect capital markets, implies that when interest rates rise, firms with less collateral could face challenges in obtaining debt in the debt market. In other words, the risk premium required by the lender depends on the capital structure of the firm as recorded in the balance sheet (through the cash flow-capital ratio). Therefore, monetary policy will have an impact on firms' investment decision beyond the interest rate channel through their financial position. Moreover, in the case of credit constrained firms, monetary policy shocks will affect their cash flow as well as alter the net value thereby affecting their ability to provide collateral (Butzen, et al., 2001). In this regard, an understanding of how firms' financial positions are impacted by monetary policy decisions can provide additional information to policy makers, (Chatelain, et al., 2001).

In regard to the interest rate channel, firms' investment decision are impacted when their supply of loans are disrupted and they incur additional cost which are associated with finding a new lender and establishing a credit relationship (Bernanke and Gertler, 1995). More succinctly, a reduction in the supply of bank credit, relative to other forms of credit, is likely to increase the external finance premium[2] and reduce real activity. Therefore, changes in monetary policy that impact the supply or relative pricing of bank loans will impact firms' investment decisions.

[2] External finance premium refers to the wedge between the cost of funds raised externally (by issuing equities) and the opportunity cost of internal funds (by retaining earnings) (Bernanke and Gertler, 1995)

In the literature, researchers associate the balance sheet channel with a "financial accelerator" concept that links balance sheet and cash flow data to firms' investment decisions (Bernanke and Gertler, 1995). The financial accelerator effect model posits that endogenous cyclical movements in the borrower's balance sheets can propel business cycles. Intuitively, business investment decisions are impacted by variations in the quality of the borrowers' balance sheets. In this regard, the financial position of the firm is impacted directly and indirectly by monetary policy action. Tight monetary policy directly weakens borrowers' balance sheet due to increased interest expenses which reduce net cash flows as well as asset prices and indirectly by reducing spending by customers thereby reducing firm revenues. This reduces the firm's net worth and credit worthiness over time.

This paper seeks to contribute to the discussion of the monetary transmission mechanism by investigating the impact of monetary policy on firms' investment decision through the balance sheet channel in Jamaica. The study departs from others in that it uses micro data to assess the existence of a balance sheet channel. The paper uses data from the financial reports of non-financial firms that are publicly listed on the Jamaica Stock Exchange.

The literature on monetary policy transmission through the various channels has been mainly examined with macro data. Analysis of this kind, however, has limitations as aggregation potentially distorts the differences in the transmission of monetary policy across sectors as well as the identification of important aspects of the transmission mechanism. Chrinko, Fazzari and Meyer (1999) note that aggregate data explicitly neglect firms' heterogeneity, capital market friction as well as produces biased estimates due to the problems of simultaneity. Although the simultaneity bias produced with aggregate data can be reduced by instrumental variables or GMM estimation, the deficiencies of aggregate analysis are attributed to the fact that studies at the aggregate level often fail to find a statistically significant relationship between investment spending and the user cost of capital. On the other hand, micro analysis of firm data is preferred when examining the different channels through which investment is impacted. This is credited to the advantages of panel data estimation over traditional (pooled) time series

analysis as panel estimation takes into account both the inter-temporal dynamics and the heterogeneity of entities (Chatelain, et al., 2001). This is particularly important in a context where, the broad credit channel[3] emphasizes the relevance of the symmetries in the transmission of monetary policy, which can be robustly identified by analyzing the behaviour of different groups of agents[4].

The rest of the paper is structured as follows. Section II reviews the main empirical research in this area while Section III presents the theoretical framework used in this paper. Section IV presents the empirical results and tests the board credit channel as well as the statistical relationship between monetary policy, user cost, sales and cash flow. Section V highlights the conclusions from the study.

2.0 Empirical Studies

Empirical evidence of the broad credit channel at the micro level has been examined with a variety of methods using various proxies for firm's financial position. Nonetheless, the underlining conclusion is that firms' investment is sensitive to factors that affect its financial position. This section outlines the various ways of assessing the financial position and its role in the broad credit channel as outlined in the empirical literature.

Angelopoulou and Gibson (2007) examine the sensitivity of investment to firms' cash flow using a panel of manufacturing firms in the United Kingdom (UK) over the period 1970 to 1991. The authors attempted to establish the existence of a balance sheet channel or financial accelerator in the UK economy. In particular, the extent to which investment becomes more sensitive to cash flow in periods of monetary tightness. Their findings prove that firms' investment show greater sensitivity during periods of tight monetary policy with the effect being more pronounced among firms that are small and financially constrained. The paper presents evidence that points to the possible existence of all channels of the transmission mechanism; balance sheet, interest rates, exchange rate and

[3] Together the bank lending channel and the balance sheet channel have also been referred to as the broad credit channel (Bernanke and Gerlter, 1995).

[4] Chatelain, et al.(2001) propose that analyzing the reaction to a common shock of groups of firms characterized by weaker balance sheets and comparing to other firms that are in a better financial position solves the identification problems encountered with the use of macro data.

bank lending channels. The authors find that the financial accelerator effects were a determining characteristic of UK business cycles. In this regard, monetary policy is found to be effective in influencing the business cycles since it operates not only through traditional channels but also though its effect on firms' net worth and hence spending decisions.

Similar results are obtained by Butzen, Fuss and Vermeulen (2001) who investigate the effects of monetary policy on firms' investment behaviour using a large panel of Belgian firms' data on all sectors of the economy. The authors differ in the methodological approach as they use a reduced form investment equation derived from the neo-classical model, however, augmented by a cash flow variable. The authors also examine the elasticity of the user cost of capital for different samples grouped according to sectors and sizes. The results indicate that small firms' investment are more sensitive to monetary policy and that the services industries are mostly unaffected by changes in monetary policy. Given the differing impact across sectors and sizes, the paper concludes that monetary policy produces distributional effects.

A panel estimation methodology is also used by Chatelain et al (2001) in their investigation of the effect of monetary policy on firm investment decision in Germany, France, Italy and Spain between 1985 and 1999. The paper estimates the classical investment relationships via the GMM using sales, user cost and cash flow data. The results show investment to be sensitive to user cost for all countries validating the existence of an interest rate channel. Additionally, the study finds that investment in all countries is sensitive to sales and cash flow movements. Further, only in Italy do small firms' investment decisions react more than large firms to cash flow movements than large firms.

An investigation of the existence of a credit channel in Austria is done by Wesche (2000). The author uses firm data, which show that highly indebted firms have higher average interest expenses and lower investment to sales ratio relative to lower indebted firms. The panel estimation results confirm that investment decisions within small and medium size

firms are more largely influenced by financial variables. Using the two-stage nonlinear procedure similar to that of Kashyap and Stein (1997), the study finds that financial restrictions to firms' investment increase with a restrictive monetary policy. The study concludes that the credit channel seems to play a role in the transmission of monetary policy to firm's investment decision. Further, firms are dis-proportionally affected by the impacts of monetary policy.

Nascimento de Oliveria (2006) investigates the response of large public corporations' inventories, operational revenues and short term debt to monetary contractions in Brazil. Using balance sheet data, the study employs a two variable vector autoregressive (VAR) model and examines the impulse responses from the system. Short term debt and operational revenues are used in the system and the results indicate that firms' investment is affected by monetary policy with an asymmetric impact for large and small firms. A structural analysis using aggregate data finds similar results to the VAR model. The study also employs a variable effect, panel unbalanced analysis and concludes that small firms were more sensitive to monetary conditions than large firms.

Other studies such as Benito and Whitley (2003) and Horvath (2006) investigates whether a firm's balance sheet position influences the interest rates firms face on capital for the United Kingdom and the Czech Republic, respectively. Using individual company data, both authors examine and confirm that there is a positive relationship between the firms' cost of finance and net worth/ debt by using the Blundell and Bond (1998) GMM system estimation method. On the other hand, Horvath (2006) looks at the extent to which balance sheet positions are pro-cyclical and if monetary policy has heterogeneous effects on small firms during periods of economic downturns. The study uses data on leverage, liquidity, market access and collateral value to corporate interest rates for the period 1996 and 2002. The author's estimation procedure is based on the static panel data modeling which accounts for endogenity of regressors as opposed to the Arellano and Bond procedure used in other studies. The study finds that balance sheet indicators are vital in determining the interest rate paid by firms. Additionally, the strength of the balance sheet indicators is seen to vary with firm size. While both authors consider the

impact of the balance sheet channel, they do not explicitly examine the link between the firms' investment decisions and their balance sheets.

Regional empirical literature on the relevance of the credit channel in the transmission mechanism is documented by Ramlogan (2004) for Jamaica, Trinidad & Tobago, Barbados and Guyana. Work has been done by Allen and Robinson (2005) and Serju (2006) for Jamaica. Ramlogan (2006) finds that the credit and exchange rate channels are of greater importance than the money channel in the transmission of monetary policy impulses to the real sector. With regard to the studies on Jamaica, Allen et al. finds evidence to conclude that the exchange rate is the main transmission channel of monetary policy and that the credit channel plays a relatively small role in the transmission of monetary policy. Serju (2003) obtained similar results in her study of the response of output to monetary policy at the sectoral level in Jamaica. Additionally, she finds that the manufacturing sector is most sensitive to an interest rate shock. The aforementioned regional studies, however, did not differentiate between the bank lending and balance sheet channels and did not account for frictions in credit markets. Consequently, the effect of a change in monetary policy rates on the finance premium was not explored.

3.0 The Theoretical Framework

This paper examines the importance of the transmission mechanism in Jamaica similar to Chatelain et al (2003) by estimating firms' investment equation, and deriving the elasticity investment to its main determinants: user cost, sales and the cash flow. This permits an assessment of the relative importance of the different channels of monetary transmission as well as the absence or existence of asymmetries.

The model follows from the generalized Constant Elasticity of Substitution (CES) production function with the first-order condition for profit maximization given as:

$$\log K_t = \theta \log Y_t - \sigma \log r_t + \log h_t \qquad (1)$$

with $\theta = \left(\sigma + \frac{1-\sigma}{v} \right)$ and $h_t = A_t^{\frac{\sigma-1}{v}} \cdot (v\alpha)^{\sigma}$

where r_t is the user cost of capital, K_t is capital, Y_t is real sales, A_t is productivity and σ and v are the elasticities of substitution and scale respectively. The variable h_t depends on the time-varying productivity A_t. Given firm specific effects on the level and growth of productivity the first difference of equation 1 is as follows:

$$\Delta \log K_t = \theta \Delta \log Y_t - \sigma \Delta \log r_t + \Delta \log h_t \qquad (2)$$

Using the approximation $\Delta \log K_t \approx I_t / K_{t-1} - \delta$ and replacing $\log h_t$ by time dummies and confining individual productivity shocks to the error term it follows that:

$$A(L)\Delta \log K_{i,t} = B(L)\theta \Delta \log Y_{i,t} + C(L)\sigma \Delta \log r_{i,t} + \phi_t + \lambda_t + \varepsilon_{i,t} \qquad (3)$$

where $A(L)$, $B(L)$, $C(L)$ being polynomials in the lag operator and ϕ_t is a firm-specific constant representing depreciation and possible trend in the capital-demand equation 1, λ_t is a time specific shock equal for all firms and $\varepsilon_{i,t}$ is the transitory shock.

Similar to the approach taken in the literature, a measure of liquidity is included to account for access to internal funds that may affect investment in the presence of financial constraints (Chatelian et al, 2001). In this regard, a contemporaneous and lagged real cash flow per unit of capital, $CF_{i.t} / K_{i,t-1}$, is included to yield:

$$A(L)\Delta \log Ki_{i,t} = B(L)\theta \Delta \log Y_{i,t} + C(L)\sigma \Delta \log r_{i,t} + D(L)\, CF_{i.t} / K_{i,t-1} + \phi_t + \lambda_t + \varepsilon_{i,t} \qquad (4)$$

Following Chatelian et al. (2003), the user cost of capital, $r_{i,t}$, is slightly modified and defined as the weighted sum of the cost of debt and equity. Both of which are weighted by their respective share of the firm's total liabilities, as follows.

$$r_{i,t} = AI_{i,t}\left(\frac{D_{i,t}}{D_{i,t}+E_{i,t}}\right) + LD_t\left(\frac{E_{i,t}}{D_{i,t}+E_{i,t}}\right) \quad (5)$$

where $AI_{i,t}$ is the apparent rate, measured as interest payment over gross debt, LD_t the long-term debt rate used as a proxy for the opportunity cost of equity , $E_{i,t}$ the book value of equity and $D_{i,t}$ represents the book value of debt. Intuitively, the coefficient for cash flow variable may be construed as an indication of the level of financial constraints, assuming that investment of credit constrained firms is more sensitive to the availability of internal funds (Buzten, et al., 2001).

4.0 The Empirical Analysis

This section details the regression results for the specification in equation 4. The results for a typical firm using random effects model are first presented, which is followed by the results from the GMM estimator developed by Arellano and Bond (1991).Next, the GMM procedure is then applied to large and small firms separately as well as manufacturing and non-manufacturing firms to investigate the difference in investment behaviour of specific firms. Finally, we examine the elasticity of capital to changes in monetary policy by looking at the sensitivity of capital to the market interest rate.

4.1 Data

The analysis uses balance sheet data on publicly listed firms from 1994 to 2008. A summary of the data statistics is provided in Table 1. The dataset consists of 23 non-financial firms publicly listed on the Jamaican Stock Exchange. The firms encompass eleven (11) manufacturing, three (3) communications, four (4) conglomerates, three (3) retail, one (1) tourism and one (1) categorized as other. The data draws on 15 years of information from the audited financial statements of each company/group to create an unbalanced panel dataset. The use of an unbalanced panel is ideal for storing as much information as possible from the dataset, which should lead to more efficient estimates (Buzten, 2001). The paper recognizes the limitation that the number of firms on the Jamaica Stock Exchange is small, however, these firms are large players in their respective industries and behave in a typical manner. In this regard, it is believed that the

dataset is reasonable representative of the corporate sector in Jamaica and as such the results are useful. From the dataset the paper computes the investment to capital ratio, real sales growth, user cost growth and the cash flow to capital ratio variables.

The average value of firms assets relative to other firms listed on the Jamaica Stock Exchange is the criterion use to dichotomize firms by size. Using this criterion the data was split into six (6) large and seventeen (17) small enterprises. Additionally, the manufacturing firms where extracted from the dataset to examine the investment dynamics of the subgroup. With the reclassification, equation (4) is re-estimated for both categories.

Table 1: Summary Statistics

	$\Delta \log K$	$\Delta \log r$	$\Delta \log Y$	$CF_{i.t} / K_{i,t-1}$
Mean	0.10262	-0.0121	-0.02987	0.156674
Std. Dev.	0.226761	0.058147	0.212107	0.347109
Sum	25.24454	-2.97578	-7.34832	41.67526
Sum Sq. Dev.	12.59802	0.828355	11.0224	31.92845
Observations	246	246	246	266

The assessment starts with an examination of the data properties[5]. The existence of a panel unit root is formally tested using the Levin, Lin & Chu panel unit root test. The null hypothesis of a unit root is rejected the at the 5 per cent level for the log of capital, the log of user cost, the log of sales and the log of cash flow as a percentage of capital[6]. The data was then examined so as to determine if the series collectively have a long run co-integrating relationship. Given the theoretical structure of the analysis, the regression is conducted in first difference. The Pedroni Residual co-integration test[7] shows that two of the eleven test statistics do not reject the null of no co-integration relationship amongst the variables in first difference. Despite these results the sample, however, maybe too short to establish any long run relationship with a reasonable degree of certainty.

[5] The plot of each of the variables in levels is given in the Appendix plotted (see Figure 1 in Appendix).
[6] The Levin, Lin and Chu test assumes a common unit root process in the panel and test results are detailed in the Appendix plotted.
[7] The variables are included in levels.

Equation 4 is first estimated with random effects after which the Hausman test is used to determine the appropriateness of the fixed versus the random effect specification. The Hausman test indicates a failure to reject the null hypothesis of no misspecification of the model (see Table 2). A comparison of the coefficients of the models estimated by fixed and random effects reveals a failure to reject the null hypothesis of no difference between the user cost, cash flow to capital and sales growth coefficients estimated by the random and fixed effects method at the 5 per cent level (see Table 3). Given the results from the Hausman test, the random effects model is used to estimate equation (4).

Table 2: Correlated Random Effects - Hausman Test with cash flow capital ratio

Correlated Random Effects - Hausman Test with cash flow capital ratio
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	1.046286	3	0.7901

Table 3: Comparison of random and fixed effects specification

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
DLUC	-0.372573	-0.38117	0.000187	0.5298
DLSALES	0.409728	0.418398	0.000627	0.7291
CF_K	0.126056	0.115071	0.000812	0.6998

Table 4: Long-run coefficients

	Coefficient	**t-Statistic**
Random Effects (with cash flow capital ratio)		
C	0.091809	5.462624
DLUC	-0.38117	-1.707109
DLSALES	0.418398	6.684382
CF_K	0.115071	2.765444
Random Effects (without cash flow capital ratio)		
C	0.10987	7.106959
DLUC	-0.378505	-1.675745
DLSALES	0.419553	6.638552

The results find that within the random effects model the cash flow to capital ratio and fluctuations in sales and user cost variables are statistically significance at the 5 per cent level (see Table 4). These results are consistent with the neo-classical theory. The results show that higher cash balances relative to capital result in an increase in investment by firms, which is indicated by the positive and statistically significant coefficient on the cash flow to capital variable. This is indicative of the high cash flow sensitivity of the typical firm due to strong financial constraints. The magnitude of the effect of cash flow on investment is consistent with Chatelain, et al. (2001) findings from a low of 0.079 for Germany to a high of 0.301 for Italy. The coefficient of the user cost variable is also consistent with Chatelain, et al. (2001) which found the coefficients to are in a range of -0.03 for Belgium and a high of -0.52 for Germany.

Given that sales and cash flow variables are closely linked, the study examines whether their elasticities are sensitive to the inclusion of cash flow data in the model[8]. To carry out this examination equation 4 is re-estimated excluding the cash flow to capital variable. Based on the Hausman test, the regression is better specified as a random effects model (see Tables 5). The results show that the magnitude and statistically significance of the sales variable remains unchanged (see Table 4). Of note, the exclusion of the cash flow variable decreases the magnitude of the negative relationship between user cost and investment. This speaks to the importance of capturing both the interest rate channel from the balance sheet channel as highlighted by Bernanke and Gertler (1995). These findings further reiterate that typical firm investment is not only dependent on the user cost of capital but also the availability of internal liquidity as captured in the cash flow variable and changes in sales which encompass the financial accelerator effect.

Given the possible existence of serial correlation in the model, the GMM estimator is used to derive robust estimates of a dynamic panel model. The paper follows the work of Arellano and Bond (1991) and fits a dynamic model of investment to the unbalanced panel data. Accordingly, the study uses the one-step Arellano–Bond estimator as the standard errors for the two-step estimator may not be reliable given it susceptibility to

[8] Leverage, an alternate measure of liquidity, defined as the ratio of assets to capital, is used also in place of the cash flow to capital ratio, however, the coefficient is also negative and insignificant.

small sample biases. The instrumental variables used in the GMM were the first lag of the changes in the user cost of capital, sales and cash flow-capital. The results of the dynamic panel regression indicate that, for all firms, sales, user cost and the cash flow to capital variables are statistically significant at the 5 per cent level (see Table 5). Intuitively, present investment decisions are positively related to the firm's current financial position or availability of internal liquidity and contemporaneous changes in sales. In addition firms' investment decisions are negatively influenced by their user cost of capital. The Sargan test for over-identifying restrictions fails to reject the null that the over-identifying restrictions are valid[9]. In addition, the residuals from the panel estimation are normally distributed.

Overall, the results suggest that investment decisions are more sensitive to contemporaneous fluctuations in user cost and sales than changes in cash flow. This is primarily reflected in the results of small and manufacturing firms. Similarly, the results give merit to the statistical significance of the availability of internal liquidity towards the overall responsiveness of investment. This result is borne out primarily in the manufacturing firm subgroups. Buzten, et al (2001) point out that while the dependence on cash flow may be indicative of severe financing constraints it could also reflect that the cash flow is a more important predictor of future profits. Overall, the dependence of business investment to contemporaneous cash flow changes is indicative of the role their balance sheet position plays in their decision.

.

[9] The Sargan statistic is distributed as a $\chi(p-k)$, where k is the number of estimated coefficients and p is the instrument rank.

Table 5: Dynamic Panel Results

	All Firms		Large Firms		Small Firms		Manufacturing		Non-Manufacturing	
	GMM	t-Statistic	GMM	t-Statistic	GMM	t-Statistic	GMM	t-Statistic	GMM	t-Statistic
DLK(-1)	-0.029858	-0.49795	0.20245	1.193286	-0.024879	-0.381694	-0.027984	-0.452192	-0.015866	-0.096047
DLUC	-0.799077*	-2.538795	-0.333829	-0.439549	-0.875666*	-2.500964	-1.022966*	-3.084226	0.038519	0.055912
CF_K	0.131462*	2.064476	0.260982	1.33731	0.065077	0.939328	0.149016*	2.179874	-0.2535**	-1.585271
DLUC(-1)	-0.325587	-1.105616	0.12259	0.1612	-0.327892	-1.01885	-0.186063	-0.606005	-0.124365	-0.184577
CF_K(-1)	0.019291	0.342562	-0.180862	-1.219811	0.037268	0.616745	0.022619	0.385743	0.089312	0.6257
DLSALES	0.224166*	3.901473	0.29901**	1.73622	0.224786*	3.649389	0.198634*	3.580492	0.228388	0.826204
DLSALES(-1)	0.083508	1.355566	0.174602	0.631839	0.072473	1.135132	0.102923**	1.689308	-0.70516*	-2.629274
@LEV(@ISPERIOD("1997"))	-0.117043	-1.703266	-0.064038	-0.42603	-0.058915	-0.717748	-0.130282	-1.764001	0.134229	0.850294
@LEV(@ISPERIOD("1998"))	0.027893	0.431943	0.082515	0.566878	0.046734	0.620752	0.07945	1.170805	0.009505	0.060268
@LEV(@ISPERIOD("1999"))	0.054488	0.983716	-0.064891	-0.499018	0.097901	1.525584	0.093583	1.577401	-0.087345	-0.684763
@LEV(@ISPERIOD("2000"))	-0.066552	-1.387079	0.084722	0.808348	-0.098589	-1.730108	-0.105755	-1.954554	0.012687	0.116849
@LEV(@ISPERIOD("2001"))	-0.00681	-0.141936	-0.127897	-1.085481	-0.001157	-0.020799	-0.019443	-0.369219	-0.056795	-0.530107
@LEV(@ISPERIOD("2002"))	0.114754*	2.36428	0.246805*	2.141969	0.094875**	1.677338	0.215317*	4.100313	-0.080271	-0.741305
@LEV(@ISPERIOD("2003"))	0.027282	0.478226	-0.190129	-1.347853	0.007959	0.122028	-0.081731	-1.320597	0.165784	1.281753
@LEV(@ISPERIOD("2004"))	-0.173406*	-2.67939	-0.145062	-0.920351	-0.174971*	-2.334533	-0.192455*	-2.829688	-0.2752**	-1.811189
@LEV(@ISPERIOD("2005"))	0.044791	0.713184	0.108774	0.733127	0.054976	0.752843	0.08499	1.276628	0.062418	0.399909
@LEV(@ISPERIOD("2006"))	-0.006642	-0.12972	0.011964	0.105877	0.065488	1.088185	0.052689	0.980502	-0.027527	-0.225879
@LEV(@ISPERIOD("2007"))	0.111661	2.334089	0.014335	0.147093	0.012138	0.208285	0.021448	0.42271	0.00313	0.028774
@LEV(@ISPERIOD("2008"))	-0.042726	-0.786034	-0.053401	-0.497904	-0.061667	-0.96507	-0.017781	-0.317786	-0.18004	-1.386835
Effects Specification										
S.E. of regression	0.197404		0.227959		0.196436		0.182554		0.215288	
J-statistic	93.89789		45.12092		65.1628		75.10008		34.10475	
Sum squared resid	7.326032		2.130576		4.939149		4.39903		1.714905	
Instrument rank	96		60		91		93		56	

* and ** indicates statistical significance at the 5% and 10 % level respectively.

4.2 Investment Asymmetry

In this section we test whether small and large firms exhibit different investment behaviour depending on their user cost of capital, growth in sales and their level of financial constraint, as measured by their cash flow to capital ratio. This analysis is conducted by examining the differences in the coefficient estimates of each variable for large and small firms[10]. In this regard, the identification of the asymmetry is facilitated by testing whether the effect of the cash flow to capital ratio, sales and/or user cost is significantly different for large and small firms. Intuitively, the test evaluates the reactions of small firms that are likely to be characterized by weaker balance sheets with that of large firms. A similar analysis was done to compare the diference in firm investment in manufacturing and non-manufacturing firms.

The results are somewhat contrary to those found in the literature where it is shown that cash flow to capital is an important variable when considering investment decision for both large and small firms. This study finds that large firms' investment decisions are principally influenced by changes in their sales revenue while small firms' decisions are predominantly sensitive to changes in their user cost of capital (see Table 5). The study shows the importance of the sales variable for all subgroups when making investment decisions. This is indicative of the existence of the financial accelerator concept within investment decisions of firms. With regard to the analysis comparing manufacturing and non-manufacturing firms, the results indicate the statistical significance of cash flow to capital and user cost in manufacturing firms' investment decisions as well as the contemporaneous and lagged changes in sales. The importance of manufacturing firms' financial position in influencing their investment decision pinpoints that manufacturing firms have a high level of cash flow sensitivity and therefore rely more on internal financing than non-manufacturing firms. This possibly reflects the intra-group lending within conglomerates to alleviate financial constraints of member firms. Investment behaviour of non-manufacturing firms is influenced by their cash flow to capital and change in sales variables at the 10 per cent and 5 per cent level of significance,

[10] The split in the sample was done to unearth group dynamics which maybe undermined by the pooled regression.

respectively. Of note is the statistical significance of the time dummies in 2002 and in 2004 for the typical firm. These findings are attributed to the large level of foreign domestic investment (FDI) in 2002 to 2004 which of course would have a lagged impact on local investment.

4.3 Effects of Monetary Policy on Investment

In this section we investigate the effects of monetary policy on firms' investment decision by employing the methodology used by Buzten et al. (2001). The analysis is carried out by estimating the long-run elasticity of capital to market interest rate, which is the summation of the elasticity of the user cost of capital and the elasticity of cash flow with respect to the market interest rate. Intuitively, the total effect of monetary policy on the broad credit channel is the summation of the interest rate and the balance sheet channels. The calculation is denoted as follows:

$$\frac{\partial K_{it}}{\partial r_t}\cdot\frac{r_t}{K_{it}} = \frac{\partial K_{it}}{\partial UC_{it}}\cdot\frac{UC_{it}}{K_{it}}\cdot\frac{\partial UC_{it}}{\partial AI_{it}}\cdot\frac{AI_{it}}{UC_{it}}\cdot\frac{\partial AI_{it}}{\partial r_t}\cdot\frac{i_t}{i_{it}} + \frac{\partial K_{it}}{\partial CF_{it}}\cdot\frac{CF_{it}}{K_{it}}\cdot\frac{\partial CF_{it}}{\partial AI_{it}}\cdot\frac{AI_{it}}{CF_{it}}\cdot\frac{\partial AI_{it}}{\partial r_t}\cdot\frac{i_t}{AI_{it}} \quad (6)$$

where AI_{it} is the apparent interest rate faced by the firm and i_t is the interest rate on the 180-day Treasury bill[11]. Each term on the right-hand side of equation 6 consists of three elements[12]. The first element, the long run elasticity of capital with respect to user cost (cash flow), is given by the estimates in the previous sections. The second element represents the elasticity of the user cost (cash flow) with respect to the apparent interest rate and is derived as follows:

$$\frac{\partial UC_{it}}{\partial AI_{it}}\cdot\frac{AI_{it}}{UC_{it}} = \frac{AI_{it}}{UCi_t} \quad (7)$$

[11] The three month Treasury bill rates are used as it is highly influenced by the Central Bank's open market rates.

[12] The elements are: the long run elasticity of capital with respect to user cost (cash flow); the elasticity of the user cost (cash flow) with respect to the apparent interest rate; and the elasticity of the apparent interest rate to the market interest rate.

$$\frac{\partial CF_{it}}{\partial AI_{it}} \cdot \frac{AI_{it}}{CF_{it}} = \frac{\text{int}\,erest\ ch\,\text{arg}\,es_{it}}{CF_{it}} \qquad (8)$$

Following Butzen (2001) equations 7 and 8 are approximated by taking the mean values of the elasticities and the elasticity of the apparent interest rate to market interest rate (which is fixed at value of 1[13]). The results are presented in Table 6 and the statistical significance of the variables is derived from the point estimates in the dynamic panel regression results. With regard to the interest rate channel, small firms' investment is more sensitive to an interest rate adjustment than large firms. A similar result is found for manufacturing firms relative to non-manufacturing firms. For the balance sheet channel, the findings show that it plays a limited role in the transmission of interest rate adjustments to firms' investment decisions as the coefficient estimates are close to zero. Nevertheless, the results show that small firms are more sensitive to changes in cash flow than large firms. The combined elasticity estimates indicate that following monetary tightening small and manufacturing firms' investment are more sensitive to interest rate fluctuations. The results show that the interest rate channel is greater than the balance sheet channel. Intuitively, firms' investment decisions are more responsive to cost of external funding than to the availability of internal financing.

The findings are similar to those of Buzten et al. (2001) that finds that small firms are more negatively impacted by a monetary contraction than large firms. Additionally, the paper's result for the Jamaican manufacturing industry is somewhat consistent with the outcome of Serju (2003) that finds that manufacturing firms had the largest decline in output in response to an interest rate shock.

[13] The value of 1 is thought to correspond with its long-run equilibrium value. This value is chosen to avoid unreliable estimates from estimations with low degrees of freedom. However, this assumption negates heterogeneity across sectors and sizes (Buzten, 2001).

Table 6: Total elasticity with respect to the market interest rate

Through The User Cost (Interest Rate Channel)	
Large firms	-0.2532
Small firms	-2.0224
Manufacturing	-1.6831
Non Manufacturing	-0.1916
All firms	-1.8157
Through The Cash Flow (Balance Sheet Channel)	
Large firms	-0.0014
Small firms	-0.0228
Manufacturing	-0.0101
Non Manufacturing	0.0733
All firms	-0.0245
Total Elasticity Of Capital With Respect To Market Interest Rate	
Large firms	-0.2545
Small firms	-2.0452
Manufacturing	-1.6932
Non Manufacturing	-0.1183
All firms	-1.8402

5.0 Conclusion

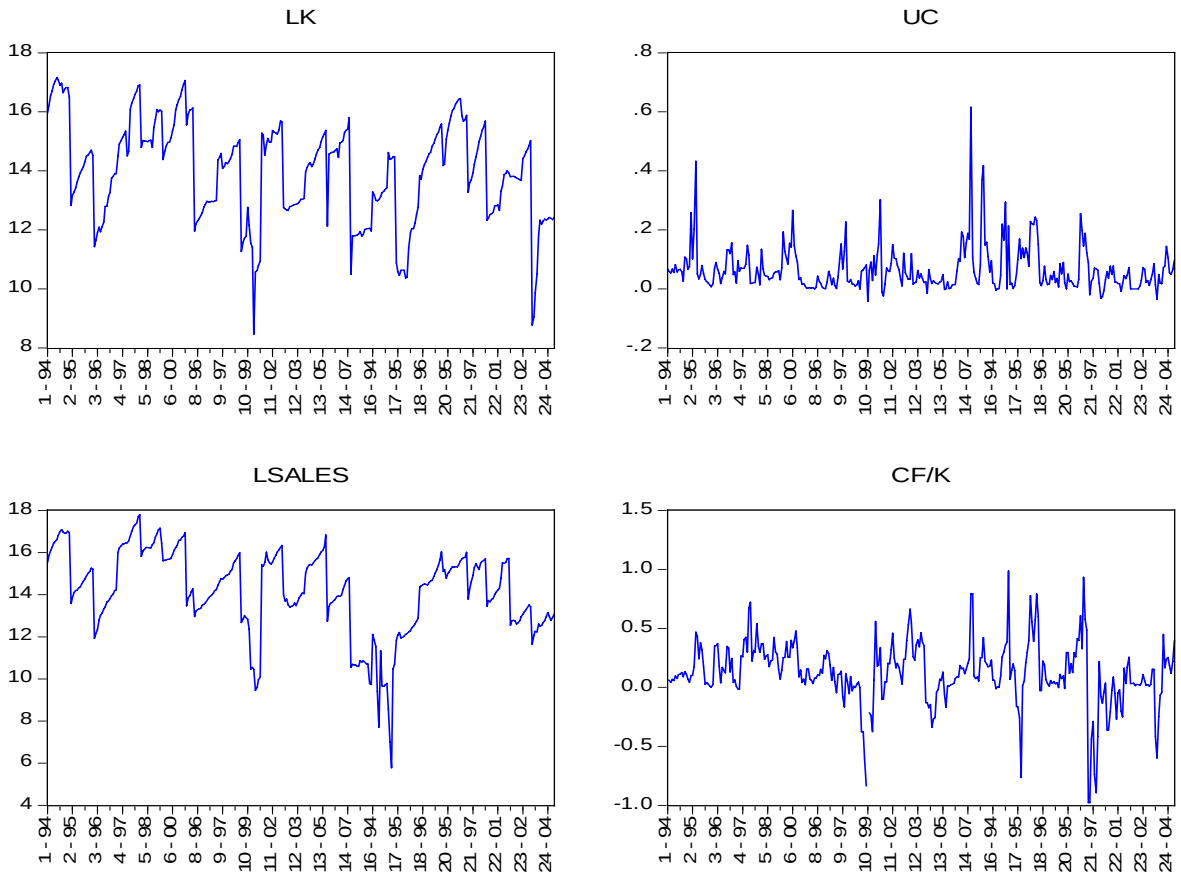
Firms' investment spending is a major determinant of business cycles and hence can influence fluctuations in the economy. By conducting a micro-econometric investigation of firm investment behaviour using a panel dataset of public listed companies, the paper finds that firm's financial position measured by their cash flow to capital ratio, user cost of capital and sales are important when considering investment decisions. After the data is arranged according to firm size and industry, the paper finds that the user cost of capital is an important determinant of investment decisions of small firms and manufacturing firms. Additionally, the research shows evidence of the financial accelerator principle by the significance of fluctuations in sales amongst all subgroups. This is indicative of the pro-cyclical nature of firm investment. Further, manufacturing firms, in addition to being sensitive to user cost of capital and changes in sales are also responsive to the availability of internal liquid funds. . Therefore, tight monetary policy impacts the typical firm through both the interest rate and the balance sheet channels. This impact is greater for manufacturing firms and small firms. The analysis of the elasticity of investment to market interest rates indicate that following monetary tightening, firms in general, are more sensitive to interest rate fluctuations than volatility of internal funds when contemplating investment. In light of these findings, the research

provides evidence to support the greater importance of the interest rate channel in Jamaica over the balance sheet channel. The paper also presents evidence of the asymmetric effect of balance sheet channel on the investment behaviour of large and small firms.

Given these results further investigation should be conducted on the dynamics of external finance premia beyond the differences in firm size. Greater insight might be garnered from examining other distinguishing characteristics, which impact the liquidity of the firm. These include, amongst others, grouping firms by their industry, age and policy on dividend payouts and relationship between firms and their banks. Also, given the structure of the Jamaican economy additional investigation should be done on the validity of the exchange rate channel on firm investment. This is alluded to by Tomar (2006), who highlights that when firms' revenues are denominated in domestic currency while their debts are in a foreign currency, changes in the nominal exchange rate deteriorate firms' balance sheets and affect their capacity to borrow and invest. It is plausible to hypothesize that large firms' investment decisions may be less impacted by changes in user cost as they have the capacity to insolate or hedge the adversely impact of contractionary policy.

Appendix

Figure 1: Plot of Variables



Pedroni Residual Cointegration Test (a)

Series: DLK DLUC DLSALES CF_K
Sample: 1994 2008
Included observations: 266
Null Hypothesis: No cointegration
Trend assumption: No deterministic trend
Lag selection: Automatic SIC with a max lag of 3
Newey-West bandwidth selection with Bartlett kernel

Alternative hypothesis: common AR coefs. (within-dimension)

	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	0.337	0.377	-1.692	0.095
Panel rho-Statistic	0.698	0.313	1.426	0.144
Panel PP-Statistic	-7.593	0.000	-6.055	0.000
Panel ADF-Statistic	-6.899	0.000	-5.642	0.000

Alternative hypothesis: individual AR coefs. (between-dimension)

	Statistic	Prob.
Group rho-Statistic	3.239	0.002
Group PP-Statistic	-7.771	0.000
Group ADF-Statistic	-6.933	0.000

Pedroni Residual Cointegration Test (b)

Series: LK UC LSALES CF_K
Sample: 1994 2008
Included observations: 266
Null Hypothesis: No cointegration
Trend assumption: No deterministic trend
Lag selection: Automatic SIC with a max lag of 3
Newey-West bandwidth selection with Bartlett kernel

Alternative hypothesis: common AR coefs. (within-dimension)

	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	-1.401	0.150	-1.513	0.127
Panel rho-Statistic	2.559	0.015	2.410	0.0218
Panel PP-Statistic	-0.197	0.391	-0.591	0.3351
Panel ADF-Statistic	-0.097	0.397	-1.217	0.1902

Alternative hypothesis: individual AR coefs. (between-dimension)

	Statistic	Prob.
Group rho-Statistic	4.169	0.000
Group PP-Statistic	-0.300	0.381
Group ADF-Statistic	-2.173	0.038

Panel unit root test: Summary

Sample: 1994 2008

Exogenous variables: Individual effects

Automatic selection of maximum lags

Automatic selection of lags based on SIC: 0 to 2

Newey-West bandwidth selection using Bartlett kernel

	Series: LK		Series: UC		Series: LSALES		Series: CF_K		Series: DLK		Series: DLSALES	
Method	Statistic	Prob.**	Statistic	Prob.**	Statistic	Prob.**	Statistic	Prob.**	Statistic	Prob.**	Statistic	Prob.**
Null: Unit root (assumes common unit root process)												
Levin, Lin & Chu t*	-2.400	0.008	-8.585	0.000	-17.074	0.000	-3.400	0.000	-26.384	0.000	-10.171	0.000
Null: Unit root (assumes individual unit root process)												
Im, Pesaran and Shin W-stat	0.896	0.815	-5.556	0.000	-3.782	0.000	-0.717	0.237	-13.989	0.000	-5.914	0.000
ADF - Fisher Chi-square	54.909	0.037	100.633	0.000	60.192	0.012	42.868	0.270	146.372	0.000	111.429	0.000
PP - Fisher Chi-square	54.051	0.044	120.217	0.000	92.822	0.000	53.321	0.051	165.197	0.000	108.789	0.000

References

Allen, C. and Robinson, W. (2002), Monetary Policy Rules and the Transmission Mechanism of Monetary Policy, Money Affairs XVIII, CEMLA.

Arellano, M. & Bond, S. (1991). Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations, Review of Economic Studies, Blackwell Publishing, vol. 58(2), pp. 277-97,

Benito, A. and Whitley, J. (2003). Implicit Interest Rates and Corporate Balance Sheets: An Analysis using Aggregate and Disaggregated UK Data. Bank of England Working Paper No. 193. Available at SSRN: http://ssrn.com/abstract=502584

Bernanke, B. and Gertler, M. (1995). "Inside the Black Box: The Credit Channel of Monetary Policy Transmission". The Journal of Economic Perspectives, Vol. 9, No. 4. pp. 27-48.

Bertrand, M. & Mullainathan, S. (2005). Profitable Investments or Dissipated Cash?: Evidence on the Investment-Cash Flow Relationship From Oil and Gas Lease Bidding," Harvard Institute of Economic Research Working Papers 2063, Harvard - Institute of Economic Research.

Butzen, P.l, Fuss, C., Vermeulen, P., Sevestre, P. and Worms, A. (2001).The Interest Rate and Credit Channels in Belgium: An Investigation with Micro-level Firm Data. ECB Working Paper No. 107. Available at SSRN: http://ssrn.com/abstract=356680

Chatelain, J., Generale, A., Hernando, I., Von Kalckreuth, U. and Vermeulen, P. (2001). Firm Investment and Monetary Policy Transmission in the Euro Area ECB Working Paper No. 112; Deutsche Bundesbank, Economic Research Centre Discussion Paper No. 20/01. Available at SSRN: http://ssrn.com/abstract=303122

Chatelain, J.-B., I. Hernando, A. Generale, U. von Kalckreuth and P. Vermeulen,(2003). New Findings on Firm Investment and Monetary Transmission in the Euro Area. Oxford Review of Economic Policy, Vol. 19(1).

Chirinko,R.,Fazzari, S. and Meyer, A.(1999). How Responsive is Business Capital Formation to it User Cost? An Exploration with Micro Data". Journal of Public Economics, Vol. 74, pp. 53-80.

Gómez, J. & Acevedo, P. (2009). "Bank Lending Channel of Monetary Policy: Evidence for Colombia, Using a Firms´ Panel," Borradores de Economia 545, Banco de la Republica de Colombia.

Hernando, I. and Tiomo, A. (2002). "Financial Constraints And Investment In France And Spain: A Comparison Using Firm Level Data", in French and Spanish industrial

corporations over the period 1991-1999: a comparative study, Banque de France and Banco de Espana.

Horvath, R. (2006). Financial Accelerator Effects in the Balance Sheets of Czech Firms. William Davidson Institute Working Paper No. 847. Available at SSRN: http://ssrn.com/abstract=945635

Love, I. and Zicchino, L.(2004). Financial Development and Dynamic Investment Behavior: Evidence from Panel Vector Autoregression. World Bank Policy Research Working Paper No. 2913. Available at SSRN: http://ssrn.com/abstract=610319

Mojon, B., Smets, F. and Vermeulen, P. (2001).,Investment and Monetary Policy in the Euro Area. Journal of Banking and Finance, Forthcoming. Available at SSRN: http://ssrn.com/abstract=303802

Oliveira, FN (2008). Effects of Monetary Policy on Corporations in Brazil: An Empirical Analysis of the Balance Sheet Channel. Effects of Monetary Policy on Corporations in Brazil: An Empirical Analysis of the Balance Sheet Channel. Premio Andima de Renda Fixa, Rio de Janeiro.

Ramlogan, C., (2004), The Transmission Mechanism of Monetary Policy: Evidence from the Caribbean, Journal of Economic Studies, 31(5), 435-447.

Serju, P.(2003). Monetary Policy and the Jamaican Economy: A Sectoral Analysis. Research Department, Bank of Jamaica.

Settlements, Bank for International,. (2007). Evolving Banking Systems in Latin America and the Caribbean: Challenges and Implications for Monetary Policy and Financial Stability. BIS Paper No. 33. Available at SSRN: http://ssrn.com/abstract=1190942

Wesche, K. (2000), Is There a Credit Channel in Austria? The Impact of Monetary Policy on Firms' Investment Decisions, Oesterreichische Nationalbank, Working Paper No. 41.