The dynamics of firm growth, size and liquidity constraints for Botswana listed firms

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Abstract

The study employed panel Ordinary Least Squares (OLS) model and panel Vector Autoregressive (VAR) model to examine the dynamic linkages among firm growth, liquidity and firm size. Specifically the study sought to: examine the key variables explaining the growth of firms in an emerging market; examine the reaction of one variable to innovations in another variable within the system and to identify the major drivers of changes in the main variable and the magnitude of the total effect over a certain period of time. Findings, using both panel VAR and panel OLS, showed that growth of firms is financially constrained by the availability of cash flows. There is a significant relationship between cash flows and firm growth which is consistent with theoretical prediction of imperfect capital markets. The panel VAR analysis further that the presence of financial constraints is sensitive to the measure of firm growth. The study shows the existence of causal relationship among firm size, liquidity and growth. Firm size, depending on measure adopted, is affected by availability of cash flows. Variations in investment expenditure were the main drivers of changes in firm growth, firm size and liquidity. The study suggests the need to improve and have a diversified access to finance. Policy makers should aim to develop the financial sector to guarantee sustainable access to bank and stock market finance. The development of strong institutions and reduction of information asymmetry is highly recommended.

***Keywords**: Panel VAR, Liquidity, Firm Growth, Botswana*

JEL Classification: G31, G32, L25

INTRODUCTION

The growth of firms is fundamental in addressing challenges faced in emerging economies such as unemployment and attaining a prosperous life, by the general populace. Policy makers in different economies are cognizant of the role played by firm growth in driving economic growth. They are very much interested in employment creation while firms are interested in growth of their sales (Coad and Holzl, 2010). Consequently, they have devoted resources to assist firms to attain growth and ensure economic prosperity. Studies on macroeconomic settings have failed to bring clarity on firm growth and subsequently its role on economic growth. Previous studies (Hermelo and Vassolo, 2007, de Wit, and Zhou, 2009, Gopinath, 2012) have been done to test the theories of growth and how they apply to developed nations. There is not much evidence on the applicability of such theories in emerging markets. They have failed to reach consensus on the factors explaining growth due to differences in measuring the growth variable. Growth has been measured using employment levels, differences in logarithms

and rate of growth of sales (Coad and Holzl, 2010, Zhou and de Wit, 2009, Oliveira and Fortunato, 2005).

The extent and magnitude to which firms are affected by financial constraints has not received adequate attention in literature. Financially constrained firms may fail to generate enough resources to support their size and growth efforts. As a result they remain small as they are limited by available internal sources. Firms in economies with cheaper and alternative sources of finance tend to take up growth opportunities easily than their counterparts in less development markets. The development of financial markets may indicate the growth potential of firms. More so, the availability and cost of finance affects the rate of firm growth. Overall, investment volume falls in economies where firms have limited access to financial resources (Campello et al, 2010, Duchin et al, 2010). Firms with limited access to externally generated funding resort to retained earnings which may be inadequate for growth.

This study combines the literature on firm growth and investment literature to understand their dynamic linkages in the context of an emerging market. By engaging literature on financial constraints, the study contributes to the existing knowledge on firm growth. The dynamics of firm growth may be better explained by analyzing its linkages with financial constraints. Past studies have focused on the traditional sources of growth and more so they do not provide adequate guidance to a policy maker in developing market. The standard panel data models used in previous studies and results which they generate are limited in scope and hence their applicability in developing nations. They fail to provide evidence on the dynamic linkages among variables which is important to a policy maker. By employing panel vector autoregression (panel VAR) techniques, the study addresses the following key questions to a policy maker: what are the key variables explaining the growth of firms in an emerging market? How does each variable react to innovations in another variable within the system? Which factors are the major drivers of changes in one variable and what is the magnitude of the total effect over a period? Findings suggest that firms in Botswana are financially constrained in relation to growth. However such constraints are linked to the measure of growth employed. The study provides evidence of causal linkages among the key variables. Variations in investment expenditure were the main drivers of changes in firm growth, firm size and liquidity.

The Botswana Stock Exchange (BSE) is among the leading exchanges in the region and provides a greater variety of investment products in an effort to promote economic development. It started off as the Botswana Share Market (BSM) in 1989 with five listed firms and only one stock broker. The BSM grew over the years culminating into the formation of the BSE in 1994 by the Act of Parliament. The BSE, which became operational in 1995, currently comprises of twenty five (25) listings under the domestic equity (main board and venture capital), foreign equity (main board and venture capital) with ten (10) listings. These thirty five (35) listings can be categorized into financial and non-financial entities. Listings on the domestic equity are relatively small compared to those on the foreign equity with current market capitalization of Botswana Pula (BWP) 41, 737.27 million and BWP 412,872.63 million respectively. The BSE also include, on foreign equity, four (4) exchange traded funds with a current market capitalization of BWP 15016 million.

There is still untapped potential for growth for all firms listed on the BSE. Despite the size of firms and moderate rate of growth, studies focusing on BSE firms have looked at issues other than growth. For example, Josiah, Themba and Matenge (2016) focused on the evaluation of corporate governance in Botswana to check the level of compliance with the code by listed firms. This follows the moving away from the King code, from

neighboring South Africa, which had been governing the manner in which firms operate. Chiwira and Muyambiri (2012) evaluated the presence of the weak form efficiency and they found that the BSE is inefficient in the weak form. Their findings are consistent with those by previous studies (Magnusson and Wydick, 2002, Smith et al, 2002). The rest of this paper is organized into six sections as follows: summary of key studies that focused on area under study; methodology; discussions of findings and conclusion and policy implications.

LITERATURE REVIEW

Theoretical review

The discussions on firm growth in this study are underpinned by the Gibrat's law of proportionate growth. The theory by Gibrat (1904–1980) in 1931 is one of the very first models of industrial dynamics. It suggested an independent relationship between the proportionate growth of a firm and its absolute size. This is sometimes rendered as the law of Proportionate Effect because the rudimentary principle underlying the model is that at the inception of the period of examination a firm's rate of growth is independent of its size. Thus the probability of a given proportionate change in size during a specified period is the same for all firms in a given industry. The theory suggested that both large and small firms have equal probabilities of growth. The manner in which firms grow is merely by chance as some tend to enjoy above average growth rates while others remain stagnant or they decline. However, Bain (1956) argued that firms below their minimum efficient scale grow more that those that have reached their optimal levels. Firm sizes higher than the minimum efficient scale were associated with losses as enshrined in the neoclassical theory of growth.

The study is also supported by the theory on financial constraints which shows that firms follow the pecking order theory of finance as they source funding (Myers and Majluf, 1984). The theory shows that when faced with constraints to access external funding, firms would resort to internal funding which are considered as cheaper. There are informational asymmetries between lenders and borrowers on investment opportunities or growth potential faced by firms. This results in huge differences on the costs of using internal and external sources of finance to take advantage of such potential. Suppliers of external finance would require a premium to compensate for this lack of information which creates uncertainty.

Arguably, studies linking the theory of growth to the theory of financial constraints (Carpenter and Petersen, 2002, Cummins et al, 2006 and Carpenter and Guariglia, 2008) showed that there is a strong link between these two strands and periods of high profitability were associated with more growth potential. On the other hand, more profitable episodes may be associated with more debt where there is easy access to such markets. This is made possible where firms would use the internal resources as collateral in debt markets. This kind of behavior shows the existence of financial constraints in the market. Discussions that follow focus on the key variables employed in this study in relation to the two theories summarized above.

Firm growth and liquidity constraints

The financial markets are imperfect as such firms may fail to grow due to limited sources of external funding. Firms would rather rely on the availability of cash-flows for making investment. Firms that are financially constrained rely more on availability of cash flows for exploiting growth opportunities. There are studies that bear testimony to this assertion which have been summarized in this study. Markovic and Stemmer (2017) showed that highly financially constrained firms rely more on retained earnings for

growth. Similarly, previous studies (Gopinath, 2012, Oliveira and Fortunato, 2005) showed that leverage has a negative effect on firm growth while liquidity has a positive effect. Furthermore their study showed that manufacturing firms with foreign participation grow faster than service firms. The study showed that the dynamic firm growth model is applicable in manufacturing and not in services industry. Their findings show the significance of industry effects on the analysis of growth. Again, Aregbeyen (2012) showed that firm growth is affected by the financial constraints. These findings are consistent with Zhou and de Wit (2009) who showed that financial capital is important for firm growth.

The findings by Oliveira and Fortunato (2005) on the dynamic analyses of firm growth and liquidity constraints attributed higher growth-cash flow sensitivity to younger and smaller firms as opposed to their larger and older counterparts. This is inconsistent with Schiantarelli (1996) who attributed relatively more severity in financial constraints on firm growth to small and medium sized enterprises (SMEs) particularly in their early years of operation. Fagiolo et al (2004) found that the constraints of liquidity engender a negative effect on growth once controls for size are made and as such smaller firms tend to encounter more volatility in growth patterns post control of liquidity constraints. This was later supported by previous studies (Rozenfeld, et al, 2011, Malevergne et al, 2011) which argued that smaller firms that are more liquidity constrained at inception, grow quite persistently more than their larger counterpart that were less constrained at inception with liquidity.

Firm growth and firm size

Several studies have been done to show the relationship between growth and size. Aregbeyen (2012) showed that firm growth is determined by firm size. The relationship is sensitive to the measure of growth employed in the analysis. On the contrary, Gopinath (2012) showed that firm growth and firm size have an inverse relationship. More so, Hermelo and Vassolo (2007) argued that firm growth is not affected by firm size which is consistent with Gibrat's law. Furthermore, Klette and Griliches (2000) as the scholars found no relationship between firm growth and size hence purporting Gilbert's law as true. On the contrary, Bronwyn (1986) had found gross inconsistency with Gibrat's law as the smaller firms used in the sample displayed quite remarkable constraints in growth as opposed to their larger counterparts. Thorsten et al (2005) supported the precepts set by Bronwyn (1986) as opposed to Gilbert's theory, the scholar concluded that whether or not financial, legal, and corruption problems affected the growth rate of a firm, all depended on the firm size hence small firms are the most financially constrained.

Heshmati (2001) had hitherto concluded that the relationship that exists between firm size and growth in cognizance to the age of the firm is quite sensitive. In support of his finding the scholar made reference to Geroski, P. (2000) who had further suggested firm size and growth analyses must consider definition of growth and size, functional form and method of estimation. Goyal, Lehn and Racic (2002) on the other hand found a cross-sectional relationship between opportunities for firm growth and variables of leverage. The same validated the prominent role played by firm size in the theory of corporate finance.

Firm size and liquidity constraints

Evidence shows that there is a relationship between firm size and liquidity Constraints. For example, Audretsch et al (2000) showed that medium sized firms displayed more constraints to liquidity pertaining to their financial behaviour regarding investments as opposed to their smallest or largest counterparts. The scholars made reference to Elston and Ann (1998) who also found small firms to be less constrained in liquidity as emergent competition and internationalism has led to improved access to

capital by small firms. The same conclusions were also made by Klette and Griliches (2000) who added that governments are continuously getting committed to funding small enterprises hence alleviating their liquidity constraints.

'Goyal, Lehn and Racic (2002) found that a negative but highly significant effect of size to liquidity constraints as the scholars observed that the stronger the level of constraints to liquidity, the more firm operations are negatively affected by size. These findings were consistent to those by Klette and Griliches (2000) who concluded that small firms though usually constrained in liquidity at startup are prone to rapidly grow with time as they alleviate their constraints through access to funding. In relation to the same results, Abral and Mata (2003) concluded that larger firms tend to experience more liquidity constraints as they tend to overtrade unlike their smaller counterparts. In contrast to the above, Eroski (2000) rather found no relationship between the firm size and its liquidity constraints as the scholar pointed to firm mismanagement as the main cause of liquidity constraints.

METHODOLOGY

Population and sample

The population for the study comprised of 25 firms that are listed under the domestic equity. Out of this category thirteen (13) firms were dropped from the sample as follows: six (6) financial firms, two (2) firms that were listed after the year 2012, two (2) were listed as venture capital and three (3) did not have adequate data. Thus, a sample of twelve (12) non-financial firms with complete data sets remained

Data and variables

The study employed panel data for the period 2012 to 2017. This period has been selected based on data availability to assist in making a preliminary analysis of the dynamic relationship between three key variables as defined in Table 1.

Analysis tools

The study employed panel ordinary least squares (OLS) and panel vector autoregressive (panel VAR) to allow for comparison in the analysis of the dynamic linkages among variables. Firstly, the panel OLS model was specified as:

$$Growth_{it} = \beta_0 + \beta_1 Size3_{it} + \beta_2 Liquid_{it} + \beta_{it} Inv_{it} + \mu_{it} \quad (1)$$

Where:

- Growth is a measure of firm growth represented by growth1 and growth2.
- Size3 is a measure of firm size
- Liquid is a measure of financial constraints
- Investment (inv) is a measure of investment expenditure by firms
- $\beta_i =$ Parameters to be estimated
- $\mu_{it} =$ Error term

All variables have been defined in Table 1 below.

Secondly, the study specified a panel VAR model due to the potential of endogeneity among variables. This model takes all variables as endogenous and allows for individual heterogeneity. The model is specified as:

$$X_{it} = \delta_i X_{i(t-1)} + f_i + \varepsilon_t \quad (2)$$

Where:

X_t is a four vector variable: {growth, size, inv, liquid,

δ_i are the parameters,

f_i captures fixed effects in the model to allow for individual heterogeneity in the levels of variables.

Love and Zicchino (2006) argued that this technique would allow us to impose the restriction that the underlying structure is the same for each cross-sectional unit. In order to eliminate fixed effects, which are correlated with regressors, the study employed the forward mean-differencing in Arellano and Bond (1995). This transformation removes only the forward mean and preserves the orthogonality between transformed variables and lagged regressors. This allows the study to use lagged regressors as instruments and to use generalized methods of moments (GMM) to estimate the coefficients. The study performed the following diagnostic tests: panel unit root tests were done using methods by Levin, Lin & Chu test and Im, Pesaran and Shin; the problem of multicollinearity was checked using correlation analysis; the choice between fixed and random effects was done using Redundant Fixed Effects Test and Hausman tests and residuals normality test were done using the Jarque-Bera (JB) statistic.

The study employed impulse response functions (IRF) to describe the reaction of one variable to innovations in another variable within the system, ceteris paribus. Residuals were decomposed in such a way that they become orthogonal to allow for the isolation of shocks to one of the VAR errors. The identifying assumption is that variables that appear earlier in the system are taken to be more exogenous while those that appear later are more endogenous. Thus variables that come earlier in the ordering will affect those following contemporaneously as well as with a lag. Confidence intervals should be estimated when using IRF. The matrix of IRFs was obtained from the estimated VAR coefficients and the standard errors were determined and confidence intervals were generated using Monte Carlo simulations. Forecast Error Variance Decomposition (FEVD) was employed to show variables that have short and long term impact on another variable. It was employed to identify the percentage changes in one variable attributable to variations in another. FEVD identifies the major drivers of changes in a variable and the magnitude of the total effect over a certain period of time (Lutkepohl, 2008).

Definition of variables

The expected signs for variables in relation to firm growth were based on evidence found in literature. Variables employed in this study are explained in Table 1.

Table 1. Definition of variables

Variable	Definition	References	Expected signs
Growth1 [1)]	Annual total growth given by Log TA_{it} – Log $TA_{i,t-1}$.	Coad and Hölzl (2012); Markovic and Stemmer (2017); Achtenhagen et al. (2010); Gopinath (2012)	
Growth2	Annual % change in Total assets $(TA_{it} – TA_{it-1})/TA_{i,t-1}$	Gopinath (2012)	
Size3	Turnover/total assets	Aregbeyen (2012); Gopinath (2012)	+/-
Liquid	Total cash flows from operations/Total assets	Markovic and Stemmer (2017); Aregbeyen (2012)	+/-
Investment (inv)	Capital expenditure/total assets	Aregbeyen (2012)	+/-

[1)] Previous studies (de Wit and Zhou, 2009, Coad and Hölzl, 2012) usually use number of employees as a measure of growth. This variable was not used for lack of data for some firms. The study employed growth measure in log differences and in percentage to help check the potential problems of heteroscedasticity (Coad and Hölzl, 2012).

RESEARCH FINDINGS

Panel unit root test

The study employed Levin, Lin & Chu test and Im, Peseran and Shin methods to conduct panel unit root tests. Analysis using the panel OLS model and panel VAR model require that all variables employed within the system of equations are stationary, that is, I(0).

The study evaluated using Levin, Lin & Chu test and Im, Pesaran and Shin test at least at the 5% significance level. The results (Table 2) suggest, using the Levin, Lin & Chu test, that all the variables were stationary at levels I(0). Using the Im, Pesaran and Shin test, results show that size and investment variables were stationary after first differencing.

Table 2. Panel unit root tests

Variable	Levels			
	Levin, Lin & Chu [1)]		Im, Pesaran and Shin [2)]	
	Statistic	Prob	Statistic	Prob
Growth1	-18.0660	0.0000***	-9.1435	0.0000***
Growth2	-14.8152	0.0000***	-7.6667	0.0000***
Size	-2.5851	0.0005***	0.2409	0.5952
Liquid	-8.3561	0.0000***	-1.8299	0.03360**
Investment	-4.477	0.0000***	-0.9353	0.1748

**** significant at 1%; ** significant at 5%*

[1)] For the Levin, Lin & Chu test, the null hypothesis is a unit root (assumes common unit root process)

[2)] For Im, Peseran and Shin test, the null hypothesis is a unit root (assumes individual unit root process)

The study also computed the correlation matrix to check for problem for multicollinearity. Table 3 shows that all coefficients were less than 0.8 except for the measures of growth which had coefficients greater than 0.8. Thus the measures of firm growth were not used in the same model to avoid spurious results.

Table 3. Correlation matrix

	Growth1	Growth2	Size	Liquid	Inv
Growth1	1.0000	0.9906	0.0319	0.0264	-0.106
Growth2	0.9906	1.0000	0.0431	-0.030	-0.093
Size	0.0319	0.0431	1.0000	0.3589	0.6957
Liquid	0.0264	-0.030	0.3589	1.00000	0.4349
Inv	-0.106	-0.093	0.6957	0.4349	1.000

Panel OLS model results

The study employed the panel OLS model to determine the factors explaining growth. Such estimations can be done using fixed effects and random effects. The study used redundant fixed effects test on the fixed effects panel OLS model and Hausman test on random effects panel OLS model to identify the best specification. The null hypotheses were as follows, respectively: that fixed effects were redundant and that the random effects were uncorrelated with explanatory variables. Findings, Table 4, showed that fixed effects are not redundant and the random effects are correlated with explanatory variables. As a result the study employed the fixed effects specification for analysis. Using random effects model would result in spurious results.

Table 4 (a). Redundant fixed effects test

Redundant Fixed Effects Tests
Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	2.673915	(7,28)	0.0298
Cross-section Chi-square	20.476493	7	0.0046

Table 4 (b). Hausman random effects test

Correlated Random Effects - Hausman Test
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	18.037211	4	0.0012

The study estimated two (2) models (Table 5) using Panel OLS and findings showed that firm size and liquidity have negative and positive effect on growth respectively. The two models were estimated to check for robustness. Findings showed that firm growth is explained by firm size and levels of cash flows. The evidence shows that firms on the BSE are facing financial constraints on growth. This is reflected by a positive coefficient of the liquid variable in relation to firm growth. The degree of financial constraints, as measured by the coefficient of liquid variable, increases with a different measure of growth. The study shows that a 10% rise in cash flows or liquidity will result in a rise in firm growth by 10.42%. This is double the level of growth experienced when the study uses change in growth as a dependent variable. Thus firms rely more on internal sources of finance for growth. The availability of cash flows drives the rate of growth for firms. There is imperfect substitutability between internal and external sources of finance. Consistent with theory, internal finance appears to be a cheaper source as compared external sources like share issues and debt. These findings are consistent with previous studies (Carpenter and Peterson, 2002, Markovic and Stemmer, 2017, Ismail et al, 2010) which showed the presence of financial constraints among firms. They showed that very severe financial constraint is evidenced by a coefficient of liquid variable that is greater than one (1).

Firm size has a negative effect on growth of firms. This is reflected by a negative and significant coefficient which changes its magnitude depending on the measure of firm growth employed. The study shows that 10% increase in firm size results in 4.86% decline in the growth rate of firms. The result is consistent with the traditional economic theory that postulates that firm size and growth have an adverse relationship. This is explained by the fact that larger firms may not grow much since they would have reached their optimal level. They may have reached a point where the rate of growth would shrink. These findings are not consistent with the theory by Gilbrat (1931) which shows that firm size does not matter for growth. Both larger and small firms have a capacity to grow at a given rate. Furthermore, Aregbeyen (2012) showed that firm growth is positively affected by firm size. These results may be attributed to differences in economic environment where the firms operate and different measurements used for variables employed. For example Gilbrat's model employed the number of employees as a measure of firm size hence the differences in the results. This may also be explained by severe financial constraints as discussed earlier. The negative relationship between firm size and growth is consistent with past studies (Becchetti and Travoto, 2002, Mata, 1994, Hermelo and Vassolo, 2007) showing that smaller firms grow faster than larger ones.

On the other hand, the study shows that investment has a positive but insignificant effect on firm growth. Thus investment expenditure is not useful in explaining firm growth, even though the sign for the coefficient is correct.

Table 5. Fixed effects panel OLS model results

Variable	Model 1 - Dependent. Var: Growth1		Model 2 - Dependent. Var: Growth2	
	Coefficient	P-Value	Coefficient	P-Value
C	0.0190**	0.0031	0.4394 **	0.0036
Size	-0.0220***	0.0009	-0.4857***	0.0017
Liquid	0.0535**	0.0427	1.0422*	0.0974
Inv	0.0058	0.8450	0.1750	0.8016
R-squared	0.5110		0.4909	
Durbin-Watson	2.588		2.4297	
F-stat	3.031**		2.796**	
	(0.0095)		(0.0149)	

**** significant at 1%; ** significant at 5%; * significant at 10%*

It is also important to perform diagnostic tests to check if the model is good and hence its reliability. The study employed the residuals normality test using the Jarque-Bera (JB) statistic which is based on values for skewness and kurtosis. It tests the null hypothesis that the residuals are normally distributed. When residuals are normally distributed the expectation is that the values for skewness and Kurtosis should be closer to zero (0) and three (3) respectively. Findings (Figure 1), using growth1 as a dependent variable, showed that the value for skewness was 0.16 while kurtosis had a value of 3.83, the null hypothesis was not rejected at 5% level of significance. Thus the residuals are normally distributed and the conclusion is that this is a good model.

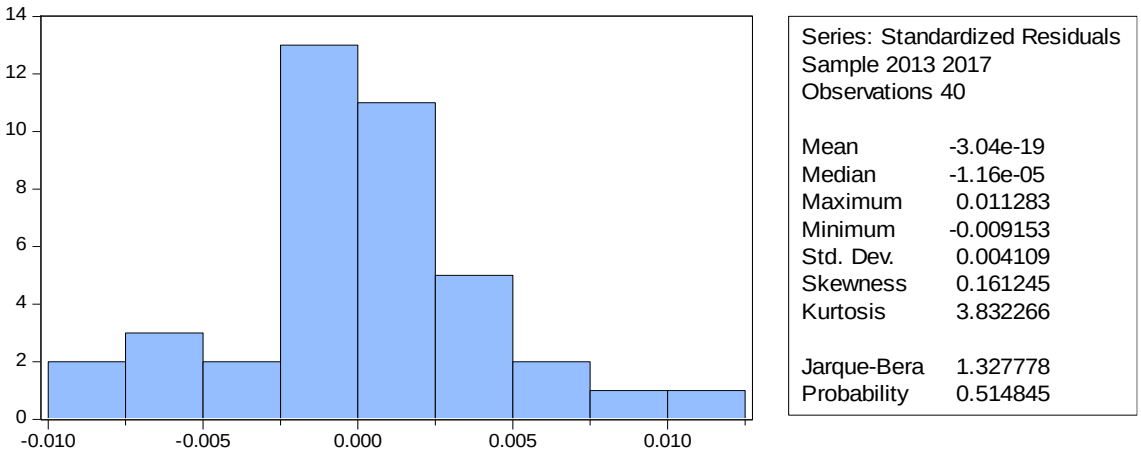

Figure 1. Residuals normality test

Panel VAR analysis

It is necessary to tests for cointegration tests to check for the existence of a long run relationship among variables. Panel Cointegration test is done on the non-stationary. If the linear combination is stationary, the conclusion reached is that there is a long-run relationship among the nonstationary variables. The findings in Table 3, using Levin, Lin & Chu test showed that all variables are stationary in levels as such a Panel VAR Model is appropriate for analysis. Thus the study employed the Unrestricted Panel VAR Model in level form (Gujarati and Gunasekar, 2012) to examine the dynamic relationships

among the variables as opposed to the determination of parameter estimates (Sims, 1980). For that reason, the coefficients in a VAR model may not be directly interpretable. This is because a VAR model is usually over parameterized making its coefficients unreliable for interpretation.

Panel VAR model results

The study shows that liquidity, as expected, has a positive contribution to growth for firms on the Botswana Stock Exchange (BSE). Specifically the study provides that a measure of growth elasticity of 0.0451, which shows that a ten percentage improvement in liquidity would lead to a 0.451 percentage growth in firms. This measure gives a direct effect of liquidity on firm growth for the one year lag while the second lag for liquidity is insignificant. Thus firms on the BSE are financially constrained as discussed using the panel OLS model. There is unidirectional causality flowing from liquidity to growth and not the other way round. However, the causal relationship between firm growth and liquidity is statistically insignificant when using the growth in percentage changes. This shows that the causal link between the two variables in sensitive to the measure of growth employed in the study.

Table 6 (a). Panel VAR Model 1

Response to / Response of:	Growth1 (-1)	Growth1 (-2)	Inv (-1)	Inv (-2)	Size3 (-1)	Size3 (-2)	Liquid (-1)	Liquid (-2)
Growth1	-0.0792	0.4071**	0.0444	-0.0511*	-0.0067	0.0067	0.0451**	-0.03010
	(0.7321)	(0.0339)	(0.1885)	(0.0848)	(0.4249)	(0.4217)	(0.0390)	(0.1687)
Inv	-1.5783	0.9321	0.5516**	0.7752***	-0.0939*	0.0698	-0.0463	-0.0182
	(0.2968)	(0.4479)	(0.0137)	(0.0001)	(0.0926)	(0.2036)	(0.7403)	(0.9001)
Size3	8.8902	0.0827	-2.1112*	3.9732***	1.2041***	-0.2268	-1.3751*	0.3122
	(0.2412)	(0.9892)	(0.0571)	(0.0001)	(0.0000)	(0.4074)	(0.0530)	(0.6681)
Liquid	1.4174	-1.2387	-0.3948	0.6589***	0.1060	-0.1213*	0.4417***	0.3932**
	(0.4203)	(0.3870)	(0.1242)	(0.0041)	(0.1028)	(0.0598)	(0.0084)	(0.023)

**** significant at 1%; ** significant at 5%; * significant at 10%*

Table 6(b). Panel VAR Model 2

Response To / Response Of:	Growth2 (-1)	Growth2 (-2)	Size3 (-1)	Size3 (-2)	Liquid (-1)	Liquid (-2)	Inv (-1)	Inv (-2)
Growth2	-0.0458	0.2967	0.1245	0.1238	0.7991	-0.5479	1.1637	-1.2151*
	(0.8590)	(0.1195)	(0.5484)	(0.5468)	(0.1082)	(0.2855)	(0.1461)	(0.0829)
Size3	0.3778	0.0351	1.1921***	-0.2147	-1.2933*	0.2863	-2.1375*	3.9224***
	(0.2897)	(0.8926)	(0.0001)	(0.4479)	(0.0598)	(0.6838)	(0.054)	(0.0001)
Liquid	0.0568	-0.0409	0.0986	-0.1140*	0.4706***	0.3681**	-0.3914	-0.6501***
	(0.4967)	(0.5032)	(0.1446)	(0.0896)	(0.0043)	(0.0289)	(0.1310)	(0.005)
Inv	-0.0717	0.0437	-0.0961*	0.0712	-0.0571	-0.0121	0.5640**	0.7823***
	(0.3124)	(3985)	(0.0939)	(0.2077)	(0.6719)	(0.931)	(0.0116)	(0.0001)

**** significant at 1%; ** significant at 5%; * significant at 10%*

Investment expenditure has a negative contribution to all measures of growth used in the study. The study shows that there is unidirectional causality flowing from investment expenditure to growth. Firm growth has not effect on investment expenditure in the case of firms on the BSE. The magnitude of the contribution worsens when measuring growth using percentage changes. Using both measures of growth, the study shows that the second lag of investment has an effect on growth while the first lag is insignificant. The study shows that a one percentage point increase in investment

expenditure would cause growth to fall by 0.0511 percent (when using log differences as measures of growth) or by 1.2151 percent (growth is measured by percentage changes).

The study shows that both liquidity and investment expenditure have an effect on firm size using the two different models. Specifically the study shows that liquidity has a negative contribution on firm size. A one percent improvement in liquidity leads to a 1.3751 percent fall in firm size. The magnitude of firm size elasticity falls as we include percentages changes in growth in the system of equations. The second lag of firm size has a negative effect on liquidity using both systems of equations. Thus the study shows that there is bidirectional causality between firm size and liquidity. However there is no evidence of the effect of financial constraints on the firm size since the coefficient of liquidity is negative. Again the study shows that there is bidirectional causality between firm size and investment expenditure using both systems of equations. Firm size has a negative contribution to investment expenditure while investment expenditure makes a negative and positive contribution to firm size when considering the first and second lag of investment respectively. This finding indicates the possibility of a non-linear relationship between investment expenditure and firm size.

The study shows that there is no causal relationship between firm size and firm growth. Firm size has the correct signs as expected but the coefficients are statistically insignificant. In the same manner the coefficients for firm growth carry correct signs but they are statistically insignificant.

Impulse response functions (IRF)

IRFs were employed to determine interrelationships among variables in the system of equations. The IRFs are equivalent to the addition of coefficients of regression on the lagged exogenous variables. The variables of interest are liquidity, firm growth and firm size. Findings are similar using the two systems of equations containing the different measures of firm growth. The study shows that firm growth responds to shocks in investment expenditure, firm size and liquidity. The impact of liquidity is more significant during the first 5 periods after which it subsides. This means firms may be financially constrained during the early years after which they will be able to access external funding. The shocks from investment expenditure and firm size remain significant even after 10 periods.

The study also shows that firm size responds significantly only to shocks in investment expenditure while shocks from liquidity and growth are insignificant. This shows the importance of the role played by investment expenditure in explaining the sizes of firms trading on the BSE. The levels of liquidity are mainly influenced by the shocks in investment expenditure and firms size. Liquidity responds to such shocks even after ten (10) periods. This is evidence that liquidity is influenced by the manner in which firms make investment decisions and change their sizes.

Variance decompositions (FEVD)

Findings suggest that variations in firm growth, measured as a percentage change, were mainly explained by variations in growth throughout the period. However, among the other variables in the system, the study shows that variations in investment expenditure explained variations in firm growth. This is followed by variations in firm size and variations in liquidity. Variations in firm growth, measured as changes in logs, were mainly explained by liquidity in periods 2 to 4 and by investment expenditure thereafter. Variations in liquidity were explained by variations in firm size from period 1 to period 6 and by investment expenditure thereafter. Variations in growth, measured as percentage changes, accounted for changes in liquidity ahead of variations in investment

expenditure up to period 4. Findings are similar, when the system of equations includes growth as measured by log changes except that variations in firm growth accounted for changes in liquidity ahead of investment expenditure in period 1. Variations in firm size were mainly explained by variations in firm growth during period 1 to 3 and thereafter investment expenditure became dominant. This result is similar for different measures of firm growth employed in the system of equations.

CONCLUSION AND POLICY IMPLICATIONS

Conclusion

The study employed panel Ordinary Least Squares (OLS) model and panel Vector Autoregressive (VAR) model to examine the dynamic linkages among firm growth, liquidity and firm size. Both panel VAR and panel OLS provide evidence that firms on the BSE are financially constrained in relation to growth. OLS method was employed to establish the factors explaining growth while the panel VAR approach helped in adding dynamics in the analysis and separate the contributions made by each individual factor to firm growth. It was also useful in determining the factors explaining the variations in the firm growth variable during the review period. It is not possible to determine such dynamics using the OLS approach only. The study employed two systems of equations with a different measure of growth. Botswana firms are heavily dependent on internal funds for growth. This may indicate the high risk aversion of finance managers such that they avoid the usage of external sources of finance like equity and debt which may be costly and result in bankruptcy. Findings, using both approaches, are consistent with theory, internal finance appears to be a cheaper source as compared to external sources like share issues and debt. The presence of financial constraints is dependent on the measure of growth employed in the analysis. The study provides evidence of causal relationships between growth variables like liquidity and investment expenditure. Investment expenditure is the main driver of variations in growth of firms, firm size and liquidity levels during the later periods. Causal linkages were established between firm size and liquidity. The size of firms is not limited by the availability of internal funding. Firms are still spending more on investment up to an optimal level. The study points out the presence of a non-linear relationship between firm size and investment expenditure which has huge policy implications. The findings suggested that firm sizes remain smaller as liquidity levels improve and vice versa. This suggests that firms are electing to spend more on growth.

Policy implications

The overreliance on internal finance suggests that Botswana needs to put in place a better developed financial sector to enhance uptake of other sources of funding. Improved and more diversified access to external finance is a priority for Botswana. The usage of debt finance may help reduce the agency costs as it brings discipline to finance managers. Finance managers need to understand the optimal levels of capital expenditure to help improve firm sizes. The overreliance of funding from the banking sector may not be a panacea for growth. The capital market still needs to be developed to facilitate sustainable access to finance. Financial markets may be limited, due to weak institutions, in the manner in which they improve access to finance by firms. It is also recommended that policy makers put in place strong institutions and reduce information asymmetry to strengthen the role of financial markets in improving access to finance.

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APPENDIX

Appendix 1. Forecast Error Variance Decomposition (FEVD)

Variance Decomposition of Growth2:					
Period	**S.E.**	**Growth2**	**Inv**	**Size3**	**Liquid**
1	0.108149	100.0000	0.000000	0.000000	0.000000
2	0.112419	93.23177	3.396292	0.000881	3.371054
3	0.119255	90.79577	5.784285	0.363246	3.056695
4	0.122703	86.25364	9.235223	0.552427	3.958714
5	0.124951	83.65315	11.66772	0.852444	3.826689
6	0.126916	81.14745	13.82533	0.954796	4.072418
7	0.127956	79.83500	14.84020	1.232250	4.092553
8	0.128940	78.62179	15.94311	1.220788	4.214310
9	0.129466	78.00237	16.15147	1.505813	4.340352
10	0.129982	77.39324	16.61713	1.524603	4.465034

Variance Decomposition of Size3:					
Period	**S.E.**	**Growth2**	**Inv**	**Size3**	**Liquid**
1	0.148831	46.92265	5.993873	47.08348	0.000000
2	0.189967	36.20595	3.743585	56.95746	3.093000
3	0.244218	26.82858	16.77924	52.20049	4.191691
4	0.272929	22.63812	22.94487	46.64665	7.770354
5	0.332043	15.75652	42.06350	33.17581	9.004175
6	0.383960	12.00881	52.74973	24.81080	10.43066
7	0.462540	8.339477	64.20499	17.35251	10.10303
8	0.540816	6.171997	70.18719	14.02002	9.620789
9	0.635701	4.488030	74.76903	12.14048	8.602467
10	0.733128	3.405452	76.92559	12.10039	7.568571

Variance Decomposition of Liquid:					
Period	**S.E.**	**Growth2**	**Inv**	**Size3**	**Liquid**
1	0.034974	14.16050	9.494750	21.79186	54.55289
2	0.043750	12.31592	14.71751	30.38600	42.58057
3	0.049963	13.85734	11.28579	34.70348	40.15339
4	0.051917	13.72630	10.48748	35.50942	40.27680
5	0.054536	13.20909	14.41052	33.37613	39.00426
6	0.056253	12.69664	17.74006	31.43389	38.12941
7	0.060684	11.05056	27.31627	27.72340	33.90977
8	0.065578	9.573623	33.77764	26.68061	29.96813
9	0.072893	7.783724	41.37283	25.75141	25.09204
10	0.080826	6.376111	45.33390	26.98724	21.30275

Cholesky Ordering: Growth2 Inv Size3 Liquid

Variance Decomposition of Growth1:					
Period	**S.E.**	**Growth1**	**Inv**	**Size3**	**Liquid**
1	0.004550	100.0000	0.000000	0.000000	0.000000
2	0.004755	92.60330	1.443636	0.032775	5.920292
3	0.005211	90.63263	4.187195	0.119670	5.060504
4	0.005385	86.18836	6.193166	0.616803	7.001674
5	0.005558	82.92564	9.848676	0.653278	6.572407
6	0.005665	80.27665	11.51006	1.102021	7.111268
7	0.005751	78.11000	13.78191	1.158707	6.949379
8	0.005805	76.70724	14.84867	1.332330	7.111769
9	0.005847	75.61641	15.81967	1.422741	7.141175
10	0.005872	74.98200	16.35251	1.440657	7.224835

Variance Decomposition of Size3:					
Period	**S.E.**	**Growth1**	**Inv**	**Size3**	**Liquid**
1	0.148287	44.34465	5.735000	49.92035	0.000000
2	0.189842	33.75889	3.538563	59.25059	3.451954
3	0.245100	26.40542	16.46443	52.74953	4.380616
4	0.273351	22.55284	22.68232	46.77419	7.990649
5	0.332540	16.17888	41.88085	32.94885	8.991421
6	0.382744	12.68145	52.15510	24.89093	10.27252
7	0.460034	9.067012	63.50014	17.58460	9.848245
8	0.534608	7.023069	69.13181	14.52745	9.317672
9	0.625544	5.318353	73.64442	12.69910	8.338120
10	0.716900	4.293725	75.67634	12.69549	7.334447

Variance Decomposition of Liquid					
Period	**S.E.**	**Growth1**	**Inv**	**Size3**	**Liquid**
1	0.034488	9.467492	8.989176	26.22682	55.31651
2	0.043112	7.966071	13.71293	36.01596	42.30504
3	0.049627	10.43749	10.35839	39.91972	39.28440
4	0.051458	10.25643	9.639927	40.95518	39.14846
5	0.054353	10.27475	14.21301	38.03022	37.48202
6	0.056053	9.938883	17.73392	35.81896	36.50824
7	0.060763	8.815234	27.90451	31.14208	32.13817
8	0.065537	7.831655	34.02694	29.65868	28.48273
9	0.072815	6.540994	41.70791	27.90468	23.84642
10	0.080324	5.604776	45.27843	28.66075	20.45604
Cholesky Ordering: Growth1 Inv Size3 Liquid					

Appendix 2. Impulse response functions