ABSTRACT

The study analyzes the relationship between private investment and growth and the key determinants of both investment and growth, with a view to drawing policy lessons from the findings. Academics and policymakers can benefit from stylized facts about how public and private investment can influence growth and help reduce poverty in low-income countries. To the extent that private investment is a determinant of long-run growth, a comprehensive assessment of what stimulates it is essential to identify and address related policy issues. The paper employs econometric techniques to investigate the short- and long-run behaviour of private investment and its links to growth. In line with earlier growth accounting studies, the study establishes that private investment is indeed a critical determinant of growth in Zimbabwe. Moreover, public investment appears to provide long-run support for private investment and growth. The analysis also shows that adverse shocks (e.g., deteriorating terms of trade) can have long-lasting growth effects, while the impact of credit to the private sector has to date been short-lived. There is thus significant potential for institutional reforms to improve the business environment, raise private investment, and invigorate growth.

KEYWORDS: Growth, Investments, Structural Vector Autoregression Model, Vector Autoregression, Vector Error Correction Model
1. INTRODUCTION

Recent analysis of the sources of growth specifically in Zimbabwe found that the greatest contribution to the country’s growth came from higher investment and an increase in Total Factor Productivity (TFP) that made more efficient use of factors of production (Serven, 2010). The improvements in factor efficiency stem from reforms in the early 1990s that improved the environment for private investment, giving the private sector a more central role in economic activity. However, both private investment and its pace of growth appear to be minimal over the period under review.

This study attempts to investigate the nexus of public and private investment and its impact on growth. Despite theoretical recognition of the impact of both public and private investment on growth, empirical analysis of African countries has been somewhat sparse because of the poor quality and limited availability of data. Nevertheless, there have been some contributions over the years (World Bank, 2005; Caseroa and Varoudakis, 2004; Devarajan, Easterly, and Pack. 1999; Gunning and Mengistae, 1999; Mataya and Veeman, 1996; Oshikoya, 1994; and Khan and Reinhart, 1990).

The study examines the relationship between private investment and growth and the key determinants of both, with a view to drawing policy lessons from the findings. Academics and policymakers can benefit from stylized facts about how public and private investment can influence growth and help reduce poverty in low-income countries.

To the extent that private investment is a determinant of long-run growth, a comprehensive assessment of what stimulates it is essential to identify and address related policy issues. The contribution of this study to the literature on growth in developing countries is twofold: First, because data related to developing economies tend to be limited and of poor quality, the study proposes a parsimonious structural VECM in the spirit of the general-to-specific approach of Hendry (1995a, 1995b, and 2000). This approach avoids the parameterization problems generally associated with standard VAR models, and it ensures that the data are congruent with the original model. Second, with the use of a coherent set of VAR outputs, the modeling procedure combines backward-looking analysis with some forward-looking outputs to determine the impact of investment on growth and to stimulate policy discussion.

Since 1997 growth of private investment has been slowing from its historical rates in Zimbabwe. Real private investment growth decelerated from an average of 14 percent a year for 1990–1997 to - 6.1 percent for 1998–2006. Similarly, in the tobacco sector, which is a major contributor to economic activity, investment has been too low to cover capital depreciation. Foreign direct investment (FDI) in the tobacco sector declined from US$270 million in 1998 (11 percent of GDP) to US$71 million in 2004 (6 percent) (World Bank, 2006).

Zimbabwe’s institutions, regulatory system, and financial sector situation probably deter private investment. The World Bank’s 2009 Doing Business report ranks Zimbabwe 157 of 175 countries in terms of ease of doing business. This lackluster performance derives partly from cumbersome licensing requirements, difficult labor market conditions, scarcity of credit, and high factor costs.

The business environment is improving only very slowly. Zimbabwe has made the least progress of all SADC countries on this front in recent years. On the Doing Business indicators, Zimbabwe moved up only 2 points between 2008 and 2010; Botswana improved by 15 points. Excessive regulation and other institutional factors may have kept Zimbabwe from improving
more, as did delays in implementing reforms and in addressing institutional weaknesses, especially in the agriculture sector.

2. METHODOLOGY

2.1. Modeling Procedure

The Vector Autoregression (VAR), a popular class of econometric models for studying data dynamics, is applied to address growth-investment dynamics. It is convenient and nicely describes the dynamics of the data. It also indicates not only the long-run equilibrium but also the pace of adjustment toward the equilibrium so long as the VAR is congruent with the data.

Although VARs or Vector Error Correction Models (VECMs) provide a solid basis for summarizing data properties, they may not apply to specific economic structures because of their reduced-form status (Lutepohl and Kratzig, 2004). Shapiro and Watson (1988) introduced the class of structural VARs (SVARs); instead of identifying the autoregressive parameters, SVAR models look at the error component terms of congruent systems. **HD, VD, and IRF** are standard VAR outputs.

The structural VECM approach gives a clearer picture of the relationship between the selected economic variables and their dynamic behavior. By contrast, descriptive statistics or ordinary least square regressions do not account for endogeneity problems or for contemporaneous and dynamic interactions between variables. For instance, simple descriptive statistics do not account for the silent dynamics of the direct and indirect contribution of private investment to the business cycle.

There are five steps to the estimation process:

- Time series analysis and unit root tests
- Unrestricted VAR specification analysis, including lag length choice and diagnostics checks for misspecification
- Cointegration analysis and exogeneity tests
- Conditional structural VECM, eliminating all insignificant variables using the PcGETS (which eliminates automatically the least significant variables)
- IRF, VD and HD analysis on the basis of step 4.

2.2. The Model

The model is represented as follows:

\[ Y_t = \sum \Pi_i Y_{t-i} + CD_t + \mu_t \]

where \( Y_t \) is 6x1 vector of observations at time \( t \), for \( t=1, ..., T \); \( \Pi_i \) is a constant parameter; and \( \mu \) is an unobservable Gaussian zero-mean independent white-noise process with a time-invariant positive definite covariance matrix; \( D_t \) contains deterministic regressors; and \( C \) and \( \Pi_i \) are constant parameters. The VAR system is also assumed to be stable; that is, the polynomial defined by the determinant of the autoregressive operator has no roots in and on the complex unit circle. The model incorporates the following endogenous variables:

\[ Y_t = (TOT_t, GINV_t, CRED_t, PINV_t, GDP_t, INST_t) \]
Where \( TOT \) is the log of trade volume index (the external factor variable); \( GINV \) is the log of public investment (the proxy for the fiscal variable); \( CRED \) is the log of credit to the private sector (the proxy for the financial variable, rather than the interest rate); \( PINV \) is the log of private investment incorporating private sector behavior; and \( GDP \) is the log of constant GDP at market price (represents supply factors). A variable capturing institutional strength, \( INST_t \), is measured using the POLITY project alternative to Freedom House.

2.3. Variable Choices and Ordering

As the introduction suggests, understanding the impact of private investment on Zimbabwe’s long-run growth must begin with an understanding of the country’s institutional factors and the regulatory framework. There is not much empirical research in this area, particularly for developing countries. Most studies have looked separately at financial development or trade liberalization and growth, or have emphasized the role of public policy, fiscal policy, or institutions. Less attention has been paid to the relationship between private sector dynamics and growth; instead, many studies have controlled for public investment, financial sector development, external factors, and institutional changes.

The analysis here uses the time-to-build approach to estimate the potential impact of private investment on growth. In this approach, capital stock becomes productive once planned investment projects are completed in sequence. It acknowledges that lags in investment returns depend on production technology (Altug, 1989, 1993; and Kydland and Prescott, 1982), unlike the cost-of-adjustment model or under uncertainty models, which attribute investment lags to inactivity as investors await new information. The empirical model used here is a structural vector autoregression model (SVECM) that captures the time lag needed for initial investment to contribute to future growth and that addresses endogeneity problems among the system variables.

The choice of variables is motivated by the findings in the literature. Public capital \( (GINV) \) is included in the model to help assess whether fiscal policy has a crowding-in or crowding-out effect on private investment. \( CRED \), credit to the private sector, is chosen because, as is well documented, it is more effective than the interest rate channel in capturing the effectiveness of monetary policy (Dailami and Giugale, 1991). The \( CRED \) variable can also be viewed as a structural variable, given that Zimbabwe’s financial sector has grown in response to continuing reforms. Furthermore, this variable helps capture the extent to which financial deepening may stimulate growth.

For convenience the system variables are ordered according to an assumed decrease in exogeneity: terms of trade is assumed to be most exogenous, and GDP most endogenous. Public investment and credit to the private sector are considered policy instruments, but credit to the private sector is assumed to be endogenous to the fiscal instrument.

3. EMPIRICAL RESULTS

3.1. Statistics Tests

The analysis uses annual data for 1990–2009 from World Bank Development Indicators 2009 and IMF International Financial Statistics of June 2010. The data in these series (except for terms of trade and institutions) are at constant prices \((2000 = 100)\). The study controls for the problem of small sample size using a retained model estimate (through PcGive). Juselius (2006) explains
that the question of how big the sample should be has, unfortunately, no obvious answer—whether the sample is “small” or “big” is a function not only of the number of observations but also of the amount of information in the data. She emphasizes that when the data are very informative about a hypothetical long-run or cointegration relation, there might be good test properties even if the sample period is relatively short, citing the case where the equilibrium error crosses the mean line several times during the period. This result is evidenced in subsequent statistical tests and various reduction processes. Unit root test results (Appendix B) indicate that most of the economic variables are non stationary. All six variables are entered with 4 lags.

Based on F-statistics, a 1-lag VAR seems to be appropriate; however, after several attempts and given the limited number of observations, it is useful to generalize the model to allow for 2 lags to ensure that error terms are outliers. The unrestricted VAR (2) diagnostic test is conducted to ensure that it is congruent with the data. The tests confirm the absence of serial autocorrelation and heteroskedasticity. The residuals are normally distributed without an ARCH effect. Further, the model variables were stable enough at lag 2 to pass the 1-up and N-down Chow tests, indicating that the system is stable.

Next, Johansen’s likelihood ratio (LR) trace test is applied to test for the cointegration rank of the six-variable system. The test indicates 2 cointegrating equations at 5 percent significance. The analysis focuses on the behavior of private investment and its relationship with GDP. The exogeneity test statistics (WETS) indicate that TOT, CRED, and INST are only weakly exogenous; GINV and GDP are weakly exogenous to the private investment long-run equation; and PINV is weakly exogenous to the GDP equation.

Finally, a parsimonious structural VECM is estimated using the full information maximum likelihood (FIML) method of the general-to-specific approach in the I(0) space. This yields more efficient estimates. The general-to-specific approach consists of eliminating redundant or insignificant variables. The recursive constancy Chow tests indicate that the system of three endogenous variables is stable; the GDP, PINV, and GINV equations are normally distributed, showing no serial correlation or heteroskedasticity.

### 3.2. Economic Interpretations

The investment equation supports the conclusion that the trade index and public investment have a positive impact on private investment in the long run. It appears that credit to the private sector does not have a significant long-run impact on private investment or on GDP growth. However, public investment and the export index have both a direct and an indirect effect—via private investment—on GDP growth. This result is consistent with the literature, which suggests that public investment stimulates private investment (Oshikoya, 1994; Odedokun, 1997; and Ramirez, 2000).

\[
\begin{align*}
\text{PINV} &= 0.140\times\text{TOT} + 0.437\times\text{GINV} + 0.653\times\text{INST} + \text{ECM (PINV)} \\
& (2.444) \quad (2.005) \quad (1.993)
\end{align*}
\]

\[
\begin{align*}
\text{GDP} &= 0.569\times\text{TOT} + 0.337\times\text{GINV} + 0.276\times\text{PINV} + 0.498\times\text{INST} + \text{ECM (GDP)} \\
& (2.894) \quad (1.977) \quad (2.009) \quad (2.015)
\end{align*}
\]

ECM (PINV) is the error correction term for the private investment equation and ECM (GDP) the error correction terms for the GDP equation. They are the residual terms between actual value (left-hand side) and estimated values (right-hand side).
From the short-run dynamic equations (Table 1 – Appendix D), it follows that private investment is a long-run determinant of growth, though its sluggish adjustment tends to dampen output response in the short run. A 1 percent increase in private investment will yield a 0.3 percent long-run increase in GDP. The GDP dynamic equation suggests that 27 percent of its deviation from long-run equilibrium is corrected every year, so it takes two to three years to close half the gap. Finally, changes in institutions, past growth performance, public investment, and credit to the private sector significantly and positively affect private investment.

The terms of trade, public investment, and institutions have a positive effect on private investment in the long run. There is no evidence of public investment crowding out private investment in the short run. Credit to the private sector, supply factors, and the institutional framework significantly affect private investment in the short run. The positive impact of institutions on growth is confirmed by Ali (1997) and Ali and Crain (1999), who found that economic freedom is a more robust determinant of growth than are political freedom and civil liberties.

Interestingly, the study finds that the long-run response of private investment to public investment is 0.4, consistent with what Oshikoya (1994) found for Cameroon. However, he finds 0.54 for Morocco and 0.61 for Mauritius, while for the pooled middle-income countries the coefficient estimate is 0.10. This suggests that the elasticity of private - public investment elasticity in Zimbabwe is far from being among the lowest. It also indicates that there may be a specification problem, for instance the absence of the real exchange rate, which is not modeled here.

The results demonstrate the complementarity of public and private investment. Both in theory and empirically the effect of public investment on private investment is mixed or ambiguous. For Zimbabwe both short- and long-run positive elasticity supports a crowding-in effect. This may work through the direct effects of productivity on public investment. The limited impact of credit to the private sector on growth may be associated with the country’s financial depth and structure.

4. POLICY IMPLICATIONS AND CONCLUSIONS

The study models investment and growth in Zimbabwe using a consistent set of VAR outputs; using annual data for 1990–2009. It employs a coherent set of structural VAR outputs. Both the short- and the long-run elasticity of investment are estimated using a conditional parsimonious VECM. Institutional and regulatory frameworks, terms-of-trade developments, public investment, and credit to the private sector appear to have a positive impact on growth. It also appears that Zimbabwe’s poor rating on the economic freedom index is an obstacle to private investment; the rating in turn reflects the relative weakness of its institutions and the slow pace of structural reforms. Cointegration analysis of speed of adjustment suggests that 27 percent of the deviation of GDP from its long-run equilibrium is corrected every year, so that it takes two to three years to cut the gap in half. Credit to the private sector indirectly affects growth through its impact on private sector investment; this effect, however, is short-lived, apparently because credit in Zimbabwe has tended to be short-term.

Under certain conditions, both the short- and long-run effects of public and private investment on growth are positive. Furthermore, the HD and IRF suggest that growth in Zimbabwe is public-private-partnership-led, and that fiscal policy should avoid or limit any short-run private sector crowding-out effects. However, the analysis does not identify or discuss
channels through which, say, public investment affects growth, such as conventional productivity, crowding-in, and crowding-out effects and other channels documented in Agénor and Moreno-Dodson (2006). A more challenging exercise would be to conduct an empirical micro-foundation and externality-based analysis. In fact, public investment may impact the informal sector, including microfinance institutions.

REFERENCES


Appendix A: Variable Definitions and Data Sources

GDP Natural log of constant GDP at market price (constant prices 2000=100).
Source: World Bank Development Indicators 2006
GINV Natural log of public investment (constant prices 2000=100).
Source: World Bank Development Indicators 2006
PINV Natural log of private investment (constant prices 2000=100).
Source: World Bank Development Indicators 2006
CRED Natural log of credit to the private sector (constant prices 2000=100).
Source: World Bank Development Indicators 2006
TOT Natural log of trade volume index (Index 2000=100).
Source: World Bank Development Indicators 2006
INST Variable capturing institutional strength.
Source: POLITY project alternative to Freedom House

Appendix B: Unit root test (1990-2009)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Dickey-Fuller</th>
<th>Phillips-Perron</th>
<th>Dickey-Fuller</th>
<th>Phillips-Perron</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>-2.23</td>
<td>-2.27</td>
<td>-6.97***</td>
<td>-8.91***</td>
</tr>
<tr>
<td>GINV</td>
<td>-2.2</td>
<td>-2.26</td>
<td>-2.83</td>
<td>-3.63**</td>
</tr>
<tr>
<td>PINV</td>
<td>-1.47</td>
<td>-1.46</td>
<td>-6.96***</td>
<td>-11.58***</td>
</tr>
<tr>
<td>GDP</td>
<td>-1.75</td>
<td>-1.72</td>
<td>-5.89***</td>
<td>-5.97***</td>
</tr>
<tr>
<td>CRED</td>
<td>-1.26</td>
<td>-1.48</td>
<td>-5.50***</td>
<td>-5.63***</td>
</tr>
<tr>
<td>INST</td>
<td>-2.45</td>
<td>-2.45</td>
<td>-3.26*</td>
<td>-3.35*</td>
</tr>
</tbody>
</table>

MacKinnon critical values for Dickey-Fuller and Phillips-Perron test are
1 percent = -4.2050; 5 percent = -3.5266; 10 percent = -3.1946
* Rejection of the null hypothesis (unit root) at 10 percent level
** Rejection of the null hypothesis (unit root) at 5 percent level
*** Rejection of the null hypothesis (unit root) at 1 percent level

Appendix C. Optimal Lag Length

<table>
<thead>
<tr>
<th>Lag</th>
<th>Significance of each lag</th>
<th>Significance of all lags up to 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lag 4</td>
<td>0.79730 [0.7470]</td>
<td>Lag 4 - 4 F(36,33) 0.79730 [0.7470]</td>
</tr>
<tr>
<td>Lag 3</td>
<td>0.92976 [0.5860]</td>
<td>Lag 3 - 4 F(72,43) 1.0871 [0.3893]</td>
</tr>
<tr>
<td>Lag 2</td>
<td>2.10227 [0.4759]</td>
<td>Lag 2 - 4 F(108,47) 1.3715 [0.1125]</td>
</tr>
<tr>
<td>Lag 1</td>
<td>1.7858 [0.0479]*</td>
<td>Lag 1 - 4 F(144,48) 8.6101 [0.0000]**</td>
</tr>
</tbody>
</table>

1/ F-Statistics, F(36,33)
APPENDIX D

Table 1. Error Correction Model, 1990 - 2009 (Retain model using PcFIML1)

LONG RUN PARAMETERS

<table>
<thead>
<tr>
<th></th>
<th>Public Investment</th>
<th>Private investment</th>
<th>Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GINV--</td>
<td>PINV--</td>
<td>GDP—</td>
</tr>
<tr>
<td>ECM (GDP)</td>
<td>-0.36</td>
<td>-0.27</td>
<td>-0.27</td>
</tr>
<tr>
<td></td>
<td>[-2.01]**</td>
<td>[-1.99]**</td>
<td></td>
</tr>
<tr>
<td>ECM (PINV)</td>
<td></td>
<td>-0.24</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>[-2.14]**</td>
<td></td>
</tr>
</tbody>
</table>

SHORT RUN PARAMETERS

<table>
<thead>
<tr>
<th></th>
<th>Public Investment</th>
<th>Private investment</th>
<th>Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GINV--</td>
<td>PINV--</td>
<td>GDP—</td>
</tr>
<tr>
<td>DTOT (-1)</td>
<td></td>
<td></td>
<td>0.13</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[1.716]*</td>
</tr>
<tr>
<td>DGINV (-1)</td>
<td>0.12</td>
<td>0.14</td>
<td>0.16</td>
</tr>
<tr>
<td></td>
<td>[3.571]**</td>
<td>[3.26]**</td>
<td></td>
</tr>
<tr>
<td>DPINV (-1)</td>
<td>0.14</td>
<td>0.15</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>[2.152]**</td>
<td>[1.905]*</td>
<td></td>
</tr>
<tr>
<td>DCRED (-1)</td>
<td>0.22</td>
<td>0.15</td>
<td>0.11</td>
</tr>
<tr>
<td></td>
<td>[3.08]**</td>
<td>[3.31]**</td>
<td></td>
</tr>
<tr>
<td>DGDP (-1)</td>
<td>0.77</td>
<td>0.35</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>[3.626]**</td>
<td>[2.457]**</td>
<td></td>
</tr>
<tr>
<td>DINST (-1)</td>
<td>0.10</td>
<td>0.45</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>[1.84]*</td>
<td>[3.11]**</td>
<td>[1.76]*</td>
</tr>
<tr>
<td>CONSTANT</td>
<td>4.23</td>
<td>-7.98</td>
<td>1.13</td>
</tr>
<tr>
<td></td>
<td>[2.02]**</td>
<td>[-2.42]**</td>
<td>[2.01]**</td>
</tr>
</tbody>
</table>

Note: t-statistics in [ ], 41 observations, optimal lag length = 2, (*) and (**) significant at 10 percent and 5 percent respectively.
ECT (GDP)= Error correction term for GDP;
ECT (PINV)= Error correction term for private investment;