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The Finance-Growth Nexus, Again: New Evidence from Kenya

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ABSTRACT

The primary objective of this paper is to shed further light on the connection between financial development and economic growth in Kenya over the period 1960-2013. A Cobb-Douglas production function, augmented by incorporating financial development and other factors, is used. This paper uses a vector autoregressive (VAR) model to determine the causal relationship between financial development and economic development. Three alternative production function representations are proposed: a basic model including financial development and inflation along with capital and labour, a variant adding foreign direct investment (FDI), and a third focusing on the interaction between financial development and FDI. The results show that financial development is a by-product of growth. The interaction between FDI and financial development is causing growth. There is bidirectional causality between growth and the labour force. Policy-makers in Kenya can obtain fruitful impacts of FDI to enhance growth by improving the role of financial development. They may also need to improve the quality of labour to sustain growth.

1. INTRODUCTION

KENYA POSSESSES A PROMISING AND YOUNG POPULATION; with 60 per cent of the Kenyan population under the age of 25 years, the country belongs to the youngest population cohort in the world (Farzaneh 2011). Important elements can help kindle economic growth. For example, soil fertility and heterogeneity make it interesting to locate different cash crops and provide access to farming households, regardless of their wealth levels. Other stimulants to growth include international financial lenders and donors, who remain important to Kenya's economic growth and development. These factors have helped Kenya to attract around $3.273 billion in foreign direct investment (FDI), equivalent to six per cent of GDP, in 2013. Despite these opportunities, Kenya continues to face chronic budget deficits. In early 2012, inflationary pressures reached a peak at 18.3 per cent, which led to a sharp currency depreciation against the US dollar. Currency depreciation reached 22 per cent in 2012 relative to 2008, but has since abated following interventions by the central bank.

From another point of view, growth also expedited the development of existing financial institutions in Kenya. Croswell and McCutcheon (2001) discuss the success of road construction projects in employing domestic labour and serving agricultural producers in Kenya. Moreover, some local commercial banks have offered to finance local contractors to build paved roads, using a government annuity scheme that pays the contractor after the successful completion of the contract. These things considered, Kenya has fought impediments to economic growth and continues to pique researchers' curiosity as to the causality between financial development and economic growth.

Recently, several studies have focused on the role of the financial sector, a large contributor to the Kenyan economy (Popiel 1994; Hulme and Mosley 1996; Ngugi and Kabubo 1998; Odhiambo 2008). Kenya, though hampered by persistent corruption and by reliance upon primary goods whose prices have remained low, has recently attracted many Chinese investments. Increased demands for more employment and higher wages, coupled with the rise of global economic institutions, have affected the role of the state in Africa. In this setup, financial institutions become enablers of potential investors, to channel funds to productive projects; good governance then would permit the efficient management of such projects, encouraging growth.

This paper contributes to the existing literature on Kenya by adopting an augmented Cobb-Douglas framework, with new variables in line with Uddin et al (2013). Specifically, we re-examine the relationship between economic growth and financial development measured by the percentage of domestic credit to private sector controlling for FDI, inflation, capital formation, and labour. Three alternative specifications for the finance-growth nexus are used in this paper: i) a plain Cobb-Douglas function using four macroeconomic factors (financial development, inflation, capital and labour), ii) an extended Cobb-Douglas function using the previous specification in addition to FDI, and iii) another specification of the same setup that captures the interaction term between FDI and financial development. The last model serves to determine whether FDI is beneficial for Kenya's financial development. This paper adds to previous studies on Kenya and would help to expand our knowledge on the critical role of financial development in Kenya, via a study using data over the period of 1960-2013 in a vector autoregressive (VAR) model.

The rest of the paper is organised as follows. The next section reviews the literature on the links between financial development and growth. It also surveys previous papers on Kenya. Section 3 describes the data and the variables used in the regression analysis. It also presents the empirical methodology. The results of the empirical analysis are discussed in Section 4. The final section concludes.

2. Literature review

Endogenous growth theory as articulated by, amongst others, Greenwood and Jovanovic (1990) and Bencivenga and Smith (1991), stresses that financial development is an important factor for fostering long-run economic growth.

This theory argues that finance is able to facilitate growth by enabling an efficient inter-temporal allocation of resources, capital accumulation and technological innovation (see, for example, Levine 2005; Ang 2008; Abu-Bader and Abu-Qarn 2008; Demirgüç-Kunt and Levine 2008). Consequently, two main hypotheses have emerged in connection with the finance-growth nexus; the 'supply-leading' hypothesis claims that a rigorous and efficient financial system can expand efficiency (Schumpeter 1911; Hicks 1969; Levine 1997; Levine and Zervos 1998; Arayssi and Fakih 2015). This hypothesis is also supported by endogenous growth.

On the other hand, the 'demand-following' hypothesis proposes a causal association from economic growth to financial development. The latter is considered a by-product of economic activity that is stimulated with the level of economic development (Robinson 1952; Kuznets 1955; Friedman and Schwartz 1963; Lucas 1988). A series of empirical studies (see, inter alia, Shaw 1973; Gupta 1984; Demetriades and Hussein 1996; Rousseau and Vuthipadadorn 2005; Quartey and Prah 2008; Abosedra and Fakih 2014) have emerged, but are not yet conclusive as to which hypothesis is more important.

Evidence for the 'supply-leading' hypothesis in the empirical economic growth literature identifies the level of financial development and the inflow of capital, including FDI, in an augmented Cobb-Douglas function. Arisoy (2012), for example, shows that FDI contributes positively to total factor productivity, using a Cobb-Douglas production function, and growth via capital accumulation. Barrell and Pain (1997) find that firm-specific knowledge-based assets are an important factor behind the growth of FDI, thus leading to economic growth. Bwalya (2006) demonstrates that FDI is effective in the transfer of technology through spillover effects to domestically owned firms in the host country.

FDI has been shown to be highly correlated with growth performance across countries (Sachs *et al* 1995; De Mello 1997; Todo 2003; Basu and Guariglia 2007; Aduda *et al* 2014). Love and Zicchino (2006) use impulse-response analysis to investigate the role of financial development in improving capital allocation and growth in 36 countries. They appreciate the role of availability of internal funds in explaining investments in countries with less developed financial systems. Beck *et al* (2007) and Baltagi *et al* (2009) show that countries with more advanced financial systems develop faster; and that financial development helps the poor relative to the rest of the economy.

Several empirical studies have found no significant relationship between FDI and growth (e.g., Grilli and Milesi-Ferretti 1995; Kraay 1998; Rodrik 1998). Carkovic and Levine (2002) find results that are irreconcilable with the notion that the FDI yields a positive impact on growth, independently of other growth determinants. However, FDI can help developing countries if domestic savings are insufficient to finance economic expansion, when an appropriate capability to assimilate some progressive technologies is available in the recipient economy (Borensztein *et al* 1998). Lee and Chang (2009) find few potential gains associated with FDI when coupled with financial development in a global economy. Blomström *et al* (1994) find that FDI only promotes growth in higher-income developing countries. Alfaro *et al* (2004) show that FDI alone plays an ambiguous role in contributing to economic growth, however well-developed financial markets countries significantly benefit from FDI. Economic theory predicts that both financial development and FDI may enhance economic growth. Under what conditions can FDI be growth enhancing in Kenya?

Inflation has been regarded as a tax that distorts the consumption of cash goods relative to credit goods (King and Levine 1993). *The Mundell-Tobin effect* states that more inflationary monetary policy enhances growth as investors substitute growth-improving investment for money (Orphanides and Solow 1990). Another argument is based on the study of exogenous growth models. For instance, Sidrauski (1967) constructs a model in which larger inflation is neutral to the economic growth and to the steady state output. Financial regulations and the interaction of inflation with such regulations have been found to have substantial effects on growth (Chari *et al* 1996).

Empirical studies have put these two theories to the test. High inflation has been found mostly to have negative growth consequences. For example, Bruno and Easterly (1998) relate the significant negative effect of extreme inflation on growth, but not for long-run average inflation. Sarel (1996) and Rousseau and Wachtel (2002) find similar results. Yilmazkuday (2013) shows the catch-up effect (all economies in time will converge in terms of per capita income, since poorer ones grow at a faster rate than wealthier ones) for developing countries only works when inflation is below 12 per cent and that financial development is only effective when inflation is moderate (i.e., below ten per cent). Bittencourt (2011) finds that inflation rates have deleterious effects on financial development in Brazil. He argues that a low and stable inflation rate is a precondition to achieve better development in the financial sector. Keho (2010) examines the finance-growth nexus using data on seven African countries. He finds that financial development has no impact on growth, regardless of the level of inflation.

Given that there is weak evidence in the literature that high growth, controlling for FDI and inflation, may encourage the development of financial markets and institutions, we ask the reverse question in this paper.

The existing literature on Kenya has focused primarily on the banking sector, the backbone of the financial system, and its securities market, the fourth largest in Africa in terms of market capitalisation (Barve 1984). Aduda and Kalunda (2012) review the literature and explain the mechanism through which enhanced measures of financial inclusion, including access and usage, should be applied to create financial stability. Better financial inclusion, specifically stock market development measured by trade volume and capitalisation, to create financial stability and growth, was analysed by Ikikii and Nzomoi (2013). They find the existence of bidirectional Granger causality between all variables in the model. Aduda et al (2014) focus on the effect of capital market deepening on economic growth. A high turnover ratio indicates low transaction costs in the stock market, which contribute to the capital deepening of the financial sector. They find that capital deepening, measured by bond market turnover, positively affects gross domestic product (GDP) growth.

Ahmed and Wahid (2011) present evidence of unidirectional causality running from financial development and financial activity to economic growth in a panel of seven Sub-Saharan African countries, including Kenya. Evidence of unidirectional causality is shown and higher levels of banking system development are positively associated with capital accumulation growth and lead to faster rates of economic growth.

Finally, Wolde-Rufael (2009) examines the Granger causality of financial deepening variables in Kenya. He finds that financial development, notably when measured by domestic credit by banks, total domestic credit by the banking sector, and liquid liabilities, significantly impacts economic growth in the long-run. Uddin *et al* (2013) examine financial depth, savings and economic growth in Kenya. In the long-run, financial development is shown to positively impact economic growth, without allowing for trade openness. They suggest an extension following Shahbaz (2012) by integrating foreign capital inflows (e.g., Shahbaz and Rahman 2012 for the case of Pakistan) in a Cobb-Douglas production function setting.

3. Econometric model and data

3.1. Econometric model

The main objective of this paper is to provide further analysis of the causal relationships between economic growth and financial development on Kenya. We employ a standard Cobb-Douglas production function, augmented by a number of new indicators introduced in this paper, namely FDI, domestic credit and inflation, in addition to the usual capital formation and labour, in line with the theoretical framework proposed by Mankiw et al (1992) and Uddin et al (2013). The standard Cobb-Douglas production function allows us to introduce the role of labour and capital in addition to other controls in the finance-growth nexus, where economic growth (the outcome) is modeled as a function of financial variables, labour, capital, and other variables. Following Mankiw et al (1992) and Uddin *et al* (2013), the aggregate production function with constant returns to scale technology, assuming marginal contribution of capital and labour in production at time *t*, is as follows:

$$G_t = A_t K_t^{\alpha} L_t^{1-\alpha} \quad (1)$$

where G_t is gross domestic output in real terms, A_t denotes technological progress, which is a positive constant, K_t denotes the capital stock variable measured by gross capital formation as percentage of GDP, L_t denotes the total labour force. The returns to scale associated with capital and labour are shown by parameters α and 1-α.

We assume that the level of technological advance can be determined by the degree of development of the financial system, the amount of FDI, and the inflation situation in the country. These factors seem to be more important in developing countries, such as Kenya, and may contribute to a higher growth rate originating from innovation and improved production techniques in explaining the economic growth (e.g. Levine 1997; Choong 2012; Hajilee and Al Nasser 2015). For instance, a well-developed financial market enhances the capacity of businesses to expand their economic activities, by improving the capital formation in Pakistan (Shahbaz 2012). Choong *et al* (2010) show, using data on 65 developing countries, that private capital flows have positive effects on growth in the presence of a well-developed financial sector. By the same token, a well-developed financial market may contribute to generating greater FDI inflows, mainly because it impacts the costs of investments. Consequently, FDI will have positive effects on economic growth (Suliman and Elian 2014; Hajilee and Al Nasser 2015).

A high rate of inflation renders the financial market unable to expand credit efficiently. Thus, economic growth will be affected. Technological progress in the economy, or of some industries, will deteriorate because of the high costs of inflation (Boyd *et al* 2001; Lee and Wong 2005; Keho 2010; Bittencourt 2012). Thus, A_t can be written as follows:

$$A_t = f(D_t, F_t, I_t) \tag{2}$$

where D_t is domestic credit to the private sector as a percentage of GDP, F_t is FDI as a percentage of GDP, and I_t is the inflation rate. Therefore, the classical Cobb-Douglas function is augmented by the variables financial development, FDI and inflation, as follows:

$$G_t = D_t^{\beta_1} F_t^{\beta_2} I_t^{\beta_3} K_t^{\alpha} L_t^{1-\alpha} \quad (3$$

Taking the natural logs of Equation (3) can be illustrated as follows:

$$\ln G_t = \beta_0 + \beta_1 \ln D_t + \beta_2 \ln F_t + \beta_3 \ln I_t + \beta_4 \ln K_t + \beta_5 \ln L_t + \varepsilon_t \tag{4}$$

where β_0 is the intercept, β_1, β_2, β_3, β_4 and β_5 are the parameters to be estimated of variables D_t, F_t, I_t, K_t, and L_t, respectively; and ε_t is the stochastic error term. These variables are added together in order to examine the validity of the input hypothesis represented in equation (3).

In order to estimate equation (4), we first examine the stationarity properties of the time-series data used in the econometric analysis. We run three different tests that are commonly used in the literature for robustness checks: i) the Augmented Dickey-Fuller (ADF) (1981), ii) the Phillips-Perron (PP) (1988), and iii) the Elliott, Rothenberg and Stock (Dickey-Fuller GLS de-trended, i.e. DF-GLS) tests (1996). In addition, we conduct the Clemente, Montanes and Reyes (1998) unit root test to account for the possibility of the existence of a structural break in the time-series data.[2] These variables are found to be integrated of order zero, i.e. I(0). Hence, causality between variables can be examined using a VAR model:

$$\begin{bmatrix} \ln G_t \\ \ln D_t \\ \ln F_t \\ \ln I_t \\ \ln K_t \\ \ln L_t \end{bmatrix} = \begin{bmatrix} a_1 \\ a_2 \\ a_3 \\ a_4 \\ a_5 \\ a_6 \end{bmatrix} + \sum_{i=1}^{n} \begin{bmatrix} \alpha_{1i} & \lambda_{1i} & \delta_{1i} & \gamma_{1i} & \mu_{1i} & \theta_{1i} \\ \alpha_{2i} & \lambda_{2i} & \delta_{2i} & \gamma_{2i} & \mu_{2i} & \theta_{2i} \\ \alpha_{3i} & \lambda_{3i} & \delta_{3i} & \gamma_{3i} & \mu_{3i} & \theta_{3i} \\ \alpha_{4i} & \lambda_{4i} & \delta_{4i} & \gamma_{4i} & \mu_{4i} & \theta_{4i} \\ \alpha_{5i} & \lambda_{5i} & \delta_{5i} & \gamma_{5i} & \mu_{5i} & \theta_{5i} \\ \alpha_{6i} & \lambda_{6i} & \delta_{6i} & \gamma_{6i} & \mu_{6i} & \theta_{6i} \end{bmatrix} \begin{bmatrix} \ln G_{t-i} \\ \ln D_{t-i} \\ \ln F_{t-i} \\ \ln I_{t-i} \\ \ln K_{t-i} \\ \ln L_{t-i} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \\ \varepsilon_{6t} \end{bmatrix} \quad (5)$$

Equation (5) is the matrix representation of the VAR system. We define a to be the deterministic factor; $\alpha, \lambda, \delta, \gamma, \mu$ and θ are the parameters to be estimated; ε_i is the stochastic error term with mean equal to zero; i is the lag length; and t represents the time subscript. It should be noted that the parameters of equation (4) are defined as follows $\beta_1 = -\lambda_i/a_i$, $\beta_2 = -\delta_i/a_i$, $\beta_3 = -\gamma_i/a_i$, $\beta_4 = -\mu_i/a_i$, $\beta_5 = -\theta_i/a_i$.

The above matrix is applied to three VAR systems: VAR1 (G, D, I, K, L), VAR2 (G, D, F, I, K, L), and VAR3 (G, D, F, D*F, I, K, L). These VAR systems are similar in terms of estimation, despite each having different variables. VAR1 is the benchmark model that estimates the production function, while in VAR2 we add FDI, and in VAR3 we add the interaction term between financial development and FDI to VAR2. We estimate Granger causality between the variables in each VAR system through the F-test, applied to the coefficients associated with the lagged variables in one equation. The null hypothesis in each VAR is defined as no causal relationship between the variables. The rejection of the null implies that Granger causality exists. Finally, to test the strength of the Granger causal relationships between the variables, we use the variance decomposition approach. This allows us to quantify the predicted error variance of the variables from the innovations of the VAR model that would be introduced by the independent variables over time.

3.2. Data description

This paper uses annual data for the period 1960-2013; a total of 54 observations. The data are taken from the World Development Indicators database of the World Bank. Table 1 presents the definitions and summary statistics of the variables used in the regression analysis. As can be seen from the table, the variables used in this paper consist of the following: GDP per capita (constant 2005 US$); domestic credit to private sector is measured by loans, purchases of non-equity securities, and trade credits and other accounts receivable as a percent of GDP; FDI is measured as net inflows of investment to acquire a lasting management interest (ten per cent or more of voting stock) in an enterprise operating in an economy other than that of the investor's, as a percentage of GDP; the inflation rate is measured as the percentage change in the consumer price index; gross capital formation consists of outlays on additions to fixed assets in the economy, plus net changes in the level of inventories as a percentage of GDP; and the total labour force comprises of people aged 15 and older in the economically active population — all people who supply labour for the production of goods and services during a specified period. We use the GDP deflator (base 2005) in calculating the percentages.

Table 1: Summary statistics of sample series (before taking logarithm)

Variable	*Definition*	*Mean*	*Std. dev.*	*Min.*	*Max.*
G	GDP per capita (constant 2005 US$)	516.284	40.392	359.569	594.618
D	Domestic credit to private sector (% of	27.878	4.973	15.119	37.362
	GDP)	0.611	0.570	0.005	2.677
F	Foreign direct investment (% of GDP)	0.125	0.083	0.016	0.460
I	Inflation rate	20.617	3.526	15.004	29.760
K	Gross capital formation (% of GDP)	9,576,272	3,569,571	4,434,898	16,600,000
L	Total labour force				

Source: Data from the World Bank - *World Development Indicators Online Database.*

4. Empirical results

Appendix Table A1 shows the results of the stationary tests. The null hypothesis for ADF, PP and DF-GLS tests the presence of non-stationarity. We reject the null hypothesis and find that the variables are stationary in levels I(0) by the three tests, except for domestic credit to private sector, gross capital formation, and total labour force variables using the DF-GLS test. We also run an additional test to detect the potential presence of a structural break in the time-series. The results of the Clemente-Montanes-Reyes (1998) test with outliers, presented in Appendix Table A2, show that all variables are stationary, with no structural breaks.

Appendix Table A3 details the six various test statistics that we calculate in order to determine the optimal lag length. The optimal lag for VAR1 (G, D, I, K, L) is found to be four periods, according to four out of the six lag order criteria. The optimal lag length for VAR2 (G, D, F, I, K, L) is found also to be four periods. The optimal lag length for VAR3 (G, D, F, D*F, I, K, L) is two periods, the significant lag order according to three out of the six criteria used.

4.1. Granger causality results

We conduct the Granger causality test to identify the direction of causality between the variables. We estimate the VAR system presented in matrix formulation (5). The results of the Granger causality tests are presented in Tables

2-4. We show the Chi-square statistics in addition to the *p*-values in these tables. Table 2 presents the results for VAR1, whilst Tables 3 and 4 show the results for VAR2 and VAR3, respectively.

Table 2: Granger causality tests: VAR1 (G, D, I, K, L)

Dependent variable	$\ln G_t$	$\ln D_t$	$\ln I_t$	$\ln K_t$	$\ln L_t$
	Chi-square statistic				
$\ln G_t$	—	3.208 (0.073)	0.0143 (0.905)	0.311 (0.577)	6.275 (0.012)
$\ln D_t$	9.457 (0.002)	—	0.001 (0.965)	3.369 (0.066)	1.644 (0.200)
$\ln I_t$	0.000 (0.998)	0.001 (0.971)	—	4.946 (0.026)	0.404 (0.525)
$\ln K_t$	5.875 (0.015)	3.170 (0.075)	1.622 (0.203)	—	7.677 (0.006)
$\ln L_t$	6.914 (0.009)	3.899 (0.048)	0.383 (0.536)	5.565 (0.018)	—

Note: Figures in parentheses represent *p*-values

Table 3: Granger causality tests: VAR2 (G, D, F, I, K, L)

Dependent variable	$\ln G_t$	$\ln D_t$	$\ln F_t$	$\ln I_t$	$\ln K_t$	$\ln L_t$
	Chi-square statistic					
$\ln G_t$	—	2.114 (0.146)	0.949 (0.330)	0.296 (0.586)	0.038 (0.845)	3.209 (0.073)
$\ln D_t$	7.029 (0.008)	—	0.152 (0.697)	0.015 (0.903)	2.582 (0.108)	0.771 (0.380)
$\ln F_t$	0.024 (0.876)	1.340 (0.247)	—	0.193 (0.661)	0.400 (0.527)	0.017 (0.897)
$\ln I_t$	0.040 (0.841)	0.066 (0.797)	0.004 (0.953)	—	5.286 (0.022)	0.680 (0.410)
$\ln K_t$	4.838 (0.028)	2.399 (0.121)	0.017 (0.895)	1.150 (0.283)	—	7.286 (0.007)
$\ln L_t$	4.582 (0.032)	2.265 (0.132)	1.102 (0.294)	1.108 (0.293)	3.691 (0.055)	—

Note: Figures in parentheses represent *p*-values

Table 4: Granger causality tests: VAR3 (G, D, F, D*F, I, K, L)

Dependent variable	$\ln G_t$	$\ln D_t$	$\ln F_t$	$\ln D_t$*$\ln F_t$	$\ln I_t$	$\ln K_t$	$\ln L_t$
	Chi-square statistic						
$\ln G_t$	—	1.829 (0.176)	7.756 (0.005)	7.410 (0.006)	0.014 (0.907)	1.512 (0.219)	10.298 (0.001)
$\ln D_t$	14.949 (0.000)	—	11.512 (0.001)	10.290 (0.001)	0.100 (0.752)	5.988 (0.014)	2.852 (0.091)
$\ln F_t$	0.310 (0.578)	0.895 (0.344)	—	0.011 (0.916)	0.001 (0.977)	0.007 (0.933)	0.000 (0.991)
$\ln D_t$*$\ln F_t$	0.654 (0.419)	0.325 (0.569)	0.261 (0.610)	—	0.004 (0.951)	0.005 (0.945)	0.057 (0.811)
$\ln I_t$	0.037 (0.847)	0.228 (0.633)	0.461 (0.497)	0.594 (0.441)	—	11.157 (0.001)	1.274 (0.259)
$\ln K_t$	1.063 (0.303)	1.028 (0.311)	6.052 (0.014)	5.875 (0.015)	0.985 (0.321)	—	2.439 (0.118)
$\ln L_t$	7.800 (0.005)	0.002 (0.964)	2.770 (0.096)	2.614 (0.106)	1.029 (0.310)	5.546 (0.019)	—

Note: Figures in parentheses represent *p*-values

When looking at the benchmark model in Table 2, we find the existence of bidirectional Granger causality between financial development level and economic growth in Kenya. Thus, the basic specification supports the feedback hypothesis between financial development and growth. However, this result becomes unidirectional, running from growth to financial development, when we add FDI in Table 3, and when we add an interaction variable between financial development and FDI in Table 4. Overall, these results lend support to the 'demand-following' hypothesis, indicating that financial development is a by-product of economic activity that is stimulated with the level of economic development (Robinson 1952; Kuznets 1955; Friedman and Schwartz 1963; Lucas 1988).

We find unidirectional causality running from FDI to growth and financial development in Table 4. These findings first validate the FDI-led growth hypothesis. Thus, it can be argued that FDI enhances growth in the host country through the new opportunities created in the economy and the transfer of technology that improves the allocation of resources (De Mello 1997; Yalta 2013). This result can be related to the causality running from growth to financial development, which suggests that financial markets in the host (developing) countries that receive FDI can benefit from these inflows, where FDI can be seen as an important precondition for financial development through growth (Hermes and Lensink 2003; Alfaro *et al* 2004; Azman-Saini *et al* 2010).

To examine whether FDI helps Kenya to benefit more from its financial development, we use an interaction term between the two variables. The results in Table 4 show that the interaction variable between FDI and financial development is causing growth. This suggests that Kenya can obtain fruitful gains from financial development by attracting more FDI inflows. Therefore, one can argue that enhancing financial development could be more efficient with the existence of FDI inflows that contribute to promoting economic growth in Kenya. It seems that Kenya's financial markets benefit strongly from higher growth, and in turn better growth can be related to more FDI inflows. This suggests that FDI is complementary with financial development to increase growth levels in Kenya.

We find evidence that capital formation is a by-product of economic growth, except in VAR3. In addition, we find bidirectional causality between growth and labour force in all three VARs, in line with the recent evidence from Pakistan in Shahbaz (2012). These findings suggest that the employment level contributes more to growth in the presence of FDI (Uddin et al 2013), where the results are highly significant at the one per cent significance level in VAR3. It has been argued in the literature that openness (through exports and/or FDI) works to enhance the quality of labour, which will result in higher labour productivity and which, in turn, raises economic growth (Alcalà and Ciccone 2004). Dutta and Ahmed (2004) find that labour contributes to increase the productivity of the industrial sector in Pakistan. This is relevant for Kenya where FDI is found to play an important role through its interaction with financial development. In other words, Kenya can benefit from labour to attract more FDI, conforming with the finding in the literature, in developing countries, that labour is more likely to increase the fruits of FDI (Shahbaz 2012).

The results also indicate the absence of Granger causality between growth and inflation. Indeed, the relationship between inflation and economic growth is a controversial one and has been much debated in the literature. This result should, therefore, be interpreted with caution. For instance, inflation can be seen as having an inconclusive effect on growth (Friedman 1973). In the case of Kenya, it seems that the economic growth rate is not affected by inflation. Policies that target increased growth may still have to control for inflation stability (Bruno and Easterly 1998).

Finally, we examine the stability of the estimated parameters of the VAR system (equation 5) over time. We use the cumulative sum of recursive residuals (CUSUM) and the CUSUM of squares (CUSUMSQ) tests. The resulting statistics are reported in Figures A1, A2 and A3. The plots indicate that the coefficients are stable in our estimated models.[3]

4.2 Variance decomposition

The results of the variance decomposition of VAR1, VAR2, and VAR3 are presented in Appendix Tables A4, A5, and A6, respectively. The results in Table A4 suggest that 21.3 per cent of economic growth is explained by its own innovative shocks, while shocks to financial development contribute only 1.1 per cent to economic growth . By the same token, the role of inflation is less important, with its shock contributing 0.2 per cent to economic growth . The roles of labour and capital, however, are more important. These variables, by their shocks, contribute around 21.4 per cent and 56.1 per cent, respectively, to economic growth. It is found that the variance decomposition of inflation that economic growth contributes significantly to inflation, by 27.5 per cent; and financial development shocks contribute 25 per cent to inflation.

Moving to the results of VAR2, we find that the contribution of financial development, inflation, capital formation, and FDI are negligible. However, 87.5 per cent of economic growth is explained by its own shocks. Interestingly, the innovation shock to economic growth explains 46.4 per cent of the innovation in financial development. This lends support to our results that economic growth causes financial development, when FDI information is taken into account among the control variables.

Finally, in Appendix Table A6, the innovative shocks of capital and labour contribute to economic growth by 42.4 per cent and 54.7 per cent, respectively. We find that inflation shocks contribute by 33.6 per cent to this interaction term. Capital and labour shocks contribute 8.3 per cent and 20.7 per cent to shocks of the interaction term. Growth contributes 2.8 per cent to the shocks of inflation. This can be explained if aggregate demand expands faster than aggregate supply in Kenya.

The results of the variance decomposition overall suggest that the contribution of financial development, capital, and labour depends on the control variable of FDI. This reinforces the hypothesis that FDI complements financial development in Kenya.

5. Conclusion and policy implications

The aim of this paper has been to re-investigate the associations between financial development and economic growth, using annual data for Kenyan annual data over the period 1960-2013, in a vector autoregressive model. It uses an augmented version of the Cobb-Douglas production function framework, following Mankiw et al (1992), to provide additional evidence on the relationship between finance and growth in Kenya.

Conditional on inflation, labour, and capital, the Granger causality results show that financial development is a by-product of growth. As found in Popiel (1994), Hulme and Mosley (1996), Ngugi and Kabubo (1998), and Odhiambo (2008), we reconfirm that growth led to a larger and deeper financial sector in Kenya over the period of the study. The results also reveal that FDI is affecting growth. The outcomes indicate that there is causality running from the interaction term between financial development,-FDI and growth, leading us to believe that FDI contributes to economic growth and to the productivity of financial development in Kenya. Finally, we find strong bidirectional causality between growth and the labour force.

The findings of this paper add several interesting conclusions to the existing studies on Kenya and they might be helpful to policy-makers in other developing countries. First, they emphasise the role of developing economies' growth in promoting the expansion of their financial sector. This is particularly important in low-income countries, which lack domestic savings to provide more asset transformation and portfolio diversification through the existence of robust and widespread financial institutions.

Second, the results highlight the prominence of FDI as a facilitator of economic growth and as a contributor to financial development and growth. The Kenyan government needs to capitalise on FDI inflows for the aim of overall development of the economy. This is especially relevant for Kenya, where it has become one of the largest recipients of FDI in Africa, mainly as a result of China's investment in mining and hydrocarbon sectors.

Third, given that there is a bidirectional relationship between labour and growth, policies should target the labour-intensive sectors in the economy, such as donor financed road construction and manufacturing-under-bond schemes, that were successful in efficiently producing more jobs in Kenya. Therefore, efforts should be undertaken to stimulate financial development, aiming at improving the productivity and skill level of labour. We suggest that policies should encourage FDI to focus on labour-intensive industries that prevail in Kenya in order to raise the workers' productivity and provide further domestic investment opportunities.

Further studies can look at how monetary policy, through its effect on the financial sector and its regulation, can impact growth in Kenya. Another important aspect of economic development would be labour training and its ability to lead to growth through accommodating foreign investors' technological requirements.

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Table A1: Standard stationarity unit root tests

Variable	*Augmented Dickey-Fuller (ADF)*		*Phillips-Perron (PP)*		*Dickey-Fuller GLS (DF-GLS)*	
	t-statistics	*Unit root*	*t-statistics*	*Unit root*	*t-statistics*	*Unit root*
ln G_t	-5.694 (0)***	I(0)	-4.767 (0)***	I(0)	-2.516 (0)*	I(0)
ln D_t	-2.963 (0)**	I(0)	-3.036 (0)**	I(0)	-2.321 (0)	I(0)
ln F_t	-6.875 (0)***	I(0)	-6.879 (0)***	I(0)	-4.904 (0)***	I(0)
ln I_t	-5.060 (0)***	I(0)	-5.023 (0)***	I(0)	-3.189 (0)*	I(0)
ln K_t	-3.370 (0)**	I(0)	-3.245 (0)**	I(0)	-2.062 (0)	I(1)
ln L_t	-5.081 (0)***	I(0)	-2.861 (0)***	I(0)	-2.591 (0)	I(1)

Notes: The statistics represent the test with trend and constant. The null hypothesis for the ADF, PP, and DF-GLS tests is the presence of non-stationarity. The lag order is presented in parentheses. Lag lengths are of order zero based on the Akaike information criterion (AIC). *** indicates rejection of the null hypothesis at 1 per cent. ** indicates rejection at 5 per cent. * indicates rejection at 10 per cent.

Table A2: Clemente-Montanes-Reyes structural break unit root analysis

Variable	*Innovative outliers*			*Additive outliers*		
	t-statistics	*Break year*	*Decision*	*t-statistics*	*Break year*	*Decision*
ln G_t	-3.291 (4)*	1975	Stationary exists	-6.810 (4)***	2007	Stationary exists
ln D_t	-3.450 (0)*	1976	Stationary exists	-3.552 (0)*	1975	Stationary exists
ln F_t	-7.759 (0)***	1979	Stationary exists	-6.553 (0)***	1986	Stationary exists
ln I_t	-5.538 (4)**	1993	Stationary exists	-2.979 (0)*	1991	Stationary exists
ln K_t	-5.753 (0)**	1990	Stationary exists	-5.419 (0)***	1993	Stationary exists
ln L_t	-4.630 (1)**	2004	Stationary exists	-6.151 (14)***	1994	Stationary exists

Notes: The null hypothesis is the presence of non-stationarity with a structural break. The lag order is presented in parentheses. Lag lengths are of order zero based on the Akaike information criterion (AIC). *** indicates rejection of the null hypothesis at 1 per cent. ** indicates rejection at 5 per cent. * indicates rejection at 10 per cent.

Table A3: Lag length selection criteria

VAR1 (G, D, I, K, L)

Lag	*LogL*	*LR*	*FPE*	*AIC*	*SC*	*HQ*
0	81.987	—	0.000	-3.948	-3.735	-3.872
1	341.527	519.080	0.000	-15.976	-14.6961*	-15.517
2	374.653	66.253	0.000	-16.393	-14.046	-15.551
3	402.948	56.591	0.000	-16.561	-13.149	-15.337
4	448.763	91.629*	2.9e-14*	-17.6289*	-13.150	-16.0219*

VAR2 (G, D, F, I, K, L)

Lag	*LogL*	*LR*	*FPE*	*AIC*	*SC*	*HQ*
0	22.788	—	1.70E-08	-0.884	-0.625	-0.792
1	278.808	512.040	1.60E-13	-12.464	-10.6536*	-11.820
2	328.376	99.136	9.10E-14	-13.178	-9.816	-11.982
3	374.703	92.654	8.00E-14	-13.721	-8.808	-11.973
4	443.165	136.920*	3.9e-14*	-15.421*	-8.966	-13.121*

VAR3 (G, D, F, D*F, I, K, L)

Lag	*LogL*	*LR*	*FPE*	*AIC*	*SC*	*HQ*
0	-789.764	—	3.80E+09	41.935	42.0423	42.2366
1	-525.813	527.9	49086.2	30.6217	31.4804	33.035
2	-465.519	120.59	35576.9	30.0273	31.6373	34.5522
3	-394.986	141.07	26262.6	28.894	31.2552	35.5305
4	-247.908	294.16*	1387.07*	23.732*	26.8446*	32.4802*

Notes: LR denotes sequential modified LR test statistic. FPE denotes the final prediction error. AIC denotes the Akaike information criterion. SC denotes the Schwarz information criterion. HQ denotes the Hannan-Quinn information criterion. * indicates the lag order selected by the criterion and is significant at the 5 per cent significance level.

Table A4: Variance decomposition: VAR1 (G, D, I, K, L)

	ln G_t	ln D_t	ln I_t	ln K_t	ln L_t
Variance decomposition of ln G*t*					
1	1.000	0.000	0.000	0.000	0.000
3	0.785	0.051	0.003	0.030	0.132
5	0.531	0.048	0.003	0.130	0.288
7	0.369	0.029	0.003	0.203	0.395
9	0.299	0.019	0.003	0.203	0.476
11	0.269	0.015	0.003	0.196	0.517
13	0.241	0.013	0.002	0.205	0.539
14	0.226	0.012	0.002	0.210	0.550
15	0.213	0.011	0.002	0.214	0.561
Variance decomposition of ln D*t*					
1	0.086	0.914	0.000	0.000	0.000
3	0.082	0.849	0.002	0.014	0.053
5	0.059	0.610	0.006	0.092	0.232
7	0.041	0.384	0.004	0.172	0.399
9	0.029	0.268	0.004	0.195	0.504
11	0.024	0.202	0.005	0.209	0.559
13	0.022	0.157	0.005	0.216	0.600
14	0.021	0.141	0.006	0.220	0.612
15	0.020	0.127	0.006	0.224	0.624
Variance decomposition of ln I*t*					
1	0.275	0.348	0.377	0.000	0.000
3	0.513	0.150	0.255	0.004	0.077
5	0.407	0.233	0.224	0.059	0.078
7	0.344	0.264	0.199	0.087	0.106
9	0.299	0.254	0.181	0.132	0.135
11	0.297	0.234	0.185	0.127	0.156
13	0.289	0.241	0.184	0.135	0.152
14	0.282	0.252	0.183	0.134	0.149
15	0.275	0.250	0.179	0.142	0.154
Variance decomposition of ln K*t*					
1	0.116	0.107	0.028	0.749	0.000
3	0.112	0.090	0.016	0.558	0.224
5	0.079	0.062	0.038	0.612	0.210
7	0.065	0.048	0.028	0.588	0.272
9	0.061	0.043	0.023	0.561	0.313
11	0.054	0.036	0.019	0.555	0.336
13	0.052	0.031	0.016	0.556	0.345
14	0.051	0.029	0.015	0.555	0.351
15	0.050	0.027	0.014	0.553	0.356
Variance decomposition of ln L*t*					
1	0.000	0.000	0.130	0.006	0.865
3	0.002	0.003	0.142	0.008	0.846
5	0.001	0.004	0.153	0.009	0.833
7	0.002	0.005	0.130	0.025	0.837
9	0.004	0.005	0.104	0.050	0.837
11	0.005	0.004	0.090	0.064	0.837
13	0.005	0.004	0.082	0.074	0.836
14	0.005	0.003	0.078	0.078	0.835
15	0.006	0.003	0.075	0.082	0.834

Table A5: Variance decomposition: VAR2 (G, D, F, I, K, L)

	ln G_t	ln D_t	ln F_t	ln I_t	ln K_t	ln L_t
Variance decomposition of ln G_t						
1	1.000	0.000	0.000	0.000	0.000	0.000
3	0.934	0.004	0.009	0.000	0.004	0.048
5	0.900	0.004	0.024	0.000	0.004	0.068
7	0.894	0.003	0.022	0.001	0.004	0.076
9	0.890	0.003	0.019	0.001	0.005	0.083
11	0.885	0.003	0.018	0.001	0.005	0.088
13	0.880	0.003	0.016	0.000	0.006	0.094
14	0.877	0.003	0.015	0.000	0.006	0.097
15	0.875	0.004	0.015	0.001	0.007	0.100
Variance decomposition of ln D_t						
1	0.049	0.951	0.000	0.000	0.000	0.000
3	0.140	0.604	0.106	0.055	0.093	0.003
5	0.256	0.566	0.077	0.034	0.062	0.005
7	0.348	0.497	0.062	0.031	0.054	0.007
9	0.388	0.474	0.055	0.027	0.046	0.010
11	0.417	0.453	0.054	0.024	0.041	0.012
13	0.442	0.434	0.052	0.021	0.036	0.016
14	0.453	0.424	0.052	0.019	0.034	0.018
15	0.464	0.415	0.051	0.018	0.032	0.020
Variance decomposition of ln F_t						
1	0.073	0.012	0.591	0.104	0.133	0.087
3	0.076	0.065	0.351	0.097	0.222	0.190
5	0.070	0.044	0.263	0.180	0.313	0.131
7	0.116	0.040	0.232	0.173	0.323	0.115
9	0.125	0.035	0.213	0.182	0.346	0.100
11	0.135	0.031	0.196	0.187	0.360	0.090
13	0.140	0.029	0.183	0.192	0.374	0.082
14	0.144	0.028	0.178	0.193	0.378	0.079
15	0.146	0.027	0.174	0.195	0.383	0.076
Variance decomposition of ln I_t						
1	0.054	0.061	0.000	0.884	0.000	0.000
3	0.058	0.040	0.046	0.771	0.067	0.018
5	0.038	0.040	0.044	0.792	0.068	0.018
7	0.034	0.036	0.037	0.805	0.070	0.018
9	0.027	0.034	0.030	0.821	0.073	0.015
11	0.024	0.033	0.027	0.832	0.071	0.013
13	0.020	0.032	0.023	0.840	0.072	0.011
14	0.019	0.032	0.022	0.844	0.072	0.011
15	0.018	0.032	0.021	0.847	0.071	0.010

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Variance decomposition of ln K_t						
1	0.257	0.029	0.000	0.020	0.694	0.000
3	0.405	0.093	0.013	0.044	0.429	0.016
5	0.407	0.106	0.014	0.045	0.407	0.021
7	0.414	0.118	0.012	0.054	0.376	0.025
9	0.421	0.125	0.011	0.057	0.363	0.024
11	0.426	0.129	0.010	0.059	0.354	0.022
13	0.430	0.131	0.010	0.060	0.348	0.021
14	0.431	0.132	0.009	0.061	0.346	0.021
15	0.432	0.133	0.009	0.061	0.344	0.020
Variance decomposition of ln L_t						
1	0.106	0.065	0.000	0.065	0.046	0.718
3	0.242	0.036	0.055	0.059	0.058	0.550
5	0.283	0.022	0.072	0.081	0.081	0.462
7	0.326	0.019	0.063	0.081	0.087	0.424
9	0.353	0.017	0.055	0.078	0.088	0.408
11	0.367	0.016	0.052	0.076	0.088	0.400
13	0.377	0.016	0.050	0.075	0.089	0.393
14	0.381	0.015	0.049	0.075	0.089	0.391
15	0.384	0.015	0.048	0.075	0.089	0.389

Table A6: Variance decomposition: VAR3 (G, D, F, D*F, I, K, L)

	ln G_t	ln D_t	ln F_t	ln Dt*ln Ft	ln I_t	ln K_t	ln L_t
Variance decomposition of ln G_t							
1	1.000	0.004	0.000	0.003	0.030	0.611	0.021
3	0.983	0.567	0.033	0.016	0.116	0.512	0.091
5	0.950	0.421	0.017	0.012	0.156	0.533	0.221
7	0.945	0.543	0.059	0.084	0.121	0.479	0.400
9	0.933	0.620	0.104	0.103	0.108	0.424	0.474
11	0.906	0.644	0.109	0.115	0.100	0.360	0.498
13	0.882	0.593	0.113	0.112	0.098	0.336	0.521
14	0.873	0.573	0.103	0.107	0.091	0.424	0.547
15	0.873	0.573	0.103	0.107	0.091	0.424	0.547
Variance decomposition of ln D_t							
1	0.000	0.996	0.004	0.001	0.005	0.135	0.414
3	0.000	0.252	0.130	0.094	0.021	0.122	0.386
5	0.001	0.141	0.180	0.180	0.219	0.113	0.250
7	0.002	0.115	0.166	0.155	0.189	0.133	0.109
9	0.010	0.080	0.153	0.143	0.169	0.173	0.051
11	0.019	0.092	0.141	0.122	0.148	0.135	0.034
13	0.018	0.092	0.136	0.125	0.247	0.144	0.023
14	0.017	0.086	0.116	0.108	0.268	0.135	0.018
15	0.016	0.084	0.115	0.110	0.257	0.134	0.014

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Variance decomposition of ln F_t

1	0.000	0.000	0.995	0.991	0.514	0.012	0.033
3	0.004	0.131	0.489	0.542	0.087	0.045	0.016
5	0.008	0.371	0.494	0.485	0.048	0.044	0.007
7	0.005	0.218	0.466	0.448	0.042	0.090	0.022
9	0.005	0.169	0.447	0.439	0.041	0.113	0.050
11	0.030	0.135	0.456	0.448	0.070	0.184	0.070
13	0.049	0.215	0.455	0.438	0.061	0.187	0.081
14	0.048	0.227	0.488	0.464	0.072	0.173	0.081
15	0.045	0.227	0.480	0.443	0.076	0.150	0.084

Variance decomposition of ln D_t * ln F_t

1	0.000	0.000	0.000	0.005	0.201	0.053	0.182
3	0.002	0.029	0.172	0.179	0.707	0.067	0.160
5	0.032	0.042	0.183	0.195	0.433	0.092	0.273
7	0.030	0.078	0.176	0.182	0.436	0.072	0.283
9	0.031	0.088	0.158	0.168	0.421	0.067	0.249
11	0.027	0.097	0.157	0.173	0.442	0.100	0.227
13	0.029	0.063	0.151	0.167	0.363	0.104	0.215
14	0.033	0.065	0.165	0.186	0.339	0.096	0.213
15	0.036	0.073	0.168	0.190	0.336	0.083	0.207

Variance decomposition of ln I_t

1	0.000	0.000	0.000	0.000	0.250	0.170	0.130
3	0.010	0.020	0.032	0.023	0.059	0.220	0.216
5	0.009	0.025	0.024	0.019	0.099	0.190	0.167
7	0.017	0.023	0.038	0.038	0.175	0.162	0.143
9	0.018	0.025	0.058	0.065	0.221	0.162	0.153
11	0.016	0.020	0.053	0.057	0.204	0.158	0.154
13	0.020	0.025	0.061	0.071	0.185	0.160	0.149
14	0.024	0.030	0.052	0.061	0.181	0.148	0.144
15	0.028	0.030	0.055	0.065	0.192	0.151	0.139

Variance decomposition of ln K_t

1	0.000	0.000	0.000	0.000	0.000	0.020	0.219
3	0.001	0.002	0.171	0.176	0.000	0.035	0.167
5	0.001	0.001	0.143	0.145	0.011	0.033	0.131
7	0.001	0.001	0.105	0.110	0.042	0.033	0.105
9	0.001	0.001	0.102	0.108	0.045	0.029	0.083
11	0.001	0.001	0.090	0.095	0.041	0.024	0.062
13	0.001	0.023	0.094	0.093	0.037	0.065	0.042
14	0.003	0.017	0.086	0.085	0.034	0.062	0.030
15	0.003	0.017	0.081	0.082	0.040	0.061	0.023

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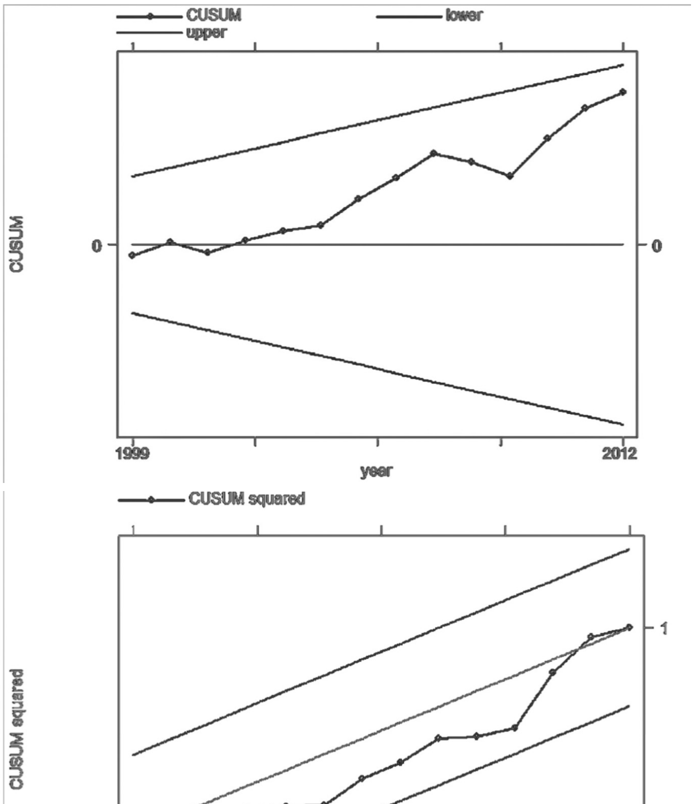
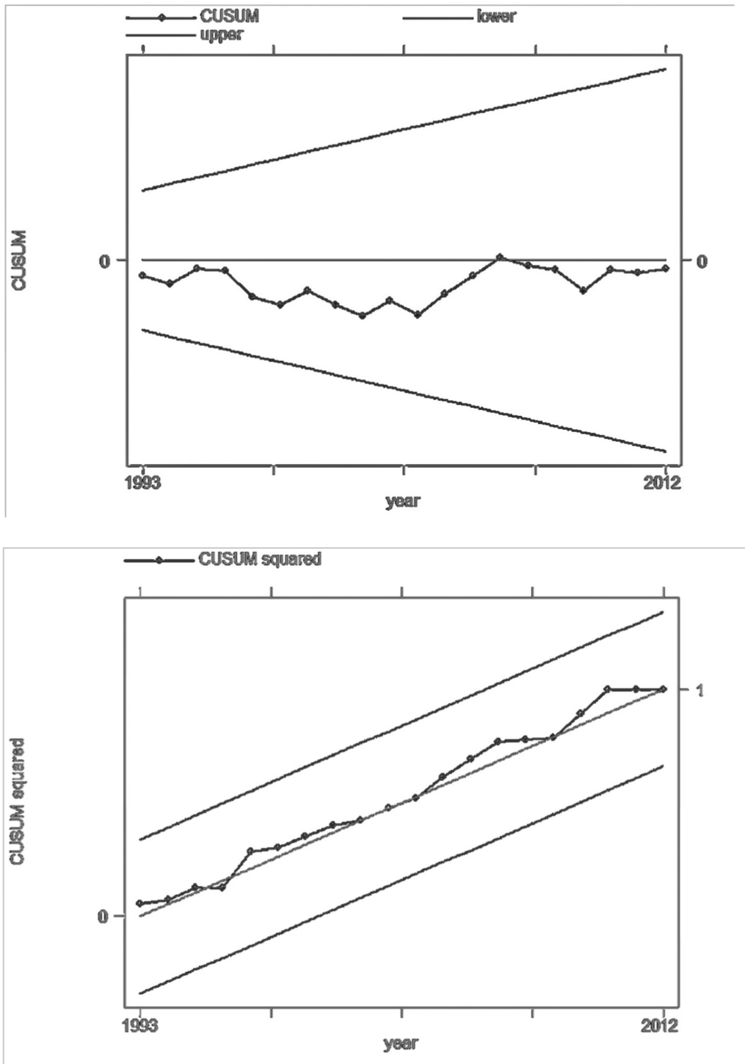
Variance decomposition of ln L_t							
1	0.000	0.000	0.000	0.000	0.000	0.000	0.110
3	0.016	0.027	0.024	0.106	0.057	0.023	0.079
5	0.012	0.021	0.015	0.073	0.054	0.056	0.061
7	0.018	0.035	0.019	0.067	0.050	0.066	0.066
9	0.023	0.033	0.041	0.098	0.038	0.068	0.079
11	0.028	0.030	0.038	0.092	0.038	0.070	0.071
13	0.030	0.031	0.037	0.087	0.037	0.074	0.066
14	0.029	0.036	0.037	0.091	0.034	0.075	0.067
15	0.031	0.034	0.040	0.098	0.031	0.076	0.073

Figure A1: Plots of Cumulative Sum of Recursive Residuals (CUSUM) and Cumulative Sum of Squares of Recursive Residuals (CUSUMSQ): VAR1 (G, D, I, K, L)



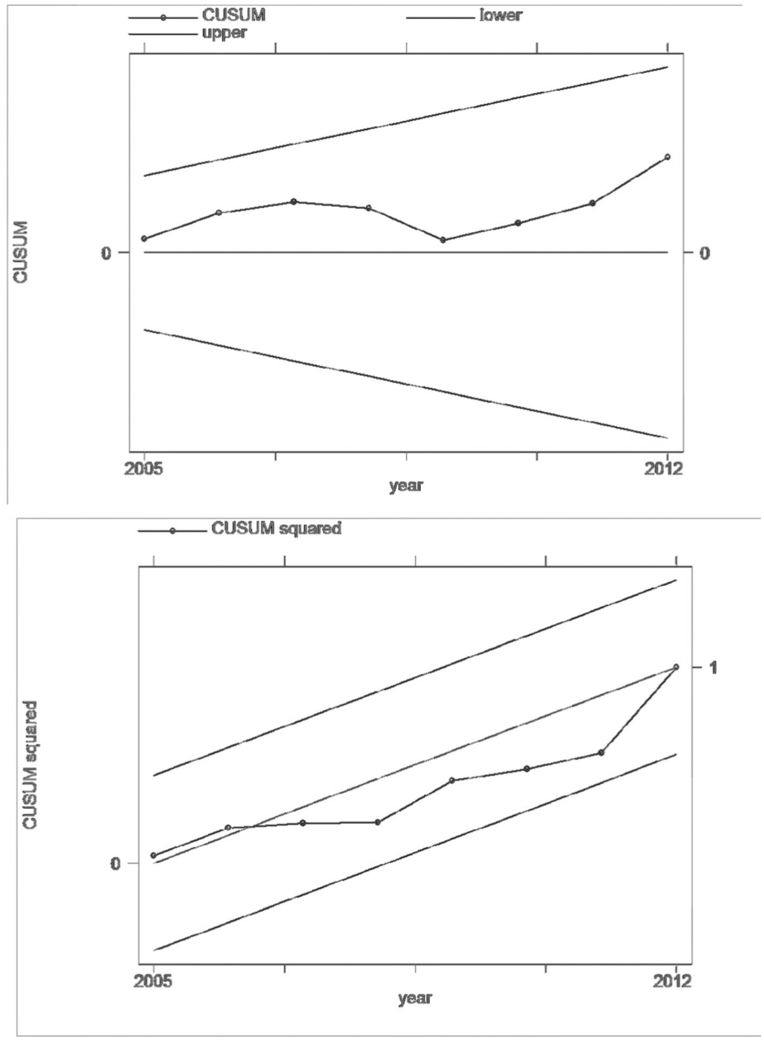
Notes: The straight lines represent critical bounds at 5% significance level.

Figure A2: Plots of Cumulative Sum of Recursive Residuals (CUSUM) and Cumulative Sum of Squares of Recursive Residuals (CUSUMSQ): VAR2 (G, D, F, I, K, L)



Notes: The straight lines represent critical bounds at 5% significance level.

Figure A3: Plots of Cumulative Sum of Recursive Residuals (CUSUM) and Cumulative Sum of Squares of Recursive Residuals (CUSUMSQ): VAR3 (G, D, F, D*F, I, K, L)



Notes: The straight lines represent critical bounds at 5% significance level.

ENDNOTES

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2. We run the Clemente-Montanes-Reyes (1998) structural break unit root test. The test fails to reject the non- stationarity null hypothesis when a structural break is present. The Clemente-Montanes-Reyes test considers the joint null hypothesis of the presence of non-stationarity and no structural break in the time series. The alternative hypothesis indicates the presence of stationarity with a one time-period structural break. It should be noted that this test has the advantage of showing the results of two models: the innovative outliers and the additive outliers. The first one takes into account gradual changes in the mean of the series, while the second model takes into account sudden changes in the mean of a series.

3. The test results are plotted alongside the break point to demonstrate the stability of all parameters over the sample period. The null hypothesis is that all coefficients are unchanging over time. We reject the null hypothesis when the plot of the CUSUM and CUSUMSQ exceeds the 5 per cent significance level bounds.

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