Financial Sector Efficiency and Economic Growth: The Case of East African Community (EAC) Countries

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The views expressed in this paper are solely those of the author

Abstract

This paper analyzes the link between financial sector efficiency and economic growth using a fixed-effects model and balanced panel data from three East African countries, namely, Tanzania, Kenya and Uganda, during the period 1994 – 2005. The paper concentrates on banking sectors as they typically dominate financial intermediation in these countries. We consider both the qualitative and quantitative aspects of the banking sector and measure the qualitative development in the sectors with the commercial banks' efficiency. As in many earlier studies, two indicators of quantitative development of banking sectors are used, namely the amount of bank credit allocated to the private sector as a share of GDP and the ratio of broad money to GDP. The general hypothesis of this paper is that banks are essential for economic growth, because they perform the function of allocating financial resources by selecting and monitoring of entrepreneurs. The empirical results of the study are consistent with this hypothesis. The bank efficiency variable is found to be positively related to economic growth for all specifications considered. The coefficient of the commercial banks' credit to the private sector is also statistically significant with the expected positive sign, suggesting that the credit allocated to the private sector by commercial banks has a positive impact on economic growth. Generally the study points out to the existence of an independent effect exerted by financial system efficiency on real growth and that financial system efficiency affects real sector mainly through capital productivity improvement and an increase in the level of savings. One important policy implication of this study is that governments in the East African region can achieve higher rates of economic growth by adopting policies that encourage efficient financial sectors.

1.0 Introduction

Many studies find a close link between financial sector development and economic growth and conclude that policies affecting financial sectors have substantial effects on the pattern of economic development (King and Levine, 1993). A study by the World Bank (1994), for example, estimates that policies that would raise the M2/GDP ratio by 10% would increase the long-term per capita growth rate by 0.2 – 0.4 percentage points.

Recently there have been a growing number of empirical studies on the factors that influence economic growth and policies that would reduce poverty and promote economic development in the Sub-Sahara African region. While the role of factors such as foreign direct investment, international trade, fiscal policy, labour force, etc., have received considerable attention in empirical work[1], the role of financial sector development on economic growth in Africa, and in particular, East African region, has largely been ignored. The purpose of this paper is to determine the relationship between financial sector development and economic growth in the East African Community member states.

Traditional measures of financial sector development usually used in empirical studies can be classified roughly in to two broad categories[2]. The first refers to the presence and diffusion of the banking system: here the most commonly used indicators are the ratio between liquid liabilities of the banking system and GDP. The second group of variables measures the amount of financing intermediated by banks. Among these variables are the ratio between domestic credit and GDP, the share of credit granted to the private sector (i.e. credit to the private sector as a ratio of total credit) and the credit granted to the private sector in ratio to GDP.

Riccardo et al. (2000), argues that these measures suffer from two major shortcomings. Firstly, there is the problem of causality. The growth of the banking system and the amount of credit disbursed are closely influenced by the level of economic development. So it is perfectly possible that financial systems develop in response to higher economic

[1] See for example Nnadozie E. (2003), Ibrahim A. and Ndulu B. (1995),
[2] See Riccardo L. et al, (2000), Nnadozie E. (2003)

growth. Secondly, these two types of measures have the further shortcoming that they essentially concentrate on the role of banks in stimulating capital accumulation. Yet, as Stiglitz and Weiss (1988) argue, the specific role performed by banks in the economic system is not to intermediate savings, but rather to certify the quality of borrowers. They argue that banks are essential to economic development in that they are a crucial device for the selection of entrepreneurs and the allocation of financial resources. However, the existing literature has focused on the impact of increased volume of financial services (both bank–based and market-based) on the economic growth. The importance of the quality of financial services has been ignored. This study explores the importance of the quality of financial services to economic growth by investigating the relationship between bank efficiency and economic growth in the economies of the three East African Community countries. The specific objective of this paper is to (1) estimate bank efficiency in the region, (2) Investigate the relationship between bank efficiency and economic growth and (3) examine the channels of transmission from financial sector to economic growth.

The rest of the paper is organized as follows: The next section presents background to the economies of East African countries. Section three reviews the relevant literature while section four discusses the methodology of the study. Finally section five analyzes the empirical results and provides concluding remarks.

2.0 Background to the Economies of East African countries

The East African Community (EAC) comprises the countries of Kenya, Tanzania and Uganda. The three countries share a common political and economic history that dates back to the colonial period. After the First World War, the three countries were placed under British rule and they formed a currency area region which shared a common currency – East African shilling. The currency was issued by the East African Currency Board (EACB) which was established in December, 1919 to manage the supply and exchange of currency in the three countries. During this period, all commercial banks and other financial institutions in the region were foreign owned, with their headquarters and most of their business operations outside East Africa.

After political independence in early 1960s, the three countries, albeit to different degrees, pursued inward-looking economic development strategies, emphasizing a key role of the state to accelerate economic development. In Tanzania for example, where the role of state was most pronounced, the economy was managed through central planning and public ownership, and the role of private sector was considerably limited. Kenya maintained a more market-oriented economy, but government intervention was very high during 1960's and 70's. Excessive government intervention together with the stagnation of export prices, deterioration of terms of trade and rising interest rates in international financial markets, adversely affected the performance of the three economies mostly during the second half of 1970s and early 80s.

By the late 1980s the three countries were facing increasing economic difficulties, including high rates of inflation, low economic growth rates, low income per capita, rising external debt and low savings rates among others. Given this experience, the three countries embarked on wide ranging structural adjustment reforms with the help of the International Monetary Fund (IMF*)* and the World Bank. The key objectives of reforms were to reduce direct government involvement, which translated to privatization, and strengthening of the role of market forces in the allocation of economic resources. Consequently, financial sector reforms formed a major and important part of the entire structural adjustments programs in all the three countries. Financial sector reforms in

Kenya began in 1989 while in Tanzania and Uganda the reforms were initiated in 1991 and 1992 respectively. Essentially, financial sector reforms in these countries involved two distinct but complementary types of changes. The first type of change was the liberalization of the sector, which means allowing the market forces rather than the state, to make decisions pertaining to credit allocation and interest rates. Second, was the establishment of the prudential supervision designed to compel the private sector to make decisions that broadly take in to account the general interests of the society The broad objectives of these changes were to improve the capacity of financial institutions to mobilize domestic savings, enhance the effectiveness of monetary policy instruments, and to promote competition among banks in order to improve their efficiency.

2.1 Recent Economic Performance in the Region

As table 1.1 below shows, the three countries had a combined GDP of $ 43.3 billion in 2006. Kenya is the largest of the three economies, with a GDP of $ 21.2 billion in 2006, a population of 35 million and per capita GDP of $ 455.8. Tanzania is the second largest economy with GDP of $ 12.8 billion, a population of 39.5 million and GDP per capita of $ 334.6, in the same year. Uganda's GDP in 2006 was $ 9.3 billion, and it had a population of 29.9 million and per capita GDP of $ 274.3. During the past recent the three countries have shown a strong economic performance. Tanzania's growth was modest in the early 1990s but accelerated dramatically in the second half of the decade. From 1990 to 1995, the economy grew at an annual rate of 2.5 percent. Since 1995, growth has picked up, with real GDP increasing at an annual rate of about 5.2 percent, exceeding seven percent in 2002. Except in 1995, Tanzania grew faster than Kenya during the period 1995 to 2006, and since 2001, it has also grown faster than Uganda. This strong growth performance reflects the fruits of responsible monetary and fiscal policies, concerted reforms, and significant debt relief.

On its part, Uganda's economy grew at an impressive rate that averaged about 7 percent per annum the period of ten years starting from 1990. The high rates of economic growth were due to good economic policies that led to an increase in foreign direct investment and substantial donor support following the restoration of relative political and economic

Table 1.1 Financial and other macroeconomic indicators for EAC countries (in millions unless indicated otherwise)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Indicators						**Kenya**						
Narrow money (M1)	66,524.5	76,237.6	89,487.1	93,489.1	109,067.1	118,672.4	125,670.5	149,130.1	193,130.0	209,368.3	230,844.6	291,741.0
Broad money (M2)	196,485.9	246,246.1	295,974.7	304,650.5	324,415.2	340,337.2	349,908.9	390,856.7	437,457.2	497,378.7	547,120.7	645,575.3
Broad Money (M2) as % of GDP	37.5	32.2	35.2	35.3	34.7	34.3	33.8	36.4	37.3	36.6	36.0	39.0
Domestic credit (% of GDP)	52.7	39.8	41.4	40.5	41.0	39.2	37.6	41.1	40.5	40.1	37.5	40.3
Credit to private sector (% of GDP)	34.5	27.0	27.9	27.3	29.3	28.4	25.2	26.3	25.0	26.7	25.3	27.7
Gross domestic savings (% of GDP)	15.3	11.5	9.1	10.3	10.7	9.4	11.3	13.1	13.3	12.4	9.0	8.1
Gross domestic savings (current US$)	1,380.2	1,390.7	1,191.8	1,458.1	1,376.1	1,198.0	1,471.6	1,690.6	1,950.6	1,997.9	1,732.8	1,710.7
Gross capital formation (% of GDP)	21.8	15.0	15.1	16.7	15.5	17.4	19.3	16.7	17.9	18.2	16.4	17.1
GDP growth (annual %)	4.4	4.1	0.5	3.3	2.3	0.6	3.8	0.6	3.0	4.9	5.8	5.7
GDP (current US$ millions)	9,046.3	12,045.8	13,115.7	14,093.2	12,896.1	12,705.3	12,983.5	12,914.5	14,638.9	16,143.3	19,193.2	21,185.9
GDP per capita (constant 2000 US$)	419.6	425.8	417.3	421.0	420.8	414.0	420.5	413.9	417.2	427.9	442.3	455.8
Inflation, consumer prices (annual %)	1.6	8.9	11.4	6.7	5.7	10.0	5.7	2.0	9.8	11.6	10.3	14.5
Population growth (annual %)	2.7	2.6	2.5	2.4	2.3	2.2	2.2	2.1	2.1	2.2	2.3	2.6
Population, total	27.2	27.9	28.6	29.3	30.0	30.7	31.4	32.0	32.7	33.5	34.3	35.1
Official exchange rate	51.4	57.1	58.7	60.4	70.3	76.2	78.6	78.7	75.9	79.2	75.6	72.1
						Tanzania						
Narrow money (M1)	428,284.0	449,214.0	493,869.0	545,517.0	632,582.0	695,006.5	766,019.9	958,786.6	1,113,379.1	1,315,605.2	1,758,810.2	1,950,328.8
Broad money (M2)	757,805.0	821,496.0	927,069.0	1,026,984.0	1,217,530.0	1,397,688.8	1,636,730.7	2,047,683.1	2,388,316.1	2,847,996.0	3,934,986.6	4,653,421.0
Broad Money (M2) as % of GDP	22.0	21.0	18.6	17.5	17.4	18.0	18.3	19.5	20.8	21.2	23.9	26.8
Domestic (% of GDP)	23.0	15.7	12.4	12.2	13.0	12.0	9.7	9.6	8.4	8.8	13.4	11.2
Credit to private sector (% of GDP)	6.7	3.1	3.5	4.3	4.7	4.6	4.9	6.1	7.7	8.6	10.0	12.2
Gross domestic savings (% of GDP)	2.4	4.6	5.4	1.4	4.5	10.2	8.8	11.8	12.0	11.2	10.9	12.0
Gross domestic savings (current US$)	123.9	300.9	417.1	119.8	386.7	927.5	826.1	1,148.8	1,236.7	1,276.4	1,371.8	1,537.7
Gross capital formation (% of GDP)	19.8	16.6	14.9	16.2	15.5	17.6	17.0	19.2	18.7	18.3	18.2	18.6
GDP growth (annual %)	3.6	4.5	3.5	3.7	3.5	5.1	6.2	7.2	5.7	6.7	6.8	5.9
GDP (current US$ millions)	5,255.2	6,496.2	7,683.9	8,382.5	8,637.6	9,079.3	9,440.9	9,758.1	10,282.8	11,351.4	12,586.3	12,783.8
GDP per capita (constant 2000 US$)	248.6	253.0	255.5	258.7	261.5	268.2	277.9	290.5	299.1	311.0	323.8	334.6
Inflation, consumer prices (annual %)	28.4	21.0	16.1	12.8	7.9	5.9	5.1	1.0	3.5	0.0	8.6	9.8
Population growth (annual %)	3.0	2.7	2.5	2.4	2.4	2.5	2.6	2.6	2.6	2.6	2.6	2.6
Population, total	29.9	30.7	31.5	32.3	33.0	33.8	34.7	35.6	36.6	37.5	38.5	39.5
Official exchange rate	574.8	580.0	612.1	664.7	744.8	800.4	876.4	966.6	1,038.4	1,089.3	1,128.9	1,251.9
						Uganda						
Narrow money (M1)	408,700.7	450,836.0	512,532.0	612,437.2	689,357.6	805,492.3	908,796.3	1,099,443.5	1,234,914.4	1,341,237.8	1,604,446.5	1,906,485.1
Broad money (M2)	642,002.4	766,208.0	914,987.0	1,124,856.2	1,277,368.0	1,509,110.0	1,648,197.4	2,060,551.9	2,428,662.4	2,697,711.2	3,142,341.4	3,694,785.9
Broad Money (M2) as % of GDP	11.2	11.5	12.7	13.5	14.7	15.5	15.8	18.1	19.1	19.4	19.3	20.1
Domestic (% of GDP)	4.4	5.2	6.6	7.5	8.0	12.8	10.2	15.3	12.6	11.0	9.9	9.5
Credit to private sector (% of GDP)	4.6	5.3	4.8	5.6	6.4	6.5	5.9	6.6	6.9	6.9	6.7	8.0
Gross domestic savings (% of GDP)	3.4	8.7	10.7	5.7	7.6	8.1	6.5	4.7	6.3	8.4	7.1	7.9
Gross domestic savings (current US$)	194.1	526.4	673.3	374.1	453.0	479.8	367.2	271.6	396.8	572.8	623.5	737.9
Gross capital formation (% of GDP)	12.4	20.2	18.2	16.4	19.5	20.0	18.6	19.3	20.5	22.3	21.2	24.9
GDP growth (annual %)	11.5	9.1	5.1	4.9	8.1	5.6	4.9	6.3	4.7	5.5	6.6	5.3
GDP (current US$millions)	5,755.8	6,044.6	6,269.3	6,584.8	5,998.6	5,926.4	5,681.2	5,836.0	6,249.7	6,816.7	8,724.5	9,321.9
GDP per capita (constant 2000 US$)	206.6	218.7	223.1	227.2	238.1	243.8	247.7	254.7	257.8	262.6	270.2	274.3
Inflation, consumer prices (annual %)	8.6	7.2	6.9	(0.0)	6.6	2.8	2.0	(0.3)	7.8	3.3	8.2	6.6
Population growth (annual %)	3.1	3.0	3.0	3.0	3.0	3.1	3.2	3.3	3.4	3.5	3.5	3.6
Population, total	20.9	21.5	22.2	22.9	23.6	24.3	25.1	26.0	26.9	27.8	28.8	29.9
Official exchange rate	968.9	1,046.1	1,083.0	1,240.3	1,454.8	1,644.5	1,755.7	1,797.6	1,963.7	1,810.3	1,780.7	1,831.5

Source: World Bank's WDI Data base

order. However, since 1999, Uganda's average annual rate of growth started to slow down. In 2006, the most recent year for which data is available, growth was 5.3 percent, which is well below the rate achieved in Tanzania (5.9) and Kenya (5.7).

On the other hand, Kenya's average economic performance since early 1990s to 2003 was comparatively poor. During 1990 – 2003, Kenya's real GDP grew at an annual average rate of 1.8 percent. This compares unfavorably with that of Uganda (6.5) and Tanzania (4.5) during the same period. According to IMF (2002), high real interest rates combined with high transaction costs and high business uncertainty resulted to the slow output growth in Kenya. Also the prevalence of high rates of corruption, affected Kenya's credibility in the international community, as reflected in the withdraw of the IMF and World Bank support for the economy. However, since 2004 growth has picked up with annual average growth rate exceeding 5 percent in the last three years.

Table 1.1 also shows that, money supply as measured by various monetary aggregates (M1, quasi money and M2), has shown a phenomenal growth in all three countries. For instance M2 in nominal terms increased six, five and three fold in Tanzania, Uganda, and Kenya respectively during the period from 1995 to 2006. Over the same period however, the ratio of M2 to GDP (a measure that has been widely used in the literature as a monetization variable) showed different trends for the three countries. For Uganda, the ratio of M2 to GDP increased from 11.2 percent in 1995 to 20.1 percent in 2006, while that of Tanzania rose from 22 percent to 26.8 percent for the same period with some fluctuations. Kenya on the other hand, experienced a marginal increase in M2 to GDP ratio during the period 1995 to 2006 going up from 37.5 percent to 39 percent. However, as the table show, Kenya's financial sector is significantly larger than that of Tanzania and Uganda.

Although as shown above, economic growth has been impressive in all three countries, much faster and sustainable growth is required in the region to absorb the rapidly rising labor force and materially improve living conditions. There is a need to raise average real GDP growth rates to above 7 percent a year on a sustainable basis in order to achieve the

Millennium Development Goals. Other things being equal, attaining such high growth rates over long periods of time would imply investment-to-GDP ratios in excess of 25 percent, similar to those achieved in the periods of sustained high growth in Asian countries. It will also require substantial improvements in capital productivity. The ratio of investment to GDP in the region is currently highest in Uganda (25 percent) and lower in Tanzania (18.6 percent) and Kenya (17.1 percent) (see figure 1.1). The gross domestic savings in the region is also very low, standing on average at 12, 8.1 and 7.9 percent of GDP in Tanzania, Kenya and Uganda respectively, putting into question the region's ability to maintain high growth rates on sustainable basis. Given the declining international assistance for financing investment, the region needs to achieve substantially higher rates of domestic savings in order to finance the required increases in investment thereby accelerating its growth and development. Attaining high rates of domestic savings will in turn require well developed and efficient financial sectors.

Figure 1.1 Gross Capital Formation (% of GDP)

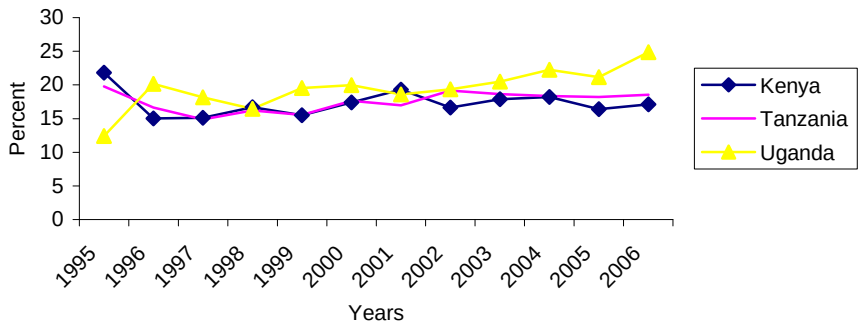
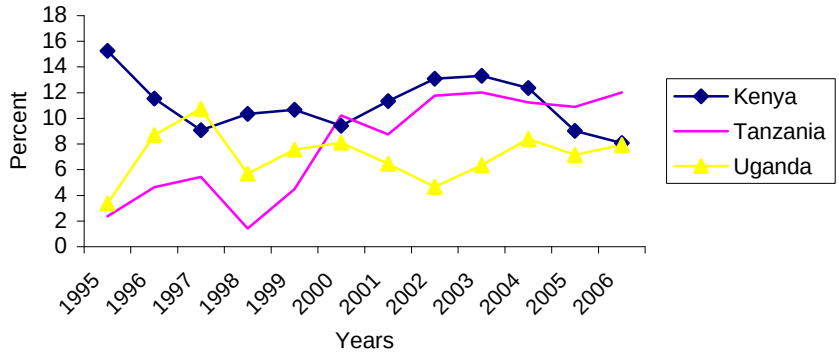


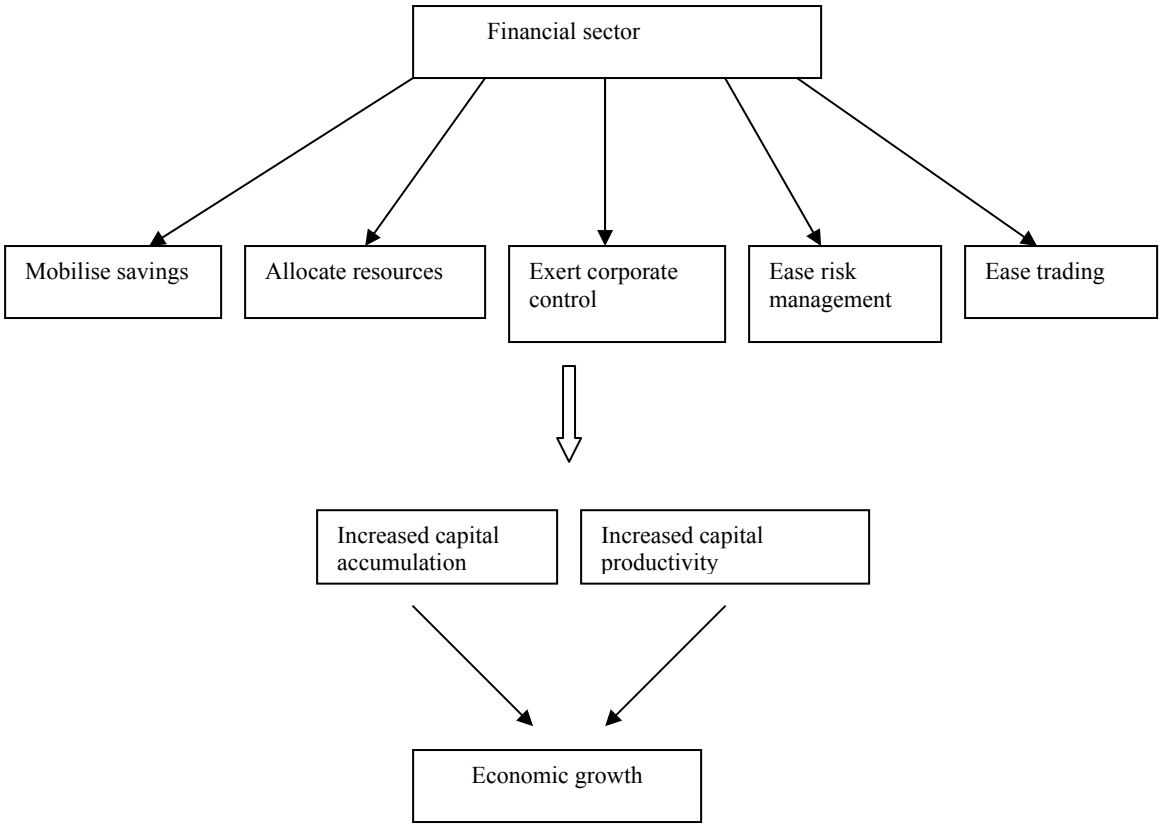
Figure 2.2: Gross Domestic Savings (% of GDP)



3.0 Review of literature

There is a large body of theoretical and empirical literature on the role of financial sector development in economic growth[3]. Levine (1997) identifies five basic channels through which an efficient financial sector influences economic growth. These channels may be represented by figure 3.1 below, which illustrates how financial arrangements provide five functions that affect savings and allocation decisions, and how these functions then influence economic growth through two channels, namely capital accumulation and capital productivity.

Fig 3.1: The channels through which the financial sector influences economic growth



Source: Levine (1997) with some modifications

[3] For a comprehensive survey of theoretical literature on finance-growth link, see Gertler (1988) and Thakor (1996). Also see Levine (1997) for a comprehensive overview of theoretical and empirical studies.

Following Levine (1997), the meaning of the functions in figure 3.1 can be elaborated as follows: First of all, the mobilization of savings is perhaps the most obvious and important function of the financial sector. The provision of savings facilities enables households to store their money in a secure place, and allows this money to be utilized productively by lending it to individuals or enterprises to finance investments, thus encouraging capital accumulation and promoting private sector development. Without the pooling of individual savings through financial intermediaries, the scale of investment projects is more likely to be constrained below what might be efficient. Investments and thus capital accumulation and technological innovations depend on mobilised savings, which increase with a more developed financial sector. Thus, an efficient financial sector will relax credit constraints in an economy, which may improve the investment rate and accelerate economic growth.

As noted by Andersen (2003), the basis for accelerating economic growth is the allocation of resources to new and higher return projects. Individual savers are unlikely to have the time or capacity to collect, process and compare information on many different enterprises, managers and market conditions before choosing where to invest. In addition, they will be less keen to invest in activities about which they have little information. Thus high information costs may prevent capital from flowing to its highest value use. Financial intermediaries that specialise in acquiring and evaluating information on potential investment projects enable small investors, for a minimal fee, to locate higher return investments. The improved allocation of savings among investment projects should enhance growth prospects.

Also financial sectors exert corporate control and serves in the monitoring of investments to reduce the risk of resource mismanagement. The ability of banks to monitor the performance of enterprises on behalf of many investors, who would not otherwise have the resources to do so individually, and to exercise corporate control (e.g. lenders holding meetings with borrowers to discuss business strategy) helps to ensure that investors receive returns that properly reflect enterprise performance (i.e. ensures enterprises are not being defrauded by the managers of firms as a result of their lack of information), and

creates the right incentives for the managers of the borrowing enterprises to perform well. Thus financial arrangements that improve corporate control tend to promote faster capital accumulation and growth by improving the allocation of capital (Bencivenga and B. Smith 1991).

Regarding risk management, banks are uniquely positioned to intermediate across maturities. Many projects or enterprises require a medium to long-term commitment of capital, whereas most savers prefer to have the option to draw on their savings, or move them into another investment opportunity should the need arise, i.e. they like their savings to be 'liquid'. Banks accept funds from investors who desire to lend for short term and in turn lend to borrowers who desire long term maturities. Thus borrowers and lenders with different preferred maturities are not compelled to agree on a common maturity. This is possible because banks combine many household savings and, usually, all servers are not expected to withdraw their money at the same time. Also banks bear the risk of borrowing at volatile, short-term interest rates and lending at stable long-term interest rates. By doing so, they help to ensure that capital is allocated to the best projects, even if they require a long-term financial commitment (Bencivenga & Smith 1991).

The above literature covers the main views in the theoretical finance-growth debate by suggesting links by which financial sector development can affect economic growth. However, Gregorio and Guidotti **(**1995) consolidate the framework presented in figure 3.1 in to two main channels by which efficient financial sector can promote economic growth. They argue that financial sector development has a dual effect on economic growth. An efficient financial sector can contribute to economic growth by enhancing the efficiency (productivity) of capital or by increasing the supply (volume) of credit in the economy, which, in turn, stimulate investment and growth. They proposed a production function in which output is assumed to depend only on capital stock:

$$y_t = f(k_t), \qquad (1)$$

where y_t and k_t, denote output and the stock of capital at time t, respectively. By totally differentiating the above equation and denoting the rate of growth of output by $\hat{y}$, the savings rate (dk/y) by *s*, and the marginal productivity of capital by ϕ_t, we have:

$$\hat{y} = dk_t/y_t \, f'(k_t) = s_t \phi_t \qquad (2)$$

Equation (2) above suggests that the rate of output growth is the product of the savings rate and the marginal productivity of capital. On one hand, the development of the domestic financial sector may enhance the efficiency of capital stock or investment (hence increasing ϕ_t). On the other hand, an efficient financial sector can contribute to raising the volume of savings and, thus, investments (hence, increasing s_t). In this study we test, among other things, whether financial sector development affects growth by increasing the volume of investments (savings), its efficiency (capital productivity) or both.

The available empirical studies have attempted to investigate the different aspects of the relationship between financial sector development and economic growth by exploring the existence of this relationship, the direction of causality between the two variables and the channels of transmission between them. Table 3.1 below gives a summary of the empirical studies on financial sector development and economic growth.

Table 3.1

Summary of the Empirical Review of Financial Sector Development and Economic Growth

Author	Variables		Results
	Economic growth	**Financial development**	
Gregorio and Guidotti (1995)	Real per capita GDP growth	Ratio between bank credit to the private sector and GDP	Positive relationship between financial development and growth, but the impact changes across countries and is negative for Latin America
King and Levine (1993)	Per capita GDP growth Per capita growth rate of physical capital accumulation	The ratio of liquid liabilities of the financial system to GDP The ratio of deposit money bank domestic assets to deposit money bank domestic assets plus central bank domestic assets The ratio of claims on the non-financial private sector to total domestic credit The ratio of claims on the non-financial private sector to GDP	Financial services stimulate economic growth by increasing the rate of capital accumulation and by improving the efficiency, with which the economy use that capital.
Ahmed and Ansari (1998)	Per capita nominal and real GDP	The ratio of M2 to nominal GDP Quasi-money as a percentage of nominal GDP The ratio of domestic credit to nominal GDP	A high degree of association between financial sector development and economic growth Causality tests provide a strong support for the supply leading hypothesis

Choe & Moosa (1999)	Real GDP Gross fixed capital formation	Household sector holdings of securities & equities Household holdings of various deposits in finance Business sector securities & stocks in total financial liabilities Growth of business sector loans	Financial development leads to real growth and financial intermediaries are more important than the capital markets
Odedokum (1996)	Annual growth rate of GDP	Ratio of average nominal value of the stock of the liquid liabilities to the nominal annual GDP	Financial development promote economic growth in about 85% of the 71 countries in the study Growth promoting effects of financial intermediation are invariant across the various regions of the globe
Al-Mashat (2002)	Real GDP growth	Real interest rate The ratio of M2 to GDP Ratio of reserve money to total deposit	Positive relationship between Economic growth and financial sector reforms.
Bolbol et al. (2004)	Total factor productivity	Ratio of domestic credit to the private sector to GDP Ratio of commercial bank assets to the sum of commercial banks and central banks assets Ratio of market capitalization to GDP	Bank related financial development indicators are negatively related to the total factor productivity growth
Andersen S. (2003)	Annual growth in GDP per capita	Liquid liabilities Credit to the private sector Volume of credit provided by banks	Strong and significant relationship between financial sector development and economic growth Strong influence of financial sector development on long term economic growth than on simultaneously growth
Berger et al. (2004)	GDP growth SME employment shares	Total market shares of community banks Weighted average efficiency ranks of community banks	Greater market shares and efficiency ranks of small, private, domestically owned banks are associated with better economic performance.

Andrus O. (2001)	Industrial production index	Ratio of bank credit to the private sector to GDP Ratio of claims on the private sector to domestic credit Ratio of domestic credit issued by deposit banks to domestic credit issued by deposit banks and central bank The wedge between interest rate of the loans and the deposits	Depending on the time period and sub-sample, the correlation of the financial development with economic growth can be negative or positive The causality (in Granger sense) can run one way or the other, depending on the particular country.
Koivu (2002)	Annual GDP growth	The margin between lending and deposit rates The amount of bank credit allocated to the private sector	The presence of efficient banking sector accelerate economic growth in the transition economies The amount of bank credit allocated to the private sector does not speed up economic growth in transition countries The causality runs mostly from economic growth to credit growth

From the above table several observations can be made: First, most studies have confirmed a positive association between financial development and economic growth. Regarding the direction of causality some studies lend support to the supply leading hypothesis, which means financial sector influence economic growth, while some found that causality can run one way or the other depending on a particular country.

Second, we note that some studies have attempted to establish whether financial deepening leads to improved growth performance, while others have dealt with the strength and direction of this relationship. Some studies have also focused on identifying the channels of transmission from financial intermediation to economic growth. However, as Berger et al (2004) have noted, researchers have not come to consensus regarding exactly which dimension of the financial system matters most – the size of the financial system or its efficiency. While the majority of the studies point to the strong link between financial sector development and economic growth, it remains unclear whether the financial system improves economic growth primarily through higher levels of investment or primarily through improving the quality of investment. So far, the variables used by most of the studies emphasise the role played by the size of the financial system in promoting economic growth. The issue relating to how efficient the bank is in channelling the deposit to loans, thus its ability to provide quality investments has been ignored in linking financial intermediation to economic growth.[4] This study contributes to the finance-growth literature by focusing on the ignored dimension – the efficiency of the financial system.

[4] As Table 1.1 show, with the exemption of Berger et al (2004) study, all the others have focused on the share or quantity effects of financial sectors without considering their efficiency or quality.

4.0 Methodology

4.1 Measures of Bank Efficiency

There are two main approaches to estimating bank efficiency scores. One is based on a parametric specification of an econometric model that allows for stochastic disturbances (*stochastic frontier approach*) and the other uses a non-parametric mathematical programming technique to envelop a data set (*data envelopment analysis).* This paper adopts DEA because the size of our sample is rather small. By its nature, the stochastic frontier models require a large sample size while DEA can work equally well with a small sample.

4.2 Data Envelopment Analysis (DEA)

The data envelopment analysis is a non-parametric technique used to analyse production, cost, and revenue and profit data of a number of entities called Decision Making Units (DMUs). It involves linear programming methods to construct a non-parametric frontier over the data. In other words, instead of using traditional regression analysis to find an average relationship, a piecewise linear surface is produced that yields a convex production possibilities set. The technique identifies the set of best practice observations for which no other firm can produce as much or more of every output given the inputs. Efficiency measures are then calculated relative to this surface. The DEA assumes that there are no random fluctuations so that all deviations from the estimated frontier represent inefficiency.

There are two most frequently used versions of DEA model: the CCR-model (so named after Charnes, Cooper, Rhodes, 1978) and the BCC-model (named after Banker, Charnes and Cooper, 1984). The main difference between these two models is the treatment of returns to scale: while the latter allows for variable returns to scale, the former assumes that each DMU operates with constant returns to scale.

4.3 CCR-model

Charnes, Cooper and Rhodes introduced a measure of efficiency for each DMU that is obtained as a maximum of a ratio of weighted outputs to weighted inputs. The weights

for the ratio are determined by the restriction that the similar ratios for every DMU have to be less than or equal to unity. The efficiency measure is then a function of the weights of the input-output combination. Formally, the efficiency measure for DMU_0 can be calculated by solving the following mathematical programming problem:

$$\text{Maximize } h_0(u,v) = \frac{\sum_{r=1}^{s} u_r y_{r0}}{\sum_{i=1}^{m} v_i x_{i0}} \tag{3}$$

Subject to

$$\frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1,\ j = 1,2.....n \tag{4}$$

$$u_r \geq 0, r = 1,2,....., s \tag{5}$$

$$v_i \geq 0, i = 1,2,....., m \tag{6}$$

where x_{ij} = the observed amount of input of the i_{th} type of the j_{th} DMU ($x_{ij} > 0$, i=1,2,...,m, j=1,2,...,n) and y_{rj}= the observed amount of output of the r_{th} type for the j_{th} DMU ($y_{rj} > 0$, r = 1,2,...,s, j = 1,2,...,n).

The variables u_r and v_i are the weights to be determined by the above programming problem.

For the above linear programming problem, the dual can be written as follows:

$$\underset{\lambda}{Min}\, z_0 = \Theta_0 \tag{7}$$

Subject to

$$\sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{r0}, r = 1,2,..., s \tag{8}$$

$$\Theta_0 x_{i0} - \sum_{j-1}^{n} \lambda_j x_{ij} \geq 0, i = 1,2,...., m \tag{9}$$

$$\lambda_j \geq 0,\ j = 1,2,....n \tag{10}$$

Both above linear problems yield the optimal solution Θ^*, which is the efficiency score for the particular DMU_0. The value of Θ is always less than or equal to unity and DMUs for which $\Theta^* < 1$ are relatively inefficient and those for which $\Theta^* = 1$ are relatively efficient, having their input-output combination points on the frontier.

4.4 Definition of Bank Output and Inputs

Measuring bank efficiency requires the identification of inputs and output of the banking sector. However, despite the increasing interest in studying the banking industry, there is no agreement among researchers on what constitutes bank inputs and outputs. Attempts to define these concepts were made earlier by Sealy and Lindley (1977), Colwell and Davis (1992) and later by Berger and Humphrey (1997). There are two main approaches to the definition of the inputs and outputs of the banking sector, which reflect different perspectives of the banking activity: the production and intermediation approaches.

The production approach emphasises operational activity and thus banks are primarily viewed as providers of services to customers. The input set of this approach includes only the physical variables (e.g. labor, materials, space or information system) or their associated costs, since only physical inputs are needed to perform transactions, process financial documents or provide advice to customers. Interest expenses are excluded from this approach on the grounds that only the operational process is of interest. The output of this approach represents the services provided to customers and is best measured by the number and type of transactions dealt with, documents processed or specialized services provided over a given time period. When detailed transaction flow data is not available, data on the stock of deposit and loan accounts are often used instead as a proxy for the level of services provided.

Under the intermediation approach[5], financial institutions are viewed as primarily intermediating funds between savers and investors. Banks produce intermediation services through the collection of deposits and other liabilities and their application in interest-earning assets, such as loans, securities and other investments. This approach

[5] This approach is due to C. W. Sealey and T. Lindley (1977)

includes both operating and interest expenses as inputs, whereas loans and other major assets of financial institutions count as outputs.

For this study, the intermediation approach is employed for two reasons. First, we are concerned with how efficient the banks are, in channelling funds from depositors to lenders. Second, the absence of data on the number of deposit and loan accounts makes it impossible to apply the production approach in our study. Accordingly, the outputs (y_i) and inputs (x_i) can be specified as follows: y_1= total loans extended, $y_{2=}$ Debt securities, x_1 = fixed capital and equipments, x_2 = Labor (wages and salaries), x3 = total deposits received plus borrowing. The basic DEA model specification used in the analysis is as follows:

$$\textit{Maximize} \quad \Theta = \frac{U_1 LOANS_i + U_2 SECURITIES_i}{V_1 CAPITAL_i + V_2 LABOR_i + V_3 DEPOSITS_i} \tag{11}$$

Subject to

$$\text{DMU}_1 \quad \frac{U_1 LOANS_1 + U_2 SECURITIES_1}{V_1 CAPITAL_1 + V_2 LABOR_1 + V_3 DEPOSITS_1} \leq 1$$

$$\text{DMU}_2 \quad \frac{U_1 LOANS_2 + U_2 SECURITIES_2}{V_1 CAPITAL_2 + V_2 LABOR_2 + V_3 DEPOSITS_2} \leq 1$$

$$\text{DMU}_N \quad \frac{U_1 LOANS_N + U_2 SECURITIES_N}{V_1 CAPITAL_N + V_2 LABOR_N + V_3 DEPOSITS_N} \leq 1$$

Where:

LOANS is the total loans extended, SECURITIES is Debt securities, CAPITAL is the fixed capital and equipments, LABOR is the labor usage proxed by employee compensation and DEPOSITS is the total deposits received plus borrowing. U_i is the weight attached to the i^{th} output, V_i is the weight attached to the i^{th} input and N is the number of DMUs.

The objective function is to maximize the efficiency scores Θ for the best practice decision making unit (DMU_i), subject to the constraint that when the same set of *u* and *v* weights is applied to all other DMUs being compared, no DMU will be more than 100 percent efficient.

The model was estimated by DEAP[6] computer program using annual data for all commercial banks operating in each country in each year for the period 1994 to 2005[7]. The short period of time is basically due to lack of reliable data on commercial banks prior to this period. As mentioned earlier, most of the financial sector reforms in the East African region started in the first half of 1990s, and as such there is no reliable and accurate data on commercial banks before the reforms.

4.5 Modelling Bank Efficiency and Economic Growth

The empirical analysis of the effects of the banking system efficiency on the region's economic growth is based on an equation relating the GDP growth to bank inefficiency scores as one of the independent variables. Specifically, we adopt a framework based on the conventional neo-classical one sector production function in which financial development constitutes an input, as proposed by Odedokun (1994):

$Y_t = f(L_t, K_t, F_t, Z_t)$ (12)

where:

Y = Aggregate output or real GDP

L = Labor force

K = Capital stock

F = Measure of level of financial sector development

Z = Vector of other factors that can be regarded as inputs in the aggregate production process.

We assume a production function of Cobb-Douglas type:

$$Y_t = e^h K_t^{\alpha} L_t^{\beta} F_t^{\theta} Z_t^{\delta} . \quad (13)$$

Taking a natural log of both sides, we get

[6] The DEAP software can be downloaded from the internet at www.uq.edu.au/economics/cepa/deap.htm. I thank Prof. Tim Coelli at the University of New England Australia for providing the DEAP software for free.

[7] It is important to note that over the review period, there was entry of new banks in to the financial systems while some banks exit the market. But this is not expected to affect our results, since our objective is to obtain the average efficiency scores in each year for each country.

$$LnY_t = h + \alpha LnK_t + \beta LnL_t + \theta LnF_t + \delta \ln Z_t \quad (14)$$

As far as the role of financial sector development in economic growth is concerned, the main variable that is widely used as indicator of financial development is the volume of credit allocated by banking system in the economy. We argue that a volume of credit may have little contribution towards economic growth if such credit is not efficiently allocated. One way through which banking system can contribute to economic growth is its ability to allocate financial capital to those projects where the marginal product of capital is highest. Thus, the capital that is channeled to its best possible use results in a higher capital productivity thereby promoting growth. This key function of the banking system can best be captured by the efficiency of the banking system.

Therefore, following Lucchetti et al (2001), the variable F_t in equation (14) can be thought of as a composite of both qualitative and quantitative aspects of the banking sector. The quantitative aspect would be captured by the volume of credit funneled to the economy by the banking sector, while the qualitative aspect would be captured by a measure of banking sector efficiency. Accordingly, variable F_t can be replaced by a new measure of development of financial system which takes explicit account of the banking system inefficiency as follows:

$$F = \frac{C}{(1+i)^{\lambda}} \quad (15)$$

where C is the amount of credit allocated by the banking system in the economy, i is the measure of bank's inefficiency and λ is the weight of such inefficiency in the allocative process. For simplicity, we drop time subscript. From equation (14);

$$\theta LnF = \theta Ln\left[\frac{C}{(1+i)^{\lambda}}\right] \quad = \theta LnC - \psi Ln(1+i) \quad (16)$$

where $\psi = \theta\lambda$

Substituting (16) in to (14) we get,

$$LnY = h + \alpha LnK + \beta LnL + \theta LnC - \psi Ln(1+i) + \delta LnZ \qquad (17)$$

For simplicity we use lower case letters to denote logarithms of the variables so that equation (17) becomes:

$$y = h + \alpha k + \beta l + \theta c - \psi \ln(1+i) + \delta z \qquad (18)$$

Equation 18 reveals two possible ways through which financial development can affect growth: it can rise c which is the volume of credit extended by banking system, or it may reduce i which is the banking sector inefficiency. If financial sector development affect growth of output by increasing the volume of credit in the economy, then θ will be statistically different from zero. On the other hand if the impact is through the efficient allocation of financial resources then ψ will be statistically different from zero. If both the volume of credit and the efficiency allocation of such credit play autonomous and significant role in promoting economic growth, then both θ and ψ will be statistically different from zero. After adding the error term (u_t), which is expected to satisfy the usual assumptions, equation (18) can be written as:

$$y = h + \alpha k + \beta l + \theta c - \psi \ln(1+i) + \delta z + u \qquad (19)$$

Variable Z is intended to capture additional control variables that influence the growth rate of GDP. These variables are: Inflation rate (INF), international trade (TRADE) and Government expenditure (EXP). Inclusion of these variables will help to eliminate the bias caused by omitted variables. Furthermore, by including control variables, we can assess the strength of an independent link between bank efficiency and growth. Therefore the estimated model over all time periods (T) and cross section units (N) can be given as:

$$y_{it} = h + \alpha k_{it} + \beta l_{it} + \theta CREDIT_{it} + \psi EFFIN_{it} + \xi (EFFIN_{it} * CREDIT_{it}) + \gamma INF_{it} + \delta TRADE_{it} + \Omega EXP_{it} + u \qquad (20)$$

For i = 1……N, and t = 1 ….T.

4.6 Definition of Variables

The annual growth rate of population size is used as a proxy for the labor force growth, while the growth rate of capital is proxied by the growth rate of the ratio of investment to GDP. To capture the impact of qualitative aspect of financial sector in the economy, we use the average efficiency scores (*EFFIN*) obtained form the estimation of DEA model in equation 11. Note that the variable *EFFIN* enters equation (20) with a positive sign to indicate the use of efficiency scores as opposed to inefficiency scores (variable i) as in equation (19). *CREDIT* is the ratio of credit to the private sector to GDP and is expected to capture the extent of intermediation[8]. The inclusion of this variable will serve several purposes. First, it will prevent the influence of bank efficiency from becoming indistinguishable from the effects of growth in the size of financial sector. Second, it will enable us to compare our results with previous results, since most studies have used this variable as a measure of financial sector development. We also include an interaction term (EFFIN *CREDIT), which is intended to measure the interaction between bank credit and efficiency scores, with the expectation of a positive interaction effect. That is, we expect the marginal benefit of an increase in the commercial bank credit to the private sector to be greater, the more efficient these banks are.

We also tried to replace the variable *EFFIN* by an alternative measure of bank efficiency (*MARGIN*) which is the spread between commercial bank lending and deposit rates. It is hypothesized that higher spread is associated with higher operating costs reflecting management's inability to combine inputs optimally. Therefore, higher spread can be used as an indicator of bank inefficiency. Koivu (2002) argues that, the interest margin is likely a good estimator for efficiency in the banking sector as it describes transaction costs within the sector. If the margin declines due to a decrease in transaction costs, the share of savings going to investments increases. As growth is positively linked to investment, a decrease in transaction costs should accelerate economic growth.

[8] This variable has been used in many studies to proxy financial sector development. See for example Levine, et al. (2000), Allen and Ndikumana (2000)

4.7 Testing the Channels of Transmission

To the extent that the relationship between bank efficiency and economic growth was established, we endeavour to analyze the channels through which the financial sectors contribute to economic growth. Two possible transmission mechanisms were hypothesized. One possible transmission mechanism is through improved *capital productivity* resulting from the ability of more efficient banks to channel available funds to the most productive users. A second mode of transmission is through *increased volume of capital* or savings and therefore increased investment and economic growth.

The two hypothesized channels of transmission were tested in two ways:
First, we included the two variables; capital productivity and volume of savings to the growth equation and test for positive effects of these variables on GDP growth to see if capital productivity and volume of savings directly influence economic growth. Secondly, we estimate two separate equations, one for capital productivity and another for savings function to ascertain whether variations in these variables can be explained by bank efficiency variable (EFFIN) among other variables that have been associated with savings rate and capital productivity in other studies. Following Deaton, A. (1989), the saving function of the following form was estimated:

$$SAVINGS_{it} = \beta_0 + \beta_1 INT_{it} + \beta_2 GPDI_{it} + \beta_3 INF_{it} + \beta_4 EFFIN_{it} + \varepsilon \qquad (21)$$

where, SAVINGS is the private savings measured as the deposit money bank's time and saving deposits, INT denotes savings rate, and GPDI is the gross private disposable income measured as per capita GNP. INF is the rate of inflation and EFFIN is the bank efficiency variable, both as defined before. We hypothesize a positive relationship between SAVINGS and INT variable to indicate that higher rates of interest on time and saving deposits will induce higher saving rates. The variable GPDI is expected to bear a positive sign since an increase on the level of private disposable income, leads to higher propensities to save and therefore higher savings. The rate of inflation (INF) is expected to have negative impact on private savings. This is because in the inflationary environment, economic agents are expected to increase their demand for money in order

to maintain their standards of living, and therefore they save less of their income. Finally, a positive relationship is expected for the bank efficiency variable (EFFIN) indicating that more efficient financial sectors enhance private savings.

To test for the positive association between capital productivity and bank efficiency, we examined the following linear equation:

$$IOCR_{it} = \beta_0 + \beta_1 K_{it} + \beta_2 EFFIN_{it} + \beta_3 ERD_{it} + \beta_4 FDI_{it} + \alpha_{it} \qquad (22)$$

Where, IOCR stands for incremental output capital ratio, which measures output per unit of capital employed, and is used to capture the average productivity of capital[9]. An increase in this ratio indicates a rising productivity as either less capital is used to produce same level of output or more output is produced using same amount of capital. K is the total stock of capital and is used to capture the influence of degree of returns to capital. A diminishing returns technology would suggest that the average productivity of capital is inversely related to the capital stock, whereas a constant returns technology would indicate no relationship between the two variables. EFFIN is bank efficiency variable as defined before. Bank efficiency is expected to exert a positive impact on capital productivity because of improved intermediation and the screening and monitoring functions performed by the efficient financial institutions. ERD is expenditure on Research & Development (R&D) which is included to capture technological innovation. This variable is expected to show a positive association with capital productivity to indicate that an increase in the use of modern technology resulting from R&D has a positive influence on the average productivity of capital. However, due to lack of data on this variable, high-technology export as percentage of GDP was used instead[10]. Finally, FDI is foreign direct investment as a percentage of GDP and is introduced in the model to determine the extent to which variation in average productivity of capital is due to the better quality of foreign entrepreneurs. We hypothesize a positive association between this variable and capital productivity.

[9] See Odedakum (1996) for use of IOCR as performance variable in policy evaluation

10 High-technology exports are products with high R&D intensity, such as in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery

4.8 Data Sources

Table 4.1 below presents the summary statistics of aggregate bank level data used in the estimation of the DEA model in equation 11. As the table shows, Kenyan banking system is by far the largest, with average total assets being about 3 times and 5 times that of Tanzania and Uganda respectively. This can be explained in the light of the higher industrialization of the Kenyan economy when compared to those of the other two countries. Also as mentioned earlier, the Kenyan banking sector has been opened to private and foreign banks since independence. Table 4.1 also indicates that commercial banks in the three countries have strong preference for holding debt securities (liquid, low-risk assets) as compared to extending loans. This is however, more pronounced in Tanzania and Uganda. The average loan to total asset ratio of the banking system is about 51 percent in Kenya while that of Uganda and Tanzania is about 31 and 23 percent respectively. The average loan to deposit ratio is about 67 percent in Kenya and about 33 and 46 percent in Uganda and Tanzania.

Table 4.1 Bank data descriptive statistics, 1994 - 2005 (Millions of US dollar)

	Loans	Debt securities	Fixed assets	Wages and salaries	Deposits	Total assets
Kenya						
Mean	3087	190	260	190	4606	5987
SD	470	21	58	21	496	645
Median	2938	188	234	188	4538	5947
Maximum	4067	228	356	228	5623	6993
Minimum	2582	164	202	164	4043	5177
Tanzania						
Mean	472	443	52	46	1421	2046
SD	230	116	23	28	463	521
Media	413	450	49	44	1338	2110
Maximum	1079	643	241	128	2478	3417
Minimum	68	99	19	6	236	355
Uganda						
Mean	364	305	71	27	780	1151
SD	73	203	9	11	309	334
Media	352	276	71	25	760	1076
Maximum	539	588	90	47	1346	1831
Minimum	296	42	60	8	395	747

Sources: Central bank of Kenya, Bank of Uganda, Bank of Tanzania and own calculations

Table 4.2 below presents the summary statistics for the macroeconomic variables used to estimate the growth model. Government expenditure was calculated as the ratio of general government final consumption expenditure as percentage of GDP. Trade is defined as the sum of exports and imports of goods and services measured as a share of GDP. For inflation, we used the annual percentage change of the consumer price index. The investment – GDP ratio was computed as gross nominal fixed capital formation plus the increase in nominal stocks, both divided by nominal GDP. Labor force growth was proxied by population growth, which in turn, was calculated as the annual growth rate of population. Credit to private sector is defined as the claims on the private sector by deposit money banks divided by GDP. The data on GDP growth, population growth, and inflation were sourced from the Bank of Tanzania's *Economic and Operations Report* (various issues), Bank of Kenya's *Annual Report* (various issues), and Bank of Uganda's

Annual Report (various issues). The data on private sector credit, investment, trade and the government expenditure are from the International Monetary Fund's *International Financial statistics (various issues),*and the World Bank's *World Development Indicators* database. To the extent that all variables used in the estimation of the growth model are either expressed as a ratio to total GDP, or are in growth rates, it was not necessary to convert these variables into a common currency.

Table 4.2: Descriptive Statistics of the macroeconomic variables (EAC: 1994-2005)

	GDP growth	Government expenditure	Trade (openness)	Inflation	Investment to GDP	Labor force growth	Credit to private sector
Mean	4.6	13	45.6	8.9	0.17	2.6	0.12
Standard Deviation	2.1	2.9	11	7.9	0.03	0.5	0.1
Median	4.7	13	43	6.4	0.17	2.5	0.06
Maximum	10.5	17.7	71.7	37	0.25	3.5	0.32
Minimum	0.4	7.7	27.8	-2	0.13	1.6	0.03
Observations	36	36	36	36	36	36	36

Table 4.3 represents the summary descriptive statistics of the variables used to estimate savings function and capital productivity equation with the aim of testing the channels of transmission. IOCR is computed as a ratio of current GDP divided by the previous period gross fixed capital formation. We use previous period capital stock because essentially current output is a result of past investments. K is the total stock of capital measured as gross capital formation in Millions of US dollars. FDI is the inward foreign direct investment stock as percentage of GDP and was obtained from UNCTAD database http://www.unctad.org/Templates/Page.asp?intItemID=3277&lang=1). ERD is the value of high-technology exports divided by GDP. The value of high-tech exports was obtained from the World Bank's *World Development Indicators* data base. SAVINGS is the private savings measured as time and savings deposits, while INT is the interest rate on savings. GPDI is gross private disposable income proxied by per capita GNP. Data on SAVINGS, INT and GPDI were obtained form International Monetary Fund's *International Financial Statistics (*various issues).

Table 4.3: Descriptive statistics of the variables used to estimate channels of transmission

	IOCR	FDI	K	ERD	GPDI($ millions)	INT	SAVINGS ($ Millions)
Mean	57.9	17.2	1474.9	0.00073	7526.3	6.1	1856.4
Std. Dev.	64.7	13.9	374.9	0.00075	5233.6	5.5	1775.5
Median	36.8	10.2	1443.0	0.0004	5684.5	4.0	871.0
Maximum	316	54.4	2307.2	0.0026	16253.0	24.0	6270.0
Minimum	2.2	3.0	778.3	0.0	2093.0	1.2	214.0
Observations	36	36	36	36	36	36	36

5.0 Empirical results

5.1 Analysis of Bank Efficiency Scores

Table 5.1 presents a summary of technical efficiency scores under both constant returns to scale (CRS TE) and variable returns to scale (VRS TE). Scale efficiency scores are also calculated as the ratio of CRS TE to the VRS TE (see Tim Coelli, 1998). Several observations can be made from table 5.1: First, the financial sectors in the three countries have experienced variations in efficiency scores over the sample period. For example, the VRS TE scores have ranged between 0.82 and 0.98 for Kenya, and between 0.85 and 0.99 for Tanzania while for Uganda the ranges are between 0.83 and 1. Second, the table shows that the banking systems in the region have become increasingly more efficient in the last few years of the sample. This trend is more pronounced in Uganda and Tanzania.

Table 5.1: Banking sector efficiency scores 1994-2005: Summary of DEAP results

	Uganda			Tanzania			Kenya		
	CRS technical Efficiency[11]	VRS technical Efficiency[12]	Scale efficiency	CRS technical efficiency	VRS technical efficiency	Scale efficiency	CRS technical efficiency	VRS technical efficiency	Scale Efficiency
1994	0.71	0.84	0.85	0.79	0.85	0.93	0.88	0.91	0.96
1995	0.77	0.85	0.91	0.81	0.85	0.95	0.88	0.96	0.91
1996	0.81	0.83	0.98	0.81	0.86	0.94	0.89	0.91	0.98
1997	0.85	0.87	0.98	0.84	0.89	0.94	0.90	0.91	0.99
1998	0.96	0.99	0.97	0.86	0.91	0.95	0.86	0.87	0.99
1999	0.97	0.99	0.97	0.92	0.96	0.96	0.79	0.82	0.96
2000	0.96	0.98	0.98	0.95	0.97	0.98	0.81	0.83	0.98
2001	0.98	0.99	0.99	0.96	0.98	0.98	0.84	0.87	0.97
2002	0.98	0.99	0.99	0.96	0.98	0.98	0.94	0.97	0.97
2003	0.98	0.99	0.99	0.97	0.98	0.99	0.97	0.98	0.99
2004	0.97	0.99	0.98	0.97	0.98	0.99	0.97	0.97	1.00
2005	0.98	1.00	0.98	0.98	0.99	0.99	0.97	0.98	0.99
Mean	0.91	0.94	0.96	0.90	0.93	0.96	0.89	0.91	0.97

[11] The CRS TE provides overall efficiency, which includes scale efficiency
[12] The VRS TE provides pure technical efficiency, which excludes scale efficiency

The third observation that can be made from table 5.1 is that scale inefficiency is relatively lower for Kenya as compared to those of Uganda and Tanzania. The average scale efficiency measured about 97 percent in Kenya and about 96 percent for Uganda and Tanzania. This means that the banking system in Kenya could on average increase output by about 3 percent if all banks operated at optimal scale, while those in Tanzania and Uganda could increase the same by approximately 4 percent. This may be a reflection of the fact that the size of Kenyan banking system is the largest in the region, and therefore, there is little room left for economies of scale. Also in all three counties, pure technical inefficiencies are much higher than scale inefficiencies. The average pure technical efficiency is 91 percent for Kenya while for Uganda and Tanzania is 94 and 93 percent respectively.

5.2 Bank Efficiency and Economic Growth

This section provides empirical evidence on the impact of bank efficiency on economic growth using panel data estimation techniques. We first endeavor to undertake tests of panel data models in order to determine the model that best fits our data. There are three basic methods of panel data estimation namely pooled Ordinary Least Squares (OLS), Fixed Effects model (FEM), and Random Effects model (also known as Error-Component Model-ECM). The first technique combines all the time series and cross-section data and estimates the underlying model by ordinary least squares (OLS). The assumptions underlying the disturbance term for pooled OLS are that it is normally distributed with zero mean and constant variance. However, this technique does not impose strict exogeneity of the variables and the error term across all individuals and over all time periods. Fixed Effect model (FEM) on the other hand, helps minimize the omitted variables problem of cross – section analysis by introducing dummy variables that allow the intercept terms to vary across cross section-units, adding more information to the model.

To decide between pooled OLS (restricted model) and FEM (unrestricted model) estimation techniques, we perform F-test to determine significance of the country specific coefficients in the unrestricted model relative to restricted model. The restricted model specified over all time periods (T) and all countries (N) is specified as

$$Y_{it} = \alpha + \beta EFFIN_{it} + \lambda X_{it} + U_{it} \qquad \text{for i = 1---N and t = 1-----T ;} \qquad (23)$$

where Y_{it} is the GDP growth rate, $EFFIN_{it}$ is the measure of bank efficiency and X_{it} represent a vector of conditioning variables to control for other factors associated with economic growth. α is the common constant for all countries , β and λ are the coefficients to be estimated. On the other hand, the unrestricted model is specified as

$$Y_{it} = \alpha_i + \beta EFFIN_{it} + \lambda X_{it} + U_{it} \qquad \text{for i = 1---N and t = 1-----T ;} \qquad (24)$$

where the intercept with subscript *i* suggests that the constant term for each country may be different due to specific features for each country. In order to allow the intercept to vary for each country, we introduce differential intercept dummies so that equation (24) becomes:

$$Y_{it} = \alpha + \beta_1 DT + \beta_2 DK + \beta_3 EFFIN_{it} + \lambda X_{it} + U_{it} \qquad (25)$$

where DT and DK are dummy variables for Tanzania and Kenya respectively (i.e. DT = 1 if observation belongs to Tanzania, 0 otherwise, and DK = 1 if observation belong to Kenya, 0 otherwise). Since we have three cross-section units, we use two dummies to avoid falling in to the dummy variable trap.

F-test is then given by

$$F = \frac{(SSR_R - SSR_{UR})/m}{SSR_{UR}/(n-k)}$$

where SSR_R is the sum of squared residuals from the restricted model and SSR_{UR} is the sum of squared residuals from the unrestricted model, m is the number of linear restrictions, k is the number of parameters in the unrestricted regression and n is the number of observations. The null hypothesis is that constant terms are all equal against an alternative hypothesis that intercepts varies for each country.

i.e. HO: $\alpha = \beta_1 = \beta_2$

HA: $\alpha \neq \beta_1 \neq \beta_2$

The F-test produced an F statistic of 25.25, which at 95 percent level of the F-distribution with 2 and 31 degrees of freedom, rejects null hypothesis that intercepts are all the same in the three countries. The results therefore suggest that FEM, incorporating country specific effects is a better model. We do not conduct a test to compare FEM and random effect model because our data do not fit random effect model[13].

5.3 Regression Results

The results of empirical analysis are setout in tables 5.2 and 5.3, which give the estimates of the coefficients associated with the main explanatory variables of the growth model. In order to facilitate reading, the coefficients of country dummies have been omitted. All exogenous variables were lagged one year to reflect the assertion that the present value of GDP growth depends on the past values of bank efficiency indicators as well as other macroeconomic variables. Moreover lagging exogenous variables may also help mitigate the potential endogeneity problem. We estimate a total of seven regressions with various forms of the specifications in order to check the robustness of the findings.

Regression 1 in table 5.2 analyzes the relationship between bank efficiency and economic growth by regressing real GDP growth against bank efficiency variable (EFFIN) and country dummies but excluding other variables. Regression 2 includes EFFIN, CREDIT and country dummies but exclude the interaction effect between bank efficiency and bank credit to private sector and control variables. Regression 3 adds interaction term (EFFIN*CREDIT) while regression 4 adds control variables, namely, investment rate, labor force, government spending, inflation and trade. Regressions 1 to 3 in table 5.3 are

[13] Random effect model requires that the number of cross section units be greater than the number of variables included in the model, which is not the case with out data.

identical to those in table 5.2, except that bank efficiency variable is replaced by variable MARGIN which is the commercial banks' interest rate spread.

Table 5.2: Fixed Effect Model estimation of growth model

Variable	*Reg1*	*Reg2*	*Reg3*	*Reg4*
Constant	*6.142***	*0.272***	*0.156***	*3.020***
	(3.25)	*(7.358)*	*(0.139)*	*(5.550)*
EFFIN	*0.617***	*0.227***	*0.106***	*0.051**
	(3.74)	*(6.313)*	*(2.761)*	*(2.272)*
CREDIT		*1.073***	*0.317)***	*0.89***
		(3.821)	*(3.917)*	*(3.169)*
*EFFIN*CREDIT*			*0.717***	*0.087***
			(5.564)	*(4.451)*
Investment rate				*0.019***
				(5.542)
Population growth				*-0.262*
				(-1.285)
Government				*0.108*
spending				*(-1.104)*
Inflation				*-0.031*
				(-1.443)
Trade				*0.465***
				(3.207)
Adjusted R^2	*0.36*	*0.38*	*0.42*	*0.51*
Durbin-Watson Stat	*1.8*	*1.7*	*1.7*	*1.8*

Country dummies are included but are not shown in the table.

EFFIN*CREDIT is the interaction between average bank efficiency and credit to the private sector.

*, **, *** indicate significance at 10%, 5%, and 1% levels, respectively.

t- Statistics are shown in the parentheses

In Table 5.2, estimated coefficients on efficiency variable (EFFIN) are positive and statistically significant at the 5 percent level or better in all 4 cases, consistent with the hypothesis that countries with relatively efficient commercial banks have greater GDP growth, *ceteris perbus*. The estimated coefficients on the interaction term EFFIN*CREDIT are also positive in all cases in which they appear and are statistically

significant at 1 percent level of significance. This is consistent with the hypothesis that bank credit extended to the private sector by relatively more efficient banks will have greater marginal benefits. This finding suggests that banking system efficiency is one of the preconditions for credit to have positive and significant impact on economic growth.

The variable CREDIT which is commercial banks' credit to the private sector is also statistically significant and it bears the expected sign in all regressions in which it appears. This is in line with our hypothesis that credit allocation to the private sector has both a statistically and economically positive impact on economic growth. Previous empirical studies have also shown that credit to the private sector is important to economic growth. See for example studies by Beck and Levine (2001), Bencivenga, Smith and Starr (1996), Levine and Zervos (1998).

We evaluate the economic significance of these findings based on the most complete specification shown in regression 4 of table 5.2. Since we used logarithmic functional form, the regression coefficients can be interpreted as elasticities. Hence the estimated coefficient of CREDIT in regression 4 predicts that a 10 percent exogenous increase on bank credit allocated to the private sector would increase annual GDP growth by about one percentage point. With respect to the estimated coefficient of bank efficiency variable, a 10 percent increase in banking system efficiency is predicted to increase GDP growth by about half of one percentage point. Although the magnitude of the marginal effects of bank and credit to the private sector seems small (05% and 1%) we argue that, these effects are economically significant when evaluated in the light of mean GDP growth during the period under analysis. For example, for the period of 12 years (1994 – 2005) the Kenyan GDP growth mean was about 3 percent. Obviously an increase of 0.5 percent in one year is economically significant.

Regarding other explanatory variables, inflation (INF) and government spending (GOV) appears to have no significant impact on economic growth. Population growth rate which is a proxy for labor force growth is also insignificant and has a wrong sign. This finding contradicts earlier findings by Barro (1991), Levine (1997) and Levine and Zervos

(1998). We argue that population may not be a good measure for labor force growth in East African region since these countries are experiencing very high rates of unemployment . Probably data on actual labor force employed in various sectors such as manufacturing, agriculture, mining etc. would have yielded more robust results. However such disaggregate data is not available.

Growth rate of investment which is a proxy for growth in physical capital is statistically significant at one percent level with a positive sign in line with our expectations. Also imports and exports as a share of GDP (TRADE) which is a measure of trade or openness is positive and significant at one percent level confirming a positive link between international trade and economic growth as hypothesized.

In table 5.3 we replace the variable EFFIN with an alternative measure of banking system efficiency, MARGIN, which is the spread between lending and deposit interest rates of the commercial banks. As expected the variable MARGIN is negatively and significantly associated with economic growth as it appears in regression 1 of table 5.3. This result does not change significantly when CREDIT variable and other control variables are added in the model (reg. 2 and reg.3). In all cases the variable MARGIN is negative and statistically significant at the 10 percent level or better. The results are in line with our hypothesis that a shrinking interest rate margin (a measure of efficiency of financial sector) promotes economic growth.

Table 5.3: Fixed Effect model estimation of growth model

Variable		*Reg1*	*Reg2*	*Reg3*	*Reg4*
Constant		*5.952****	*4.942****	*4.368****	*-0.931*
		(12.8)	*(21.8)*	*(7.112)*	*(-0.52)*
MARGIN		*-0.465***	*-0.163**	*-0.197****	
		(-2.463)	*(-1.99)*	*(-5.03)*	
EFFIN					*0.87***
					(2.67)
CREDIT			*0.156***	*0.264**	*0.44****
			(2.261)	*(1.9)*	*(3.12)*
Investment rate				*0.351*	
				(0.186)	
Population growth				*-0.268*	
				(-0.81)	
Government spending				*0.292*	
				(1.665)	
Inflation				*-0.079*	*-0.386**
				*(-2.175)***	*(-1.9)*
Trade				*0.232*	*0.72****
				(1.092)	*(4.56)*
SAVINGS					*0.0001****
					(4.56)
IOCR					*1.113****
					(3.38)
Adjusted R^2		*0.28*	*0.31*	*0.49*	*0.44*
Durbin-Watson	*Stat*	*2.3*	*2.07*	*1.9*	*1.6*

Country dummies are included but are not shown in the table.

*, **, *** indicate significance at 10%, 5%, and 1% levels, respectively.

t-statistics are shown in the parentheses

5.4 Analysis of the Transmission Mechanism Results

Regression 4 in table 5.3 represents the regression results of the growth model with savings and IOCR as additional explanatory variables. In order to spare the degrees of freedom, we drop some of the control variables which were statistically insignificant in the main regression. Also investment was dropped because of high colinearity with savings. As the table shows, the estimated coefficients of savings and IOCR are all statistically significant and positive as expected. The results suggest that a 10 percent increase in the incremental output to capital ratio, which is a measure of capital productivity, will increase the GDP growth rate by about 11 percent. The coefficient of the bank efficiency variable remained positive and statistically significant, at the 5 percent level.

In table 5.4 we present regression results for the saving function with efficiency scores as one of the explanatory variable. The regression presented in column one of the table display very poor results. The results indicate that, with exception of the inflation rate, all the exogenous variables have the correct signs as predicted by the theory. However, three out of the four explanatory variables are found to be statistically insignificant. Also the Durbin-Watson statistics is very low (about 0.2). To make sure that the model does not violate the classical assumptions, we conducted the test for autocorrelation. From the Durbin-Watson statistical table, we find that the lower and upper critical values of the d-statistics with 36 numbers of observation and 4 explanatory variables are 1.236 and 1.724 respectively. Since the estimated value of D-W (0.2) lies below the lower critical value of 1.236, we can not reject the hypothesis that there is positive autocorrelation in the residuals. We correct for autocorrelation by running pooled Generalized Least Squares (GLS) regression and the results are presented in column 2. The GLS results show a significant improvement. Adjusted R-squared increased from 0.75 to 0.989, while D-W rose from 0.19 to 1.83. Except for the coefficient of inflation rate, all the exogenous variables exhibit the correct signs as predicted by the theory. Also the coefficients of the interest rate and per capita GNP are statistically significant at lest at the 10 percent level of significance. This indicates that increases on deposit rates and per capita GNP may have a significant positive impact on saving mobilization. More importantly for our

study, the efficiency variable (EFFIN) is positive and statistically significant at the 5 percent level of significance. The results suggest that a 10 percent increase in the bank efficiency would increase the volume of savings by about 9.6 percentage points.

Table 5.4: Regression results for the savings function

Variable	Reg1	Reg2
Constant	-2.6 (-1.6)	-1.7*** (-2.9)
EFFIN	2.304 (1.5)	0.96** (2.26)
INT	-0.193 (-1.3)	0.09* (1.9)
INF	3.23 (1.5)	0.08*** (3.37)
GPDI	1.175*** (9.5)	5.57*** (5.6)
AR(1)		0.14*** (10.96)
Adjusted R^2	0.75	0.99
DW-stats.	0.19	1.8

*, **, *** indicate significance at 10%, 5%, and 1% levels, respectively.

t-statistics are shown in the parentheses

Table 5.5 reports the results of estimating capital productivity equation to examine the effects of bank efficiency variable on the average productivity of capital stock, while conditioning on other variables which, are suggested by the economic theory and literature to have influence on productivity of capital. The results presented in table 5.5 show that the coefficient of the capital stock is not statistically significant at the conventional levels. The coefficient of the foreign direct investment is positive and statistically significant at the 1 percent level, suggesting that foreign entrepreneurs have a positive impact on the average productivity of capital stock. More importantly for our study, the results in table 5.5 show that bank efficiency variable (EFFIN) has the correct sign and is statistically significantly correlated with productivity of capital (IOCR) at the 5 percent level of significance. The results suggest that a 10 percent increase in

commercial bank efficiency would increase capital productivity by about 1 percentage point. Taken together, these results support our hypothesized channels of transmission that improved bank efficiency promotes economic growth by influencing the productivity of capital and increasing the levels of savings.

Table 5.5: Regression results for the capital productivity (IOCR) function

Variable	Reg1
Constant	0.446 (0.67)
EFFIN	0.103** (2.23)
K	-0.62 (-0.64)
FDI	2.38*** (4.91)
ERD	0.402 (1.8)
Adjusted R^2	0.54
DW-stats.	1.4

*, **, *** indicate significance at 10%, 5%, and 1% levels, respectively.
t-statistics are shown in the parentheses

Generally our empirical findings suggest that the banking systems in the EAC countries influence economic growth through various channels. Specifically the findings confirm that financial sectors impact economic growth not only through capital accumulations as argued by among others, McKinnon and Shaw (1973) but also through the degree of banking efficiency in a particular country.

5.6 Concluding Remarks and Policy Implications

This study has had to contend with low quality of data that is presently inevitable in most developing countries, especially those in Sub-Saharan Africa. We were also limited or constrained in extending our sample period as far as we would wish, due to unavailability of adequate commercial banks' data. However, not withstanding these limitations, we hope that the study has shed some light on a number of policy issues. The empirical findings of this study provide some useful steps in understanding the link between financial sector and economic growth. In particular, the study suggests that banking sector efficiency plays an independent role in promoting economic growth in the East African region. The implication of this finding is that future studies linking financial sector and economic growth should emphasize the importance of both the size and the quality (efficiency) aspects of the financial sectors. As mentioned earlier, the existing literature on the subject has focused attention on impact of increased volume of financial services on the economic growth. The importance of quality of financial services has so far been ignored.

Another important policy implication of this study is that governments in the East African region can help promote economic growth by adopting policies that encourage efficient financial sectors. Opening the banking sectors to foreigners and privatizing the state owned banks do not necessarily lead to efficient banking systems. Much more reform measures are needed along with liberalization and privatization in order to achieve the desired efficiency in the financial sectors. Such reforms may include, improving the legal frameworks and enabling information sharing among financial institutions on creditworthiness of borrowers. These measures would help reduce operating costs and also encourage competition in the banking sectors. Also since competition forces banks to operate more efficiently, there is a need for the governments in the region to put in place policies that may reduce the dependence of banks upon government securities as a source of low-risk, high-yielding assets[14]. This could lead to increased competition, as banks would have to identify new lending opportunities and expand their customer base

[14] As noted earlier, the commercial banks in the three countries have strong preference for holding government securities as compared to extending loans.

in order to generate income. Efficiency in the banking systems could also be improved by reinforcing technology such as comprehensive computerization of the banking systems. This could enable banks to provide products and services in large volumes at competitive costs with better risk management practices.

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