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June 2012

Online at https://mpra.ub.uni-muenchen.de/43577/
MPRA Paper No. 43577, posted 06 Jan 2013 02:02 UTC

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SOURCES OF GROWTH IN POST-CONFLICT BURUNDI
FROM DESTRUCTION TO PRODUCTION

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The World Bank
Africa Region
Poverty Reduction and Economic Management 5
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Abstract

Burundi, a small fragile economy, went through sporadic civil war since its independence in 1962 during which rampant insecurity had adverse impact on the country's social and economic development. While Burundi is agriculturally rich, high rate of growth of rural population places overwhelming pressure on limited land resources. It is widely recognized that without significant growth in agriculture it will be virtually impossible to address poverty reduction. Given the high population density and limited off-farm employment opportunities, enhancing agriculture productivity is key for sustainable economic growth and improving the living standard of rural families.

This paper highlights the importance of:

- Improved technology packages (at the production, post-harvest, processing and marketing stages).
- Building the capacity of producers' organizations.
- Irrigation development (marshland irrigation systems) and conservation measures.
- Basic rural infrastructure (feeder roads).
- Increasing the production and improving the processing and marketing of high value export crops (coffee and tea) and diversifying agricultural exports (horticulture).

To examine the roles of aforementioned factors, the paper employs a structural composition model. In so doing, it provides quantitative evidence that Burundi's economic growth is largely determined by total factor productivity (TFP), which in turn is affected by macroeconomic policies and stability, and infrastructural and institutional quality.

SOURCES OF GROWTH IN POST-CONFLICT BURUNDI FROM DESTRUCTION TO PRODUCTION[1]

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Keywords: Agriculture, Burundi, Productivity, Sources of growth, World Bank

JEL codes: Q1, O4, O5, F33

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[1] An earlier version of this paper served as the background paper to the 2007 Sources of Rural Growth Report: "Breaking the Cycle - A Strategy for Conflict-sensitive Rural Growth in Burundi." The authors thank John McIntire, Yvonne Tsikata, Philippe Dongier, Mercy Tembon, Albert Zeufack, Paolo Zacchia, Xavier de la Renaudière, and Steffi Stallmeister who provided useful comments on this paper. Comments from Prof. Charles Ncho and Sulaiman Wasty are also appreciated. Francisco Galroa Carneiro was the peer reviewer.

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INTRODUCTION

Burundi is a small country with a high population density. While the country is agriculturally rich, there is strong competition for resources, particularly in the rural areas where 90 percent of the population lives and farming land is scarce. The thirteen years of recurring conflict created a devastating effect on Burundi's economy. With a population of 8.5 million, Burundi's per capita income fell by about 38 percent, from US$180 in 1993 to US$111 in 2008. Further, with the beginning of peace large numbers of internal and external refugees are returning to land that has been cultivated by others in their absence. This is leading to tensions about resource ownership and use and affects earning potential of past and present users.

Equitable growth and developing human capital is top policy agenda of the government. The PRSP notes that promoting equitable growth depends mainly on developing the rural sector, where more than 90 percent of Burundi's poor live. Agriculture is the major component of Burundi's economy, accounting for more than 80 percent of employment, about 95 percent of the food supply, and more than 60 percent of foreign exchange earnings. To increase the sector's contribution to the creation of wealth and poverty reduction, rural development encompasses three target objectives for improving food export crops, livestock and fish farming: (i) increasing the volume of output and productivity; (ii) improving cost control; and (iii) raising and stabilizing income from sales.

Methodology

This paper investigates the sources of economic growth in Burundi, which are critical to the country's long-term economic prospects. We examine the economic sector that is more capable of generating higher rates of growth in the overall economy. A specific emphasis is placed on the importance of productivity in agriculture for Burundi's economic development. Technically, as is common in the empirical literature, the elasticity of output to capital accumulation was estimated by using an econometric method (Johansen's co-integration approach), which makes no a priori assumption on the exogeneity of capital accumulation. We hypothesized, based on a graphical inspection of the TFP growth and real GDP growth and cross-country evidence, that both variables are strongly correlated. Consequently, the key to foster economic growth starts by first improving the efficiency with which primary inputs (labor and capital) are transformed into output (total factor productivity). The determinants of TFP were therefore investigated.[2]

Economy-wide modeling was conducted not only to analyze the various linkages of the Burundian economy but also to take a closer look at the issue of agriculture productivity. The key sector analysis revealed that food crops and other food industries are key sectors in the sense that they exhibit both strong backward and forward linkages. This analysis also found that forestry, livestock, export crops, fishing, and mining, quarrying and energy

[2] By estimating a production function of Cobb-Douglas-type on over 1962-2005, we obtained a capital income share (0.34), which is consistent with findings in available empirical literature. The estimated capital accumulation income share was then used to conduct a growth accounting exercise over 1970-2005. TFP growth generally explains more economic growth than inputs accumulation does.

could be referred to as stimulating sectors in the sense that they can stimulate significantly other sectors of the economy. Finally, a comparison of the productivity shock simulation among the three sectors (primary, secondary, and tertiary) reveals that a productivity shock (0.5 percent of GDP) in agriculture leads to GDP effects ranging from 0.8 percent to 1.4 percent compared to between 0.5 percent and 1.2 percent for industry and services.

Structure of the Paper

The rest of the paper is organized as follows: A brief review of Burundi's economic performance including an overview of some policy reforms is presented in the next section. Using a simple statistical framework and a parsimonious set of explanatory variables, Section 2 discusses Burundi's economic growth and assesses the long-term dynamics of economic growth. Section 3 presents a growth accounting analysis along with an examination of the determinants of growth using a single equation estimate of the TFP growth. Section 4 calibrates the linkages of the Burundian economy and identifies the key sectors for economic growth. Section 5 provides concluding remarks and policy recommendations.

1. OVERVIEW OF BURUNDI'S ECONOMY, 1960-2009

Burundi's economic record

In the ten years since the Arusha Agreement in 2000, Burundi has experienced both great strides and major setbacks on the road to lasting peace.

Burundi's economic settings and performance during 1960-2009 can be summarized into four discrete historical periods. In the aftermath of independence (1962-1972), Burundi showed a remarkable economic performance, but began to weaken as the political instability spread in the early 1970s. During this period, while inflation rate was reasonably low (4 percent per annum on average), real GDP growth averaged 5.3 percent while per capita GDP grew by 3.6 percent, with population growth rate of just 1.6 percent. Notably, GDP growth declined significantly in 1972 mainly due to severe ethnic conflict and poor agricultural productivity. During 1973-1991, Burundi's economy grew by an average of 4.1 percent, primarily driven by the coffee boom and considerable increase in investment. Although Burundi's economy grew steadily and exchange rate remained relatively stable, this period was also characterized by high inflation rate, increasing debt, and resource mismanagement. Looking at it closely, external debt as share of GDP was only 2.8 percent in 1972 but it reached 82.5 percent in 1991.

During the period 1992-2000, GDP growth rate fell by an average of 2 percent per annum. Due to power shortage, several industries disrupted or seized their productions. In 1995 alone, industrial output fell by 16.6 percent, agriculture by 6.8 percent and services by 3.6 percent, while aggregate real GDP fell by 7.9 percent. Between 1992 and 1999, Burundi's Franc continually plummeted by 15.6 percent on average, and inflation was elevated to an average of 22.9 percent (with the highest rate of 31 percent in 1997). In 1999, external debt reached 140.4 percent of GDP, which is about 23 times higher than its level in 1970 or about 8 times higher than its level in 1980.

During 2001-2008, while inflation was exacerbated by the 2008 food and fuel crisis, real GDP growth recovered to 3 percent per annum and exchange rate continued to be stable,

indicating the government's commitment to address the country's socio-economic issues. Nonetheless, agriculture performance continued to be unimpressive between 2000 and 2005, as it fell by 6.6 percent in 2005, partly because of the adverse weather condition but structural constraints, including highly fragmented land-ownership, declining soil productivity and a lack of inputs, had also significant negative impact on the economy. It is, therefore, the lack of improvements (exacerbated by drought in the Northern provinces) in the agriculture sector that caused real GDP to grow at a mere 0.9 percent in 2005, despite improvements in the manufacturing, construction and trade sectors. In more recent years, however, economic growth has accelerated by an average of 4.4 percent. In 2008, real GDP grew by 4.5 percent, up from 3.6 percent growth in 2007, mainly due to good food crops and coffee harvest. As a result of lower private transfer and foreign direct investment following the global financial and economic crisis, real GDP growth declined to 3.5 percent in 2009.

2. STRUCTURAL COMPOSITION, AGRICULTURAL PRODUCTIVITY, AND ECONOMIC GROWTH

There has been some structural progression in Burundi's economy between 1970 and 2008. The services sector's contribution has more than doubled between 1970 and 2008, from 19 percent in 1970 to 45 percent in 2008.[3] On the other hand, the share of agriculture in GDP has fallen by about 36 percentage points. Industry's contribution has also increased by about 10 percentage points. However, over the entire study period (1970-2008), agriculture remained the dominant sector both in terms of its contribution to GDP and employment generation. The decline in the contribution of the agriculture sector to GDP is essentially due to poor productivity, which has been affected by weather and periodical civil strife[4] that had significant negative effect on the rural infrastructure and investment in agriculture.

The current economic structure of Burundi is indicative of a very low development and productivity in the sector where a large share of labor force takes part. Over the eight-year period to 2008, agriculture production grew by an average of just 1.1 percent. It indicates that the agriculture sector has not yet fully recovered from the recent droughts and the effects of the war. Agriculture is the stronghold of the economy, but the war, accompanied by massive population displacement, has been particularly harmful to this sector. Poor rains from 1997 to 2000 also dented production, though output has since improved in step with improved rainfall.

[3] Data on the sectoral share of GDP is obtained from World Bank's World Development Indicators (2007), and is computed by disaggregating the value added by sector. Value added is computed separately for each industrial sector, and the sums are then added together to get the GDP figure. Thus, the figures for sectoral share of GDP may differ from other similar studies, such as IMF (2006).

[4] Undoubtedly, this results from a productivity decline in the sector, direct consequence of a prolonged period of ethnic conflicts and military coups (1976, 1987, and 1993). The period 1976-1989 was marked by two military coups: in 1976 Micumbero who came to power in 1966 was overthrown by J-B Bagaza, and the latter was removed by Pierre Buyoya in 1987. Moreover, 1988 was marked by ethnic clashes, resulting in several deaths in both main ethnic groups.

Table 2.1: Sectoral output contribution, 1970-2008

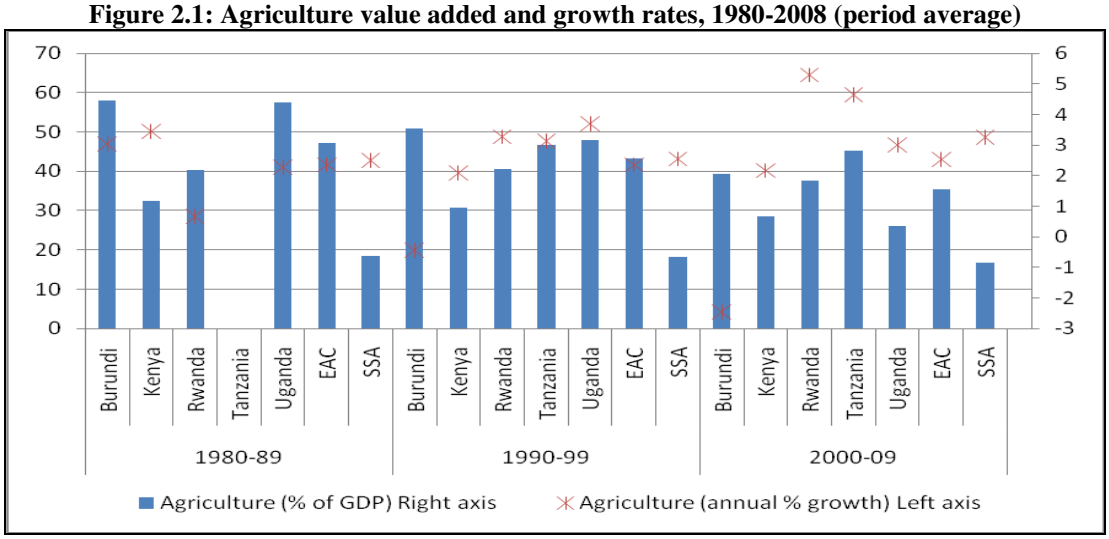
	Agriculture	Industry	Services	Overall
	% GDP			
1970-1979	65.5	13.1	21.5	100
1980-1989	58.1	15.1	26.8	100
1990-1999	50.8	18.7	30.5	100
2000-2008	47.5	14.6	38.0	100
1970-2008	55.5	15.4	29.2	100
	Growth rate (%)			
1970-1979	6.8	6.3	2.2	4.5
1980-1989	3.0	5.3	1.8	4.3
1990-1999	-0.4	-1.0	4.1	-1.4
2000-2008	1.1	5.7	5.7	4.2
1970-2008	2.6	4.1	3.5	3.4

Source: Authors' estimate based on World Development Indicators

The contribution of the industry sector, which comprised mostly of small and medium enterprises, rose marginally to about 19 percent of GDP. Because this sector is mainly dominated by agro-based industries, the sluggish performance of the agriculture sector explains the slow growth in the industry sector. In recent years, industry and service sectors have shown significant progress in their contribution to GDP. The service sector, in particular, became one of the mainstays of the economy (45 percent of GDP in 2008), and had continued its impressive growth performance since 2000, recording 14.4 in 2004 and 10.6 percent in 2005. The largest part of services sector in Burundi is public services (administration), but distributive trade has been on its rise in the past few years. However, in recent years the telecommunications sub-sector has also contributed to the growth in services. The number of mobile phone subscribers increased to 153,000 in 2005 compared to 800 in 1999.

Agricultural productivity: Burundi's agricultural productivity is among the lowest in the Sub-Saharan Africa (SSA). Figure 2.1 depicts growth dynamics in Burundi for 1980-2008 as compared to the EAC countries. It reveals that over the period, compared to the selected countries, Burundi recorded the lowest average annual GDP growth (2.2 percent). Interestingly, while Burundi's agriculture still accounts for a high percentage of GDP (55 percent of GDP) compared to 53 percent for both Uganda and Ethiopia, their respective average GDP growth rates are 3.1 percent and 3.5 percent, which are fairly more than Burundi's average rate of growth. Labor productivity in agriculture is therefore extremely low compared to that for other sectors, suggesting the need for the government and the donor community to develop strategies aimed to increase productivity in agriculture.

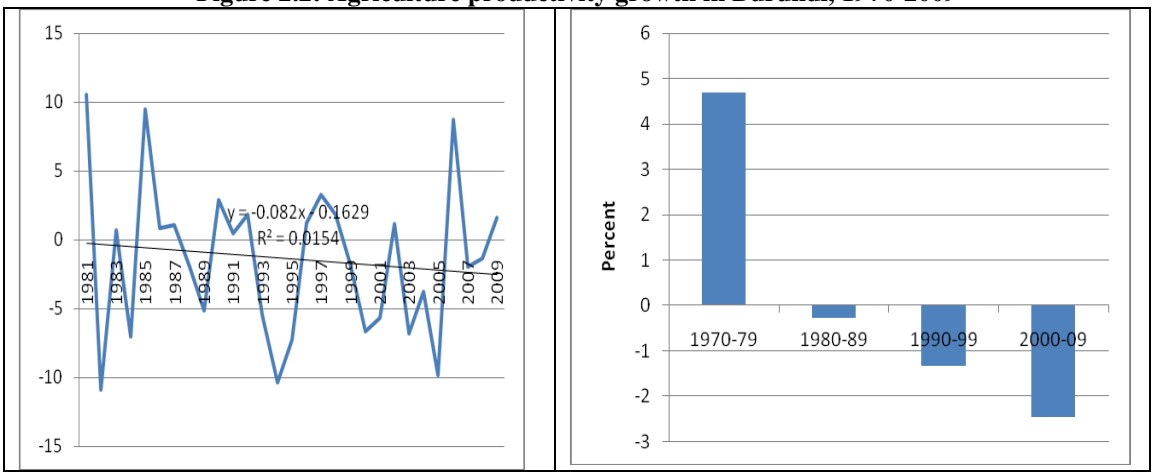
Figure 2.1: Agriculture value added and growth rates, 1980-2008 (period average)



Source: Authors' estimate based on World Development Indicators

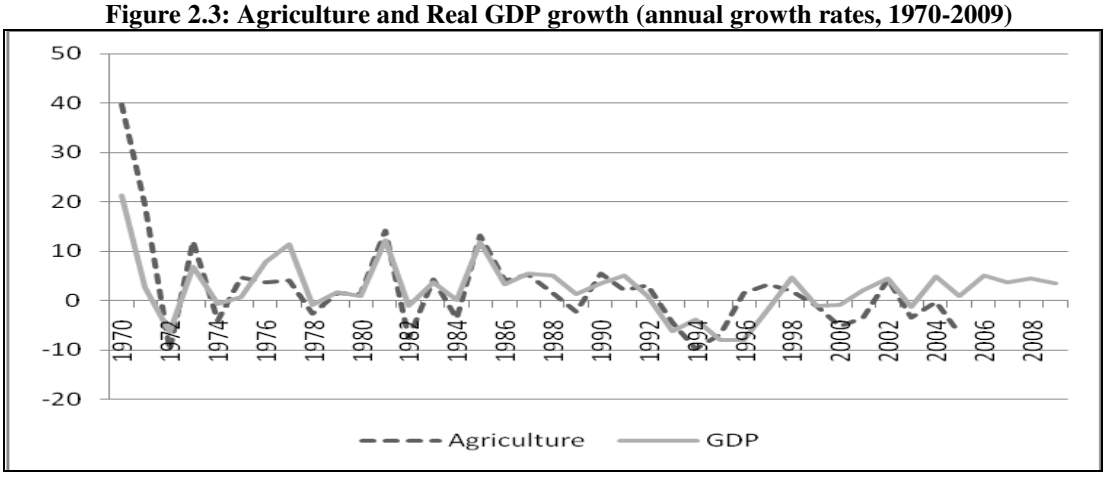
Productivity growth in agriculture has been sluggish over 1970-2009**:** Figure 2.2 shows the trends in agriculture productivity growth between 1970 and 2009. It indicates that productivity growth in agriculture has trended downward over the sample period from a peak of over 30 percent in 1981 to extremely low level of -30 percent in 2005. Figure 2.2 also shows that after a period of growth registered in the seventies, agricultural productivity has declined.

Figure 2.2: Agriculture productivity growth in Burundi, 1970-2009



Source: Authors' estimate based on World Development Indicators

Figure 2.3: Agriculture and Real GDP growth (annual growth rates, 1970-2009)



Source: Author's estimates based on World Development Indicators database.

Despite the recent structural manifestation, Burundi's overall socio-economic structure shows that agriculture is the most important sector for long term economic growth and poverty reduction. Even during the years when services experienced a high rate of growth (such as in the mid 1990s), the overall GDP growth rate was negative, mainly due to a weak performance of the agriculture sector (Figure 2.3). This is further supported by our regression results, which indicate that a unit change in agriculture value added growth leads to a 0.47 unit increase in overall GDP growth compared to 0.21 if that came from industry growth, and 0.29 unit from services growth (see Annex 1).

The development of rural sector crucially depends on enhancing productive activities both within agriculture and outside. Currently, rural Burundi is incompetent of attracting new investment and creating job opportunity and income. The fundamental issues for rural Burundi include its poor productivity (affected by both policy and non-policy factors), inadequate access to resources, and weak institutional capacity. The major policy challenges for Burundi that affects output and job creation by small-scale farmers and rural poor are identifying opportunities to diversify agriculture and the economy, increase the quality of commodities produced, create better access to markets, promote small-scale businesses, and create business environment for non-agricultural activities such as rural industries, tourism and other services, through promotion and incentive schemes; these can strengthen agriculture too.

3. GROWTH ACCOUNTING, AND DETERMINANTS OF GROWTH

In this section, we analyze the sources of growth in Burundi over the sample period (1962-2005)[5]. The analysis focuses on evaluating the relative contributions of capital accumulation and total factor productivity (TFP) to economic growth, defined as the growth of aggregate output per worker. The first step of the growth accounting exercise is the choice of the elasticity of output per worker with respect to capital-labor ratio. Rather

[5] The sample period 1962-2005 was used for the estimation of the elasticity of output per worker with respect to capital-labor ratio to gain more degree of freedom. However, due to data availability, the subsequent growth analyses were based on the 1970-2005 period.

than imposing this coefficient a priori, which is a common practice in several sources of growth studies and to some extent is arbitrary, it is estimated econometrically in this study. The estimated output per worker-capital labor elasticity is 0.34, and it is in the range of other cross-countries sources of growth studies on African countries (0.2-0.5).

Decomposition of Economic Growth

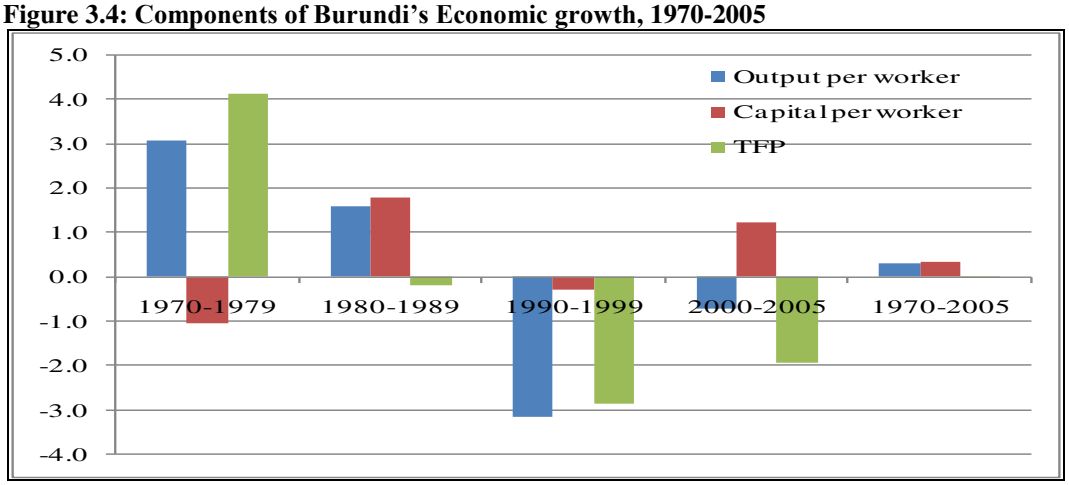
Figure 3.4 shows TFP growth in Burundi over the last four decades. Here, TFP is measured as a residual that accounts for effects on growth in GDP per worker that is not explained by the capital accumulation (as measured by the growth rate of physical capital per worker). Note that there are no input quality adjustments as human capital is not included as input.

Growth accounting reveals that during the first decade, output per worker grew at about 3 percent explained mainly by a productivity boom (4.1 percent) despite the fact that the period 1970-79 was marked by two political events: ethnic massacres of 1972 and the 1976 military coup. In this period, the contribution of capital accumulation was negative. The productivity boom in 1970-79 could partly be attributed to post-independence momentum. In fact, institutions established during colonization continued to function well several years after independence. Many educated Burundians were trained in public administration management, health, and education in Butare (Rwanda) at a sub-regional school established by Belgium for nationals from its former colonies (Burundi, Democratic Republic of Congo, and Rwanda). This might have also helped boost total factor productivity growth during the first decade.

During the second decade (1980-89), output per worker declined compared to the preceding decade, although it remained positive. It stood at 1.6 percent mostly explained by capital accumulation growth. Total factor productivity (TFP) growth experienced a decline of 0.2 percentage point. The military coup of 1987 and the 1988 ethnic killings may partly explain such a productivity slowdown. During 1990-99, output per worker experienced its highest decline (-3.2 percent), which was mainly explained by the highest TFP decline (-2.9 percentage points). Capital accumulation growth recorded a slight decline (-0.3 percentage point). Presumably, economic efficiency may have dropped during this period because it is characterized by several years of civil conflict that erupted following the military coup of 1993 and the resulting ethnic massacres. Moreover, an embargo was imposed on Burundi in 1996 by neighboring countries, which significantly handicapped Burundi's economy.

Finally, over 2000-05, output per worker, although negative, improved significantly from its level in the preceding period (-0.7 percentage point vs. -3.2 percentage points, respectively). This period was characterized by peace agreements and a lifting of the embargo, and consequently, the progressive reengagement of the international financial community. In short, the reconstruction of institutions and policies took place. TFP growth remained negative during this period but improved when compared to 1980-89. Capital accumulation improved from -0.3 to become positive at 1.2 percentage points. Presumably, the capital flows increase resulting from the international community's reengagement in Burundi could be an explanation. During this period, official development assistance as a share of GDP on average increased to 30 percent from about an annual 9 percent of GDP during 1996-99. Institutional reforms associated with foreign development assistance partly explain the slight TFP improvement during this period.

Figure 3.4: Components of Burundi's Economic growth, 1970-2005



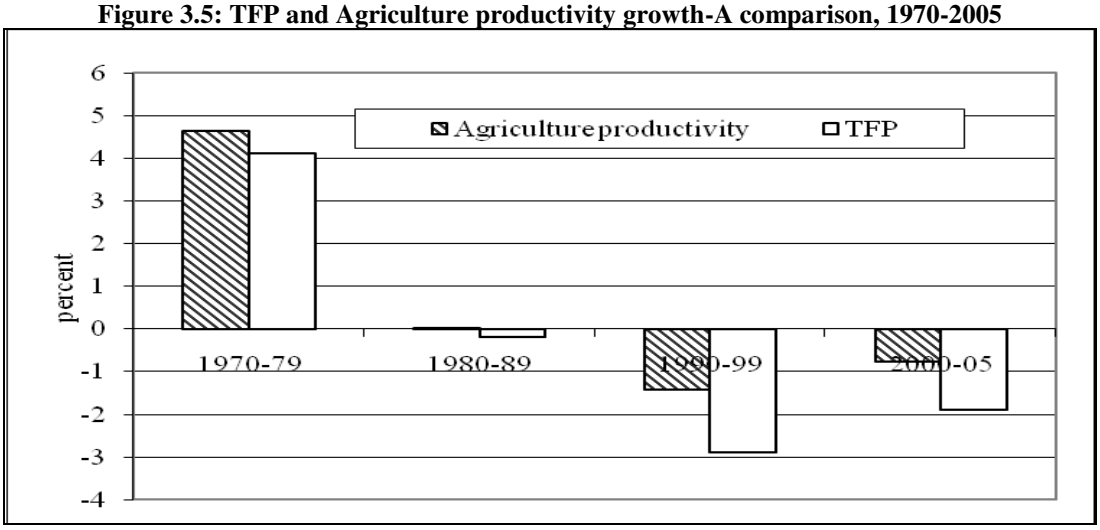
Source: Author's estimates based on World Development Indicators database.

In sum, the above growth accounting calculations clearly show that the key difference between the first decade (1970-79) and the three subsequent decades is TFP growth. Our calculations may exaggerate the actual importance of TFP, since due to data availability estimations were not corrected for human capital, but it would be surprising if the inclusion of human capital significantly reduced the importance of TFP.

There is also a strong correlation between agriculture productivity and TFP growth. Figure 3.5 below displays a comparison between average growth rates of TFP and agriculture productivity. It reveals a strong link between the two measures of productivity as they illustrate almost a similar pattern. In the 1970s, agriculture productivity grew at 5 percent compared to 4 percent for TFP. The former was zero in the 1980s while the latter was slightly negative. During the crisis (1990s), productivity growth in agriculture was about -1.5 percent on average compared to -2.9 percent for TFP growth. This indicates that in addition to the decline in agriculture productivity, other factors (e.g., governance[6]) explained the decline in the growth of the productivity of the Burundian economy. In the first half of the following decade (2000s), both agriculture productivity and TFP growth improved marginally from their slump of the previous period, even though they remained negative and far from the levels achieved in the 1970s. We expect the estimated coefficient for agriculture productivity to be positive in the TFP regression.

[6] Governance has received increasing attention as a determinant of economic growth (see for instance, Barro (1996), Kauffman, Kraay, and Zoido-Lobaton (1999)).

Figure 3.5: TFP and Agriculture productivity growth-A comparison, 1970-2005

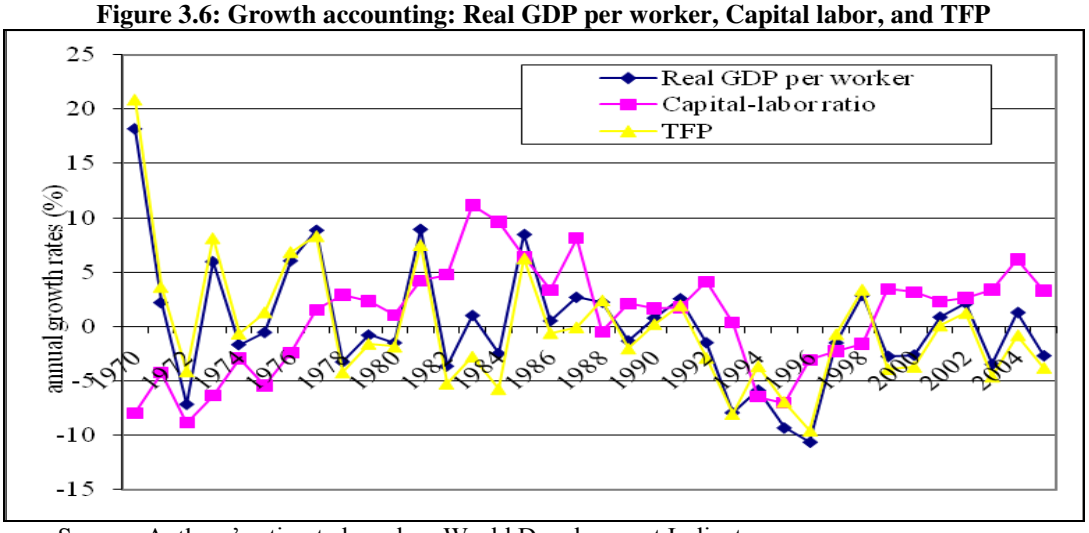


Source: Authors' estimate based on World Development Indicators

Determinants of Economic Growth - TFP and Economic Growth

The importance of TFP in Burundi's economic growth performance is illustrated in Figure 3.6 where TFP growth follows a similar graphical pattern to that of economic growth rate. Table 3.2 also confirms the importance of TFP in economic growth among 107 countries.

Figure 3.6: Growth accounting: Real GDP per worker, Capital labor, and TFP



Source: Authors' estimate based on World Development Indicators

Based on the above discussion, we derive a simple model that examines the factors that potentially affect TFP growth (see Annex 3). Such factors include various indicators that measure the quality of institutions and economic policies. Beyer and Vergara (2002) have shown that growing countries exhibit positive rates of TFP growth and that factor accumulation does a poor job in explaining differences in economic growth across countries.

Table 3.2: Sources of Growth: Cross country experience (Average growth rate, percent)

	Output	Factor Accumulation	TFP
Top 10% fastest growing countries	7.55	3.88	3.67
Bottom 10% slowest growing countries	-1.19	2.29	-3.48
Difference	8.74	1.59	7.15

Note. Sample comprises 214 observations, based on two ten-year averages (1980-1990 and 1990-2000) for 107 countries --- Source: Harald Beyer and Rodrigo Vergara: " Productivity and Economic Growth: The Case of Chile" in "Economic Growth: sources, trends and cycles" (2002), Loayza and Soto (Eds), Santiago, Chile

Studies on growth theory have emphasized the importance of sound policies in creating a framework that fosters economic growth through factors accumulation and efficient use of resources (see Ghura and Hadjimichael (1996); Elbadawi and Ndulu (1996); Sachs and Warner (1997); and Patillo, Gupta, and Carey (2005)). For our purpose, a non-exhaustive list of factors ranging from agriculture productivity growth, aid (as percent of investment), inflation, trade openness, exchange rate policy, and private sector access to domestic credit were identified to influence TFP growth and therefore economic growth (as measured by the growth in output per worker). These factors, presented in Table 3.2, are regrouped into 4 broad categories: sectoral efficiency, structural policies and institutions, stabilization policies, and external factors.

Table 3.3: Determining Factors of TFP growth[7]

Category	Indicators
Sectoral efficiency	Agricultural productivity
Structural policies	1. Trade openness (exports + imports as percent of GDP) 2. Political stability (war dummy) 3. Financial depth a. Credit to private sector (as percent of GDP) b. Credit to private sector (as percent of total domestic credit)
Stabilization policies	1. Consumer price index (CPI) inflation 2. Exchange rate policies a. Real effective exchange rate (REER) b. REER depreciation dummy
External factors	Official development assistance (as percent of investment)

[7] Annex 3 discusses these factors in more detail.

Estimation Results

Annex 3 presents the estimation results obtained using OLS.[8] Several model specifications are presented depending on the issue investigated. Model specification 1 can be considered as our basic model. It is a parsimonious specification with 5 explanatory variables (agriculture productivity, aid, openness, inflation, and the real effective exchange rate). In specification 2, the exchange rate devaluation dummy is introduced in place of real effective exchange rate. Specification 3 builds on specification 2 by introducing the war dummy as a way of capturing the growth effects of political instability. Specification 4 builds on specification 3 by including credit to private sector (as a share of total domestic credit). In addition to the variables in specification 4 the war dummy variable is added in specification 5. Finally, specification 6 is similar to specification 5 with the only difference that credit to private sector (as a share of total credit) is replaced by credit to private sector (as share of GDP). Our preferred specification is specification 3. The reported diagnostics include two Chow tests for parameter constancy (one with a mid-sample split and the other for end of sample constancy), a Jarque-Bera test for residual normality (denoted Normality), a one-through-fourth order Box-Pierce autocorrelation test (denoted AR 1-4), a one-through-fourth order autoregressive conditional heteroskedasticity (ARCH 1-4), and a White's (1980) test for residual heteroskedasticity (denoted Hetero).

Overall, policy variables and other determinants of TFP growth provide results that are consistent with our model's predictions

Sectoral efficiency: Agriculture productivity has the expected positive sign and it is statistically significant. It affects TFP growth positively as its coefficient is statistically significant (at 1 percent level) in all model specifications: a 1 percentage point increase in agriculture productivity leads to a 0.57-0.62 percentage point increase in TFP growth. This result is consistent with our earlier observation of a co-movement between agriculture efficiency and overall economic efficiency. We previously also, estimated separately that agriculture growth accounts for 47 percent of GDP growth compared to industry (21 percent), and services (29 percent) (see Annex 1).

Structural policies and institutions: All variables related to structural policies show coefficients with expected signs although not all are statistically significant. Economic efficiency (TFP growth) increases with trade openness, and this relationship is generally statistically significant, except in specification 1. Trade openness induces a TFP boost and therefore economic growth: a percentage increase in trade openness leads to an increase in TFP growth ranging from 0.17 percentage point to 0.32. This result is broadly consistent with a vast empirical literature on endogenous growth (Dollar (1992), Loayza and Soto (2002)). Despite the importance of openness it is worth noting that there is little trade diversification in Burundi, as coffee exports still account for about more than 60 percent of total exports revenue.

While Levine, Loayza, and Beck (2000), and Loayza and Soto (2002) found a positive and statistical significant effect of financial depth on economic growth, our estimations

[8] The estimation methodology is discussed in detail in annexes 2 and 3.

(specifications 4, 5, and 6 which introduce financial depth) found a low statistical significance, although with a positive sign.

Regression results also reveal that our measure of political stability (war dummy) is generally negatively related to TFP growth as predicted[9], but this is not statistically significant. Nevertheless, it provides further evidence that war has had devastating consequences on the efficiency of the Burundian economy.

Stabilization policies: For the variables in this category, all estimated coefficients carry the expected signs and are generally statistically significant. As stated earlier, economic efficiency, and hence growth, generally decreases when the government does not carry out policies conducive to macroeconomic stability. Like Fischer (1993), and Loayza and Soto (2002), we find that an increase in the inflation rate leads to a reduction in TFP growth. This result is statistically significant in specifications 2, 3, and 6. Our results suggest that a point percentage increase in inflation rate could lead to a TFP growth reduction estimated between 0.08-0.11 percentage point.

Exchange rate policy seems to positively affect TFP growth: depreciation in the real effective exchange rate and dummy exchange rate devaluation all positively affect economic efficiency. This result is consistent with economic theory: real exchange rate depreciation makes exports more competitive, which in turn, positively affects economic growth. The effect of REER on TFP growth in specification 1 is not statistically significant (but at 12 percent). The exchange rate depreciation dummy is rather statistically significant at all conventional levels (see specifications 2-6).

External factors: The regression confirms the importance of foreign aid. It suggests that sound macroeconomic policies should be supported by foreign assistance (measured by official development assistance as a share of gross capital formation). In all the specifications, we obtain the expected sign and statistical significance (except in specification 6). Our results indicate that a one percentage point increase in aid (to gross capital formation) leads to about a 0.01 percentage point increase in economic efficiency.

Overall diagnostic test results of the various specifications are also reported in Annex 3. They indicate that our model performs well on statistical grounds. The estimated residuals are free of heteroskedasticity and autocorrelation but the hypothesis of normality is rejected only in the first specification[10]. However, once the real effective exchange rate is replaced by exchange rate devaluation dummy (specifications 2-6), the hypothesis that the residuals are distributed normally (and white noise) cannot be rejected. The two chow tests indicate that the hypothesis of model stability and parameter constancy cannot be rejected except in the first specification.

4. ECONOMY-WIDE ANALYSIS OF PRODUCTIVITY IN BURUNDI

The economic linkages are captured using a social accounting matrix (SAM). The Burundi social accounting matrix presents an excellent framework for understanding and

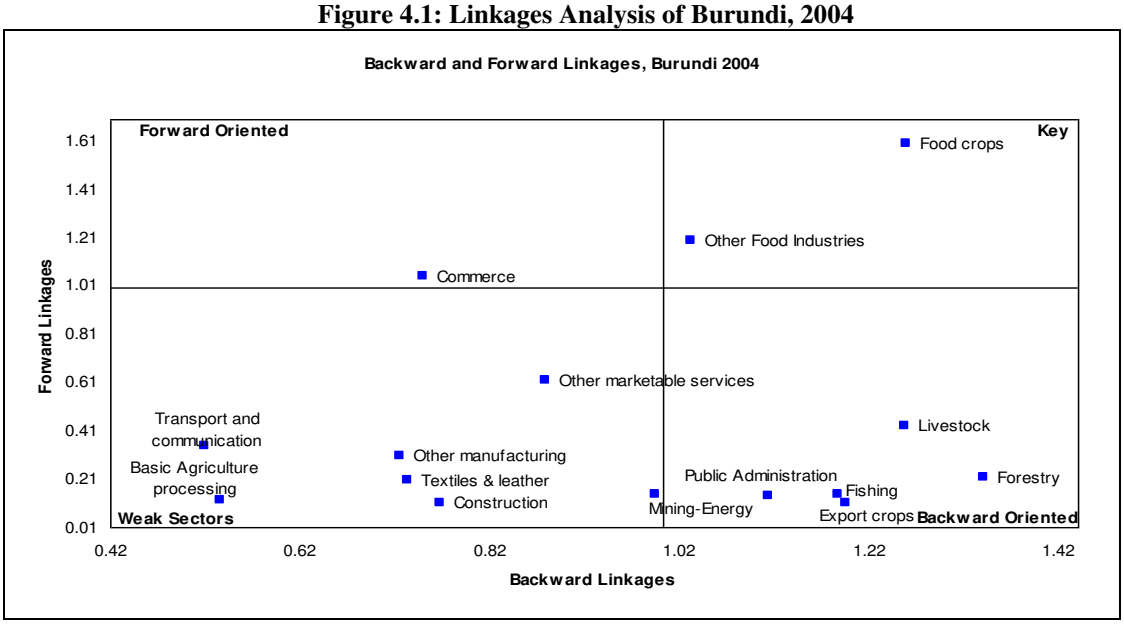
[9]The war dummy has the expected sign in two (Model 3 and 5) of the three model specifications where it was introduced.

[10] The non-significance of hetero, autocorrelation tests indicates the absence of heteroskedascity and serial correlation of residuals. This is also true for the normality test.

measuring inter-sectoral growth linkages in the economy. The matrix is equally relevant for understanding the linkages between sectoral output growth and household groups in the country. However, a few words of caution: Although the simplified social accounting matrix used here is calibrated on macroeconomic data of 2004, it is based on a 1998 input-output (I-O) table. Consequently, given the limitation of the analysis to inter-industry transactions (with a single household account), its findings remain very indicative.

KEY SECTORS ANALYSIS

Figure 4.1: Linkages Analysis of Burundi, 2004



Source: SAM multiplier model based on Burundi 2004 single household (quasi-) SAM using SAMSIP-SAM software

The linkage analysis[11] based on the SAM multiplier matrix and presented in Figure 4.1 shows that growth would be sustained in Burundi if the following key sectors are stimulated: food crops agriculture and other food industries. These sectors are characterized by both backward and forward linkages indices greater than the economy's linkage average (i.e., one). The strongly backward-linked sectors but weakly forward-linked include forestry, livestock, export crops, fishing, public administration, and mining, quarrying and energy (which is borderline). As such, these sectors can stimulate significantly other sectors of the economy.

The linkages analysis also reveals that only commerce was found to be strongly forward linked but weakly backward linked with the rest of the economy. This indicates that this sector is likely to be stimulated. In a sense, this is reasonable since there would not be any activity in commerce if economic activity is low in all other tradable sectors. Finally,

[11] The forward linkage (in percentage terms) of sector *j* quantifies the change in income in sector *j*, relative to the average change in the economy, caused by a unitary injection in the final demand of all sectors. If the forward linkage for sector *j* is greater than 100%, the change in sector *j*'s income is higher than the average income change in the economy after a unitary injection in all sectors. On the other hand, the backward linkage of sector *j* quantifies the change in economy wide income, relative to the average change in the economy, caused by a unitary injection in the final demand of sector *j*.

agriculture processing (which includes the activities of washing stations, coffee milling, and tea processing), transport and communication, other manufacturing, textiles & leather, and construction are sectors, which cannot be strongly stimulated nor can stimulate significantly other sectors. Given the inadequate status of equipment in agriculture processing that are said to be old and the state of roads and communication that is still dismal, we can explain why these sectors are among the weakly linked sectors. Also, the input-output table on which this study was done is for 1998, and we know that during that period Burundi was still in the midst of a civil conflict (although towards the end), which presumably could only explain why transport, construction and other basic agriculture processing are only weakly linked with the rest of the economy. It is worth noting that although this linkages analysis is useful, one should be cautious when using it to draw policy implications. In effect, it is possible that a sector has strong linkages with households, but this is not taken into account here since our analysis focuses mainly on inter-industry transactions.

POLICY SIMULATIONS: DESIGN AND RESULTS

Simulation design

Three sets of simulations are conducted to assess the importance of economic linkages in Burundi. These are respectively a comparison of the economy-wide effects of a productivity shock in the agriculture sector (food crops, export crops, livestock, fishing, and forestry), industry sector (basic agro-processing, other food industry, textiles & leather, mining and energy, other manufacturing, and construction), and the services sector (transport & communication, commerce, other marketable services, and public administration). In each set of simulations, we examine for each subsector of agriculture, industry, and services sectors, the effects on sectoral and aggregate GDP of an output increase of 0.5 percent of GDP (i.e., about FBu 3.83 billion).

Normalizing the size of the shock to GDP allows us to compare these scenarios (on the same basis) in terms of which sector will provide the greatest benefits if its productivity were to be improved. It is worth stressing more the importance of these simulations since agriculture accounts for about 45 percent of Burundi's GDP and is responsible for more than 80 percent of employment creation. Consequently, improved productivity in agriculture would have an impact on incomes in the rural sector where poverty is high. This, in turn, will have an impact on the rest of the economy and the strength of this economy-wide effect depends on the strength of economic linkages between household income, consumption, and production. Comparing the effects of a productivity shock in agriculture with that in industry and services can viewed as a way of evaluate where do we get the biggest bang for the bucks. Technically, this series of simulations is performed through a SAM multiplier model as a supply/output simulation caused by a shock in productivity. Output of the sector of interest (agriculture, industry, services) is maintained exogenous/fixed in its simulation on the sector. As a result, this gives us the possibility to conduct the experiment of a change in production of that sector.

Simulation results

The results for the shock on sectoral productivity are presented in Annex 4 (Table A4.1-A4.3). Overall, these tables reveal that the productivity change naturally benefits the

destination sector of the shock. Table A4.1 displays sectoral and aggregate GDP, and household effects of a productivity shock (0.5 percent of GDP) in agriculture. The highest GDP effect (1.4 percent) is obtained when the productivity in forestry is improved. This is an important sector since many other sectors such as construction, and export crops (for coffee and tea processing) heavily depend on it. Export crops, livestock, and fishing are the next agricultural subsectors with a highest GDP effect (1.2-1.3 percent) following a productivity shock. Finally, a productivity-led output shock in food crops yields the least GDP effect (0.8 percent) among agriculture subsectors. In short, a production increase in agriculture by 0.5 percent leads to GDP effects ranging from 0.8 percent to 1.4 percent. This indicates that increasing agricultural productivity could have poverty-reducing effects as a striking majority of the population depends on agriculture. The effects of these simulations on household aggregate income are also presented in Table A4.1. The pattern is similar to that of GDP effects. The household income effect ranges from 0.7 percent to 1.3 percent, with the highest impact coming from forestry, and export crops activities (1.3 percent), then livestock and fishing (1.1-1.2 percent) and food crops (0.7 percent).

The results of a productivity shock (0.5 percent of GDP) in the secondary sector are presented in Table A4.2. It reveals that an improved productivity in mining-energy will lead to the highest GDP impact (1.1 percent) among secondary subsectors. This is a quite interesting result given the role that energy plays in Burundi nowadays with the energy crisis, which adversely affected several sectors of activity and household welfare alike. Construction, textiles & leather, other manufacturing, and other food industry yield between 0.7-0.8 percent of GDP increase. Basic agro-processing (mostly washing stations and tea processing) productivity shock yields the least, although not negligible, GDP effect (0.5 percent). The effects on household income follow a similar patter as that on GDP effects.

Finally, Table A4.3 presents the results of a productivity shock (0.5 percent of GDP) in the tertiary sector (services). It shows that among sectors in the tertiary a productivity-led output increase in public administration services will yield 1.2 percent GDP increase compared to 0.5-0.8 percent for other services, commerce, and transport and communication. It is worth noting that the importance of public administration arises from the fact that the public sector in Burundi (as in many other African countries) plays a major role in economic activities. In fact, given the higher unemployment rate in these countries, the state carries a heavy burden of wage bill (about 12 percent of GDP for Burundi). This increase in productivity should be viewed as an increase in the provision of services such education (more teachers and schools), improved health centers and skilled health professionals, which have immediate consequences for other sectors and household welfare.

A comparison of the productivity shock result among the three sectors (primary, secondary, and tertiary) reveals that a productivity shock (0.5 percent of GDP) in agriculture leads to GDP effects ranging from 0.8 percent to 1.4 percent, whereas GDP effects from industry are between 0.5 percent and 1.1 percent. In addition, a similar shock in services yields an overall GDP effect hovering between 0.5 percent and 1.2 percent.

CONCLUSIONS

Drawing from the experiences of conflict affected countries, Burundi needs to enhance its productivity to improve economic prospects and reduce poverty. Given its limited resources, achieving higher growth requires addressing impediments to private sector growth, improving macroeconomic conditions and agricultural productivity, as well as strengthening public institutions. This paper examined Burundi's economic growth experience over 1970-2005. We combined the growth accounting decomposition exercise with regression analysis. The accounting approach enables us to obtain a decomposition of growth rates per worker into the contributions from the accumulation of capital and from increases in total factor productivity. The regressions enable us to analyze the determinants of TFP growth. We examined the roles of agricultural productivity, external and of macroeconomic and trade policies.

The accounting exercise provides some insights into the composition of growth in Burundi. Indeed, we find that capital accumulation plays an important but limited role in determining Burundi's economic growth. Our decomposition also shows that TFP has significant role in explaining the sources of growth. The differences in the overall growth rates across the past four decades are mainly explained by the differences in average productivity growth rates.

The regression results reveal that Burundi's overall economic performance is primarily determined by the TFP growth, which in turn is significantly affected by capital accumulation, political stability and quality of public institutions. The results also indicate strong correlation between agriculture productivity and TFP growth. Besides correlation analysis between TFP growth and agriculture productivity, we derived a simple model to examine the potential determinants of TFP growth, including indicators of institutional quality and government policies. The results strongly support the increasing consensus that macroeconomic stability accompanied with outward oriented trade policy is key for long term economic growth. Sustainable and competitive exchange rate, which reflects sound macroeconomic policy, enhances economic growth, and it operates primarily through increasing TFP growth. Inflation, which we included in the regression, as another macroeconomic policy indicator, reduces growth through its adverse effect on TFP growth. Outward looking policies, as proxied by trade flow and that may not adequately distinguish between trade and macroeconomic policies, also affect growth positively.

A further analysis was carried out using the social accounting matrix (SAM) that captures inter-sectoral growth linkages through a general equilibrium framework. Since the input-output (I-O) table is a bit old, we interpret the results with caution. Nevertheless, the findings confirm the importance of rural sector related activities (food crops, food industries, livestock, export crops, and fishing) as the key for sustained economic growth.

This study provides ample evidence that agriculture is crucial for long term growth in Burundi. Based on the findings of this study, it is essential to note that agricultural productivity is the determining factor to Burundi's overall economic performance. It is thus suggestive that economic policies need to be attuned to this sector to achieve medium to long term growth. Agriculture can play an important role in both social and economic development. The authorities also need to actively promote modern farming techniques and ensure smooth functioning of markets. Furthermore, macroeconomic stability plays important role as a foundation for growth through sustained private and public investment.

ANNEXES:

Annex 1: Sectoral contribution to GDP growth – Regression results

Dependent variable: GDP growth rate, 1972 - 2005

	Coefficient	standard error	t-student	prob value
Agriculture growth	0.47	0.05	9.62	0
Industry growth	0.21	0.04	6.01	0
Services growth	0.29	0.05	5.84	0
R^2	0.91			
Number of observations	34			
Number of parameters	3			
	value	probability		
Chow(1989:1)	0.95	0.54		
Chow(2002:1)	0.06	0.98		
normality test	0.74	0.69		
AR 1-4 test	5.26	0.003		
ARCH 1-4 test	0.58	0.68		
hetero test	2.79	0.83		

Test of linear restrictions I.e. the sum of coefficients add up to 1 was not rejected

Test for linear restrictions (Rb=r):
R matrix

Dag_g	DInd_g	DSer_g
1.0000	1.0000	1.0000

r vector

1.0000

LinRes Chi^2(1) = 0.286201 [0.5927]

Note:
Variables are all stationary. The dependent variable is the first difference of rate of growth of GDP at current US$. Explanatory variables are first difference of the growth rates of the value added (at current US$) of agriculture, industry and services sectors, respectively.

Annex 2: The Choice of the Elasticity of Capital per worker to Output

In the neo-classical Solow-Swan model, GDP is a function of capital stock, labor input and total factor productivity (TFP):

$$Y = A_0 e^{bt} K_t^{\alpha} L_t^{1-\alpha} \quad (1)$$

Where *t* is a time index, *Y* is real GDP, *K* is real physical capital stock, *L* is total employment, α is the contribution of capital to output, $1-\alpha$ is the contribution of labor, and $A_0 e^{bt}$ represents TFP, which is a function that involves diminishing returns to capital and labor. Capital includes physical capital and, in several models, human capital; here, due to data limitations, we ignored the latter. TFP includes the technological, organizational, demographic, cultural and political factors that determine how well capital and labor interact to produce output (Kata, 2004). TFP measures the shift in the production function at given levels of primary inputs, and A_0 is assumed to grow at a rate *b*. Taking the logarithms of equation (1) after dividing it through by labor (*L*) yields

$$y = a + bt + \alpha k_t \quad (2)$$

where *y* and *k* denote the natural logarithms of output and physical capital (both per worker). a is the natural logarithm of A_0. If we assume A_0 to be 1 in the initial period, the estimating equation will be based only on the growth rate of TFP and of capital accumulation.

Following the estimation of Equation (2) above, growth in output per worker (g_y) can be decomposed as follows:

$$G_y = \alpha G_k + G_a \quad , \quad (3)$$

where G_y = growth in y $(=Y/L)$, G_k = growth in k $(=K/L)$, G_a = *TFP* growth, and α is the share of capital accumulation in income estimated from Equation (2).

According to Equation (3), there are only two sources of growth in output per worker (G_y): (*i*) contribution of growth in capital per worker [αG_k], and (a) contribution of growth in TFP [G_a]. TFP growth (G_a) is calculated as a (Solow) residual from Equation (3) as follows:

$$G_a = G_y - \alpha G_k \quad (4)$$

Stationary tests

We begin our empirical analysis by determining the time series properties of all variables using the augmented-Dickey-Fuller (ADF) test. To estimate the production function, both capital and output (per worker) were found to be nonstationary, with trend and without. We then transformed each variable into first differences and retested the stationarity hypothesis which was not rejected. This time, they were stationary. We can conclude that both series are nonstationary and integrated of the order 1 (I(1)).

Cointegration test

To estimate the elasticity of output per worker with respect to physical capital per worker, we use the standard Johansen's cointegration procedure to a first order vector

autoregression (VAR(1))[12] to test for cointegration between output and physical capital (per worker). The results are presented below in Table 3. Both the maximal and trace eigenvalue statistics reject the null hypothesis of no cointegrating vector but did not reject that of one cointegrating vector. The existence of a cointegrating vector suggests that output per worker and capital labor ratio (both nonstationary) move together in the long run. One advantage of the Johansen's procedure for our purpose of estimation of the output per worker capital per worker elasticity, in addition to the treatment of nonstationary data, is that it makes no *a priori* assumption on the exogeneity of physical capital per worker. The stable long-run relationship between output and physical capital is therefore given by:

OUTPUT PER WORKER = 0.34*PHYSICAL CAPITAL PER WORKER - 0.022*TREND (5)

The estimated elasticity of output with respect to capital is significant and of the expected positive sign (see Table A1 below). The coefficient on the trend term is negative; suggesting that total factor productivity (TFP) was on average negative over the sample period. The estimated output per worker-capital labor elasticity of 0.34, is in the range of other cross-countries sources of growth studies on African countries (0.2-0.5)[13]. The Johansen's co-integration procedure also estimates the speed of adjustment of the economy following a temporary disequilibrium. This coefficient is negative at about 5 percent, indicating a fairly slow adjustment to any transitional disequilibrium.

Table A1. Cointegration Analysis of Production Function

Eigenvalues	0.70	0.06	…
Hypotheses	r=0	r<=1	…
Lambda trace	52.51**	2.93	
Lamda max	50.12**	2.79	
Unrestricted vector	Standardized eigenvectors		
	Output per worker	Capital labor ratio	trend
	1.000	-0.343	0.022
	Standardized adjustment coefficients		
	Output per worker	Capital labor ratio	trend
	-0.0535	0.106	…

Source: World Bank staff estimates
Note: Estimation period is 1962-2005.The VAR includes 1 lag on each variable, a constant and a trend term.

[12] We used a lag length of 1 due to the relatively short data length.
[13] Nachega & Fontaine (2006) found 0.36 for Niger; Sarcedoti et al (1998) found a value of 0.35 for West African countries; Meanwhile, Senhadji (2000) estimated an elasticity of 0.43 for sub-Saharan Africa and Bosworth et al (1995) a coefficient of 0.4 for developing countries.

Annex 3: Description and Estimation of the Determinants of Economic Efficiency (TFP)

A. Description of Variables

1. Sectoral efficiency: the Importance of agriculture productivity

As discussed earlier, agriculture productivity is crucial for economic growth. Moreover, there is a strong correlation between agriculture productivity growth and TFP growth. We, therefore, expect its coefficient to be positive in the TFP regression.

2. Structural policies and institutions: The first component of this category is Trade openness. A number of studies, both and empirical and theoretical, have shown that trade affects economic growth through five channels[14]: (i) trade leads to higher specialization and therefore to total factor productivity (TFP) gains, as countries exploit their areas of comparative advantage; (ii) trade exploits potential markets, thus allowing domestic firms to take advantage of economies of scale, therefore leading to an increase of their TFP; (iii) thanks to trade technological innovations and improved managerial practices are transferred to domestic firms through stronger interactions with foreign firms and markets; (iv) free trade leads to reduce anticompetitive methods of local firms; and (v) trade liberalization tends to lessen the incentives for unproductive rent-seeking behavior of firms. In our empirical model, openness is proxied by the ratio of sum of total exports and imports to GDP. As was predicted by the bulk of the empirical literature, we expect the sign of the coefficient of trade openness to be positive in the TFP regression. Finally, it is worth noting that there is a positive correlation between trade and TFP growth,[15] as pointed out Easterly (2005), this could be an indication of the pro-cyclicality of international trade, as opposed to suggesting any causal effect of openness on growth.

3. Political stability is the second component of this category of policy variables. Political instability undermines economic growth by disturbing the business environment and economic activity. This, in turn, leads to economic uncertainty and therefore decreased investment incentives. We hypothesize that during a period of civil strife institutional capacities are severely hampered. In fact, the respect for civil and political rights, bureaucratic efficiency, absence of corruption, enforcement of contractual agreements, and prevalence of law and order, which are factors for good institutional quality of government could be seriously violated. In our regression analysis, we used a dummy variable (WAR) which takes the value of one during the 1987-99 period and zero otherwise. We chose a longer period to capture key political events in Burundi, including ethnic massacres of 1987, the coup of 1993 and massacres and war that followed afterwards.[16].

4. An important area of economic policy is related to financial depth. Well-functioning financial systems promote long-run growth. They influence economic efficiency and economic growth through various channels. Financial markets facilitate risk diversification by trading, pooling, and hedging financial instruments. They can help identify profitable investments and mobilize savings to them. Several studies have

[14] Loayza and Soto (2002). See also Lederman (1996)
[15] The coefficient of correlation is 0.25.
[16] Regional economic embargo was lifted in 1999.

provided empirical evidence of the positive effects of financial development and economic growth (see Levine 1997)[17]. Our measure of financial depth is the private domestic credit provided by private financial institutions as a share of total domestic credit. Alternatively, in one regression specification we used the ratio of private domestic credit provided by private financial institutions to GDP. The former offers the advantage of being less correlated with another explanatory variable (aid) as opposed to the latter.[18]

5. Stabilization policies: Macroeconomic stabilization has an impact on the long-run performance of the economy (Fischer, 1993). Fiscal, monetary, and financial policies that contribute to a stable macroeconomic environment and prevent financial and balance of payments crises are therefore important for long run growth. Moreover, a stable macroeconomic environment is the foundation for the efficient working of a market economy. According to Barro (1995), high and volatile inflation undermines growth by reducing long-term investment and the productivity of capital (Nachega & Fontaine, 2006). It has been estimated that for countries with inflation exceeding 15 percent, a 10 percent increase in inflation will cause a fall in annual GDP growth (0.2-0.3 percent) and in investment rate (0.4-0.6 percent) (Barro, 1995)). We used the consumer price index (CPI) inflation (lack of price stability) as an appropriate proxy for macroeconomic stabilization. In fact, it is a good summary measure of the quality of fiscal and monetary policies. The inflation rate is the indicator of macroeconomic stability in many cross-country growth regressions, including Fischer (1993), Easterly, Loayza, and Montiel (1997), and Barro (2001). This determinant should therefore affect TFP growth negatively.

6. External imbalances can affect economic growth. For instance following an appreciation of the real exchange rate real exports become less competitive versus their import counterparts, which leads to a decline in exports and an increase in imports that a leakage for the economy and therefore affecting economic growth. Overvalued exchange rate is the result of monetary and exchange rate policies that distort the allocation of resources between export and domestic sectors in an economy. Such a misallocation could lead to large imbalances whose correction generally leads to balance of payments crisis followed by sharp recessions (Loayza and Soto 2002). We used the IMF real effective exchange rate (REER) index (2000=100) to capture this effect. One should expect its sign to be positive in the TFP growth regression. In other regression specifications (2-5), we introduced a dummy to capture expansionary (devaluation) exchange rate policies. In fact, the exchange rate dummy takes the value of one when REER is above 100 and zero otherwise. We interpret this as devaluation since more than one unit of local currency is now required to acquire a unit of foreign currency. The introduction of this variable seems to correct the potential collinearity between inflation and REER as expressed by a correlation coefficient of 0.5 (See Table A3.1). Obviously, we expect the coefficient of the exchange rate devaluation dummy to positively affect TFP growth.

External factors: Foreign aid could be inductive to growth if it serves to finance investment rather than consumption. Additionally, investment financed through foreign aid may raise TFP by reducing the pressure on the domestic tax base, preventing costly

[17] Levine (1997) provides a review of the theoretical foundations of the role of financial development as well as a summary of the available macro- and microeconomic empirical evidence.

[18] Correlation coefficients between aid and the ratio of private domestic credit provided by private financial institutions to total domestic credit is 0.3 compared to 0.1 for that for the ratio of private domestic credit provided by private financial institutions to GDP.

distortions, in financing infrastructure projects (e.g., roads) and investment in human capital (education or basic health care), for which the private rate of return is generally lower than the social rate of return (Nachega & Fontaine 2006)). We used the ratio of official development assistance to Gross Capital Formation (GCF), as a proxy of foreign aid in the TFP regression, and one should expect its coefficient to be positive in the regression.

B. Estimation Methodology

7. We estimated a simple model of TFP growth. Our sample is dictated by the availability of data and spanned the years 1970-2005. Before the regression tests, the properties of the data were examined to avoid the spurious regression problem that arises when statistical inferences are drawn from nonstationary time series. Consequently, all the variables included in the regressions need to be stationary in order to prevent spurious regression results. Unit root tests revealed that aid, openness, real effective exchange rate, and both financial depth variables were nonstationary, whereas inflation, TFP growth, and the share of agriculture productivity were stationary. These variables are therefore included in the regressions in first differences to ensure stationarity, except for the real effective exchange rate for which second differences were required. Table A3.1 shows there is no potential of severe multicollinearity as binary correlation coefficients are below 0.4.

The empirical model to be estimated is:

$$TFP = a0 + a1\ AGPROD\ (t) + a2\ AIDGCF\ (t) + a3\ OPENES\ (t) + a4\ INFLAT\ (t) + a5\ EXCHPO\ (t) + a6\ WARDUM + a7\ FINDEP\ (t) + \varepsilon\ (t) \quad (1)$$

8. Where TFP represents total factor productivity (TFP) growth; AGPROD is the partial productivity of agriculture measured by the real agriculture value added per worker; AIDGCF represents foreign aid as a share of gross capital formation; OPENES is international trade openness; INFLAT denotes CPI inflation; EXCHPO represents exchange rate policy variables proxied by the real effective exchange rate, and alternatively by the exchange rate devaluation dummy, which takes the value of 1 when REER exceeds 100 and 0 otherwise; WARDUM is the dummy that captures political instability (1987-99) in Burundi; and finally, FINDEP represents financial depth proxied by the private domestic credit provided by private financial institutions as a share of total domestic credit and the ratio of private domestic credit provided by private financial institutions to GDP.

Table A3.1: Correlation matrix of variables in the regression, 1978-2005

		1	2	3	4	5	6	7	8	9	10
1	TFP growth	1.0									
2	Agriculture productivity	0.7	1.0								
3	Aid (% GCF)	0.3	-0.2	1.0							
4	Openness	0.2	-0.1	0.5	1.0						
5	Inflation	-0.3	-0.1	-0.4	0.0	1.0					
6	Real Effective Exchange Rate	0.2	0.1	-0.1	0.0	0.4	1.0				
7	Exchange rate valuation dummy	0.2	0.1	-0.4	-0.2	0.2	0.1	1.0			
8	War dummy (1987-99)	-0.1	-0.1	-0.1	-0.2	0.0	0.0	-0.1	1.0		
9	Credit to private sector (% total domestic credit)	0.2	0.2	0.1	0.3	-0.3	0.2	-0.4	0.3	1.0	
10	Credit to the priv. sector (%GDP)	0.2	0.2	0.3	-0.1	-0.1	0.2	-0.3	-0.1	0.2	1.0

Source: World Bank staff estimates

Table A3.2: Determinants of TFP growth: Regression Analysis Results

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	-0.36	-2.21	-2.17	-2.88	-2.70	-2.45
	(0.79)	(1.03)**	(1.19)***	(1.17)**	(1.25)**	(1.23)***
Agriculture productivity	0.58	0.62	0.62	0.59	0.57	0.59
	(0.09)*	(0.09)*	(0.10)*	(0.10)*	(0.10)*	(0.10)*
Aid (%Investment)	0.01	0.01	0.01	0.02	0.02	0.01
	(0.01)***	(0.01)**	(0.01)***	(0.01)**	(0.01)**	(0.01)
Openness	0.17	0.29	0.28	0.23	0.21	0.32
	(0.10)****	(0.10)*	(0.11)**	(0.11)***	(0.12)***	(0.12)*
Inflation	-0.09	-0.11	-0.11	-0.08	-0.08	-0.11
	(0.05)****	(0.05)***	(0.05)***	(0.05)****	(0.06)	(0.05)**
Real effective exchange rate	0.04					
	(0.03)****					
Exchange rate valuation		3.67	3.66	4.13	4.11	3.89
		(1.09)*	(1.13)*	(1.15)*	(1.17)*	(1.16)*
War dummy (1987-99)			-0.06		-0.47	0.04
			(0.98)		(1.02)	(0.99)
Credit to private sector(% total domestic credit)				0.0724	0.08	
				(0.06)	(0.06)	
Credit to the private sector (%GDP)						0.20
						(0.22)
R^2	0.77	0.78	0.78	0.79	0.80	0.79
Adjusted R^2	0.71	0.73	0.72	0.74	0.73	0.72
Number of observations	28	28	28	28	28	28
Number of parameters	6	6	7	7	8	8
Diagnostic tests						
Chow(1990:1)	5.02**	0.52	0.46	1.33	1.28	0.38
	(0.02)	(0.86)		(0.35)	(0.39)	(0.94)
Chow(2001:1)	0.10	0.14	0.14	0.48	0.37	0.09
	(0.91)	(0.87)		(0.63)	(0.69)	(0.91)
Normality	4.81	1.76	1.72	0.43	0.52	1.95
	(0.09)	(0.41)		(0.80)	(0.77)	(0.38)
AR 1-4	1.13	0.21	0.20	0.04	0.01	0.26
	(0.38)	(0.93)		(0.1)	(0.1)	(0.90)
ARCH 1-4	0.09	0.84	0.78	0.98	0.90	0.87
	(0.98)	(0.52)		(0.45)	(0.5)	(0.51)
Hetero	8.59	7.91	10.68	13.65	16.59	10.27
	(0.57)	(0.54)		(0.25)	(0.17)	(0.59)

Source: World Bank staff estimates

Note. (*) significant at the 1 percent level; (**) significant at the 5 percent level; (***) significant at the 10 percent level; (****) significant at 11-14 percent level.

Annex 4: Economy-wide Effects of Sectoral Productivity Shocks

Table A4.1: Simulation results-Productivity shock in the primary sector

	Productivity shock simulations				
Sectoral GDP effects	Food crops	Export crops	Livestock	Fishing	Forestry
Food crops	1.4	1.2	1.1	1.2	1.3
Export crops	0.0	16.7	0.0	0.0	0.0
Livestock	0.7	1.2	6.8	1.2	1.3
Fishing	0.6	1.1	0.9	52.9	1.1
Forestry	0.5	1.0	0.9	0.9	17.4
Basic Agricultural Processing	0.0	0.0	0.0	0.0	0.0
Other Food industries	0.6	1.1	1.0	1.1	1.2
Textiles and leather products	0.4	0.8	0.7	0.7	0.8
Mining, quarrying and energy	0.4	0.7	0.6	0.7	0.7
Other manufacturing and handicrafts	0.4	0.6	0.6	0.7	0.7
Construction	0.0	0.0	0.0	0.0	0.0
Transport and Communication	0.5	0.9	0.8	0.8	0.9
Wholesale and Retail Trade	0.6	1.1	0.9	1.0	1.1
Other Marketable services	0.5	0.8	0.7	0.8	0.9
Public Administration & non-marketable services	0.0	0.1	0.1	0.1	0.1
Overall GDP effects	0.8	1.3	1.2	1.3	1.4
Household income effects	0.7	1.3	1.1	1.2	1.3

Source: SAM multiplier model based on Burundi 2004 single household (quasi-) SAM using SAMSIP-SAM software

Table A4.2: Simulation results-Productivity shock in secondary sector

	Productivity shock simulations					
Sectoral GDP effects	Basic agro-processing	Other Food industry	Textiles	Mining-Energy	Other manufacturing	Construction
Food crops	0.4	1.0	0.6	0.9	0.6	0.7
Export crops	0.0	0.0	0.0	0.0	0.0	0.0
Livestock	0.4	0.9	0.6	0.9	0.6	0.7
Fishing	0.4	0.6	0.6	0.8	0.6	0.6
Forestry	0.5	0.5	0.5	0.8	1.0	1.3
Basic Agricultural Processing	6.2	0.0	0.4	0.0	0.0	0.0
Other Food industries	0.4	1.8	0.6	0.9	0.6	0.6
Textiles and leather products	0.4	0.4	14.1	0.6	0.4	0.5
Mining, quarrying and energy	1.5	0.4	1.5	48.7	0.4	0.5
Other manufacturing and handicrafts	0.3	0.4	0.4	0.5	7.3	2.5
Construction	0.0	0.0	0.0	0.1	0.0	4.8
Transport and Communication	0.6	0.5	0.6	1.0	0.6	1.1
Wholesale and Retail Trade	0.7	0.6	0.9	1.1	0.6	0.7
Other Marketable services	0.4	0.5	0.5	0.9	0.5	0.5
Public Administration & non-marketable services	0.0	0.0	0.0	0.0	0.0	0.0
GDP effects	0.5	0.7	0.8	1.1	0.7	0.8
Household income effects	0.5	0.7	0.7	1.0	0.7	0.7

Source: SAM multiplier model based on Burundi 2004 single household (quasi-) SAM using SAMSIP-SAM software

Table A4.3: Simulation results-Productivity shock in the tertiary sector

	Productivity shock simulations			
Sectoral GDP effects	Transport & communication	Commerce	Other marketable services	Public administration
Food crops	0.4	0.5	0.7	1.1
Export crops	0.0	0.0	0.0	0.0
Livestock	0.4	0.5	0.7	1.1
Fishing	0.4	0.5	0.8	1.1
Forestry	0.4	0.4	0.6	0.9
Basic Agricultural Processing	0.0	0.0	0.0	0.0
Other Food industries	0.4	0.5	0.7	1.1
Textiles and leather products	0.3	0.3	0.4	0.7
Mining, quarrying and energy	0.3	0.5	0.5	0.7
Other manufacturing and handicrafts	0.6	0.4	0.4	0.6
Construction	0.0	0.0	0.0	0.0
Transport and Communication	7.8	1.1	0.6	0.8
Wholesale and Retail Trade	0.6	2.1	0.6	1.0
Other Marketable services	0.3	0.4	3.0	0.8
Public Administration & non-marketable services	0.0	0.0	0.0	4.0
GDP effects	0.5	0.7	0.8	1.2
Household income effects	0.4	0.5	0.7	1.1

Source: SAM multiplier model based on Burundi 2004 single household (quasi-) SAM using SAMSIP-SAM software

References

Barro, R. (1995) *Economic Growth.* McGraw-Hill.
Barro, R. (1996) "Determinants of Economic Growth: A Cross-Country Empirical Study," Cambridge, MA: MIT Press.
Barro, R. (2001) "Economic Growth in East Asia before and after the Financial Crises." *Working paper W8330*. Cambridge, Mass.: National Bureau of Economic Research.

Beyer, H. and R. Vergara (2002) " Productivity and Economic Growth: The Case of Chile" in *Economic Growth: sources, trends and cycles* (2002), Loayza and Soto (Eds), Santiago, Chile.
Bosworth, B.S., S. Collins, and Y. Chen (1995) "Accounting for Differences in Economic Growth." Paper prepared for a conference on "Structural Adjustment Policies in the 1990s: Experience and Prospects." Nov. 5-6, Tokyo, Japan.
Dollar, D. (1992) "Outward-Oriented Developing Economies Really Do Grow More Rapidly: Evidence from 95 LDCs, 1976-1985." *Economic Development and Cultural Change* 40(3): 523-44.
Easterly. W, N. Loayza, and P. Montiel (1997) "Has latin America's Post-Reform Growth Been Disappointing?" *Journal of International Economics* 43(3-4): 287-311.
Easterly, W. (2005) "National Policies and Economic Growth: A Reappraisal," in *Handbook of Economic Growth* (1A) P. Aghion and S. Durlauf (Eds), Elsevier.
Elbadawi, A. and B. J. Ndulu (1996) "Long-run Development and Sustainable Growth in Sub-Saharan Africa," in *New Directions in Development Economics: Growth, Environmental Concerns and Governments in the 1990s* (London: Routledge).
Fischer, S. (1993) "The Role of Macroeconomic Factors in Growth," *Journal of Monetary Economics* 32: 485-512.
Ghura, D. and M.T. Hadjimichael (1996) "Growth in Sub-Saharan Africa," *IMF Staff* Papers 43 (3): 605-34.
IMF (2006) "Burundi - Selected Issues and Statistical Appendix"**,** prepared by a staff team comprising Paul Mathieu (head), Alvaro Manoel, Olivier Basdevant, and Issouf Samaké (June).
Kata, E (2004) "Total Factor Productivity" Mimeo. Institute of International Economics, Washington, DC.
Lederman, D. (1996) "The Sources of Economic Growth: A Survey from a Latin America Perspective," Washington: World Bank, Office of the Chief Economist of Latin America and the Caribbean Region. Mimeo.
Levine, R. (1997) "Financial Development and Economic Growth: Views and Agenda." *Journal of Economic Literature* 35(2): 688-726.
Levine, R., N. Loayza, and T. Beck (2000) "Financial Intermediation and Growth: Causality and causes." *Journal of Monetary Economics* 46(1): 31-77.
Loayza, N and R. Soto (2002) "The Sources of Economic Growth; An Overview." in "Economic Growth: sources, trends and cycles" (2002), Loayza, N. and R. Soto (Eds), Santiago, Chile.
Nachega, J-C, and T. Fontaine "Economic Growth and Total Factor Productivity in Niger." *IMF Working Paper* 06/208 (Washington, D.C.).
Patillo, C., S. Gupta, and K. Carey (2005) "Sustaining and Accelerating Pro-Poor Growth in Africa" IMF, Mimeo.

Sachs, J. and A. Warner (1997) "Sources of Slow Growth in African Economies," *Journal of African Economies* 6(3): 335-76.
Sarcedoti, E., S. Brunschwig, and J. Tang (1998) "The Impact of Human Capital on Growth: Evidence From West Africa." *IMF Working Paper* 98/162 (Washington, D.C.)
Senhadji, A. (2000) "Sources of Economic Growth: An Extensive Growth Accounting Exercise," *IMF Staff Papers*, 47: 129-58.
World Bank (2010), Republic of Burundi: Country Economic Memorandum. Washington, D.C.
World Bank (2011), *Policy Note:* Putting Burundi on a High Growth Path for Poverty Reduction. Washington, D.C.