Economic Convergence for Developing And Developed Countries: A Cointegrated Time Series Data Analysis Comparison For Rwanda And Japan From 1970 To 2013

Jean Niyigaba[1]

Abstract

The main aim of this research is to examine the economic growth of developing and developed countries and see if those categories will converge economically by comparing the per capita growth models for the developed with developing countries. To realize this catch up event, assume that the economic growth rates in developing countries are on average higher than those in developed countries as most of the developing countries still having in abundance natural resources and many economic areas to be exploited. We compare the economic growth of Rwanda and Japan which are developing and developed countries respectively, having a similar history leading them to the catastrophic fall down of their national economies (for the Rwanda civil war and the genocide of 1994 and for Japan, the second World War and the effects of the atomic bombs launched at Nagasaki and Hiroshima in 1945). We use GDP per capita(Y1) in the model depending on Consumption (X1), Gross capital formation(X2), Exports of goods and services(X3) and imports of goods and services (X4) from 1970 to 2013). By Johansen Cointegration approach, we verify the long run correlation and goodness of the models. Findings reveal that all independents variables in the study contribute significantly to the per capita of those countries, but the potentiality of each counties category are different as for the developing countries the most contributors is a negative contributor to per capita where in the developed countries the most contributor is the positive one. The study concludes that, however GDP per capita growth rate in developing countries is on average higher than those in developed countries considering their opportunities, it can take a long time for poor countries to catch up with the rich even never as those poor countries also will arrive at a point where their economy will growth at a low rate as the developed countries. We recommend to developing countries, to reduce the importation of goods and services as a said negative contributor to the per capita, encourage local products consumption, empowerment of the Gross capital formation to encourage production beyond domestic consumption for all products and expand the growth of other sectors that are useful in accelerating the economy. For developed countries, however the most contributor is a positive to the per capita, this most contributor is the consumption, this imply that they consume a greatest part of their production. We recommend to the developed countries, to reduce the consumption and exports goods at low prices. Those will promote the situation convergence. Otherwise it can't be realized soon with the normal situation.

Keywords: Gross Domestic Product per capita, economic growth, Consumption, Gross capital formation, Exports of goods and services and imports of goods and services

[1] Huazhong University Of Science And Technology (Hust), Wuhan-China

ABBREVIATIONS AND ACRONYMS USED

ACET : African Centre for Economic Transformation
ADF : Augmented Dickey Fuller
BNR : National Bank of Rwanda
CES : Current Employment Statistics
CPI : Consumer Price Index
EDPRS : Economic Development and Poverty Reduction Strategy
EICV : Enquête Intégrale sur les Conditions de Vie des ménages
FDI : Foreign Direct Investment
GDP : Gross Domestic Product
GoR : Government of Rwanda
HDI : Human Development Index
HIPC : Heavily indebted poor countries
IPAR : Institute of Policy Analysis and Research Rwanda
MEDC : More Economically Developed Country
MINAGRI : Ministry of Agriculture
MINECOFIN : Ministry of Finance and Economic Planning
MINICOM : Ministry of Commerce and Industries
NISR : National Institute of Statistics of Rwanda
PPI : Producer Price Index
PPP : Purchasing power parity
ULK : Université Libre de Kigali
UN/DESA : United Nation Department of Economic Statistics administration
UNCTD : United Nations Conference on Trade and Development
UNDP : United Nation Development Program
VAR : Vector Auto-regression
VECM : Vector Error correction model

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INTRODUCTION

1.1. Background

During recent decades the world has been characterized by increasing interdependence of national economies and of the international scope of markets, distribution systems, capital, labour, and technology. This trend towards globalization has been manifested in the sustained growth of world trade and flows of investment and technology as well as in the convergence of national economic and social systems. For most regions, this growing integration has led to rapidly increasing per capita incomes, while Developing countries has stagnated at the income level achieved since past decades ago.

Rwanda and Japan are two independent countries developing African landlocked and developed Asian coastal countries respectively.

Despite the economic difference these two countries have had a similar history in the nineteenth century led them to the catastrophic fall of their national economies (for the Rwanda civil war and the genocide of 1994 and for Japan, the second World War and the effects of the atomic bombs launched at Nagasaki and Hiroshima in 1945).

These tragedies for these two countries had the tendency to bring their economic power at the beginning, where comes our choice of comparing their economic emergence in this project.

Comparing Rwanda and Japan two independent countries developing African landlocked and developed Asian coastal countries respectively, the question posed in this paper is whether developing countries can link up with the developed countries and start a catch-up process, or whether marginalization is inevitable. The research is structured as follows:

The first significant area of research in economics is trying to comprehend the factors that contribute to economic growth and political change and how this affects the economic rise or decline of nations. The second looks at whether developing countries economic growths have barriers for catchment with the developed. Finally discusses the way forward for developing countries to catch up with the developed.

1.1.1. Rwanda

Rwanda is a landlocked country situated in Central East Africa covering 26,338 square Kilometers with 25,000 square kilometers of land and 1,338 square kilometers of water. Also known as 'the land of a thousand hills', Rwanda has five volcanoes, twenty-three lakes and numerous rivers, some forming the source of the River Nile. The country lies 75 miles south of the equator in the Tropic of Capricorn, 880 miles 'as the crow flies' west of the Indian Ocean and 1,250 miles east of the Atlantic Ocean - literally in the heart of Africa. Rwanda is bordered by Uganda to the north, Tanzania to the east, Burundi to the south and the democratic republic of Congo to the west.

Land area: 26,338 square Kilometers.

The Rwandan Population is around 10,515,973 according to new census carried out in August 2012.

Capital: Kigali, Dialing code: +250, Currency: Franc rwandais

1.1.1.1. Economic Situation

According to the report published by Institute of Policy Analysis and Research Rwanda (IPAR) (Malunda, 2012), Rwanda's economic growth over the last decade has been remarkable. With a government that is committed to achieving sustainable economic growth coupled with growth in employment opportunities for its people, Rwanda has made impressive progress in rehabilitating and stabilizing its economy to exceed pre-1994 levels. The overall economy is growing at a significant rate. The average annual growth rated in GDP was 8.8 per cent between 2005 and 2012. Rwanda's GDP per capita has increased from less than 200US$ in 1994 to 540 US$ in 2010.Although still at an early stage, the Government of Rwanda has set a set path towards economic transformation which shows signs of economic transformation in Rwanda.

There is evidence of a significant increase in private sector investment following the introduction of a revised tax code and implementation of the doing business reforms since 2005 although there was a downturn due to the World economic crisis in 2009. Both foreign and domestic investments have increased with FDI exceeding local investment and new jobs have been created. Exports have increased and there is some evidence of a beginning of export diversification into areas prioritized by government as well as an increase in revenues from tourism. However, imports have also increased and so the balance of trade has worsened.

Although GDP per capita and government revenues as a proportion of GDP have increased, Rwanda remains dependent on Overseas Development Assistance for about 40% of its annual budget. Another evidence of Rwanda's emerging economic transformation is significant shift with respect to productivity is that agriculture is breaking out of its long standing stagnation. There is an incipient structural shift in the mode of production away from low-productivity subsistence farming to a higher degree of market-orientation and more use of soil-enriching and yield-enhancing cash inputs. Such a transformation is fundamental for a dynamic and sustainable development and economic transformation. The pace of agricultural transformation is important, as will measures to ensure that not only the large and medium sized farms, but also small-holders are be able take part in and benefit from this structural change.

Substantial increases in production and yields in recent years are evidence of the high dividends of this structural change.

Another sign of Rwanda's economic transformation is that development of the non-agricultural sectors of the economy has clearly begun. So far, this has been dominated by a proliferation of small scale business and activities operating on an informal or semi-informal basis. The magnitude of this phenomenon over the past few years has been large enough to make non-agricultural entrepreneurship and wage employment a major source of new employment and income opportunities and to have quite a significant impact on the structural pattern and pace of economic growth. According to the 2011 Integrated Household Living Conditions Survey 3 (EICV 3) results, the majority of Rwandese (62%) work in their main job on their own farm, but this is changing fast in the 10 years between EICV1 and EICV3, waged employment on farms grew by 14% per year, waged employment in non-farm establishments grew by 12% per year, and non-farm self-employment grew by 14% per year. Farm self-employment by contrast stagnated and remained at a similar level of around 3 million people despite rapid population growth. During the period from 2005/06 to 2010/11, the growth rates for non-farm waged jobs remained constant, but the growth rates for waged farm work slowed to 7% while the growth rate for those working in their own independent businesses also slowed to 7% ((NISR), 2011). It is important that this development continues, and that the business climate evolves so that the many new small-scale businesses are able to grow and increase demand for non-farm labor. This will enhance long term economic transformation in Rwanda.

Rwanda's economy is agrarian. Agriculture employs almost 80 percent of the population (UNDP, 2007); accounting around 40 percent of gross domestic product and more than 70 percent of exports (Unit, 2006). Apart from unexploited gas reserves beneath Lake Kivu,

Rwanda is poorly endowed with mineral resources. Subsistence food production is the dominant activity in the agriculture sector. Production of coffee and tea for export is still modest.

The service sector contributes approximately 39 percent of GDP and employs roughly 6.5 percent of the working population. Within this sector, wholesale and retail trade as well as public administration account for approximately 50 percent of services. The economic contribution of tourism, while growing rapidly, remains marginal

The industrial sector makes up 20 percent of the GDP and employs slightly less than 2 percent of the working population. Manufacturing constitutes the most important source of industrial activity, accounting for almost 12 percent of GDP while construction accounts for another 8 percent.The percentage of Rwandans living in poverty has decreased from 60.4 percent in 2000-2001 to 56.9 percent in 2005-2006. As a result of the country's high population growth rate, this progress has been overshadowed by an increase in the absolute number of people living in poverty, increasing from 4.8 million to 5.4 million persons during the same period. Poverty in Rwanda is mainly a rural phenomenon: while the population is 83 percent rural, 92 percent of the poor live in rural areas. There are also significant inequalities within and between rural and urban provinces.

Rwanda has implemented a number of policies to shape its economic transformation agenda and these policies continue to evolve depending on changing needs of the economy. Rwanda's vision is to build a knowledge-based economy and to become a private sector led middle income country by 2020.

Rwanda's ambitious programme for development is encapsulated in Vision 2020. The Economic Development and Poverty Reduction Strategy (EDPRS) is the mid-term framework to implement the Government's long-term development agenda (Ministry of Finance and Economic Planning 2007).

The EDPRS is based on three pillars designed to accelerate economic growth and promote human development:

1. Sustainable growth for jobs and exports - investing in improving the climate for business investment, thereby achieving private-sector growth. In the shorter term the priority is reinforcing the productive and export potential of the agricultural sector, but in the longer term the goal is to diversify the economy by promoting the non-farm sector.

2. Vision 2020 Umurenge is a pro-poor rural development and social protection programme. It aims to eliminate extreme poverty by 2020 through releasing the productive capacity of the very poor. It includes public works, credit packages and direct support and is implemented at village level using participatory methods;

3. Good economic governance is seen as a precondition for poverty reduction and development by creating a comparative advantage in 'soft infrastructure' (good governance and institutional arrangements important for private investors) thus compensating for Rwanda's relatively poorly developed hard infrastructure and disadvantaged geographical location. ((MINECOFIN), 2013)

Rwanda takes a developmental state approach with the key objective being sustainable economic growth and social development. The main aim of EDPRS was to overcome the key constraints to economic growth identified through a growth diagnostic and investment climate analysis by: systematically reducing the operating costs of business; investing in the private sector's capacity to innovate; and, widening and strengthening the public sector. Government policy is to promote private sector investment through good governance, a legal framework, promoting savings and the banking sector and investment in infrastructure, health and education including vocational training. The aim is to: create new jobs to absorb new entrants to the labor market and surplus labor created by the modernization of farming; facilitate technology transfer; the transfer of skills to Rwandan; an increase in the production of goods and services for export; and, generally promote economic growth. Public investment is targeted to induce substantial private sector investment and foster growth in agriculture, manufacturing and the service sector. Investment is targeted at developing skill and capacity for productive employment, improving the infrastructure, promoting science technology and innovation and strengthening the Financial Sector. Reforms to the 'soft' infrastructure for business and reducing business costs were seen as the first priority. Incentives for FDI including export processing zones and industrial parks were seen as an important element of the strategy. Partnership of FDIs with Rwandan companies was to be encouraged and stimulating domestic investment was also seen as integral element of the policy. Diversifying and increasing exports was also seen as central to the strategy and the Government has identified the main areas for export growth, beyond the strategic exports of tea, coffee, horticulture, hides and skins and minerals. These are tourism, mining services, business process outsourcing, silk textiles, fruit and vegetable processing and dairy processing. ((MINICOM), 2009).

FDI was seen as bring a number of benefits beyond job creation including the investment of foreign capital, know-how and managerial skills and export promotion. FDI as well as local investment was to be encouraged in resource based manufacturing (e.g. tea and coffee), low technology products (e.g. footwear, textiles), high technology manufacturing (e.g. chemicals, ICT, pharmaceuticals) and services including tourism where there is seen to be a high potential for growth.

The 2010 Development Driven Trade Policy Framework prepared by the and the Ministry of Trade and Industry ((UNCTD), 2010) argues that the trade policy should be development-driven and not demand led. It suggests that investment, including FDI, should enable the diversification of exports and markets, build local processing industries that add value to exports especially in agriculture but also in manufacturing and services. Also investment should provide opportunities for employment in rural areas. It argues that tax reductions/exemptions in terms of tariffs should promote the inflow of industrial inputs and that consideration should be given to more strategically located export processing zones with more effective incentives provided.

Generally it advocates making the financial regime effective and well administered. It recommends making financial incentives outcome based, targeted to development goals and designed to minimize the impact of taxation on companies 'cash-flow' (UNCTD, 2006).

Rwanda's agricultural policy is embodied in Rwanda's Strategic Plan to Transform (PSTA) the agricultural sector and is now in its second phase. The policy is mainly concerned with the modernization of the agricultural sector and commercialization. The overall objective is to increase agricultural outputs and incomes under sustainable production systems for all groups of farmers and food security for all. The emphasis in increased output is on crops for export. There are four interrelated programs: intensification and development of sustainable production systems; support for the professionalization of producers; promotion of commodity chains and agribusiness development and institutional development. This government policy seeks to modernise the agricultural sector and promote the production of cash crops for export as part of the broader drive for economic growth and transformation. This may well bring benefits to the population in the medium and long term as all benefit from economic growth and increased prosperity. However, there seems to be no indication that this policy is pro-poor in the short term since small holder farmers may end up as working poor agricultural wage laborers.

1.1.1.2. Macroeconomic indicators

Rwanda's economic growth was rapid in the years following the genocide, largely due to determined economic policy, the 'catch-up' effect (due to starting from a very low baseline in 1994) and relatively high aid flows. Economic growth has been more modest in recent years. For 2014, the Government of Rwanda forecast for GDP growth is 8.0.

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According to Fitch Ratings, Rwanda's rating is supported by a good track record of macroeconomic management and reforms, and the receipt of substantial bilateral and multilateral debt relief in 2005 and 2006.

1.1.1.3. Economic Issues

Despite an increase in goods exports in the last years, Rwanda struggles with a chronic trade deficit. Imports have risen sharply since 2004, largely as result of the increasing costs of imported fuel and energy. The GoR is actively seeking ways to increase domestic energy production, such as exploitation of methane deposits of the Lake Kivu and different hydropower plants.

Despite strong market-oriented policies, Rwanda's economy is not yet well integrated into regional and global markets. Its landlocked position, deficient infrastructure and small domestic market with limited purchasing power have held back foreign direct investments. At the same time, a strong national currency, buoyed by the high level of development assistance, has favored imports and discouraged exports.Official economic statistics do not fully record trade by the informal sector, which constitutes a significant proportion of economic activity in Rwanda.

Much hope is placed on the integration into the East African Community, which completion was done in 2007.While the GoR admits that adjustment to competition from the larger economies of Kenya, Tanzania and Uganda will be challenging; it is convinced that long-term gains will outweigh the costs.

Figure 1 Rwandan Administrative map and its Localization in Central East Africa Region

Rwanda

1.1.2. Japan

Japan is an East Asia Country, island nation in the Pacific Ocean with high-rise-filled cities, imperial palaces, mountainous national parks and thousands of shrines and temples. Tokyo, the crowded capital, is known for its neon skyscrapers and pop culture. In contrast, Kyoto offers Buddhist temples, Shinto shrines, gardens and cherry blossoms. Sushi, the national dish, is served everywhere from casual pubs to gourmet restaurants.

Capital: Tokyo, Dialing code: +81, Currency: Japanese yen and Population: 127.3 million in (2013) according to World Bank.

1.1.2.1. Economic Situation

The economy of Japan is the third largest in the world by nominal GDP, the fourth largest by purchasing power parity and is the world's second largest developed economy. According to the united nation statistics department, the country's per capita GDP (PPP) was at $ 38527.57 the 22nd-highest in 2013.

1.1.2.2. Macroeconomic indicators

In free enterprise economies like Japan, national economic growth depends on the growth of private sector businesses including listed corporations, private corporations, partnerships, private cooperatives, etc. Therefore, to understand the nature of economic growth, we must begin with corporate growth, which includes both the growth of existing companies and the creation of new companies. This section presents a simplified analysis of how corporations decide whether or not to grow that captures the essence of what is taught in most business schools. The same techniques are used to assess the viability of new businesses seeking financial backing. In doing this, we are not departing from traditional macroeconomic thinking. We are merely going back to its root: macroeconomic performance is the sum of microeconomic performance. Moreover, King and Levine and a huge subsequent literature confirm that the sophistication of a country's financial system is closely correlated with macroeconomic performance (La Porta, 1999) and others also show that traditional financial management concern like corporate governance laws and the standing of investors in court also matter to macroeconomic performance. Consequently it is useful to connect standard ways of thinking about corporate finance issues to macroeconomics.Two caveats are in order before we proceed further.

First, in a real economy, not all growth is generated by private sector businesses. Government, state-owned enterprises, and not-for-profit enterprises account for a large fraction of GDP in many advanced economies, and Japan is no exception. The objectives that direct the growth of these enterprises may differ substantially from the economic profit-seeking behavior that governs corporate growth. However, the role of private sector businesses is arguably more fundamental. Government organs and public sector enterprises exist because the private sector generates the tax revenue that let them survive without concern for economic profits. Non-profit enterprises exist because of donations from businesses, governments, and individuals. Personal incomes derive either from employment in the private sector or from employment by government, public sector enterprises, or non-profits. The ultimate source of these funds is therefore also private sector businesses. Second, it is well-known that all businesses do not follow the economic profit seeking behavior mandated by corporate finance theory. This is because the individuals who run businesses are wont to maximize their own utility, not economic profits, which accrue to others, such as the shareholders who legally own the firm.

1.1.2.3. Economic Issues

According to the paper published by Masahiro Kawai and Shinji Takagi, (Takagi, 2009), Japan was hit hard by the global financial crisis even though it's relatively resilient financial system initially limited the direct impact. The severe collapse of industrial production that followed was no doubt attributable to a confluence of factors, including the stock price declines that eroded the capital base of commercial banks and thus limited their willingness to lend as well as the lagged impact of the sharp rise in oil and other commodity prices in the summer of 2008. As a primary cause of the severe recession, however, this paper has highlighted the impact that came from the contractionary effect of global deleveraging on the real economy. In this environment, Japan was particularly vulnerable because of the structural changes that had taken place over the past decade in its trade and industrial structures. Analysis has confirmed that, as a result of these structural changes, Japanese output became much more responsive to output shocks in the advanced markets of the US and Western Europe.

Figure 2 Japan Administrative map

1.2. Problem Statement

Rwanda as others developing countries is strangling to develop his economy from developing towards medium and developed income countries; in this way for catching up with the developed countries there is different ways forwards requires a mechanism to enable developing countries to be developed. The economic convergence with the developed countries has been an issue for developing countries long time ago. Let us first consider some simple economic explanations that have been advanced. One argument is that developing countries are exposed to a secular decline in its terms of trade because prices of commodities, which developing countries tends to export have risen by less than prices of manufactured goods and services, which it tends to import. Although developing countries especially in African, terms of trade are not significantly worse now than they were in the 1960s, we may note that during the period when it underwent its structural adjustment programmes, that is in the 1980s and 1990s, there was a significant decline in its terms of trade. This has not made adjustment easier, and may have held back economic recovery.

A second problem with the dependence on commodity exports is that prices swing a lot, which creates problems of its own even if there is no secular decline. This pattern of price fluctuations is a particular risk in the developing countries environment and puts impossible demands on economic policy management. It is hard to deal with both positive and negative shocks.

Another problem that developing countries deal with during the adjustment phase is the large debt burdens that were built up during the vain attempts to manage economies without adjustment. Although the total debt in dollars is not very large for developed countries, in terms of its share in GDP it is much higher than that in other regions. This debt has, of course, made adjustment efforts much more complicated in developed countries than they otherwise would have had to be. The recent debt relief of HIPC initiative is trying to deal with this problem by writing off part of the debt for countries that have a credible development strategy.

There are further exogenous factors that have been suggested as holding back growth in developing countries economies. One is that the most of those countries are small, so they cannot exploit scale advantages. This has some validity, at least as long as developing countries' economies are not well-integrated into the world economy.

Another factor is that the level of risk tends to be high in developing countries especially in African and some Asian countries. This means that investors require very high returns there and

estimates also show that the return on capital in that area is extremely high. Money is not flowing in, since there are few projects that can generate sufficiently high returns, which means that investment becomes low. Other factor that we mention but this is not the case for Rwanda is that most of developing countries are located in a climate zone that is not optimal for agriculture, and there is also a high prevalence of malaria, AIDS and other costly diseases.

Many developing countries including Rwanda are landlocked or have poor transportation networks that make it expensive to trade.

We shall discuss various aspects of the choice of economic policies, particularly with regard to the countries' external policies. The first observation that follows from the discussion above is that developing countries especially African countries has been too closed to the world. But there is also the whole spectrum of distortions due to ineffective economic policies, and which countries have tried to revise during the past years. These were on the one hand general macroeconomic distortions such as overvalued exchange rates, budget deficits and excessive money supply growth. On the other hand there were problems of a more institutional character such as excessive government control and regulation, state ownership of firms, poorly functioning financial markets and an ineffective (or corrupt) government sector.

There has been progress on these fronts during recent years, but it could be argued that the reforms are still insufficient. Once they are fully in place, the response may be more significant. This argument has some validity, but it begs the question of why reforms are not effectively implemented. The root of this has to be sought in the way policy-making functions in developing countries, which are the political process. Is there anything in political processes in developing countries that hinders the realization of its economic potential?

Policymaking long time ego was depends on the interaction between interest groups in different ways. In those countries, political processes, even in the more democratic set-up that currently prevails, are unusually dependent on the actions of special interest groups. There is extensive corruption and mismanagement, and the interaction between politics and ethnic rivalries was makes it hard to establish long-term stable and undistorted strategies. It may also be argued that apart from the ethnic dimension, an economic structure was tending to influence political outcomes. For example, standard trade theory suggests that a country should optimally adjust its economy according to its comparative advantages. However, what if the comparative advantages imply a policy that is counter to what is politically desirable? For example, if a country is abundant in land (or natural resources) it may be inappropriate to let the wages of

labour increase too fast, while we know that higher urban wages have been politically desirable in developing countries.

Why are there no effective forces that can guarantee good governance? There is obviously also a lack of democratic control in the countries that have been (partially) democratized. The government in power often was tends to look to the interests of its core supporters rather than the welfare of the country as a whole. The external pressure for democratic change has also been weak until recently, but it is possible that economic reform programmes to some extent have contributed to political openness. It has been argued that what were lacking are agents of restraint that can force governments to behave responsibly and to introduce sensible economic policies and stay on track. The increased openness and debate in most developing countries may in the longer term contribute to a change in this direction, but so far one can say that there in general has been a major change in government behavior especially on Rwandan economic policy. But much remains before the political process can produce effective government and policy making.

Regarding all the above issues, it is in this context that; this research thesis carrying out an economic growth modeling comparison for developed and developing countries: a co integrated time series data analysis of Rwanda and Japan from 1970 to 2013 and try to identify if there is a possibility for developing countries to catch up with the developed, where those are the most common and vital economic indicators: GDP (Gross Domestic Product), M2 (Money Supply), Consumer Price Index (CPI), Producer Price Index, Current Employment Statistics, Current Employment Statistics (CES), Manufacturing and Trade inventories etc…

For this research the economic evaluation will be basing on the population GDP per capita growth comparison for Rwanda and Japan as developing and developed country respectively.

1.3. Research Objectives

The overall objective of the research is to promote sustainable economic development for developing countries basing on their potentials areas towards the catch up with the developed countries.

1.4. Specific Objectives

Some studies have provided a comprehensive review on how developing countries could work towards the catch up state with the developed. This research provide with a greater emphasis on the 4 following objectives:

1) Assessment of the GDP per capita growth of developing and developed countries by taking an example on Rwanda and Japan from 1970 to 2013
2) Analysis of the long run correlation for GDP per capita and its independent variables of Rwanda and Japan
3) Identification of the barriers affecting the catchment of developing countries with the d**e**veloped.
4) Provide possible measures for developing countries to catch up with the developed

1.5. Research Questions

Developing countries are facing on the issue of the lower income per capita for their population and lower developed economic activities in general. Despite that issue the economic growth rates in developing countries are on average higher than those in developed countries as most of the developing countries still having in abundance natural resources and many economic areas to be exploited, therefore this research concern to answer the following questions:

- Considering the per capita assessment on developing and developed countries, will developing countries catch up with the developed?
- Are there long runs correlations between per capita and its independent variables in Rwanda as well as Japan?
- Does developing countries economic growth have barriers for catchment with the developed?
- Is there any way forward for the developing countries to promote the catch up with the developed?

1.6. Hypothesis

Due to different potentiality for resources exploitation, normally the rate of economic growth in the developing countries should be great than the one for the developed countries, but dues to many circumstances their economy still on low level vis-à-vis to the developed ones.
Considering the above statement, we formulate our hypothesis as follow:

- ✓ ***H1$_o$***: Considering the per capita assessment on developing and developed countries, developing countries will catch up with the developed.
- ✓ ***H1$_1$***: Considering the per capita assessment on developing and developed countries, developing countries will not catch up with the developed..
- ✓ ***H2$_0$***: There is long runs correlations between per capita and its independent variables in Rwanda as well as in Japan
- ✓ ***H2$_1$***: There is no long runs correlations between per capita and its independent variables in Rwanda as well as in Japan
- ✓ ***H3$_0$***: Developing countries economic growth have no barriers for catching with the developed
- ✓ ***H3$_1$***: Developing countries economic growth have barriers for catching up with the developed
- ✓ ***H4$_0$:*** There is a way forward for the developing countries to promote the catch up with the developed
- ✓ ***H4$_1$:*** There is no way forward for the developing countries to promote the catch up with the developed

1.7. Scope of the Study

The main aim of the research is to promote sustainable economic development for developing countries basing on their potentials areas towards the catch up with the developed countries. This is done by comparing the per capita growth status of Rwanda and Japan as developing country and developed country respectively and ascertains statistical quality of the parameters in the model. In general, they were found to be satisfactory, but there remain some limitations. The first limitation of this study concerns the availability of data period spanning of dependent variables in the study as some independent variables in the model are located in informal sector. The second one concerns the statistical quality of data which led to some statistical transformations in the model.

1.8. Significance of the Study

This project sets itself apart from generic social science researches that have been done before as; it combines tools of statistics, econometrics and mathematics to analyze an econometric phenomenon.

They key feature of this study is that it amalgamates economic theory with mathematical and statistical economics. A major significance of this research lies in its ability to provide empirical content to the qualitative hypothesis advanced for; that is; the study will provide numerical estimates for all coefficients of explanatory variables including in the model.

At the end the study avail its findings to be tested, it test the suitability and measurability of all variables included in the model. That is, it conducts an empirical verification of the theories that are involved.

In our opinion, research on economic growth of developing and developed countries shows the following shortcomings. First, some of these works do not implement a prior analysis background on the developing and developed countries they compare only the current economic situation.

And finally, most of the research using cross-section, time series or panel databases employs only government or international organization revenues then there is a limited private research in this area.

The main goal of this study is to estimate the relationship between GDP per capita with its explanatory variables for comparison of economic growth for developing and developed countries and examine the facts that may promote the economic convergence of those two categories towards the improvement of citizen live conditions using different econometric techniques, and controlling for institutional quality on the two country categories.

1.9. Definitions of Key Concepts

1.9.1. Growth Domestic Product (GDP)

The total market value of all final goods and services produced in a country in a given year, equal to total consumer, investment and government spending, plus the value of exports, minus the value of imports. Growth in GDP is what matters, and for Rwanda, the GDP growth has historically averaged about 6-8% per year but with substantial deviations. Each initial GDP report will be revised twice before the final figure is settled upon: the "advance" report is followed by the "preliminary" report about a month later and a final report a month after that. Significant revisions to the advance number can cause additional ripples through the markets. The GDP numbers are reported in two forms: current dollar and constant dollar. Current dollar GDP is calculated using today's dollars and makes comparisons between time periods difficult because of the effects of inflation. Constant dollar GDP solves this problem by converting the current information into some standard era dollar, such as 1997 dollars. This process factors out the effects of inflation and allows easy comparisons between periods. It is important to differentiate Gross Domestic Product from Gross National Product (GNP). GDP includes only goods and services produced within the geographic boundaries of the country, regardless of the producer's nationality. GNP doesn't include goods and services produced by foreign producers, but do include goods and services produced by country firms operating in foreign countries.

GDP measures a society's wealth by indicating how fast profits may grow and the expected return on capital.

1.9.2. Economic growth

Economic growth is a positive change in the level of production of goods and services by a country over a certain period of time. Nominal growth is defined as economic growth including inflation, while real growth is nominal growth minus inflation. Economic growth is usually brought about by technological innovation and positive external forces.

1.9.3. GDP Per Capita

A measure of the total output of a country that takes the gross domestic product (GDP) and divides it by the number of people in the country. The per capita GDP is especially useful when comparing one

country to another because it shows the relative performance of the countries. A rise in per capita GDP signals growth in the economy and tends to translate as an increase in productivity.

The gross domestic product (GDP) is one of the primary indicators of a country's economic performance. It is calculated by either adding up everyone's income during the period or by adding the value of all final goods and services produced in the country during the year. Per capita GDP is sometimes used as an indicator of standard of living as well, with higher per capita GDP being interpreted as having a higher standard of living.

1.9.4. Developing country

Developing country also called a less developed country or underdeveloped country, is a nation with an underdeveloped industrial base, and a low Human Development Index (HDI) relative to other countries. On the other hand, since the late 1990s developing countries tended to demonstrate higher growth rates than the developed ones. There is no universal, agreed-upon criterion for what makes a country developing versus developed and which countries fit these two categories, although there is general reference points such as a nation's GDP per capita compared to other nations. Also, the general term less-developed country should not be confused with the specific least developed country.

There is criticism of the use of the term developing country. The term implies inferiority of a developing country or undeveloped country compared to a developed country, which many countries dislike. It assumes a desire to develop along the traditional Western model of economic development which a few countries, such as Cuba and Bhutan, choose not to follow. An alternative measurement that has been suggested is that of gross national happiness, measuring the actual satisfaction of people as opposed to how industrialized a country is.

Countries with more advanced economies than other developing nations but that have not yet demonstrated signs of a developed country, are often categorized under the term newly industrialized countries.

According to authors such as Walt Whitman Rostow, developing countries are in transition from traditional lifestyles towards the modern lifestyle which began in the Industrial Revolution in the 18th and 19th centuries.

1.9.5. Developed country

A developed country, industrialized country, or "more economically developed country" (MEDC), is a sovereign state that has a highly developed economy and advanced technological infrastructure relative to other less industrialized nations. Most commonly, the criteria for evaluating the degree of economic development are gross domestic product (GDP), gross national product (GNP), the per capita income, level of industrialization, amount of widespread infrastructure and general standard of living. Which criteria are to be used and which countries can be classified as being developed are subjects of debate.

Developed countries have post-industrial economies, meaning the service sector provides more wealth than the industrial sector. They are contrasted with developing countries, which are in the process of industrialization, or undeveloped countries, which are pre-industrial and almost entirely agrarian. According to the International Monetary Fund, advanced economies comprise 65.8% of global nominal GDP and 52.1% of global GDP (PPP) in 2010. In 2015, the ten largest advanced economies by nominal GDP were the United States, Japan, Germany, France, the United Kingdom, Italy, Canada, South Korea, Australia and Spain. By PPP GDP, they were the United States, Japan, Germany, the United Kingdom, France, Italy, South Korea, Canada, Spain and Australia. Where Japan as the second is in our case of study.

1.9.6. Purchasing power parity (PPP)

Purchasing power parity is a component of some economic theories and is a technique used to determine the relative value of different currencies.

Theories that invoke purchasing power parity assume that in some circumstances (for example, as a long-run tendency) it would cost exactly the same number of, say, US dollars to buy euros and then to use the proceeds to buy a market basket of goods as it would cost to use those dollars directly in purchasing the market basket of goods.

The concept of purchasing power parity allows one to estimate what the exchange rate between two currencies would have to be in order for the exchange to be at par with the purchasing power of the two countries' currencies. Using that PPP rate for hypothetical currency conversions, a given amount of one currency thus has the same purchasing power whether used directly to purchase a market basket of goods or used to convert at the PPP rate to the other currency and then purchase the market basket using that currency. Observed deviations of the exchange rate from purchasing power parity are measured by deviations of the real exchange rate from its PPP value of 1.

PPP exchange rates help to minimize misleading international comparisons that can arise with the use of market exchange rates. For example, suppose that two countries produce the same physical amounts of goods as each other in each of two different years. Since market exchange rates fluctuate substantially, when the GDP of one country measured in its own currency is converted to the other country's currency using market exchange rates, one country might be inferred to have higher real GDP than the other country in one year but lower in the other; both of these inferences would fail to reflect the reality of their relative levels of production. But if one country's GDP is converted into the other country's currency using PPP exchange rates instead of observed market exchange rates**,** the false inference will not occur.

1.9.7. Convergence between economies

Convergence between economies is defined as the tendency for the levels of per capita income, or levels of per worker product (productivity), to equalize over time which will happen only if a catching-up process takes place.

1.10. Organization of the Research

This research is organized in five chapters. Chapter 1 introduces the research problem, the objectives, significance of the study and the scope of the study employed in the analysis. Chapter 2 focuses on the literature review and also reviews the empirical evidence presented in the study. Chapter 3 provides the methodology used in data collection and analysis while Chapter 4 deals with the modeling and quantitative component of this analysis, Conclusions drawn from this study and the policy recommendations are covered in Chapter 5

CHAPTER I. **LITERATURE REVIEW**

1.1. Introduction

The idea of convergence in economics (also sometimes known as the catch-up effect) is the hypothesis that poorer economies' per capita incomes will tend to grow at faster rates than richer economies. As a result, all economies should eventually converge in terms of per capita income. Developing countries have the potential to grow at a faster rate than developed countries because diminishing returns (in particular, to capital) are not as strong as in capital-rich countries. Furthermore, poorer countries can replicate the production methods, technologies, and institutions of developed countries.

In economic growth literature the term "convergence" can have two meanings. The first kind (sometimes called "sigma-convergence") refers to a reduction in the dispersion of levels of income across economies. "Beta-convergence" on the other hand, occurs when poor economies grow faster than rich ones. In our case we are during with the Beta convergence.

Economists say that there is "conditional beta-convergence" when economies experience "beta-convergence" but conditional on other variables being held constant. They say that "unconditional beta-convergence" or "absolute beta-convergence" exists when the growth rate of an economy declines as it approaches its steady state. According to Jack Goldstone, "in the twentieth century, the Great Divergence peaked before the First World War and continued until the early 1970s, then, after two decades of indeterminate fluctuations, in the late 1980s it was replaced by the Great Convergence as the majority of Third World countries reached economic growth rates significantly higher than those in most First World countries", thus the present-day convergence should be regarded as a continuation of the Great Divergence (Goldstone, 2003).

1.2. Theoretical Perspectives

Literature on economic growth tries to explain the crucial issue of whether different countries or regions become similar over time. A number of empirical studies use cross-section or time series methods to analyze whether different economies have converged or not. Convergence between economies is defined as the tendency for the levels of per capita income, or levels of per worker product (productivity), to equalize over time which will happen only if a catching-up process takes place. According to Elias Soukiazis, the convergence argues that due to diminishing returns to reproducible capital, poor countries or regions with low capital/labour

ratios have a higher marginal productivity of capital, and therefore, will grow faster than richer ones, given the same level of saving and investment. The conditions of free factor mobility and free trade are essential and contribute to the acceleration of the convergence process through the equalization of prices of goods and factors of production. The role of the government in such a process is limited to the promotion of market forces and the provision of macroeconomic stability. In this context, the tendency for disparities to decline over time is explained by the fact that factor costs are lower and profit opportunities are higher in poor regions compared to rich regions. Therefore, low income regions will tend to grow faster and will catch-up the leading ones. In the long run, income differences and growth rates will be equalized across regions (Soukiazis).

According to Robert J. Barro, convergence only takes place when the poor regions (countries) are able to absorb technical progress emanating from the advanced regions and improve their human capital efficiency and innovation capacity. In these terms, it is more likely to find convergence "clubs" among similar economies and not overall convergence when empirical studies are applied to test for convergence. Consequently, unconditional convergence is more likely to be found among regions or states of the same nation or among similar economies (Barro R. J., 1990).

In particular concerning Rwanda as developing country, according to Christian Almer and Roland Hodle; after employing the synthetic control method to study the short- and long-term economic consequences of the 1994 war and genocide in Rwanda which has been one of the most intense events of political violence since World War II, they find a large negative effect on economic performance in the short run. In particular, estimate that GDP dropped by 58 percent below its counterfactual level in 1994. Looking at the long run they find that full recovery to the counterfactual level of development is possible and happened in Rwanda after 17 years. They analysis therefore challenges two findings from cross-country growth studies. First, the negative short-run effects can be much higher than the average effects found in cross-country growth studies. This insight may not be surprising as countries with large-scale events tend to be under-represented in cross-country growth studies. The second difference is more upbeat in that they show that even countries suffering from very intense internal political violence can fully recover at least in economic terms. This finding is consistent with standard neoclassical growth models

In addition, they show that the magnitude of the short-run effect and the speed of recovery are both sector-specific. In case of Rwanda the drop in agricultural production was smaller and

recovery was faster in agriculture than in the industry and service sectors. Arguably, the relatively fast recovery in agriculture may have been an important prerequisite for the recovery of the entire economy towards the convergence with the developed countries economy. Where the Rwandan GDP growth rate is between 6-8% (Hodler, 2015).

1.3. Related case of studies

Previous empirical studies consider the possible ways on how those countries categories can converge economically and this convergence is differently argued in literature.

Philip KEEFER and Stephen KNACK (KNACK, 1998) say that poor countries would grow faster than wealthy countries, because of technological advances and diminishing returns to capital in the latter but there are falling back rather than catch up due to environment in which economic activity of these countries takes place. They suggested that deficient institutions underlie the divergence by employing various indicators of institutional quality, including the rule of law, the pervasiveness of corruption and the risk of expropriation and contract repudiation. They conclude that the ability of poor countries to catch up is determined in large part by the institution environment in which economic activity of these countries takes place.

Robert and Barro (Barro R. a., 1991) declare that the growth rate of real per capita GDP is positively related to initial human capital and negatively related to the initial level of real per capita GDP. Countries with higher human capital also have lower fertility rates and higher ratios of physical investment to GDP. Growth is inversely related to the share of government consumption in GDP, but insignificantly related to the share of public investment. Growth rates are positively related to measures of political stability and inversely related to a proxy for market distortions.

Rob Vos and staff from all collaborating agencies of the United Nations Department of Economic and Social Affairs (UN/DESA) (UN/DESA, 2013) demonstrate that, the world economy weakened considerably in 2012. A growing number of developed economies, especially in Europe, have already fallen into a double-dip recession, while those facing sovereign debt distresses moved even deeper into recession. Many developed economies are caught in downward spiraling dynamics from high unemployment, weak aggregate demand compounded by fiscal austerity, high public debt burdens, and financial fragility.

The economic growths of the developed countries are spilling over to developing countries and economies in transition through weaker demand for their exports and heightened volatility in

capital flows and commodity prices. The larger developing economies also face home-grown problems, however, with some (including China) facing much weakened investment demand because of financing constraints in some sectors of the economy and excess production capacity elsewhere. Most low-income countries have held up relatively well so far, but are now also facing intensified adverse spillover effects from the slowdown in both developed and major middle-income countries. The prospects for the next two years continue to be challenging, fraught with major uncertainties and risks slanted towards the downside.

Branko Milanovic (Milanovic, 2005) reveals that, during the recent past years, the poorest countries of the world have fallen further behind the middle-income and rich countries. The median per capita growth of the poorest countries was insignificant. This is an unexpected outcome because, from the perspective of economic theory, both globalization and economic-policy convergence imply that poor countries should grow faster than the rich.

The main reasons why this has not happened lie in poor countries' much greater likelihood of being involved in wars and civil conflicts.

This factor alone accounts for an income loss of about 40 percent over twenty years. Slower reforms in poor countries compared with faster reforms in middle-income countries played some, albeit a minimal, role.

Increased flows from multilateral lenders did not help either because the net effect of the flows on growth rates is estimated to have been zero.

Finally, neither democratization nor better educational attainment of the population can be shown to have had any notable positive impact on poor countries' growth.

Reducing the prevalence of conflict seems to be the first and most important step toward restoring economic growth and convergence.

In their view, Robert J.Barro and Xavier Sala-I-Martin, find that if the high coefficient on capital is to be explained by the presence of human capital, then the convergence should have been much greater in the early periods when human capital was not as important.

CHAPTER II. **METHODOLOGY**

2.1. Introduction.

This chapter explains the model, the test procedures, and the data included in this study. The econometric techniques could be used to determine the impact of Consumption (X_1), Gross capital formation (X_2), Exports of goods and services (X_4) and imports of goods and services (X_4) to Gross Domestic Product per capita for Rwanda and Japan developing and developed countries respectively, determine if with the normal situation, their GDP per capita will converge as soon, identify the barriers for convergence if they exist and propose the possible way forwards towards that economic convergence in a cointegrated sample size of 44 years (1970-2013).

Before testing for cointegration, a unit root test is required to ensure that the variables under study are no stationary I(1). The cointegration test is applicable only if the variables are of the same order I(1). Thus, we employ one type of unit root tests, the Augmented Dickey–Fuller (ADF) (Dickey and Fuller, 1979, 1981) and correlogram tests for stationary test are used. For the cointegration test, we use Johansen‟s method, first proposed by Johansen (1988), and Johansen and Juselius (1990). The Johansen approach is capable of determining the number of cointegrating vectors for any given number of no stationary series of the same order.

Before applying the Johansen approach, one should first determine the lag length or order of the vector auto regression (VAR). It is a key element in the specification of the VAR, which forms the basis of inference for the cointegrating rank. Generally, the lag length is chosen on the basis that the equation should pass all the diagnostic tests. The most commonly used criteria are the Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC). When using the AIC or SBC based on the estimated standard errors, the model with the lowest value for the AIC or SBC is chosen (see Pesaran and Pesaran, 2003). The dominant practice is to choose the lag length using one or both of the information criteria plus the requirement that there should be no evidence of serial correlation. One then uses the Johansen procedure to determine the cointegrating rank (see Johansen, 1988; Johansen and Juselius, 1990). The Johansen procedure gives two likelihood ratio tests for the number of cointegrating vectors: (1) the “maximum eigenvalue test” (λmax), which tests the null hypothesis that there are at least r cointegrating vectors, as against the alternative that there are r+1; (2) the “trace-test” (λtrace), where the alternative hypothesis is that the number of cointegrating vectors is equal to or less than r+1.

2.2. Model Specification

Following Stephen Knack and Philip Keefer (January 1998), our model for GDP per capita growth depending on its explanatory variables is written as follows:

$$Y_1 = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \boldsymbol{\beta_5 X_5} + \mu_{jt}$$

Where consumption (X_1), Gross capital formation(X_2), Exports of goods and services(X_3), imports of goods(X_4) and Political instability (X_5) are the main factors contributing to the GDP per capita according to Stephen Knack and Philip Keefer model. With μ_i: Stochastic disturbance term and β_0: Constant intercept or the country's GDP per capita at initial points

In our case the Political instability(X_5) is not taken into account as didn't got time series data for political instability on our sample.

Then in this research we elaborate our paper working model basing on modified Stephen Knack and Philip Keefer model as follow:

$$Y_1 = \beta_0 + \sum_{i=1}^{i=4} \beta_i X_i + \mu_i ,$$

Where:

Y_1: Gross Domestic Product per capita

X_i: Consumption, Gross capital formation, Exports of goods and services and imports of goods.

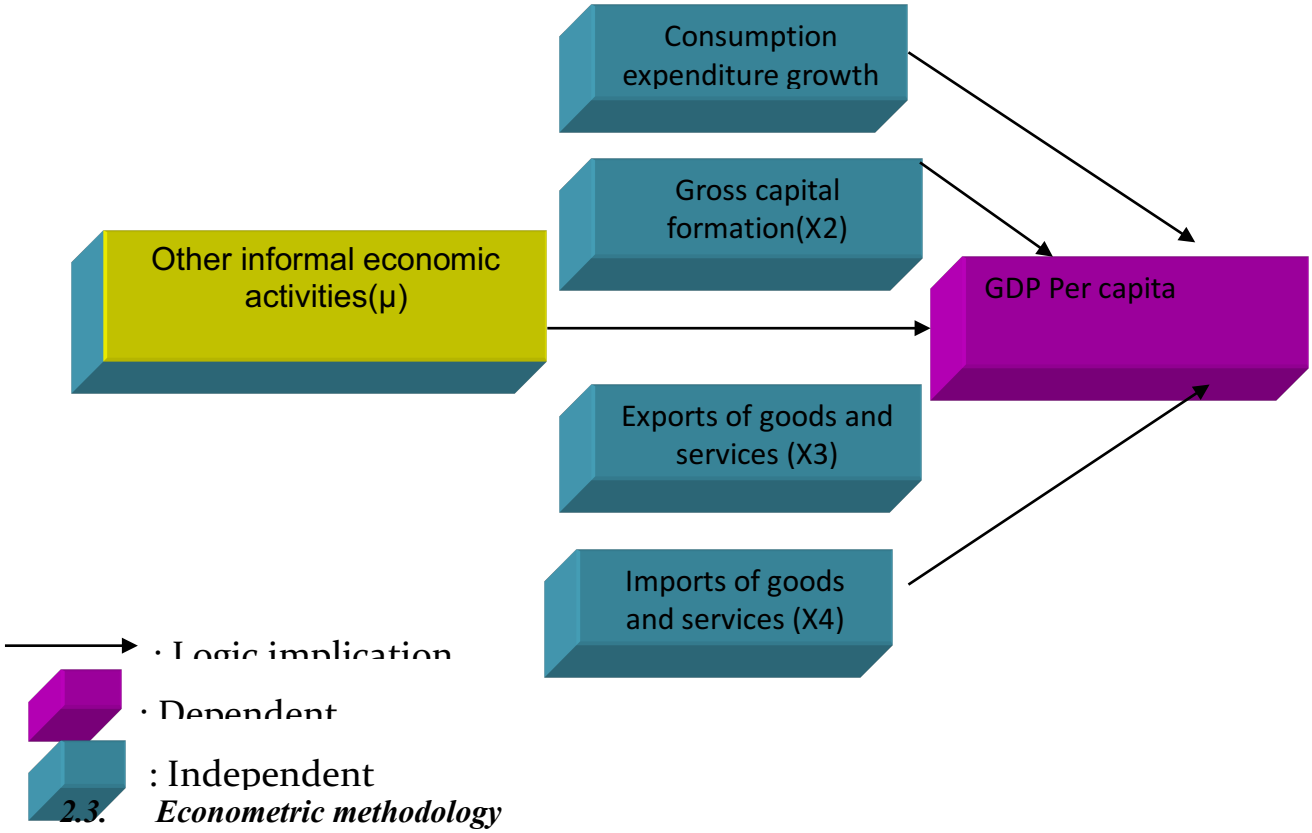
β_0: Constant intercept or the GDP countries at initial points

$\beta_{i:}$ Slope of coefficient of the explanatory variables

μ_i: Stochastic disturbance term.

To sum up, the research has used four independent variables that are likely to affect the GDP per capita for the period from 1970 to 2013 other than the five independents variables are reflected in the disturbance term.

Figure 3 Chart summarizing the project analysis.



2.3. Econometric methodology

In the recent development of time series properties, it is suggested that models in levels that ignore the non-stationarity of individual series can lead to spurious regression results, and models in the first differences are miss specified if the series are cointegrated and converge to a stationary long-term equilibrium relationship. So, in order to apply the cointegration test we need to check for non stationarity in the data set by using the Augmented Dickey-Fuller (ADF) and correlogram tests. Therefore to apply non-stationarity and cointegration tests, a brief explanation about both is necessary.

2.4. Test of stationarity

The importance of tests for stationarity of variables is rooted on the fact that regression involving non-stationary variables leads to misleading inferences since the estimated coefficients would be biased and inconsistent. When all or some of the variables are not stationary, it is important therefore to carry out appropriate transformations (differencing) to make them stationary. Since this study uses time series data for econometric analysis and cointegration tests, the non-stationarity of each series needs to be examined.

The Augmented Dickey-Fuller and correlogram tests are the most commonly used tests for detecting the possible existence of unit roots. The null hypothesis of these tests is that there is at least one unit root (i.e., the time series data are non-stationary). In performing an ADF test, two practical issues need to be addressed. First, the test will determine whether we have to include deterministic terms into the regression. We have the choice of including a constant and a linear time trend, or neither in the test regression. However, including irrelevant regressors in the regression will reduce the power of the test, which may lead to rejecting the null of a unit root. The standard recommendation is to select a specification that is a plausible description of the data under both the null and alternative hypotheses (Hamilton, 1994). The second issue is to choose the lag length, which is to specify the number of lagged difference terms to be added to the test regression. The usual advice is to include the number of lags sufficient to remove serial correlation in the residuals.

The ADF test is conducted using the ADF regressions of the form:

$$\Delta yt = \alpha_0 + \alpha_1 t + \rho y_{t-1} + \sum_{i=1}^{k} \lambda\, y_{t-i} + \mu_t \qquad (3.1)$$

And

$$\Delta yt = \alpha_0 + \rho y_{t-1} + \sum_{i=1}^{k} \lambda\, y_{t-i} + \mu_t \qquad (3.2)$$

Where Δy is the first difference of the series Y, k is is the lag order and t stands for the time. Equation (3.1) is with-constant, with-time trend, and equation (3.2) is with-constant, no time trend.

As results are known to be sensitive to the lag length, then the optimum lag length choice will be based on two alternative criteria: the Schwarz Information Criterion (SIC) and the Akaike Information Criterion (AIC). The Schwarz Information Criterion imposes a larger penalty for additional coefficients. The Akaike Information Criterion (AIC) imposes fewer penalties on the additional coefficients. AIC is defined as:

$$AIC=\log(\Sigma ui2/n) + 2k/n \qquad (3.3)$$

and SIC is defined as:

$$SIC=k\log n/n+\log(\Sigma ui2/n) \qquad (3.4)$$

Where Σui2 is the residual sum of squares k is the number of parameters to be estimated and is the number of useable observations. Since the SIC puts a heavier penalty on additional parameters, it will always choose a model with a smaller lag length than the one chosen by the AIC alternative.

2.5. Cointegration tests

The purpose of the cointegration tests is to determine whether a group of non-stationary series are cointegrated, meaning that the cointegration tests are developed to discover a stable long-run relationship among a set of non-stationary time series data. When two or more time-series are not stationary, it is important to test whether there is a linear combination of them that is stationary. This phenomenon is referred to as test for cointegration.

A substantial part of economic theory generally deals with long-run equilibrium relationships generated by market forces and behavioral rules. Correspondingly, most empirical econometric studies entailing time series can be interpreted as attempts to evaluate such relationships in a dynamic framework. Engle and Granger were the first to formalize the idea of integrated variables sharing an equilibrium relation, which turned out to be either stationary or have a lower degree of integration than the original series. They denoted this property by cointegration, signifying co-movements among trending variables which could be exploited to test for the existence of long run equilibrium relationships, within a fully dynamic specification framework. One of the important advantages of the cointegration test is that we can figure out the relationship among the variables under consideration, even though the data are not in equilibrium. Most of the data are not in equilibrium situations. In this sense, the cointegration test can build a stable relationship among the variables that are moving together, but are not in equilibrium. The cointegration vector has the interpretation of a long-run equilibrium relationship.

One of the important issues of the cointegration test is choosing a method. Three different approaches are the Engle-Granger two-step, Johansen's maximum likelihood (ML), and the stock-Watson procedures. Johansen's ML method seems to be proper one for this research. The Engle-Granger procedure is easier to implement, but it has important limitations Enders pointed out that the Engle-Granger procedure possibly indicates cointegration depending on the ordering of variables, when the model has more than one variable and/or equations, and it has no systematic procedure for the separate estimation of the multiple cointegrating vectors. In addition, because the Engle-Granger method uses two-step estimation, any error introduced by the researcher in step one is carried into step two. If the Engle-Granger method is used in this

study, these limitations will be serious because this study includes more than one variable and/or equation. When cointegration relationships depend on variable orderings, we must know exactly which variable is the dependent one. Meanwhile, it is not always known whether a time series designated to be the independent variable has been unaffected by the time series expected to be a dependent variable. Johansen's ML method can avoid this problem and it also can provide a separate estimation of the multiple cointegrating vectors. Given these reasons, and as Johansen's ML has been accepted as better than the Engle-Granger and Stock-Watson procedures by many applied economists this study employs Johansen's ML method for the cointegration tests. x_t and y_t are said to be cointegrated if there exists a parameter such that

$$u_t = yt - \alpha x_t \qquad (3.5)$$

This is a stationary process.

2.6. Cointegration analysis based on Johansen approach

A full-information maximum-likelihood procedure to test for cointegration and estimate the cointegration vectors have been developing recently, in a series of papers by distributions. Johansen and Juselius however, provide simulated distributions. Johansen (1988 and 1990) and Johansen and Juselius (1990). Here, I briefly describe the Johansen test procedure, describing some of its advantages. The Johansen procedure is maximum likelihood, but under certain assumptions it involves a series of ordinary least squares regressions. From these least squares regressions, we can compute two likelihood ratio test statistics for the number of cointegrating vectors in the multivariate system, which equals 2 minus the number of unit roots.

The first statistic, called the trace statistic, tests whether the number of cointegrating vectors is a given number or less. The second statistic, called the maximum eigenvalue statistic, tests whether the number of cointegrating vectors is r under the maintained hypothesis that there is r+1 or fewer cointegrating vectors. The asymptotic distributions of these test statistics are found in Johansen (1990) and are not the usual $\chi 2$ distributions. Johansen and Juselius (1990), however, provide simulated distributions.

The main reason for the popularity of cointegration analysis is that it provides a formal background for testing and estimating short-run and long-run relationships among economic variables. More generally, a system-based method (of which Johansen's is the most popular) can provide several advantages…

1) Flexibility To capture a rich dynamic structure and interactions; 2) Robustness Can deal with I(0) and I(1) variables avoiding much of the pre-testing problem; Can cope with testing for and estimating multiple cointegrating vectors; 3) Ability to test hypotheses Can test restricted versions of vectors and speeds of adjustment;

2.6.1. Johansen Approach

The appropriate estimation procedure is:

Step 1: Determining the cointegrating rank

Step 2: Determining the factorization P = *α β*‟: Estimating the matrix of cointegrating vectors, *β* and the weighting matrix *a*.

Step 3: Estimating the VAR, incorporating the cointegrating relations from the previous step.

Most attractive approach is the MLE proposed by Johansen. The best way of testing for unit roots is by using the system ML estimator of Johansen (1988, 1991) is a test for cointegration restrictions in a VAR representation. This estimator also gives you asymptotically efficient estimates of the cointegrating vectors (the β's) and of the adjustment parameters (α‟s). "Johansen's method" is the maximum likelihood estimator of the so-called reduced rank model.

We start with the AR(k) model

$$\Delta yt=\mu+\Gamma 1\Delta yt-1+\cdots+\Gamma k-1\Delta yt-k+1+\Pi yt-k+et \quad (3.6)$$

This under the assumption of cointegration of order k can be written as

$$\Delta yt=\mu+\Gamma 1\Delta yt-1+\cdots+\Gamma k-1\Delta yt-k+1+\alpha\beta' yt-k+et \quad (3.7)$$

Where $\alpha\ and\ \beta$both have dimension p × k. The number of parameters in the unrestricted model is p + kp2 + p(p + 1) / 2. Let $Z0t=\Delta yt, 1t=\Delta y't-1,\ldots,\Delta y't-k+1, 1\ '\ and\ Zkt=yt-k$

Define the moment matrices as: $M_{ij} = T^{-1}\sum_{i=1}^{r} Z_{it}Z'_{jt}(i,j=0,1,k)$ (3.8)

We first regress; Zit, i = 0; k on Z_{1t} and get residuals ,=0;k ; you should think of this as "purging" Δyt and $yt-k$of the short-run parameters which can be considered "noise" in the cointegrating relation. We are also purging those variables of their mean, and if you want to include exogenous variables (e.g. dummy variables) they should also be included in the $Z1t$ vector. Denote the residual sum of squares from regressing$Z0$ andZk on$Z1$ as Si ,,=0;k; in other words

$s_{ij} = \frac{1}{T}\sum_{t=1}^{r} R_{it}R'_{jt}$ (3.9)

The maximum likelihood estimator of α is a function of these residuals.

Johansen (1988, 1991), shows that β can be found from choosing the eigenvectors (,…,v r), where V =(v 1,…,v p), are the eigenvectors of the equation $*$ $\lambda Skk - Sk0(S00)-1S0k$ =0 , (3.10)

Where S00 is the moment matrix from ordinary least squares regression of Δyt on $\Delta yt-1,\ldots,\Delta yt-k+1, Skk$ is the residual moment matrix from ordinary least squares regression of $\Delta yt-k$on$\Delta yt-k+1$, and$S0k$ is the cross-product matrix.

Normalized such that V '$SkkV$ =I and ordered in the order of the corresponding eigenvalues such that λ 1>⋯>λ p>0 . Make sure you get the intuition here: Cointegration of order r implies that $\lambda 1 \neq 0 \ldots, \neq 0$ $while$ $\lambda r+1=\cdots=\lambda p=0$. (Since the estimated eigenvalues are continuous random variables they are different from zero (and from each other) with probability 1. And it is intuitively clear now that you want the eigenvectors corresponding to the non-zero eigenvalues to be the estimators of the cointegrating vectors.

In order to find those eigen values pre- and post-multiply the equation above by $(Skk)-1/2$ (youcan use the Cholesky factorization in e.g. GAUSS to get $(Skk)-1/2$, but the inverse of any matrix)

X that satisfies XX' =Skk will do and get the equivalent problem

$(**)$ $\lambda - (Skk)-1/2Sk0(S00)-1S0k(S'kk)-1/2 =0$ (3.11)

Note that this is a standard eigenvalue problem that programs like GAUSS can solve directly. The eigenvalues will be the ones that you are looking for. The eigenvectors (ui, say) that GAUSS gives you will be normalized such that $u'iui$=1 so you will use (,…,v r)=$(Skk)-1/2u1,\ldots,(Skk)-1/2ur$

In order to give some interpretations of this equation remember that the least squares Π can be obtained by regressing $R0t$ onRkt by the Frisch-Waugh theorem. So the least squares estimate of is

Π = $(S_{kk})^{-1}S_{k0}$ (3.12) Now note that:

$(S_{kk})^{1/2}S_{k0}(S00)^{-1}S_{0k}(S_{kk})^{1/2}$=$(S_{kk})^{1/2}(S_{kk})^{-1}Sk_0(S_{00})^{1/2}S_{0k}(S_{kk})^{-1}(S_{kk})^{1/2}$ = $((Skk)^{1/2}\Pi\ (S_{00})^{1/2})$ ($(S_{kk})^{1/2}$ Π $S_{00})^{1/2}$ ′. (3.13)

The intuitively natural approach would be to consider the eigen values of Π Π ′ and we can see that this is actually what the Maximum Likelihood algorithm does apart from the fact that Π has been normalized by pre-multiplying by $(Skk)^{1/2}$and post-multiplying by $(S_{00})^{1/2}$

The maximized likelihood function is: $L^{\frac{2}{T}}_{max}(r) = |S_{00}|\Pi^{r}_{i=1}(1-\lambda_i)$ (3.14) Notice that this is a function of the estimated eigenvalues where all the eigenvalues except the largest r eigenvectors are set equal to zero. So for example the test for one cointegrating vector against no cointegrating vectors consists of testing whether the largest eigenvalue is significantly different from zero. Johansen further finds

α =$S_{0k}\beta$ (3.15),

{Γ 1,…, $_{k-1}$,μ }= M_{01}−α β ′M_{k1} M_{11}^{-1} (3.16) and

λ =S_{00}−α α ′. (3.17)

The likelihood ratio test statistic *H* for the hypothesis that *Π*=$\alpha\beta'$ is of rank r against the unrestricted model where *Π* full rank p has is

$$H = -2\ln(Q) = -T\sum_{i=r+1}^{k} ln(1-\lambda_i)$$

2.6.2. Hypothesis testing

The Johansen procedure allows for testing the validity of restricted forms of cointegrating vectors. The validity of restrictions (over-identifying restrictions) in addition to those necessary to identify the long-run equilibria can be tested. Intuition: when there are r cointegrating vectors, only these r linear combinations of variables are stationary. Test statistics involve comparing the number of cointegrating vectors under the null and the alternative hypotheses. The Johansen technique determines whether the coefficient matrix contains information about the long-run properties of the VAR model. The null hypothesis of cointegration to be tested is:

$H0$:Π =$\alpha\beta'$ (3.19)

With $\alpha_{p\times r}$, $\beta_{p\times r}$ full column rank matrix. The null hypothesis implies that in a VAR model there can be r cointegration relations among the variables . Note that the Null hypothesis in (3.17) is that there are (p - r) unit roots. This corresponds to the simple residual based test previously, where we have p = 2 (if the X variable is one dimensional), and we test for 1 cointegrating relation, the null is then that there are 2 unit roots. This test statistic is often referred to as the "trace"-statistic, see e.g. Johansen and Juselius (1992). Note that this statistic is expected to be close to zero if there are at most r (linearly independent) cointegrating vectors. Another test that is often used it the "λ-max" test which looks at $-T-\ln(1-\lambda\, r+1)$ - the idea being that if the (r + 1)th eigenvalue can be accepted to be zero, then all the smaller eigenvalues can also. This test is a test of r + 1 cointegrating vectors against r cointegrating vectors.

The asymptotic distribution of the likelihood ratio test is a functional of multivariate Brownian motion (Johansen (1991)), and is tabulated for values of p up to 11 in Osterwald- Lenum (1992) and reproduced in Hamilton. The case that allows for a deterministic trend in the variables is the one that you will "normally" Often you do not really want to test whether there is (say) 3 cointegrating vectors against no cointegrating vectors, rather you want to make a decision on to what is the number of cointegrating vectors. In the situation where you directly want to test *r* + 1 cointegrating vectors against *r* cointegrating vectors you should of course use the "λ- *max*" test, but this test will not give you a consistent way of deciding the cointegration rank. A consistent (in the sense that you with probability 1 will not underestimate the number of cointegrating vectors) way to do this, using the trace test, is to start by testing for zero cointegrating vectors. (i.e. if your system is 4 dimensional, you compare the test statistic

$$-T\sum_{i=1}^{4}\ln\left(1-\lambda\mathrm{i}\right) \qquad (3.20)$$

If you reject zero cointegrating vectors, you then test for (at most) 1 cointegrating vectors. (In the 4-dimensional case, you compare the test statistic.

$$-T\sum_{i=2}^{4}\ln\left(1-\lambda\mathrm{i}\right) \qquad (3.21)$$

If this is not rejected you stop and decide that *r* = 1 - if you reject this you move on until you cannot longer reject and stop there.

Even though there is a constant in the error correction representation, this may not translate into a deterministic trend in yt. Note that this is not the same as what Campbell and Perron (1992) refer to as deterministic cointegration", namely the case where there is trend in yt but no trend

in $\beta' yt$. Johansen (1991) derives the likelihood ratio test (which we will denoteH^*) for reduced rank in the case where there is a constant in the ECM but no trend in yt, see Johansen (1991) or Johansen (1995) for the full explanation. Johansen (1992) discusses how to obtain a consistent test for the number of stochastic trends and for trend in yt at the same time. See Johansen (1991) for the derivation of the maximum likelihood estimator when there may or may not be trend. It turns out to be very convenient to program the Maximum Likelihood estimator in this case: all you have to do is to move the vector of ones in to Zkt and delete if from $Z1t$ (The Johansen (1991) article also has the most readable proof of the Granger representation theorem in my opinion). There are two drawbacks of the Johansen method. One is that it takes a little getting used to interpreting the results and formulating hypotheses in this setting. In the VAR system all variables are treated symmetrically, as opposed to the standard univariate models that usually have a clear interpretation in terms of exogenous and endogenous variables. The other drawback of the VAR system is one has to model all the variables at the same time, which will be a problem if the relation for some variable is flawed. This may give bias in the whole system and one may have been better of conditioning on that variable. Further, the multidimensional VAR model uses many degrees of freedom.

2.7. Data and Source of data

The data used in the present study include secondary data collected from the United Nation Statistics (Division, 2013) in National accounts main aggregate database on Gross Domestic Product per capita (Y_1), as explained variable and consumption (X_1), Gross capital formation (X_2), Exports of goods and services (X_3) and imports of goods and services (X_4) as explanatory variables for the period of 1970-2013.

The cointegrated data used in the research consists of a time series data covering 44 years, ranging from 1970 to 2013. This period marks a turning point in the history for economy of the two countries: Japan and Rwanda as developed and developing counties respectively.

2.8. Data Analysis Methods

The research work has used Cointegrated time series regression model using Eviews software for verification of the correlation between the dependent variable (GDP per capita) and the independent variables in the two said countries. With this analysis, the following multiple linear equations were obtained:

For each country: $Y_1 = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \mu_{jt}$.

Since the study concerns the economic analysis growth for developing and developed countries, the sample data are the time series GDP per capita for Rwanda and Japan from 1970 to 2013 collected by UN statistics. Now using Eviews software, we realize a vector error correction model to indentify the appropriate model for each country before their comparison according to the contribution rates of independent variables.

CHAPTER III. **RESEARCH FINDINGS**

This chapter reports the results and analyzes the relationship between the GDP per capita as dependent variable and consumption (X_1), Gross capital formation (X_2), Exports of goods and services (X_3), imports of goods (X_4) as independent variables. A cointegration test and innovation accounting analyses are conducted. Because non-stationarity of each series of variables is required for cointegration tests, the Augmented Dickey-Fuller test (ADF) and correlogram are applied to check for stationarity. Johansen's method is utilized for the cointegration tests, and error correction model to estimate the model.

3.1. Overview for different regions

According to the World Economic Situation and Prospects 2015 report on the Global economic outlook (UN, 2015), The global economy continued to expand during 2014 at a moderate and uneven pace, as the prolonged recovery process from the global financial crisis was still saddled with unfinished post-crisis adjustments. Global recovery was also hampered by some new challenges, including a number of unexpected shocks, such as the heightened geopolitical conflicts in various areas of the world. Growth of world gross product (WGP) is estimated to be 2.6 per cent in 2014, marginally better than the growth of 2.5 per cent registered in 2013, but lower than the 2.9 per cent projected in World economic situation and prospects as of mid-2014.

In the outlook period, premised on a set of assumptions and subject to a number of uncertainties and downside risks, the global economy is expected to strengthen in the following two years, with WGP projected to grow by 3.1 and 3.3 per cent in 2015 and 2016, respectively (table I.1).

Shifted to a lower growth path

Most economies have shifted to a lower growth path, six years after the global financial crisis; gross domestic product (GDP) growth for a majority of the world economies has shifted to a noticeably lower path compared to pre-crisis levels. Excluding the three years from 2008–2010, which featured, respectively, the eruption of the financial crisis, the Great Recession and the policy-driven rebound, four fifths of the world economies have seen lower average growth in 2011–2014 than in 2004–2007.

Table 1 Annual percentage change GDP of Growth of world output, 2008–2016

Annual percentage change	2008-2011[a]	2012	2013[b]	2014[b]	2015[c]	2016[c]	Change from WESP 2014 forecast	
							2014	2015
World	**1.9**	**2.4**	**2.5**	**2.6**	**3.1**	**3.3**	**-0.4**	**-0.2**
Developed economies	**0.1**	**1.1**	**1.2**	**1.6**	**2.1**	**2.3**	**-0.3**	**-0.3**
United States of America	0.2	2.3	2.2	2.3	2.8	3.1	-0.2	-0.4
Japan	-0.7	1.5	1.5	0.4	1.2	1.1	-1.1	0.0
European Union	-0.1	-0.4	0.0	1.3	1.7	2.0	-0.1	-0.2
EU-15	-0.2	-0.5	-0.1	1.2	1.5	1.9	-0.2	-0.3
New EU members	1.2	0.7	1.1	2.6	2.9	3.3	0.5	0.2
Euro area	-0.2	-0.8	-0.5	0.8	1.3	1.7	-0.3	-0.3
Other European countries	0.7	1.9	1.4	1.4	2.2	2.3	-1.2	-0.7
Other developed countries	1.5	2.6	2.2	2.6	2.6	2.6	0.0	-0.3
Economies in transition	**1.9**	**3.3**	**2.0**	**0.8**	**1.1**	**2.1**	**-2.5**	**-2.9**
South-Eastern Europe	1.6	-0.9	2.4	0.7	2.7	3.0	-1.9	-0.4
Commonwealth of Independent States and Georgia	1.9	3.5	2.0	0.8	1.1	2.1	-2.6	-2.9
Russian Federation	1.4	3.4	1.3	0.5	0.2	1.2	-2.4	-3.4
Developing economies	**5.6**	**4.8**	**4.8**	**4.3**	**4.8**	**5.1**	**-0.8**	**-0.5**
Africa	3.5	5.6	3.5	3.5	4.6	4.9	-1.2	-0.4
North Africa	1.8	6.6	1.4	1.6	3.9	4.3	-1.7	-0.4
East Africa	6.2	6.1	6.3	6.5	6.8	6.6	0.1	0.3
Central Africa	3.9	5.3	2.2	4.3	4.7	5.0	-0.4	0.7
West Africa	5.9	6.9	7.0	5.9	6.2	6.1	-1.0	-0.5
Nigeria	6.4	6.7	7.3	5.8	6.1	5.9	-1.1	-0.6
Southern Africa	3.3	3.4	3.0	2.9	3.6	4.1	-1.2	-0.8
South Africa	2.2	2.5	1.9	2.0	2.7	3.3	-1.3	-1.0
East and South Asia	7.2	5.6	5.9	5.9	6.0	6.0	0.0	0.0
East Asia	7.4	6.3	6.4	6.1	6.1	6.0	-0.1	0.0
China	9.6	7.7	7.7	7.3	7.0	6.8	-0.2	-0.3
South Asia	6.2	2.9	4.1	4.9	5.4	5.7	0.3	0.2
India	7.3	4.7	5.0	5.4	5.9	6.3	0.1	0.2
Western Asia	4.3	4.5	4.0	2.9	3.7	4.3	-1.4	-0.2
Latin America and the Caribbean	3.2	2.7	2.6	1.3	2.4	3.1	-2.3	-1.9
South America	3.8	2.2	2.8	0.7	1.9	2.8	-2.7	-2.2
Brazil	3.7	1.0	2.3	0.3	1.5	2.4	-2.7	-2.7
Mexico and Central America	1.6	4.2	1.8	2.6	3.5	3.8	-1.4	-1.2
Mexico	1.4	4.0	1.4	2.4	3.4	3.8	-1.6	-1.4
Caribbean	2.5	2.8	3.0	3.8	3.8	3.8	0.5	0.0
High-income countries	0.4	1.4	1.4	1.7	2.2	2.4	-0.4	-0.3
Upper-middle-income countries	5.7	4.9	4.9	4.3	4.8	5.2	-1.0	-0.6
Lower-middle-income countries	5.6	4.8	5.2	4.6	5.3	5.7	-0.4	-0.2
Low-income countries	5.7	4.9	4.9	4.4	4.9	5.3	-1.7	-1.2
Least developed countries	5.6	5.0	5.3	5.3	5.7	5.9	-0.3	0.1
World trade[e]	2.5	2.5	3.0	3.4	4.5	4.9	-1.3	-0.7
World output growth with PPP-based weights	2.7	2.9	3.0	3.1	3.5	3.8	-0.5	-0.5

Source: UN/DESA.

a. Average percentage change.
b. Actual or most recent estimates.
c. Forecast, based in part on Project LINK and baseline projections of the UN/DESA World Economic Forecasting Model.
d. Reference to the United Nations *World Economic Situation and Prospects 2014*.
e. Average of exports and imports of goods and services.

According to the said report as demonstrated in the above table, the issue is whether such a shift to a lower path of growth in most countries will become entrenched for a long period. According to some pessimistic views, major developed economies are highly likely to be entrapped in secular stagnation, while policymakers in China have indeed taken growth of 7.0–7.5 per cent as the new normal for the Chinese economy, compared with the average growth of 10 per cent that China achieved in the previous three decades. Many other large emerging economies, particularly those outside of Asia, have also seen a much slower growth trajectory in recent years as domestic weaknesses interact with challenging international conditions.

Quarterly growth rates of developed countries

A salient feature for major developed countries during 2014 has been the erratic movements in their quarterly GDP growth rates. For example, the economy of the United States of America oscillated from a decline of 2.1 per cent in the first quarter of 2014 to an increase of 4.6 per cent in the second quarter, while at the same time the economy of Japan swung from growth of 6.7 per cent to a contraction by 7.3 per cent. For the year as a whole, all major developed economies in North America, Europe and developed Asia have indeed aligned on an upward growth trajectory for the first time since 2011. Although the discrepancy in the growth rates of these economies has narrowed from the previous year, the growth picture remains diverse while the United States has managed to maintain an annual growth rate above 2 per cent in 2014, the economic situation in Europe is precarious, particularly in the euro area, where growth is exceptionally weak, with some countries close to or already in recession. Meanwhile, in Japan, momentum generated by the fiscal stimulus package and monetary easing introduced in 2013 has receded. In the baseline outlook, further improvement is expected for developed countries, with growth projected to be 2.1 and 2.3 per cent for 2015 and 2016 respectively, compared with the 1.6 per cent estimated for 2014. However, downside risks remain significant, especially in the euro area and Japan, which have seen renewed weakness in 2014.

Developing countries and economies in transition

Growth rates in developing countries and economies in transition have become more divergent during 2014, as a sharp deceleration occurred in a number of large emerging economies, particularly in Latin America and the Commonwealth of Independent States (CIS). A number of these economies have encountered various country-specific challenges, including structural imbalances, infrastructural bottlenecks, increased financial risks and ineffective macroeconomic management, as well as geopolitical and political tensions. In contrast, East Asia, including

China, managed to register relatively robust growth, while India led South Asia to a moderate strengthening. In the baseline outlook, developing countries as groups are expected to grow at 4.8 and 5.1 per cent in 2015 and 2016, respectively, up from the 4.3 per cent estimated for 2014. Growth in the least developed countries (LDCs) is expected to continue exceeding the global average, at 5.7 per cent in 2015 and 5.9 per cent in 2016. The economies in transition as a group are expected to grow at 1.1 per cent and 2.1 per cent in 2015 and 2016, respectively, up from the 0.8 per cent estimated for 2014. As in the case of developed economies, the risks to this baseline out-look are mainly on the downside. Many developing countries and economies in transition appear vulnerable to a tightening of global financial conditions and to the risk of a sharper-than-expected slowdown in major emerging economies, as well as a further aggravation of geopolitical tensions and an escalation of the Ebola epidemic.

The United States

Among the developed economies, the economy of the United States, after some erratic fluctuation in 2014, is expected to improve in 2015 and 2016, with GDP projected to expand by 2.8 and 3.1 per cent respectively, compared with an estimate of 2.3 per cent for 2014. While an increase in business investment will be the major driver, household consumption is also expected to strengthen, along with continued improvement in employment. The fiscal drag on growth is expected to remain, but with much milder intensity than in previous years. The policy interest rates are set to rise gradually after mid-2015, but the monetary policy stance will continue to be accommodative. The contribution from the external sector will be limited, as export growth is expected to be curbed by the strong appreciation of the dollar. The risks for the economy are mainly associated with the possibility of sizeable volatility in financial markets in response to the normalization of monetary policy, leading to adverse effects on the real economy.

A slight improvement in growth

A slight improvement in growth is expected in Western Europe, Western Europe continues to struggle. In the EU GDP growth is estimated to be only 1.2 per cent in 2014, with a slight pickup to 1.5 per cent and 1.9 per cent in 2015 and 2016, respectively. The region is held back by the travails of the euro area, where the level of GDP has yet to regain its pre-recession peak. Unemployment remains extremely high in many countries in the region and headline inflation is at alarmingly low levels. In the large economies, Italy is expected to contract for the third consecutive year and France has stag-nated, while Germany started the year strongly, but has

since slowed significantly. There is a ray of hope in that some of the crisis countries have resumed growth. Spain resumed positive growth in mid-2013 and has been strengthening since; Ireland and Portugal have also returned to positive growth, but all three recoveries remain extremely fragile. The only example of more robust growth is outside the euro area in the United Kingdom of Great Britain and Northern Ireland.

Private consumption

Private consumption constrained by higher taxes will weigh on Japan's growth; Japan was estimated to grow by only 0.4 per cent in 2014, technically falling into a recession in the second and third quarters. The drop in private consumption caused by the higher consumption tax is the main reason for the slowdown. Quantitative easing introduced in 2013 has predictably raised inflation expectations and the central bank further strengthened this policy in late-2014. Exports are expected to eventually benefit from the depreciation of the Japanese yen triggered by the monetary easing, while the planned cut in corporate taxes will support fixed investment. The growth rate is predicted to be 1.2 per cent in 2015 and 1.1 per cent in 2016.

Regarding other developed countries, GDP in Canada is estimated to register growth of 2.3 per cent in 2014 and is projected to grow by 2.6 per cent and 2.8 per cent in 2015 and 2016, respectively. Exports will likely expand at a robust pace and support growth. However, household indebtedness remains a concern and improvement in the labour market has been slow. GDP in Australia is estimated to grow by 3.0 per cent in 2014, before receding to 2.4 per cent and 2.3 per cent in 2015 and 2016, respectively. Exports and fixed investment in large natural resource projects will provide support for continued growth, while the slow improvement in the labour market will be a limiting factor. New Zealand became the first developed country to tighten its monetary policy stance after the Great Recession. GDP is estimated to grow by 3.0 per cent in 2014 and 3.3 per cent in 2015, with the solid expansion of investment in fixed structures as an important contributor.

Africa's growth

Africa's growth will be driven by private consumption and investment, among the developing countries, Africa's overall growth momentum is set to continue, with GDP growth expected to accelerate from 3.5 per cent in 2014 to 4.6 per cent in 2015 and 4.9 per cent in 2016. Growth in private consumption and investment are expected to remain the key drivers of GDP growth across all five sub regions and all economic groupings. Net exports will continue to moderately pull down growth. Inflation in Africa will remain flat, at an average of 6.9 in 2015, in the light of moderating global prices for commodities, food, oil and industrial imports as well as prudent monetary policies. Fiscal balances will remain negative, owing to infrastructure spending, public wage bills and social sector projects. A number of internal and external risks remain, such as a continued slow recovery in the developed countries, a slowdown in China, tighter global financial conditions, the Ebola outbreak, political instability, terrorism and weather-related shocks.

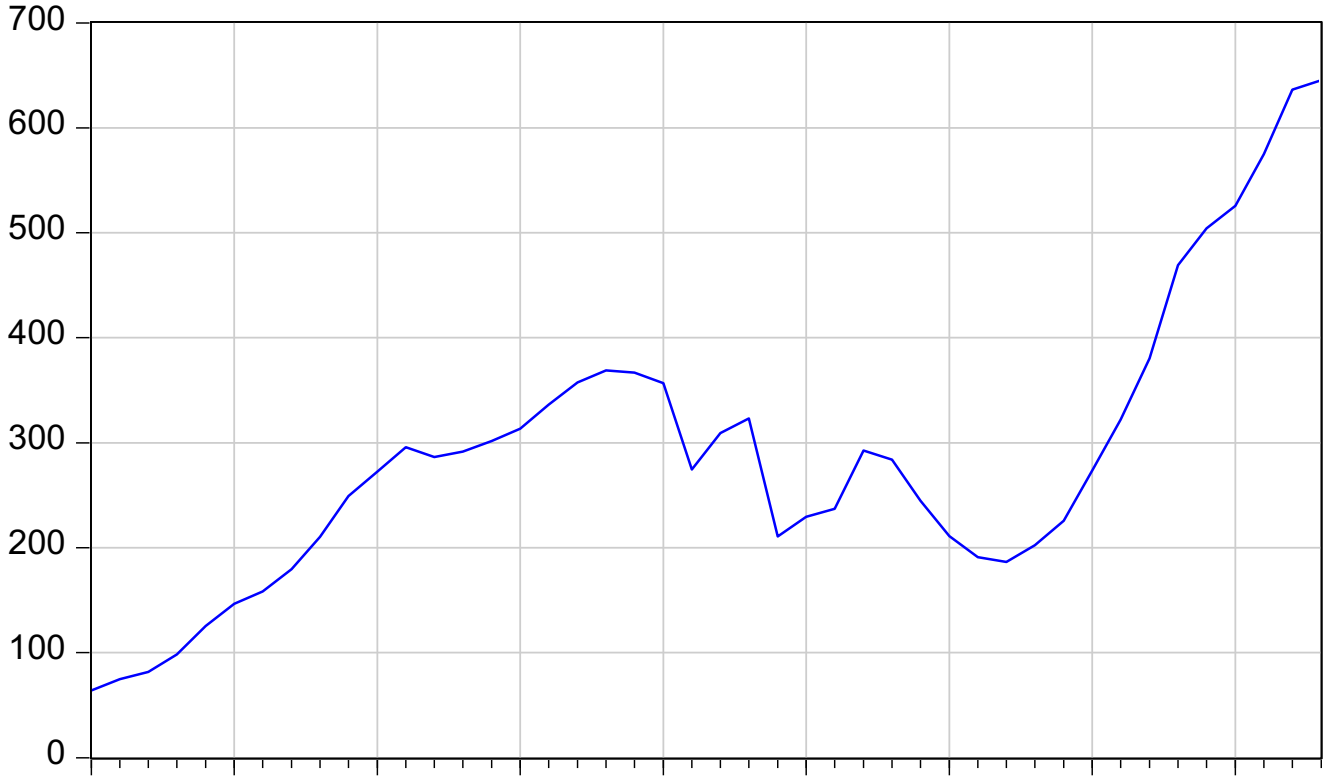
The fastest-growing region

East Asia is the world's fastest-growing region, with GDP growth estimated at 6.1 per cent in 2014. In the outlook period, the region is projected to see stable growth of 6.1 per cent in 2015 and 6.0 per cent in 2016. China's transition to more moderate growth is expected to be partly offset by higher growth in other economies, where investment and exports will likely strengthen as activity in developed countries improves. Household consumption is expected to remain strong in most economies, supported by mild inflation, robust labour markets and generally low real interest rates, even as monetary conditions will likely become less accommodative, in line with the normalization of monetary policy in the United States. Fiscal policy is expected to remain mildly supportive of growth and most countries have sufficient space to provide additional stimulus, if necessary. The key down-side risks for East Asia are related to the upcoming tightening of global liquidity conditions, which could result in weaker growth of domestic consumption and investment, and to a sharper-than-expected slowdown of the Chinese economy.

Rwandan and Japan Per capita growth 1970-2013

Rwanda

Figure 4 Rwandan GDP per capita from 1970 to 2013



Considering the above figure, the Rwandan Per capita was increased from 64.11USD in 1970 to 645.43 USD in 2013, with the following scenarios:

From 1970 to 1979: in this post colonial decade, the Rwandan economy (Per capita) was in boom period, where the per capita increased from 64.11 USD to 249.29USD, where the increment average per year was 18.52 USD.

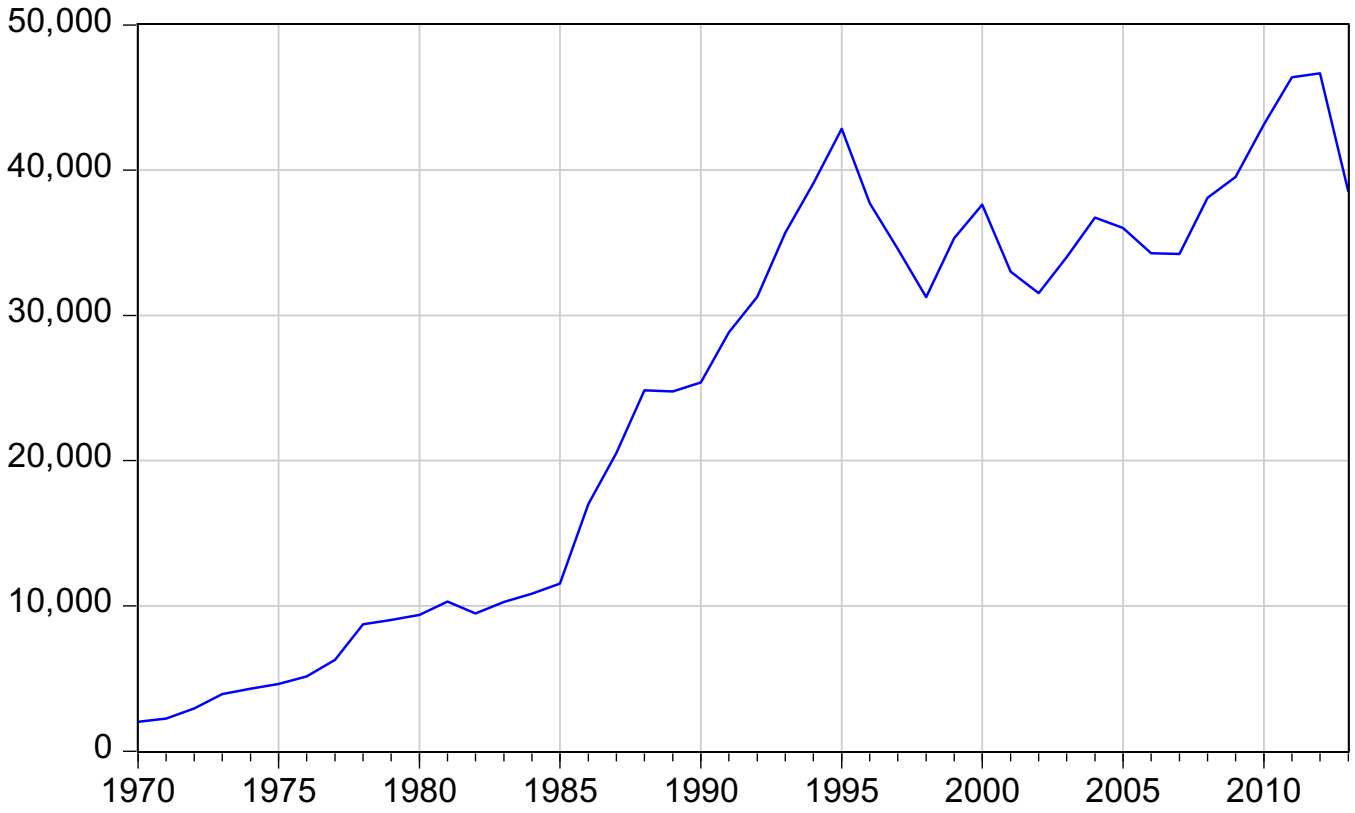
From 1980 to 1989: this decade also was a Rwandan economic boom period, where the per capita increased from 272.52 USD to 366.83USD, where the increment average per year was 9.43 USD. In this decade, the increment average per year reduced more than a half comparing with the previous one.

From 1990 to 1999: this decade was a Rwandan economic recession period, where the per capita decreased from 356.64 USD to 244.58 USD, where the decrement average per year was 11.21 USD. In this decade, the recession was due to the catastrophic fall down of the national economy caused by the Rwandan 1990 civil war and the genocide of 1994 and post war scenarios.

From 2000 to 2013: this period was a Rwandan economic boom period, with economy recover, where the per capita increased from 210.95 USD to 645.43USD, 31.03 USD increment average per year. In this period, increment average per year was more than those for other booms periods dues to more economic efforts established by the Rwandan government to recover the country economy after the Rwandan 1990 civil war and the genocide of 1994.

Japan

Figure 5 Japan GDP per capita from 1970 to 2013



Analyzing the above figure, the Japan Per capita was increased from 2015.96 USD in 1970 to 38527.56 USD in 2013, with the following scenarios:

From 1970 to 1979: in this post second World War and the effects of the atomic bombs launched at Nagasaki and Hiroshima in 1945, the Japan economy (Per capita) was in boom period, where the per capita increased from 2015.96 USD to 9021.85 USD, where the increment average per year was 100.59 USD.

From 1980 to 1989: this decade also was a Japan economic boom period, where the per capita increased from 9377.69 USD to 24764.21 USD, where the increment average per year was

1538.65 USD. In this decade, the increment average per year increased more than 15 times comparing with the previous one.

From 1990 to 1999: this decade was a Japan economic boom once again, where the per capita increase from 25388.27 USD to 35324.74 USD, where the increment average per year was 993.65 USD. In this decade, the increment average per year reduced more than a half comparing with the previous one.

From 2000 to 2013: this period was a Japan economic slow boom period. In this period, Japan was adversely affected by global economic crisis, where the per capita increased from 37634.42 USD to 38527.57 USD, 63.80 USD increment average per year. In this period, increment average per year was very slow with a recession period from 46663.04 USD in 2012 to 38527.56 in 2013, due to the global economic crisis.

Comparing the evolution of GDP per capita for Japan and Rwanda, taking the year 1970 the per capita rate for Japan and Rwanda was 2016/64 = 31 i.e. the Japan per capita in 1970 was 31 times that one for Rwanda and in 2013, the rate becomes 38428/645=60, i.e. the Japan per capita in 2013 becomes 60 times that for Rwanda which imply an increase rate rounding 100%.

3.2. Data description and sources

The data used in the present study include secondary data collected from the United Nation Statistics (Division, 2013) in National accounts main aggregate database on Gross Domestic Product per capita (Y_1), as explained variable and consumption (X_1), Gross capital formation (X_2), Exports of goods and services (X_3) and imports of goods and services (X_4) as explanatory for Rwanda and Japan on the period of 1970-2013.

The cointegrated data used in the research consists of a time series data covering 44 years, ranging from 1970 to 2013. This period marks a turning point in the history for economy of the two countries: Japan and Rwanda as developed and developing counties respectively.

Results of this study were obtained by developing **Johansen cointegration**: stationary test, VAR specification, and diagnostic statistics of VAR, determination of number of cointegrating vectors from VECM and test long-term restrictions.

3.3. Stationary test

Now the stationary test is the precondition of Johansen test where variables must be no-stationary at level but when we convert the variables into first difference then they will become stationary.

Using Augmented Dickey Fuller (ADF) Test, we have the Hypothesis:

H_0 : Variable is not stationary or got unit root

H_1: Variable is stationary.

Using Eview unit root test and ADF type, we test each variable, if the absolute test statistics is more than the absolute critical value and the P-value is less than 5% then we reject null hypothesis and accept alternative but if absolute test statistics is less than the absolute critical value then we accept null hypothesis and reject alternative.

Now for Rwandan GDP Per capita (Y_1) and its explanatory variables X_1, X_2, X_3 and X_4 after ADF test type we have:

Table 2 Stationary test for original data for Rwanda Using ADF test

Variables	test equation	t-Statistic	Absolute Test critical values at 5% level	P-value	Conclusion
Y_1	Intercept	0.470071	2.931404	0.9837	Confusion on Stationarity
	Trend and Intercept	0.303845	3.518090	0.9880	
	None	2.498833	1.948686	0.9964	
X_1	Intercept	0.378391	2.933158	0.9766	Not Stationary
	Trend and Intercept	0.930496	3.520787	0.9427	
	None	1.419986	1.948886	0.9590	
X_2	Intercept	3.984938	2.931404	1.0000	Confusion on Stationarity
	Trend and Intercept	2.080253	3.518090	1.0000	
	None	5.276487	1.948686	1.0000	
X_3	Intercept	4.319194	2.935001	1.0000	Confusion on Stationarity
	Trend and Intercept	3.005386	3.523623	1.0000	
	None	4.755928	1.949097	1.0000	
X_4	Intercept	3.300476	2.931404	1.0000	Confusion on Stationarity
	Trend and Intercept	1.309619	3.518090	0.9999	
	None	4.614785	1.948686	1.0000	

Now using our ADF test we realize that there is confusion on the stationary test and to move the confusion on stationarity we use other alternative test for stationarity which is the correlogram test.

Using Correlogram Test, we have the Hypothesis:

Now H_0: is variable is stationary

H_1: Variable is not stationary

We check each variable at (raw or initially data) and we reject H_0 at 5 % level of significance if P < 5%

Table 3 Stationary tests for original data for Rwanda using correlogram (Consumption expenditure x_1, Gross capital formation ($X_{2)}$, Exports of goods and services(X_3), Imports of goods and services ($X_{4)}$ and GDP per (Y_1))

Output for X1
Date: 08/13/15 Time: 15:28
Sample: 1970 2013
Included observations: 44

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |****** |	. |****** |	1	0.871	0.871	35.707	0.000
. |***** |	.*| . |	2	0.721	-0.156	60.751	0.000
. |**** |	. | . |	3	0.583	-0.029	77.540	0.000
. |*** |	.*| . |	4	0.448	-0.083	87.710	0.000
. |** |	.*| . |	5	0.318	-0.071	92.972	0.000
. |*. |	. | . |	6	0.210	-0.010	95.316	0.000
. |*. |	. | . |	7	0.127	0.007	96.202	0.000
. | . |	. | . |	8	0.063	-0.011	96.425	0.000
. | . |	. | . |	9	0.020	0.015	96.447	0.000
. | . |	. | . |	10	-0.006	0.008	96.449	0.000
. | . |	. | . |	11	-0.021	-0.006	96.475	0.000
. | . |	. | . |	12	-0.027	0.003	96.521	0.000
. | . |	. | . |	13	-0.033	-0.023	96.591	0.000
. | . |	. | . |	14	-0.037	-0.009	96.684	0.000
. | . |	. | . |	15	-0.044	-0.024	96.822	0.000
. | . |	. | . |	16	-0.052	-0.010	97.014	0.000
. | . |	. | . |	17	-0.050	0.029	97.199	0.000
. | . |	. |*. |	18	-0.021	0.105	97.232	0.000
. | . |	. | . |	19	0.016	0.035	97.254	0.000
. | . |	. | . |	20	0.041	-0.030	97.392	0.000

Output for X_2
Date: 08/13/15 Time: 15:32
Sample: 1970 2013
Included observations: 44

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |****** |	. |****** |	1	0.837	0.837	32.993	0.000
. |***** |	.*| . |	2	0.667	-0.115	54.411	0.000
. |**** |	. | . |	3	0.537	0.036	68.634	0.000
. |*** |	. | . |	4	0.419	-0.053	77.512	0.000
. |** |	.*| . |	5	0.284	-0.130	81.706	0.000
. |*. |	.*| . |	6	0.145	-0.109	82.827	0.000
. | . |	. |*. |	7	0.069	0.090	83.085	0.000
. | . |	. | . |	8	0.019	-0.012	83.105	0.000
. | . |	. | . |	9	-0.019	0.009	83.126	0.000
. | . |	. | . |	10	-0.043	0.009	83.236	0.000
. | . |	. | . |	11	-0.056	-0.020	83.426	0.000
.*| . |	. | . |	12	-0.066	-0.044	83.703	0.000
.*| . |	. | . |	13	-0.074	-0.005	84.062	0.000
.*| . |	. | . |	14	-0.090	-0.052	84.603	0.000
.*| . |	. | . |	15	-0.097	0.003	85.265	0.000
.*| . |	. | . |	16	-0.100	-0.002	85.987	0.000
.*| . |	. | . |	17	-0.096	0.009	86.682	0.000
.*| . |	. | . |	18	-0.077	0.043	87.141	0.000
. | . |	. | . |	19	-0.043	0.051	87.293	0.000
. | . |	. | . |	20	-0.002	0.035	87.293	0.000

Output for X_3

Date: 08/13/15 Time: 15:42

Sample: 1970 2013

Included observations: 44

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |****** |	. |****** |	1	0.809	0.809	30.780	0.000
. |***** |	. | . |	2	0.661	0.021	51.850	0.000
. |**** |	.*| . |	3	0.518	-0.066	65.087	0.000
. |*** |	. |*. |	4	0.433	0.078	74.564	0.000
. |** |	. | . |	5	0.347	-0.035	80.821	0.000
. |*. |	**| . |	6	0.193	-0.262	82.799	0.000
. |*. |	. |*. |	7	0.118	0.111	83.563	0.000
. | . |	. | . |	8	0.048	-0.024	83.691	0.000
. | . |	.*| . |	9	-0.011	-0.101	83.699	0.000
. | . |	. | . |	10	-0.047	0.065	83.831	0.000
. | . |	. | . |	11	-0.064	0.063	84.082	0.000
.*| . |	.*| . |	12	-0.078	-0.112	84.465	0.000
.*| . |	. | . |	13	-0.094	0.007	85.048	0.000
.*| . |	. | . |	14	-0.095	0.055	85.656	0.000
.*| . |	.*| . |	15	-0.096	-0.084	86.293	0.000
.*| . |	. | . |	16	-0.096	-0.022	86.955	0.000
.*| . |	. | . |	17	-0.101	0.036	87.712	0.000
.*| . |	. | . |	18	-0.086	0.002	88.286	0.000
.*| . |	. | . |	19	-0.067	-0.009	88.644	0.000
. | . |	. | . |	20	-0.043	0.066	88.799	0.000

Output for X_4

Date: 08/13/15 Time: 15:42

Sample: 1970 2013

Included observations: 44

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |****** |	. |****** |	1	0.851	0.851	34.056	0.000
. |***** |	.*| . |	2	0.694	-0.108	57.240	0.000
. |**** |	. | . |	3	0.564	0.006	72.915	0.000
. |*** |	. | . |	4	0.441	-0.061	82.764	0.000
. |** |	.*| . |	5	0.319	-0.078	88.060	0.000
. |*. |	.*| . |	6	0.203	-0.071	90.247	0.000
. |*. |	. |*. |	7	0.136	0.089	91.262	0.000
. |*. |	. | . |	8	0.084	-0.028	91.659	0.000
. | . |	. | . |	9	0.048	0.020	91.789	0.000
. | . |	. | . |	10	0.028	0.015	91.835	0.000
. | . |	. | . |	11	0.022	0.016	91.866	0.000
. | . |	. | . |	12	0.018	-0.020	91.887	0.000
. | . |	. | . |	13	0.014	0.002	91.900	0.000
. | . |	. | . |	14	0.018	0.018	91.922	0.000
. | . |	. | . |	15	0.009	-0.051	91.927	0.000
. | . |	. | . |	16	0.001	0.010	91.927	0.000
. | . |	. | . |	17	-0.011	-0.024	91.937	0.000
. | . |	. | . |	18	-0.007	0.053	91.940	0.000
. | . |	. | . |	19	-0.011	-0.037	91.950	0.000
. | . |	.*| . |	20	-0.064	-0.170	92.297	0.000

Output for Y_1

Date: 08/13/15 Time: 15:48

Sample: 1970 2013

Included observations: 44

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |****** |	. |****** |	1	0.854	0.854	34.334	0.000
. |***** |	.*| . |	2	0.686	-0.160	57.020	0.000
. |**** |	. | . |	3	0.529	-0.054	70.821	0.000
. |*** |	.*| . |	4	0.374	-0.099	77.900	0.000
. |** |	.*| . |	5	0.220	-0.110	80.410	0.000
. | . |	.*| . |	6	0.071	-0.107	80.677	0.000
. | . |	. | . |	7	-0.040	0.010	80.763	0.000
.*| . |	. | . |	8	-0.121	-0.027	81.586	0.000
.*| . |	. | . |	9	-0.176	-0.011	83.371	0.000
.*| . |	. | . |	10	-0.202	0.007	85.796	0.000
**| . |	. | . |	11	-0.211	-0.025	88.522	0.000
.*| . |	. | . |	12	-0.205	-0.015	91.169	0.000
.*| . |	. | . |	13	-0.195	-0.042	93.656	0.000
.*| . |	. | . |	14	-0.181	-0.021	95.856	0.000
.*| . |	. | . |	15	-0.163	-0.022	97.709	0.000
.*| . |	. | . |	16	-0.152	-0.044	99.379	0.000
.*| . |	. | . |	17	-0.132	0.017	100.69	0.000
.*| . |	. |*. |	18	-0.069	0.160	101.07	0.000
. | . |	. | . |	19	0.009	0.071	101.07	0.000
. |*. |	. |*. |	20	0.094	0.087	101.82	0.000

Now, all Correlograms for ,X_1 X_2 X_3,X_4 and Y_1 are with the Prob. of = 0.00 less than 0.05 then on the all variables, H_0 is rejected thus conclude that X_1 X_2 X_3,X_4 and Y_1 are not stationary.

For Japan GDP Per capita (Y_1) and its explanatory variables X_1, X_2, X_3 and X_4 after ADF test as seen in the below table.

Table 4 Stationary test for original data for Japan Using ADF test

Variables	test equation	t-Statistic	Absolute Test critical values at 5% level	P-value	Conclusion
Y_1	Intercept	1.506478	2.933158	0.5206	Not Stationary
	Trend and Intercept	1.938129	3.520787	0.6170	
	None	0.149528	1.948886	0.7243	
X_1	Intercept	0.896594	2.935001	0.7794	Not Stationary
	Trend and Intercept	2.955881	3.520787	0.1564	
	None	1.015725	1.949097	0.9157	
X_2	Intercept	1.509235	2.931404	0.5195	Not Stationary
	Trend and Intercept	0.869270	3.518090	0.9503	
	None	0.553546	1.948686	0.8318	
X_3	Intercept	0.441939	2.931404	0.8925	Confusion on Stationarity
	Trend and Intercept	3.573404	3.518090	0.0442	
	None	1.378938	1.948686	0.9558	
X_4	Intercept	0.416269	2.931404	0.9814	Confusion on Stationarity
	Trend and Intercept	2.063469	3.518090	0.5508	
	None	3.615023	1.949097	0.9998	

By doing the same as in the Rwandan data we end up by concluding that X_1 X_2 X_3, X4 and Y_1 are not stationary for Japan data.

Table 5 Stationary Test Table at 1st differentiation of Rwandan Data

Variables	test equation	t-Statistic	Absolute Test critical values at 5% level	P-value	Conclusion
Y_1	Intercept	4.617257	2.933158	0.0006	Stationary
	Trend and Intercept	4.647270	3.520787	0.0030	
	None	4.215240	1.948886	0.0001	
X_1	Intercept	4.664594	2.935001	0.0005	Stationary
	Trend and Intercept	4.504818	3.523623	0.0045	
	None	4.072536	1.949097	0.0001	
X_2	Intercept	4.598185	2.933158	0.0006	Stationary
	Trend and Intercept	4.715631	3.520787	0.0025	

Variables	**test equation**	t-Statistic	Absolute Test critical values at 5% level	P-value	Conclusion
	None	4.494109	1.948886	0.0000	
X_3	Intercept	8.401066	2.933158	0.0000	Stationary
	Trend and Intercept	3.870548	3.552973	0.0250	
	None	7.444237	1.948886	0.0000	
X_4	Intercept	7.271581	2.933158	0.0000	Stationary
	Trend and Intercept	6.900266	3.523623	0.0000	
	None	6.465209	1.948886	0.0000	

Table 6 Stationary Test Table at 1st differentiation of Japan Data

Variables	**test equation**	t-Statistic	Absolute Test critical values at 5% level	P-value	Conclusion
Y_1	Intercept	3.863254	2.933158	0.0049	Stationary
	Trend and Intercept	3.843615	3.520787	0.0238	
	None	3.708574	1.948886	0.0004	
X_1	Intercept	4.664594	2.935001	0.0005	Stationary
	Trend and Intercept	4.504818	3.523623	0.0045	
	None	4.072536	1.949097	0.0001	
X_2	Intercept	4.598185	2.933158	0.0006	Stationary
	Trend and Intercept	4.715631	3.520787	0.0025	
	None	4.494109	1.948886	0.0000	
X_3	Intercept	8.401066	2.933158	0.0000	Stationary
	Trend and Intercept	3.870548	3.552973	0.0250	
	None	7.444237	1.948886	0.0000	
X_4	Intercept	7.271581	2.933158	0.0000	Stationary
	Trend and Intercept	6.900266	3.523623	0.0000	
	None	6.465209	1.948886	0.0000	

Now, our Johansen precondition is satisfied where variables are not-stationary at level but when we convert the variables into first difference they become stationary, i.e. our variables are integrated of

same order so now, we precede by running the Johansen's test of cointegration as the precondition is satisfied after specification of the appropriate lag length of our models .

3.4. Lag Length Selection process

The lag length selection process criteria consist of important step, where information criteria are often used as a guide in model selection.

There are different tests that would indicate the optimal number of lags. The study utilizes the sequential modified LR test statistic (each test at 5% level) (LR), Final prediction error (FPE), Akaine information criterion (AIC), Schwarz information criterion and Hannan-Quinn information criterion (HQ) to ensure sufficient power to the Johansen procedure. The following tables display the results.

Table 7 Lag recommended for Rwandan data

VAR Lag Order Selection Criteria

Endogenous variables: Y1 X1 X2 X3 X4

Exogenous variables: C

Date: 08/13/15 Time: 17:15

Sample: 1970 2013

Included observations: 41

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-3534.040	NA	6.49e+68	172.6361	172.8451	172.7122
1	-3358.646	299.4524	4.28e+65	165.2998	166.5537*	165.7564
2	-3318.228	59.14972	2.13e+65	164.5477	166.8464	165.3847
3	-3266.291	63.33679*	6.67e+64*	163.2337*	166.5773	164.4513*

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

According to the above lags output, we precise the preferable lag, by regarding the one recommended by most of different tests that would indicate the optimal number of lags looking on the location of * sign as lag order selected by the criterion. Thus, the most lag order selected by the criterion for Rwandan variables is Lag 3.

Table 8 Lag recommended for Japan data

VAR Lag Order Selection Criteria

Endogenous variables: Y1 X1 X2 X3 X4

Exogenous variables: C

Date: 08/13/15 Time: 17:27

Sample: 1970 2013

Included observations: 41

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-4717.218	NA	7.56e+93	230.3521	230.5611	230.4282
1	-4487.176	392.7545	3.46e+89	220.3501	221.6039*	220.8066
2	-4443.337	64.15509*	1.46e+89*	219.4311*	221.7298	220.2681*
3	-4419.337	29.26764	1.78e+89	219.4799	222.8234	220.6974

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

As the same as Rwandan data , according to the above lags output, we precise the preferable lag, by regarding the one recommended by most of different tests that would indicate the optimal number of lags looking on the location of * sign as lag order selected by the criterion. Thus, the most lag order selected by the criterion for Japan variables is Lag 2.

According to the output the Lag recommended for Japan variables is Lag 2.

Recall that, for Rwanda as well as Japan our variables are not stationary at level (initially), but when we convert all the variables into first difference, those variables become stationary, i.e. for our two countries our variables are integrated on the same order. Now, our Johansen precondition is satisfied, we precede by running the Johansen's test of cointegration as also the appropriate lag length of our models are specified.

3.5. Johansen Cointegration test

For Johansen Cointegration test, if the trace statistic is more than the critical value we reject the number of cointegrated equations; we can check also probability value if less than 5%; we reject the number of cointegrated equations.

Table 9 Johansen Cointegration test for Rwandan data

The Eviews output for the test is:

Date: 08/13/15 Time: 17:34

Sample (adjusted): 1974 2013

Included observations: 40 after adjustments

Trend assumption: Linear deterministic trend

Series: Y1 X1 X2 X3 X4

Lags interval (in first differences): 1 to 3

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.663264	93.85919	69.81889	0.0002
At most 1 *	0.411281	50.32094	47.85613	0.0288
At most 2	0.319233	29.12870	29.79707	0.0596
At most 3	0.279644	13.74730	15.49471	0.0901
At most 4	0.015550	0.626890	3.841466	0.4285

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Regarding the above output on Rwandan data, considering our guidelines; for non cointegrating equations option; the trace statistic is more than the critical value, we check also the probability value if less than 5%. Now we reject the non cointegrating equations option.

For one cointegrating equations option; the trace statistic is more than the critical value, we check also the probability value if less than 5%. Now we reject the one cointegrating equation option.

For two cointegrating equations option; the trace statistic is less than the critical value, we check also the probability value if more than 5%. Now we accept the two cointegrating equations option. Now, the test indicates 2 cointegrating equations at the 0.05 level for Rwandan data

Table 10Japan data Johansen Cointegration test

The Eviews output for the test is:

Date: 08/13/15 Time: 17:59
Sample (adjusted): 1973 2013
Included observations: 41 after adjustments
Trend assumption: Linear deterministic trend
Series: Y1 X1 X2 X3 X4
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.552935	71.98461	69.81889	0.0332
At most 1	0.400933	38.97749	47.85613	0.2612
At most 2	0.226586	17.96985	29.79707	0.5683
At most 3	0.142921	7.435284	15.49471	0.5276
At most 4	0.026759	1.112059	3.841466	0.2916

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

As in previous on Rwandan data, the test indicate 1 cointegrating equation for Japan data.

Then in our variables for 2 counties, Rwanda and Japan, there are at most 2 and 1 cointegrating equations respectively or our variables have the long run association ship or in the long run they move together.

We know that, if the variables are cointegrated or have long run association ship, then we can run the Restrict VAR i.e. VECM model. But if the variables are not cointegrated, we cannot run VECM model, rather we shall run unrestricted VAR.

So as the cointegration is satisfied, we run the Restrict VAR i.e. VECM for Rwandan data as well as Japan.

3.6. Running for Vector error correction model (VECM)

Using quick command of EViews we run the VECM for our countries as shown with the below tables:

Table 11 Rwandan data VECM estimates

Vector Error Correction Estimates

Date: 08/13/15 Time: 18:17

Sample (adjusted): 1974 2013

Included observations: 40 after adjustments

Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1	CointEq2
Y1(-1)	1.000000	0.000000
X1(-1)	0.000000	1.000000

X2(-1)	3.18E-07	-0.540228
	(3.3E-07)	(1.36197)
	[0.94996]	[-0.39665]
X3(-1)	-1.81E-06	-1.719660
	(7.6E-07)	(3.08989)
	[-2.39198]	[-0.55654]
X4(-1)	8.68E-08	-1.614295
	(1.5E-07)	(0.59456)
	[0.59477]	[-2.71509]
C	-72.14809	-7.13E+08

Error Correction:	D(Y1)	D(X1)	D(X2)	D(X3)	D(X4)
CointEq1	-0.644870	-4726949.	-1730675.	-817341.7	-1968926.
	(0.22042)	(1230621)	(574874.)	(496876.)	(470883.)
	[-2.92562]	[-3.84111]	[-3.01053]	[-1.64496]	[-4.18135]
CointEq2	6.86E-08	0.818442	0.200219	0.002462	0.400231
	(5.1E-08)	(0.28229)	(0.13187)	(0.11398)	(0.10802)

	[1.35590]	[2.89927]	[1.51830]	[0.02160]	[3.70530]
D(Y1(-1))	-0.938613	-6800128.	-2643040.	612247.3	3879109.
	(0.76053)	(4246081)	(1983519)	(1714398)	(1624713)
	[-1.23415]	[-1.60151]	[-1.33250]	[0.35712]	[2.38757]
D(Y1(-2))	1.699178	19018343	2199433.	-3685437.	4763414.
	(1.29974)	(7256491)	(3389805)	(2929881)	(2776611)
	[1.30732]	[2.62087]	[0.64884]	[-1.25788]	[1.71555]
D(Y1(-3))	1.603087	8331575.	3756451.	1490059.	-271048.3
	(1.02366)	(5715123)	(2669769)	(2307538)	(2186825)
	[1.56604]	[1.45781]	[1.40703]	[0.64574]	[-0.12395]
D(X1(-1))	1.36E-07	0.787785	0.463369	0.088900	-0.605981
	(1.2E-07)	(0.66002)	(0.30832)	(0.26649)	(0.25255)
	[1.15384]	[1.19357]	[1.50286]	[0.33359]	[-2.39944]
D(X1(-2))	-3.24E-07	-3.220495	-0.363776	0.657212	-0.582316
	(2.2E-07)	(1.22135)	(0.57054)	(0.49313)	(0.46734)
	[-1.47990]	[-2.63683]	[-0.63760]	[1.33273]	[-1.24603]

D(X1(-3))	-1.83E-07	-1.190015	-0.470589	-0.293075	-0.045052
	(1.6E-07)	(0.88484)	(0.41335)	(0.35726)	(0.33857)
	[-1.15155]	[-1.34489]	[-1.13849]	[-0.82033]	[-0.13306]
D(X2(-1))	2.72E-07	3.313099	0.507914	-0.074343	0.823805
	(2.0E-07)	(1.09582)	(0.51190)	(0.44245)	(0.41930)
	[1.38802]	[3.02339]	[0.99221]	[-0.16803]	[1.96470]
D(X2(-2))	7.03E-09	0.941547	-0.101378	0.037427	0.632843
	(1.6E-07)	(0.91309)	(0.42654)	(0.36867)	(0.34938)
	[0.04300]	[1.03117]	[-0.23767]	[0.10152]	[1.81132]
D(X2(-3))	7.47E-08	1.752960	-0.175414	-0.314508	0.459797
	(1.6E-07)	(0.88274)	(0.41237)	(0.35642)	(0.33777)
	[0.47243]	[1.98581]	[-0.42538]	[-0.88241]	[1.36126]
D(X3(-1))	-4.95E-07	-2.321250	-1.375638	-1.929789	-2.311408
	(3.3E-07)	(1.83795)	(0.85858)	(0.74209)	(0.70327)
	[-1.50309]	[-1.26296]	[-1.60222]	[-2.60048]	[-3.28666]
D(X3(-2))	-5.30E-07	-4.888672	-1.538868	-0.771308	-2.324603
	(3.0E-07)	(1.65673)	(0.77393)	(0.66892)	(0.63393)

	[-1.78710]	[-2.95079]	[-1.98839]	[-1.15306]	[-3.66698]
D(X3(-3))	-3.13E-07	-2.168544	-0.997487	-0.786666	-0.938171
	(3.0E-07)	(1.67260)	(0.78134)	(0.67533)	(0.64000)
	[-1.04508]	[-1.29651]	[-1.27663]	[-1.16486]	[-1.46589]
D(X4(-1))	-2.99E-07	-2.961380	-0.602715	0.238356	-0.140159
	(1.6E-07)	(0.90043)	(0.42063)	(0.36356)	(0.34454)
	[-1.85280]	[-3.28885]	[-1.43289]	[0.65562]	[-0.40680]
D(X4(-2))	3.33E-08	1.262541	0.055858	-0.616594	0.383307
	(1.9E-07)	(1.08030)	(0.50465)	(0.43618)	(0.41336)
	[0.17224]	[1.16869]	[0.11069]	[-1.41361]	[0.92728]
D(X4(-3))	1.95E-07	0.958489	0.465119	0.431644	0.012747
	(1.7E-07)	(0.94910)	(0.44337)	(0.38321)	(0.36316)
	[1.14920]	[1.00989]	[1.04907]	[1.12639]	[0.03510]
C	53.68059	4.16E+08	1.30E+08	59809753	1.61E+08
	(18.3208)	(1.0E+08)	(4.8E+07)	(4.1E+07)	(3.9E+07)
	[2.93004]	[4.06990]	[2.73078]	[1.44822]	[4.11824]

R-squared	0.654761	0.815491	0.729400	0.615901	0.873046
Adj. R-squared	0.387986	0.672916	0.520300	0.319098	0.774944
Sum sq. resids	17765.39	5.54E+17	1.21E+17	9.03E+16	8.11E+16
S.E. equation	28.41686	1.59E+08	74113020	64057465	60706457
F-statistic	2.454352	5.719730	3.488282	2.075115	8.899438
Log likelihood	-178.6801	-800.0898	-769.6449	-763.8124	-761.6632
Akaike AIC	9.834005	40.90449	39.38224	39.09062	38.98316
Schwarz SC	10.59400	41.66449	40.14224	39.85062	39.74316
Mean dependent	13.67326	1.60E+08	49290279	26404553	57402820
S.D. dependent	36.32413	2.77E+08	1.07E+08	77629608	1.28E+08

Determinant resid covariance (dof adj.)	8.15E+63
Determinant resid covariance	4.10E+62
Log likelihood	-3167.224
Akaike information criterion	163.3612
Schwarz criterion	167.5834

For Rwandan data, we have 2 cointegration models: CointEq1and CointEq2.

On our Error correction Model: actually VECM automatically convert the variables into 1st difference and we see that variables were Y_1, X_1,X_2, X_3 and X_4 become: D(Y_1), D(X_1), D(X_2), D(X_3), and D(X_4) respectively, CointEq1and CointEq2 coefficients becomes error correction terms and every variable has 3 lags : D(Y_1(-1)), D(Y_1(-2)), D(Y1(-3)),…… and D(X_4(-3)), then constant (c).

Table 12 Japan data VECM estimates

Vector Error Correction Estimates

Date: 08/13/15 Time: 20:27

Sample (adjusted): 1973 2013

Included observations: 41 after adjustments

Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
Y1(-1)	1.000000
X1(-1)	-6.63E-09
	(2.8E-10)
	[-23.3992]
X2(-1)	-1.06E-08
	(5.2E-10)
	[-20.3925]
X3(-1)	-6.17E-09
	(2.5E-09)
	[-2.42655]
X4(-1)	3.12E-09
	(2.3E-09)

	[1.35022]			
C	-195.3594			

Error Correction:	D(Y1)	D(X1)	D(X2)	D(X3)
CointEq1	-3.038713	-3.60E+08	-23845360	30820462
	(1.44514)	(1.2E+08)	(6.4E+07)	(4.0E+07)
	[-2.10271]	[-3.01917]	[-0.37313]	[0.76538]
D(Y1(-1))	2.386988	1.99E+08	1.59E+08	-32808321
	(6.12890)	(5.1E+08)	(2.7E+08)	(1.7E+08)
	[0.38946]	[0.39298]	[0.58571]	[-0.19211]
D(Y1(-2))	4.567352	3.78E+08	2.54E+08	1.56E+08
	(6.34555)	(5.2E+08)	(2.8E+08)	(1.8E+08)
	[0.71977]	[0.72220]	[0.90398]	[0.88060]
D(X1(-1))	-9.54E-09	-0.586322	-1.028816	0.278754
	(4.8E-08)	(3.95633)	(2.11973)	(1.33565)
	[-0.19902]	[-0.14820]	[-0.48535]	[0.20870]
D(X1(-2))	-4.44E-08	-3.756229	-2.161511	-1.086102
	(5.0E-08)	(4.08992)	(2.19131)	(1.38075)

	[-0.89516]	[-0.91841]	[-0.98640]	[-0.78660]
D(X2(-1))	-3.40E-08	-3.312764	-1.603991	0.090972
	(5.5E-08)	(4.57122)	(2.44917)	(1.54323)
	[-0.61423]	[-0.72470]	[-0.65491]	[0.05895]
D(X2(-2))	-1.42E-08	-0.834097	-1.603550	-1.640765
	(5.7E-08)	(4.66762)	(2.50082)	(1.57578)
	[-0.25067]	[-0.17870]	[-0.64121]	[-1.04124]
D(X3(-1))	-1.12E-09	0.381847	-0.473347	1.278970
	(5.1E-08)	(4.18273)	(2.24103)	(1.41208)
	[-0.02215]	[0.09129]	[-0.21122]	[0.90573]
D(X3(-2))	2.89E-09	0.891134	-0.968940	-0.859928
	(5.1E-08)	(4.22378)	(2.26303)	(1.42594)
	[0.05650]	[0.21098]	[-0.42816]	[-0.60306]
D(X4(-1))	-1.80E-08	-1.972250	0.140581	-1.425950
	(5.3E-08)	(4.38524)	(2.34953)	(1.48045)
	[-0.33887]	[-0.44975]	[0.05983]	[-0.96319]
D(X4(-2))	-2.79E-08	-3.556566	0.587559	1.324375
	(5.7E-08)	(4.66868)	(2.50139)	(1.57614)

	[-0.49341]	[-0.76179]	[0.23489]	[0.84027]
C	1808.412	1.76E+11	4.03E+10	1.44E+10
	(532.734)	(4.4E+10)	(2.4E+10)	(1.5E+10)
	[3.39459]	[4.01208]	[1.70942]	[0.97193]
R-squared	0.686392	0.753370	0.503452	0.441057
Adj. R-squared	0.567437	0.659821	0.315107	0.229045
Sum sq. resids	1.01E+08	6.87E+23	1.97E+23	7.84E+22
S.E. equation	1865.416	1.54E+11	8.25E+10	5.20E+10
F-statistic	5.770195	8.053181	2.673023	2.080335
Log likelihood	-359.8586	-1107.238	-1081.653	-1062.716
Akaike AIC	18.13945	54.59697	53.34891	52.42517
Schwarz SC	18.64098	55.09851	53.85045	52.92671
Mean dependent	868.1529	9.30E+10	2.24E+10	1.86E+10
S.D. dependent	2836.294	2.64E+11	9.97E+10	5.92E+10

Determinant resid covariance (dof adj.)	4.23E+88
Determinant resid covariance	7.49E+87
Log likelihood	-4438.826
Akaike information criterion	219.6988
Schwarz criterion	222.4155

We have the 1 cointegration model, actually VECM automatically convert the variables into 1st difference and we see that every variable has 2 lags.

Contrary to Rwandan data, for Japan we have 1 cointegrated equation: CointEq1.

On our Error correction Model: actually VECM automatically convert the variables into 1st difference and we see that variables was Y_1, X_1,X_2, X_3 and X_4 become: D(Y_1), D(X_1), D(X_2), D(X_3) and D(X_4) respectively, CointEq1 coefficients becomes error correction terms and every variable have 2 lags : D(Y_1(-1)), D(Y_1(-2)), …… and D(X_4(-2)) then constant (c).

The top numbers are coefficients, Standard error is in () and t-statistic in [] and we know according to the formula: coefficient divided by the standard error, it is equal to the t-statistic.

But there is no p value in our output to test the test statistics then to check whether we should reject or accept the H_0.

Now let us include P value using our key dependent models D (Y_1) for Rwanda and D (Y_1) for Japan.

By proc command in EViews, we make system ordered by variable and we are interested on the D (Y_1) model as dependent variable for Rwanda as well as for Japan.

For Rwanda: D(Y1) = C(1)*(Y1(-1) + 3.17681350999e-07*X2(-1) - 1.81476837226e-06*X3(-1) + 8.68301284687e-08*X4(-1) - 72.1480949039) + C(2)*(X1(-1) - 0.540228434785*X2(-1) - 1.71965992886*X3(-1) - 1.61429473141*X4(-1) - 713425422.34) + C(3)*D(Y1(-1)) + C(4)*D(Y1(-2)) + C(5)*D(Y1(-3)) + C(6)*D(X1(-1)) + C(7)*D(X1(-2)) + C(8)*D(X1(-3)) + C(9)*D(X2(-1)) + C(10)*D(X2(-2)) + C(11)*D(X2(-3)) + C(12)*D(X3(-1)) + C(13)*D(X3(-2)) + C(14)*D(X3(-3)) + C(15)*D(X4(-1)) + C(16)*D(X4(-2)) + C(17)*D(X4(-3)) + C(18)

From C (1) to C (18) those are the coefficients then there are 18 coefficients will be estimated and this is called the system equation model

For Japan: D(Y1) = C(1)*(Y1(-1) - 6.6331296923e-09*X1(-1) - 1.05755660779e-08*X2(-1) - 6.17054573189e-09*X3(-1) + 3.1182941265e-09*X4(-1) - 195.359383259) + C(2)*D(Y1(-1)) + C(3)*D(Y1(-2)) + C(4)*D(X1(-1)) + C(5)*D(X1(-2)) + C(6)*D(X2(-1)) + C(7)*D(X2(-2)) + C(8)*D(X3(-1)) + C(9)*D(X3(-2)) + C(10)*D(X4(-1)) + C(11)*D(X4(-2)) + C(12)

By ordering variables we got a system equation model where our interest is on D (Y_1) as dependent variable. So, we continue our task with the D (Y_1) as dependent variable to estimate coefficients values and causality test. Using Eviews quick command, we estimate the equation then run our model and we get the results below.

Table 13 Rwandan data coefficients values and Long run causality test

Dependent Variable: D(Y1)

Method: Least Squares

Date: 08/13/15 Time: 18:43

Sample (adjusted): 1974 2013

Included observations: 40 after adjustments

D(Y1) = C(1)*(Y1(-1) + 3.17681350999E-07*X2(-1) - 1.81476837226E-06 *X3(-1) + 8.68301284687E-08*X4(-1) - 72.1480949039) + C(2)*(X1(-1) - 0.540228434785*X2(-1) - 1.71965992886*X3(-1) - 1.61429473141 *X4(-1) - 713425422.34) + C(3)*D(Y1(-1)) + C(4)*D(Y1(-2)) + C(5) *D(Y1(-3)) + C(6)*D(X1(-1)) + C(7)*D(X1(-2)) + C(8)*D(X1(-3)) + C(9) *D(X2(-1)) + C(10)*D(X2(-2)) + C(11)*D(X2(-3)) + C(12)*D(X3(-1)) + C(13)*D(X3(-2)) + C(14)*D(X3(-3)) + C(15)*D(X4(-1)) + C(16)*D(X4(-2)) + C(17)*D(X4(-3)) + C(18)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.644870	0.220421	-2.925622	0.0078
C(2)	6.86E-08	5.06E-08	1.355900	0.1889
C(3)	-0.938613	0.760533	-1.234152	0.2302
C(4)	1.699178	1.299739	1.307322	0.2046
C(5)	1.603087	1.023659	1.566037	0.1316
C(6)	1.36E-07	1.18E-07	1.153843	0.2609
C(7)	-3.24E-07	2.19E-07	-1.479895	0.1531
C(8)	-1.83E-07	1.58E-07	-1.151551	0.2619
C(9)	2.72E-07	1.96E-07	1.388017	0.1790
C(10)	7.03E-09	1.64E-07	0.042999	0.9661
C(11)	7.47E-08	1.58E-07	0.472426	0.6413
C(12)	-4.95E-07	3.29E-07	-1.503088	0.1470
C(13)	-5.30E-07	2.97E-07	-1.787102	0.0877
C(14)	-3.13E-07	3.00E-07	-1.045080	0.3073
C(15)	-2.99E-07	1.61E-07	-1.852798	0.0774
C(16)	3.33E-08	1.93E-07	0.172238	0.8648
C(17)	1.95E-07	1.70E-07	1.149197	0.2628
C(18)	53.68059	18.32080	2.930035	0.0078

R-squared	0.654761	Mean dependent var	13.67326
Adjusted R-squared	0.387986	S.D. dependent var	36.32413
S.E. of regression	28.41686	Akaike info criterion	9.834005
Sum squared resid	17765.39	Schwarz criterion	10.59400
Log likelihood	-178.6801	Hannan-Quinn criter.	10.10880
F-statistic	2.454352	Durbin-Watson stat	1.918619
Prob(F-statistic)	0.024666		

Now C (1) is the error correction term or the speed of adjustment towards the equilibrium.

Table 14 Japan data coefficients values and Long run causality test

Dependent Variable: D(Y1)

Method: Least Squares
Date: 08/13/15 Time: 20:54
Sample (adjusted): 1973 2013
Included observations: 41 after adjustments
D(Y1) = C(1)*(Y1(-1) - 6.6331296923E-09*X1(-1) - 1.05755660779E-08 *X2(-1) - 6.17054573189E-09*X3(-1) + 3.1182941265E-09*X4(-1) - 195.359383259) + C(2)*D(Y1(-1)) + C(3)*D(Y1(-2)) + C(4)*D(X1(-1)) + C(5)*D(X1(-2)) + C(6)*D(X2(-1)) + C(7)*D(X2(-2)) + C(8)*D(X3(-1)) + C(9)*D(X3(-2)) + C(10)*D(X4(-1)) + C(11)*D(X4(-2)) + C(12)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-3.038713	1.445138	-2.102715	0.0443
C(2)	2.386988	6.128897	0.389465	0.6998
C(3)	4.567352	6.345549	0.719773	0.4774
C(4)	-9.54E-09	4.79E-08	-0.199021	0.8436
C(5)	-4.44E-08	4.96E-08	-0.895157	0.3781
C(6)	-3.40E-08	5.54E-08	-0.614234	0.5439
C(7)	-1.42E-08	5.66E-08	-0.250669	0.8038
C(8)	-1.12E-09	5.07E-08	-0.022145	0.9825
C(9)	2.89E-09	5.12E-08	0.056499	0.9553
C(10)	-1.80E-08	5.31E-08	-0.338865	0.7372
C(11)	-2.79E-08	5.66E-08	-0.493410	0.6254
C(12)	1808.412	532.7337	3.394590	0.0020

R-squared	0.686392	Mean dependent var	868.1529
Adjusted R-squared	0.567437	S.D. dependent var	2836.294
S.E. of regression	1865.416	Akaike info criterion	18.13945
Sum squared resid	1.01E+08	Schwarz criterion	18.64098
Log likelihood	-359.8586	Hannan-Quinn criter.	18.32208
F-statistic	5.770195	Durbin-Watson stat	2.144518
Prob(F-statistic)	0.000073		

In our above models, $D(Y_1)$ are our dependent variables and 2^{nd} , 3^{rd} and 4^{th} columns indicate the coefficient values, Standard errors, t-statistics and the prob. respectively. We know that, coefficient values divided by Standard errors, we get t-statistics. Now P-values come up in our above tables, but previously there were no probability values. Those p-values will help us to test for causality.

3.7. Causality test

Recall that C (1) is the error correction term or the speed of adjustment towards the equilibrium.

Now there are two scenarios to discuss:

1. Long run causality
2. short run causality

3.7.1. Long run causality

If the C (1) coefficient is negative in sign with significant probability less than 5%, then we say that, there is long run causality running form X_1, X_2, X_3 and X_4 to Y_1, otherwise there is not.

Now, in our above models for Rwanda as well as Japan, the conditions are satisfied. Then there is long run causality running from X_1, X_2, X_3 and X_4 to Y_1, Which are not preferable for the goodness of our models.

3.7.2. Short run causality

Now, we check whether each of X_1, X_2, X_3 and X_4 has cause on Y_1 separately

Using Wald test in eviews we have:

Table 15 Rwandan data Short run causality results

Test Statistics / *Indep. variables*	***Null Hypothesis H_0: no causality***	***Wald test Chi-square probability value***	***Significance at 5%***	***Conclusion on short run causality to Y_1***
X_1	C(6)=C(7)=C(8)=0	0.0985	Not significant	H_0 accepted : i.e. no short run causality from X_1 to Y_1
X_2	C(9)=C(10)=C(11)=0	0.5761	Not significant	H_0 accepted : i.e. no short run causality from X_2 to Y_1
X_3	C(12)=C(13)=C(14)=0	0.3216	Not significant	H_0 accepted: i.e. no short run causality from X_3 to Y_1
X_4	C(15)=C(16)=C(17)=0	0.0638	Not significant	H_0 accepted: i.e. no short run causality from X_4 to Y_1

Table 16 Japan data Short run causality results

Test Statistics / Indep. variables	***Null Hypothesis H_0: no causality***	***Wald test Chi-square probability value***	***Significance at 5%***	***Conclusion on short run causality to Y_1***
X_1	C(4)=C(5)=0	0.5545	Not significant	H_0 accepted : i.e. no short run causality from X_1 to Y_1
X_2	C(6)=C(7)=0	0.7234	Not significant	H_0 accepted : i.e. no short run causality from X_2 to Y_1
X_3	C(8)=C(10)=0	0.4074	Not significant	H_0 accepted: i.e. no short run causality from X_3 to Y_1
X_4	C(11)=C(12)=0	0.0031	significant	H_0 not accepted: i.e. short run causality from X_4 to Y_1

We test for the short run causality and arrive at conclusion that all independent variables has no short run causality causes each on Y_1 for Rwandan and Japan except X_4 in Japan which has short causality on Y_1.

Thus, there is long run causality, but no short run causality running from X_1, X_2, X_3 and X_4 to Y_1, for Rwandan data and that explain the goodness of our model.

For Japan data, there is long run causality for independents variables on Y_1 and all independent variables has no short run causality cause each on Y_1 except X_4, which has short run causality on Y_1. This long run causality and X_4 short run causality to Y_1 are not preferable for the model goodness.

To remove this confusion of models goodness on the previous tests, we look also on tables: 13 and 14, by doing diagnostic checking of our models we have: R-squared = 0.654761 and Prob. (F-statistic) = 0.024666 for Rwanda and R-squared = 0.686392 and Prob. (F-statistic) =0.000073 for Japan which are acceptable for the models goodness. These imply that, the fitted models explain the real situations at 65.5% and 68.7%, for Rwanda and Japan respectively. We have well fitted models for Japan and Rwanda because R-squared are good and, Prob (F-statistic) are significant at 5% level.

3.8. Serial correlation model on residuals

Using view, Residual diagnostics and serial correlation LM test command, we test the Hypothesis:

Now H_0: The model has Serial correlation model on residuals

H_1: The model has no Serial correlation model on residuals

We check the observed R^2on the P-value, we reject H_0 at 5 % level of significance if

P > 5%

In our below tables, using the above command we check whether our models have serial correlation or not.

Table 17 Rwanda Serial correlation model on residuals results

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.661012	Prob. F(3,19)	0.5861
Obs*R-squared	3.780267	Prob. Chi-Square(3)	0.2862

Table 18 Japan Serial correlation model on residuals results

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.492161	Prob. F(2,27)	0.6167
Obs*R-squared	1.442136	Prob. Chi-Square(2)	0.4862

As shown in the tables above, for Serial correction model test on residuals, we fund that for all our countries p value is greater than 5%, then there is no serial correction in the residuals in all two countries as P value is greater than 5%. This is desirable.

3.9. Heteroskedasticity Test (using Breush pagan Godfrey)

Using View, Residual diagnostics and heteroskedasticity test command by Breush pagan Godfrey type, we test the Hypothesis:

Now H_0: There is no Heteroskedasidisity in the model

H_1: There is Heteroskedasidisity in the model

We check the observed R^2on the P-value, we reject H_0 at 5 % level of significance if

P < 5%

Table 19 Rwandan data Heteroskedasticity Test (using Breush pagan Godfrey)

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.326102	Prob. F(20,19)	0.2711
Obs*R-squared	23.30479	Prob. Chi-Square(20)	0.2741
Scaled explained SS	9.210871	Prob. Chi-Square(20)	0.9803

Table 20 Japan data Heteroskedasticity Test (using Breush pagan Godfrey)

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.644219	Prob. F(15,25)	0.8109
Obs*R-squared	11.42980	Prob. Chi-Square(15)	0.7216
Scaled explained SS	4.999933	Prob. Chi-Square(15)	0.9921

Considering the tables: 19 and 20, after checking the R^2 on P-value > 5%, we cannot reject the null hypothesis then there is no Heteroskedasidisity.

3.10. Normality in the residual test

Finally, using View, Residual diagnostics and histogram normality test command by Jarque-Bera type, we test the Hypothesis:

Now H_0: Residuals are normally distributed

H_1: Residuals are not normally distributed

We check the Jarque-Bera on the P-value, we reject H_0 at 5 % level of significance if

P < 5%

Figure 6 Rwandan data residual normality test

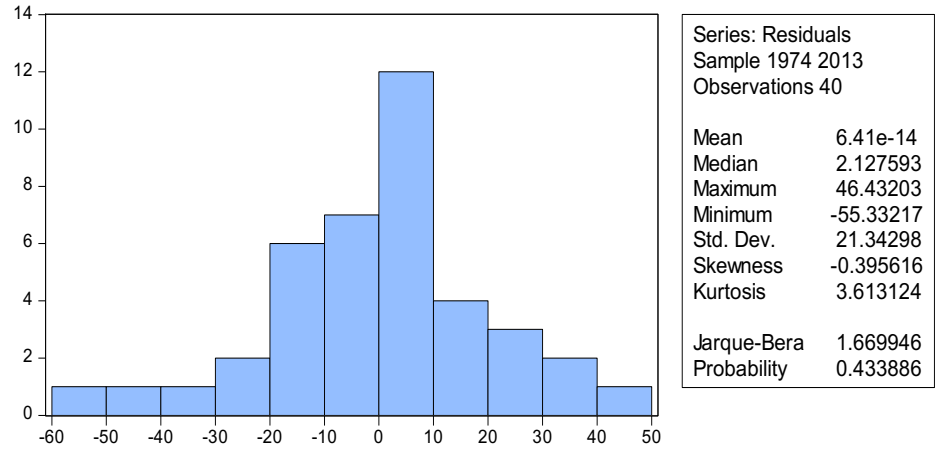
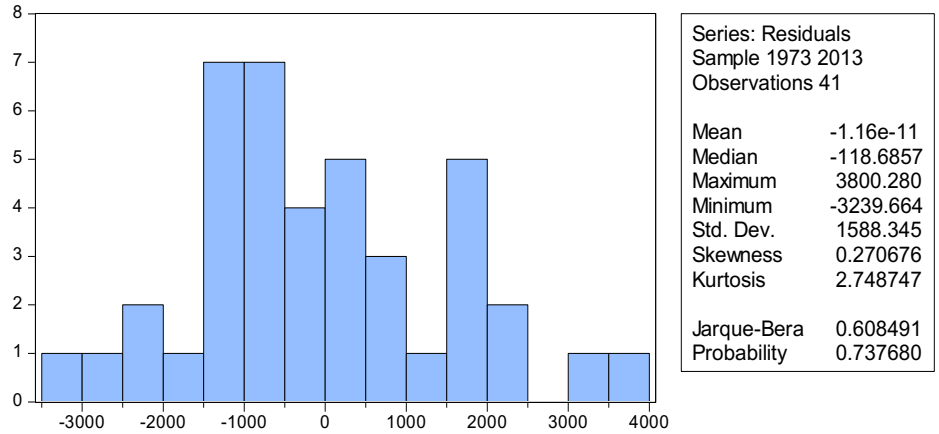


Figure 7 Japan data residual normality test



Looking on the Jarque Bera P values P> 5% on Rwandan Data as well Japan we cannot reject the null hypothesis, then residuals are normally distributed which is desirable.

Now after realizing the goodness of our models of the two countries we run Johansen Long run estimates equations for Rwanda and Japan.

3.11. Johansen Long run estimates equations

After all goodness models checking we realize that, the above testing converge towards to desirable requirements for models to be desirable

Therefore we can run our two countries desirable models.

The Eviews output of Normalized co integrating coefficients (standard error in parentheses) are as follow:

For Rwanda:

Normalized co integrating coefficients (standard error in parentheses)

LY1	LX1	LX2	LX3	LX4
1.000000	-0.085656	-0.112894	-0.345436	0.642320
	(0.11195)	(0.07285)	(0.05854)	(0.05582)

For Japan:

Normalized cointegrating coefficients (standard error in parentheses)

LY1	LX1	LX2	LX3	LX4
1.000000	-0.607843	-0.307452	-0.166597	0.113822
	(0.02413)	(0.01382)	(0.03032)	(0.02147)

NB: the sign will change for our coefficients for independents variables as in the above eviews output they are in the same side with the dependent variable in the equation.

Based on table above, the final preferred long-run equations using the full different goodness tests is as follows, with their respective coefficients and standard errors in parenthesis.

$$Y_1 = \beta_{0t} + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \mu_t$$

Where

Y_1: Gross domestic product per capita

β_{0t}: The intercept which is the starting point

X_1 : Consumption

X_2 : Gross capital formation

X_3 : Exports of goods and services

X_4 : Imports of goods and services

Replacing the coefficients by their values, we get:

Rwanda: $\boldsymbol{Y_1 = \beta_{0t} + 0.085656\, X_1 + 0.112894 X_2 + 0.345436 X_3 - 0.642320 X_4 + \mu_t}$

Japan: $\boldsymbol{Y_1 = \beta_{0t} + 0.607843 X_1 + 0.307452 X_2 + 0.166597 X_3 - 0.113822 X_4 + \mu_t}$

Noting that all the coefficients in estimate Equations have the expected signs.

Comparing the per capita contributors in Rwanda with those for Japan we realize that the more contributor on per capita in Rwanda is with negative effects on the Rwandan per capita which is the imports of goods and services (X_4) with 0.64232 as coefficient, that means when the imports of goods and services are raised by one unit the Rwandan per capita reduce by 0.6423 , while in Japan the more contributor on per capita has a positive effects on their Per capita, that is the Consumption (X_1) with 0.607843 as coefficient, that means in Japan when the consumption (X_1) is raised by one unit their per capita is increased by 0.607843.

In Rwanda the first more positive contributor to per capita is the Exports of goods and services(X_3) with a coefficient of 0.345436, followed by the Gross capital formation (X2), with a coefficient of 0.112894 and then the Consumption (X_1), with a coefficient of 0.085656.

While in the Japan the lower contributor to per capita is the negative effect contributor with 0.113822, this is the Imports of goods and services that means in this developed county the importation is at very low level considering all others contributors to the per capita that means Japan population is more self sufficient than depending on the outside .

We did not be able to forecast right now the situation but we are still working on it as we are expecting some inputs from different sides for example on the goodness of the model in order to predict our situation in the future with a certain certainty.

CHAPTER IV. CONCLUSIONS AND RECOMMENDATIONS

4.1. Conclusions

Comparing the evolution of GDP per capita for Japan and Rwanda, taking the year 1970 the per capita rate for Japan and Rwanda was 2016/64 = 31 i.e. the Japan per capita in 1970 was 31 times that one for Rwanda and in 2013, the rate becomes 38428/645=60, i.e. the Japan per capita in 2013 becomes 60 times that for Rwanda which imply an increase rate of around 100%.

The study has used the vector autocorrelation modal to analyze the Economic growth modeling comparison for developed and developing countries and its forecast by taking an example of data analysis of Rwanda and Japan from 1970 to 2013.

The findings are associated to the fact that considering the status of Rwandan Per capita the developing countries not only failed to catch up but have even failed to keep up with the rest of the world i.e. they import more than they produce and then more than they export. The reasons must be highly country specific, but, in a cross-sectional study, we can still uncover some possible causes or at least state positively why growth was so low and some time negligible considering to the developed countries.

Although the findings of the study show that if developing counties like Rwanda could increase their exports and capital formation then try for all possible to reduce the importations, their Per capita will be growing with an expectation of convergence with the developed.

4.2. Recommendations

Since the importation sector covers the highest part negatively on the developing countries per capita on the majority of the population in developing countries, it is recommended that government should empower local manufacturing and encourage the citizen to consume their local products and if possible emphasize some measurement to discourage some unnecessary imports.

Encourage production beyond domestic consumption for an even enhanced country's per capital, and expand the growth of all sectors that have proved to be useful in accelerating the economy.

Such development of those sectors has to run with an awareness company of capital creation by emphasizing the culture of saving system for citizens to be prepared for investments.

The evidence presented here by comparing one developing country with a developed country we suggests that as the institutions are powerful determinants of the ability of country to benefit from the catch up effect. while developing countries have advantages of lower cost access to advanced technology or the diminishing returns experienced by developed countries, these potential advantages appear to be squandered in countries with poor institutional frameworks that why developing countries still importing material for direct consumption without any transformation done for valorization.

We recommend to the developing countries governments to abolish the insufficiently protection of property and contractual right in order to attract internationals investors and industries in their countries in order to accelerate to rate of per capita towards the convergence with the developed in the context that investors have fixed or specialized, human capital, machinery and those properties have to be assured on the security guaranties

For developed countries, however the most contributor is a positive to the per capita, this most contributor is the consumption, this imply that they consume a greatest part of their production. We recommend to the developed countries, to reduce the consumption and exports goods at low prices. This will promote the situation convergence without discourage their economic growth situation. Otherwise, the convergence can't be realized soon with the normal situation.

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ANNEX: DATA USED IN EMPIRICAL RESULTS FOR DATA ANALYSIS

Country	Year	Consumption expenditure in US$ (X1)	Gross capital formation in US$ (X2)	Exports of goods and services in US$ (X3)	Imports of goods and services in US$ (X4)	GDP in US$ (Y)	GDP per Capita in US$ (Y1)
Japan	1970	1.23975E+11	81212484920	22147887108	19617415941	2.09071E+11	2015.962938
Japan	1971	1.44643E+11	84057229971	27114974796	20914746062	2.36155E+11	2246.036735
Japan	1972	1.93719E+11	1.10609E+11	32448394936	25494524932	3.12738E+11	2933.297638
Japan	1973	2.62441E+11	1.61028E+11	41804872089	41903254204	4.24891E+11	3931.057362
Japan	1974	2.99958E+11	1.75211E+11	62880126377	66656127180	4.71643E+11	4307.438186
Japan	1975	3.46422E+11	1.67343E+11	64337923903	64449713738	5.12861E+11	4628.524556
Japan	1976	3.89737E+11	1.82721E+11	76601287375	72435793709	5.76406E+11	5146.809141
Japan	1977	4.8066E+11	2.17881E+11	91066128032	80077615350	7.09405E+11	6274.150654
Japan	1978	6.73019E+11	3.06702E+11	1.08646E+11	92116613654	9.96742E+11	8739.165537
Japan	1979	7.10952E+11	3.35601E+11	1.1764E+11	1.27467E+11	1.03745E+12	9021.855047
Japan	1980	7.48074E+11	3.48907E+11	1.45903E+11	1.56224E+11	1.08699E+12	9377.691295
Japan	1981	8.20021E+11	3.72738E+11	1.72997E+11	1.64704E+11	1.20147E+12	10284.62202
Japan	1982	7.77567E+11	3.32027E+11	1.58615E+11	1.51571E+11	1.11684E+12	9488.158862
Japan	1983	8.59686E+11	3.38138E+11	1.66061E+11	1.45828E+11	1.21811E+12	10274.86356
Japan	1984	9.03027E+11	3.57769E+11	1.90568E+11	1.56919E+11	1.29461E+12	10849.98501
Japan	1985	9.48169E+11	3.89856E+11	1.95147E+11	1.48927E+11	1.38453E+12	11538.85728
Japan	1986	1.39901E+12	5.72751E+11	2.27662E+11	1.48649E+11	2.05106E+12	17013.98644
Japan	1987	1.70476E+12	7.07148E+11	2.52165E+11	1.79078E+11	2.48524E+12	20535.43726
Japan	1988	2.02712E+12	9.23382E+11	2.9444E+11	2.30299E+11	3.01539E+12	24831.76549
Japan	1989	2.01214E+12	9.59091E+11	3.08879E+11	2.64075E+11	3.01705E+12	24764.20731
Japan	1990	2.06606E+12	1.0083E+12	3.19309E+11	2.91102E+11	3.1037E+12	25388.272
Japan	1991	2.34048E+12	1.13931E+12	3.49239E+11	2.93616E+11	3.5368E+12	28824.19706
Japan	1992	2.59342E+12	1.17644E+12	3.76388E+11	2.94486E+11	3.85279E+12	31277.66027
Japan	1993	3.02774E+12	1.28992E+12	3.99876E+11	3.03163E+11	4.41496E+12	35702.76779
Japan	1994	3.39345E+12	1.36041E+12	4.36633E+11	3.40147E+11	4.85035E+12	39083.70118
Japan	1995	3.76291E+12	1.49872E+12	4.82858E+11	4.10559E+11	5.33393E+12	42848.53051
Japan	1996	3.33781E+12	1.34665E+12	4.56524E+11	4.34802E+11	4.70619E+12	37711.38704
Japan	1997	3.06326E+12	1.21452E+12	4.64058E+11	4.17559E+11	4.32428E+12	34580.75959
Japan	1998	2.81981E+12	1.02171E+12	4.21892E+11	3.48844E+11	3.91457E+12	31249.88543
Japan	1999	3.26586E+12	1.09624E+12	4.50945E+11	3.8045E+11	4.4326E+12	35324.7399
Japan	2000	3.47491E+12	1.18775E+12	5.1463E+11	4.46089E+11	4.7312E+12	37634.41994
Japan	2001	3.12224E+12	1.01101E+12	4.34656E+11	4.08044E+11	4.15986E+12	33021.58067
Japan	2002	3.03334E+12	8.94067E+11	4.47955E+11	3.94542E+11	3.98082E+12	31531.46631
Japan	2003	3.26789E+12	9.6383E+11	5.10878E+11	4.39655E+11	4.30294E+12	34008.99608
Japan	2004	3.51696E+12	1.04774E+12	6.1505E+11	5.23921E+11	4.65582E+12	36725.68532
Japan	2005	3.48037E+12	1.02713E+12	6.54356E+11	5.89996E+11	4.57187E+12	36004.97574
Japan	2006	3.31386E+12	9.88138E+11	7.04556E+11	6.49804E+11	4.35675E+12	34268.41406
Japan	2007	3.2858E+12	9.96888E+11	7.73111E+11	6.99455E+11	4.35635E+12	34234.85984
Japan	2008	3.72559E+12	1.11419E+12	8.58847E+11	8.49439E+11	4.84918E+12	38086.76156
Japan	2009	4.02651E+12	9.90174E+11	6.39245E+11	6.20791E+11	5.03514E+12	39536.93447
Japan	2010	4.34035E+12	1.08938E+12	8.33705E+11	7.68048E+11	5.49539E+12	43150.88289

Country	Year	Consumption expenditure in US$ (X1)	Gross capital formation in US$ (X2)	Exports of goods and services in US$ (X3)	Imports of goods and services in US$ (X4)	GDP in US$ (Y)	GDP per Capita in US$ (Y1)
Japan	2011	4.76601E+12	1.19318E+12	8.93378E+11	9.46932E+11	5.90563E+12	46384.44627
Japan	2012	4.82059E+12	1.23476E+12	8.74476E+11	9.92055E+11	5.93786E+12	46663.04037
Japan	2013	4.00782E+12	1.03051E+12	7.94869E+11	9.34277E+11	4.89853E+12	38527.56526
Rwanda	1970	216140548.7	19106743.83	22082501.12	25488153	240725319	64.11569307
Rwanda	1971	261851018.3	26378459.43	19244112.34	27893936.93	289359951.1	74.80229223
Rwanda	1972	305683659.9	22665313.25	19485588.5	32719666	325608561.6	81.73605261
Rwanda	1973	367480758.8	24875344.69	27889941.94	32863713.83	404056391.5	98.49599844
Rwanda	1974	476777052.5	57716568.09	31577866.87	52076276.13	530057250.6	125.404712
Rwanda	1975	572590429.9	92664833.79	43379809.42	78414182.99	638506594	146.4744848
Rwanda	1976	613846855.9	103946715.5	76898262.56	95828944.23	712075626	158.2472217
Rwanda	1977	699079537.1	132652551.8	88106995.8	102154026.8	833662877.6	179.3557787
Rwanda	1978	883429838.8	177399494.2	110720864.7	166997644.7	1011257335	210.4876815
Rwanda	1979	1045639915	157410059.2	193096750.3	195531729.6	1238625701	249.2906858
Rwanda	1980	1260140605	238862587.3	149817378.6	256456668	1400991932	272.5248496
Rwanda	1981	1469487557	220702313.4	114341873.8	237142585.6	1571037003	295.6615564
Rwanda	1982	1400180650	295047368.5	134466168.8	263316917.6	1571262639	286.4482559
Rwanda	1983	1481676793	236146087.5	141753770.5	237992264.4	1652137120	291.5412447
Rwanda	1984	1513342453	295937088.1	165852796.1	241845366.4	1772393834	301.7459982
Rwanda	1985	1648760881	350294180.2	153003936.6	264297240.2	1915581616	313.3848168
Rwanda	1986	1853064761	364098828	202442973.8	303638752.3	2154145072	336.2701769
Rwanda	1987	2114684786	398829449.5	164036728.5	307797391.9	2408838732	357.348026
Rwanda	1988	2288527567	430438620.6	174071794.1	329656688.8	2598562373	368.8109094
Rwanda	1989	2374302430	374066849.8	161080108.2	311340201.3	2649910471	366.8306438
Rwanda	1990	2433940018	311399005.4	147223300.4	343375779.3	2573111009	356.6485697
Rwanda	1991	1900826036	219501493.2	143173228.5	315050340.8	1915357538	274.6558392
Rwanda	1992	2012717247	279866835.2	115538165.3	337925728	2023346742	309.139164
Rwanda	1993	1952426067	291355258.6	104657787.3	369396339	1959457729	323.0087641
Rwanda	1994	1699428988	103800900	76225560.69	697959127	1206335424	210.5861928
Rwanda	1995	1396347415	153060033.2	76463483.39	341796822.3	1299874101	229.5041103
Rwanda	1996	1480660118	175293483.8	85252495.01	336634055.8	1406818374	237.2545037
Rwanda	1997	1927716426	225445035.7	147672297.2	433261282.4	1892485845	292.4732878
Rwanda	1998	2009918013	259940757.4	113906789.5	384838142.1	2034447615	283.7579721
Rwanda	1999	1899002882	293648366.4	116001614.2	404821818.6	1920753280	244.588006
Rwanda	2000	1727703992	277751289.3	112970063.1	374284310.8	1771106678	210.957112
Rwanda	2001	1654056040	254387037.5	147145371.3	393653017	1674220869	191.1210383
Rwanda	2002	1674066715	250293171.1	122556413	384989606.4	1677086979	186.6016899
Rwanda	2003	1807098021	283586802.4	161913613.1	420751143.8	1845686849	202.2411873
Rwanda	2004	1993023827	347033018.9	241091145.7	500804245	2088382766	225.6642791
Rwanda	2005	2447039777	451130522.2	306023797.2	630108629.9	2580597467	273.6740267
Rwanda	2006	2956480930	550853127.1	356951122.7	761596748.6	3110327823	321.9485776
Rwanda	2007	3487246578	746192459.7	433024169.4	925052719.3	3775447706	380.2773294
Rwanda	2008	4248075798	1182720104	706743686.1	1377372078	4796573943	469.19615

Country	Year	Consumption expenditure in US$ (X1)	Gross capital formation in US$ (X2)	Exports of goods and services in US$ (X3)	Imports of goods and services in US$ (X4)	GDP in US$ (Y)	GDP per Capita in US$ (Y1)
Rwanda	2009	4979083886	1253848260	552392404.7	1501670190	5308990209	504.1935044
Rwanda	2010	5425633446	1305034677	586277896	1665685724	5698548923	525.8549278
Rwanda	2011	5906982323	1507563170	887879745.6	1897364034	6406727020	574.8874668
Rwanda	2012	6677571931	1868808527	929520617.3	2257872323	7292911323	636.5018317
Rwanda	2013	6770424431	1996486510	1084072071	2328976517	7600876217	645.4262317