The Role of Agriculture on Brazilian Economic Growth: Evidence from time series analysis, 1980-2010

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ABSTRACT

This thesis empirically investigates the role of agriculture in the Brazilian's economic growth. Specifically it measures the influence credit in agriculture sector on the Brazilian's growth of GDP. I conducted Engel-Granger Co-Integration test (EG) and Augmented Dickey-Fuller (ADF) unit root test using a sample of annual data covering the period 1980-2010. The Augmented Dickey-Fuller (ADF) test indicates that the variables in question are all non-stationary in levels, but stationary in first differences; whereas residual-based co integration (Engel-Granger) technique shows that there is a long-run relationship among the variables. Error correction modelling framework also indicates the relationship between the role of agriculture on the Brazilian's economic growth and its determinants in the short-run. The empirical findings show that ratio of agricultural credit to total export has positive impact on growth of GDP per worker, which stimulates agricultural production as well as economic growth for both long and short-run periods. The exchange rate used in both of the periods has a negative impact on growth of GDP for each single worker. This suggestion shows us an increase in the exchange rate in order to decline in agriculture development as well as economic growth. In addition we understand that negative influence exists between interest rate and agricultural development in short-run for the Brazilian's economic growth. The ratio of agricultural credit to total credit has no meaningful results on the economic growth. This suggests that a decrease in this variable favourably makes the output growth to decline which is against the notion of empirical model for the Brazilian economy.

Keywords: Agricultural Development, Economic Growth, OLS, Unit root test, Co integration, Brazilian economy.

ÖZ

Yapılan bu tez çalışması ampirik olarak Brezilya ekonomisindeki ekonomik büyüme ile tarımdaki uygulanan kredi arasındaki ilişkiyi ölçmektedir. Bu ilişkiyi ölçerken büyüme modelleri ele alınmaktadır. Eş bütünleme ve birim kök analizleri uygulanarak yukarıda belirtilen ilişkinin rolü ölçülmeye çalışılmıştır. Yapılan durağanlık ve eşbütünleme analizleri ışığında serilerin durağan olmadığına, ancak eşbütünleşik seriler olduğuna karar verilmiştir.

Çalışma, aynı zamanda kullanılan ilgili modelin doğruluğunu da ortaya koymaya çalışmıştır. Elde edilen ampirik sonuçlarda, hem uzun hem de kısa dönemde, tarım kredisinin, döviz kuru etkili olduğu gözlemlenmiştir. Ampirik sonuçlarda döviz kuru endeksinin hemde faiz oranının Brezilya ekonomisi üzerinde büyük ve negatif etkisi olduğu ölçülerek belirtilmiştir. Aynı zamanda, tarım kredisinin toplam krediye oranının ekonomik büyüme üzerinde teorik olarak herhangi bir etkisi bulunmamıştır.

Anahtar kelimeler: Tarım ekonomisi, Brezilya Ekonomisi, Eş Bütünleme, Birim Kök, Durağanlık, En Küçük Kareler Yöntemi.

Dedicated to my parents

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ADF: Augmented Dickey Fuller

EG: Engel Granger Co integration

ECM: Error Correction Mechanism

ECT: Error correction term

FAO: Food and Agricultural Organization

GDP: Gross Domestic Production

ER: Exchange Rate

IR: Interest Rate

CTEX: Ratio of Agriculture credit to total Export

ACTC: Ratio of Agriculture Credits to Credits

GDPW: Labour Per worker

OLS: Ordinary least square

Chapter 1

INTRODUCTION

1.1. Introduction

The relationship between agricultural economy and economic development has rekindled interest in recent theoretical and empirical literature by drawing attention to such determinants interest rate, exchange rate, credit in the sector, and total export in the sector. There have been various findings and views about the effects of agricultural development on economic growth throughout the literature, depending upon the techniques used and countries analysed. Due to the role of agriculture in economy growth, this thesis illustrates bring some important questions such as, how can agriculture contribute to economy growth particularly pro poor growth. It seems that there is exists a paradox here for economic growth related to agriculture development. Agriculture can contribute to GDP and share its role over the years. At the same time, there is an increase in producing cereal products; therefore, it would be easy to predict that agriculture has become more successful and very important to decline of whole economy.

1.2. Scope and Objectives of This Study

In this study, I adopt the frameworks introduced by Marc D, 2006, Enoma AI, 2001, and Isedu M, 2008 to investigate the role of agricultural economy on economic growth.

1.3 Methodology of This Study

According to this research, (OLS) Ordinary Least Square method is applied. Within this framework, mainly F-test, t-test and R^2 are used to explain the relationship between dependent and independent variables. OLS technique relies on numerous assumptions. If some assumptions are not practical, some biases may happen in calculation output. These are referred to as multi-collinearity, serial correlation, normality, functional form between the regresses. In addition to this, unit root, co-integration and error correction methods are also conducted to get more reliable results.

1.4 Findings of This Study

This paper empirically investigates the role of agriculture sector on Brazilian economic growth using a sample of annual data covering the period of 1980 – 2010. Specifically, it focuses on whether the determinants of agriculture sector stimulate economic growth. I found out that agricultural credit and exchange rate have influences on the Brazilian economic growth in both short-run and long run.

1.5 Structure of This Thesis

Chapter 1 indicates introduction part. Chapter 2 reviews the relevant literature on agricultural economy. Chapter 3 explains an overview of Brazilian economy. In Chapter 4, I explain theoretical model and data description. In Chapter 5, the regression models and its empirical outputs are discussed and, chapter 6, concludes brief recommendations and discusses some suggestions for further studies.

Chapter 2

LITERATURE REVIEW

2.1 INTRODUCTION

According to this assumption of Lewis (1954) about economic development, he points out that agriculture can be as the basis for both economic and industrial development. In addition, agriculture can be as freeing as disguised labour for production of industry and then increase whole society growth and development. Nowadays agriculture is going to experience rapid modernization and mechanization in different parts of it, labour is free in every development of industry. Many economics declare that obligation for industrial growth must have been producing raw material for every part of industry so we can understand that industry have important role in agriculture sector. In this part we need to increase both domestic output and agriculture productivity because it is better than relying on expansion food export and finance growing; however agriculture can be called as the central section in developing countries therefore every country must construct net contribution to attract huge investment requirement, for example decrease foreign supply of raw material or increasing agriculture's output production.

2.2 Agriculture in Brazil’s Economy

Since the World Bank emphases on agriculture and rural development they have huge investment in agriculture sector from half century ago, Brazilian's economy increase, its speed on agriculture economy; because it has commitment to reduce poverty in some regions in Brazil and on the other hand, the institute helps to display demographic of poorness in different regions. Most of Brazilian citizens living in

rural regions and their life depend on agriculture; in addition agriculture bring them large share in their income.

The estimation illustrates[1] that Brazil still stands in seventh place world's richest countries due to 2,309.138 us dollar GDP. Brazil was the first country years ago, which it is called leader in export section and its economy relies on natural resources that reserves and agriculture commodities. In Brazil history, this country had important role in creating political motivation for foreign loan to constructed agriculture's base. In Western Europe, imperialist countries gained large amount of wealth and profit through the exporting good from Brazil, this relation continues to make importing cheap accessories. During the last fifty years, this transaction mentioned above caused the economic successes for imperial nation, this process which establishes and shaped cooperative resident for Brazilian's Society. This clears act and role of intermediaries among states and cities population in Brazil's literature history.

2.3 Agriculture Has Important Role in Economy

First, providing labour work force, which are not urban citizens, most of country's population live in rural areas is indirectly or directly depending on this sector for their livelihood. Agriculture sector have strong linkage with the rest of the economy. Second, producing food for expanding the population. Third, Providing export gaining to pay import cal good and capitals and balance both import and export. The aim of Agriculture has changed form “self-reliance” to “Commercialization” and this is called Economic operation in Agriculture. Farming supplies is now being changed instead of individual benefits, but as exchange commercial business. The goal of

[1] Figures used in this study, were obtained from the World Bank. www.worldbank.org

production converted into maximization the profitable level. Similar to the implication of self-sufficiency has become changed into profit maximization. When national income growing, growth in demand increasing more than the other goods and services in a country. But it moves very slowly its means than when value added as national income increase we have increase in purchasing goods and services. For example, agriculture products which are produced by farmers are purchased by intermediated input to the market, in this situation total gross domestic product (GDP) plus employment and agriculture productivity have rapid growth and it is very necessary for markets profits. If agriculture productivity developed this cause of growth in R and D because R&D has great impact on food supplies and their prices in market and after all lead to decreasing of poverty. In the early time in industrial sector but due to the declining its performance due to the political, social, environmental and climate conditions its production feedback goes down slowly and now it is the second largest sector.

2.4 Relation between Agriculture and Economic Growth

First, falling and inelastic for agriculture production related to many factors such as population density or corruption in market distribution. Second, Lack of good provision in public sector in investing in industrial agriculture section. Third, Institutional barriers to enhance productivity growth. Fourth, Low investment intensity in this sector and insufficient facilities, untrained and unskilled labour force engaged with it. In the other words, it can be said that agriculture as an engine of growth large city attracts many investors to invest in chain supermarkets, and advertising for global co-operations.

2.5 Growth in Food Export

Degree to 2015 till 2030 research on agriculture (FAO) tells that international agriculture's food developing countries changing form exporters to importers in its seem continues to near future, during 1960 till 1964 developed countries trade around 7 billion US dollars by this trade trend dramatically vanished therefore developing countries have much more budget deficit because they have double of import comparing to export so they increasing their budget deficit throw these years. According to limitations on commercial food import, they have increased in foreign exchange earning this increasing is more affected; where the food imports value goes up from 5% due to food insecurity (FAO), 2004b. For this case some reason shows us that increasing import of cereals and the other agriculture products in developing countries due to incomparativeness of their domestic product compare to foreign one limitation of foreign exchange earnings on different sectors such as food import causes increasing in their shares . Resources have impotent role in competition; on the other side lack of competiveness may occur in poor rural society. Utilizing the natural resources will cause to shape markets and growth of food imports and may be decreasing in food prices in developing countries. Nowadays we have rapid modernization of cities particularly in big and capital cities so it seems growing in food import competitiveness in same part competition in food transporting. At this time some important results occur; market's value added products is moving from one consumer to another producer in addition lack of capacity on the some section of exporter and explain tariff assessing for the both countries losing export profit. Historically agriculture engages economic development and have unique role in economic it prevents hunger and poverty in countries. Growing in agriculture decreases poverty throughout long-term development and contributes to national

income. The main factor for each developing countries is not important, this is going to result in rapid growth and mainly depends on cereal products and animal farms in this part we have some net trade in traditional agricultural export such as oil, vegetable , sugar so on and so forth . Increasing in cereal and other agriculture foods in developing countries refer to domestic demand with low level of completion of internal products.

2.6 The Role of Agriculture and Its Relation between Other Sectors in Economy

Growth in agriculture is one of the main reasons that is leading a country to independence, on the other hand agriculture have direct contribution to the national economy and Gross domestic production (GDP) has great participation in foreign exchange earnings and has specific role in supplying saving and also in labour to the different sectors. In developing countries which have middle income like Latin America they would expect to have lower consumption side multipliers on the other side they would expect to have higher rate of production multipliers; meanwhile lower consumption multipliers means agriculture has small share in national GDP or we can say higher production multipliers means that agriculture demand have higher share in intermediate inputs from rest of represent and economic principle supplier to the different sectors for example food process.

2.7 Supplying Raw Material to Growing and Development of Industrial Sector

Agriculture development has many requirements for industrial promotion since agriculture has a role in producing raw material for industry sectors. In this way we want to approach the developed agriculture productivity model to have raised domestic output better than growing of export, on the other hand third world countries must pay more attention on vast investment in industry sectors to have high

rate of contribution to agricultural products. Agriculture is the main rescuer of employment in countries in recent research some economists believe that econometric evidence can make clear relation between agriculture and economic growth, for example 70 percent of employment in developing countries is created by agriculture for whole and entire population of society: so, we can easily understand role and function of agriculture production. Through development of countries, According to econometric approach there is one solution to answer the question of contribution of agriculture development to (GNP) national growth and reduction of poverty in a country. Econometrics can show us treatment and relation between both agricultural and economic growth, which allows us to capture effects of consumers impact on agriculture GDP and also illustrate externalities would not be revealed by input or output directly. At last this econometrics can directly specify the mechanism and show some interaction between agriculture production and the industries.

2.8 Popular Reasons Can Effect on Poor Performance in Agriculture Sector:

(1)First is lack of inelastic demand for agricultural feedback refers to low density of population, problem in market and place of distribution. (2) Poor legislation and policy of investing specially in rural areas. (3) lack of attention to R&D part (4) turbulence and fluctuation in climate and resources. (5) Some barriers refer to institutional restrain, which includes productivity growth.

2.9 Globalization and Change in Agriculture Goods

Rapid growth in globalization has many results, changing world trade, corporation, decreasing in commendation expenses in some cases we have changing in agriculture benefits, here we discuss jut few of them: The first reason is increase in agriculture competition directly; the advantage of accessing global market and special area which are more profitable. The second one is changing in domestic consumers

demand on agriculture products which is direct and indirect effect on international trade. The third thing, predicts result of globalization is changing the life style such diets, especially among middle class population in big cities and also vast change in global diets changed from tradition particularly occur in modern cities and easy access to food retail and market.

Chapter 3

AN OVERVIEW OF BRAZILIAN ECONOMY: THE ROLE OF AGRICULTURE

3.1 Overview of Brazilian's Economy

The Brazilian economic development like so many other countries can be characterized by a number of clear stages. First, which began in the early 19th century and continued for 30 years economic activity which can be as a pre-industrial were based on small scale percent for agriculture and handicraft. During the second stage industrialization began in 1940 to late 1960 through these times we had gathered peace. Small scale of agriculture and also industry production was clinched to the domestic market. During 1970 to 1980 we have the third stage which was based on rapid growth of enterprises through the lines, and many new companies emerged and started their profession eventually possibly defines this stage in cities related to economic development. In 1990 markets change and characterized by this changing in international markets, and also generated from clear movements in Brazil, from producing along specialization lines. For each changing according to Brazil's structure of economy was nearly associated with changing in the whole social basic shape, as well as amount of social capital which is available to economy.

3.2 General Political Status and Trend

Brazil is the fifth largest country in world with the population around 190 million and by land mass, much bigger than USA its political system is more similar to the United States, Brazilian's macroeconomics is popular as the tenth largest economy in globally. In 2007, Brazil had approximately 1.3 trillion gross domestic products

(GDP) and its per capita income around 6,940 US dollars. In Brazil, the economists can fix and control inflation around 4 percent and economic trend showed acceptable growth of 5.4 with agriculture promotion of five percent, related to 2007 industrial sector like the other economic parts have good promotion around 5 percent. Brazil economy is very dynamic, this means that it has had great shift over the past decade, from export–led to demand-led growth, and also has decreased their debt, interest rate, and finally cut expenses. In 2008 Brazil had 25 billion trade surpluses and totally had 198 billion from export on the other hand gained 174 billion from the importing. Brazilian Agriculture is main part of Brazil's economy and had principle role in different parts such as economic growth and foreign exchange rate. Due to related years agriculture business sector contain 25 percent of Brazil gross domestic product for example including Agricultural products and the way of processing and distribution. Brazil GDP crops every production and also connected to inputs our estimation around 19 percent when the other live stock and in related inputs accessed 8%, contribution of all export section they had growth about 40 percent.

3.3 Export Growth and Relation to Social Capital Growth in Brazil

The relation of social capital for industrial development is a casual connection which has become apparent by adopting an historical approach. The critical steps understand between kind of social capital and economic growth. Social capital was generated in a period of industrialization on the other hand industrial growth due to social capital and its strength. If we have increase in interest in social capital and its relevance for economic development and social capital helps explain the growth of a small export-oriented town in Brazil.

3.4 The Population in Brazil

Brazil's population was approximately 190 million in 2006, for this reason Brazil is going to be the 5th biggest country according to size of population .This country has enormous lands, and in addition Brazil's population density is moderately low. In 2005 Brazil's land average approximately was 21.345 people per square kilometre (compare with other countries like Argentina, Mexico, and Colombia). Though; important changing in Brazil can result in population density in recent years, poverty scattered kilometres in Amazon Area around 30.7 persons per square kilometres, in northeast, and also many states in São Paulo. In the Amazon's region around eight percent of population lived in last decade (2001),In northeast twenty eight percent ,in southeast forty two percent, in south fifteen percent, and in the mid-west seven percent. One of typical features of the Brazilian's regional distribution was centralized near to seashore . In 20th century population growth into the interior borders has been remarkably mere, especially in the south of this country. In last five decades the structure of the internal capital city (Brasilia), has lower many high ways, which can connect cities to each other from 1960 to 1970 and this has caused the increase in people who want to migrate to different parts in middle of twenty century population increasing, but gently decrease. According to 1950's just three percent per year, and the other percentage refers to three percent, however these numbers of declined illustrated in 2005 thirty five percent compared with twenty two percent in the United States and fifteen percent in Germany .In 2004 the rate of Brazilian's development is 88% in fifteen recent decades. In addition, in 2004 we had 99.5 percent as a percentage registers at primary school and the years were between 7-13 groups stood. Secondary school only seventy five percent enrolment for the ages group between 14–19 years of age, and complementary education enrolment for

the 20–24 years age group around twenty percent. Increasing in percentage of the population in the younger age may lead to low labour force participation ratio. In 1950 This was approximately thirty three percent in 1970 unexpectedly decrease to thirty two percent, but in 1995 growth again to forty six percent and finally in 2005 reached forty nine percent. All the principal varieties of human race may be divided in four main categories red, white, black and yellow. Population rising up in most developing countries more than agriculture progress; therefore, Brazil needs to develop agriculture to provide food for the whole society and its population. It means that food supplies have down trend and population growth have upward trend and this influence on workers' wages and salary, then will have some impact on industrial revenue, investment related to economic growth.

3.5 Agriculture as a Principle Source of Foreign Exchange Earning

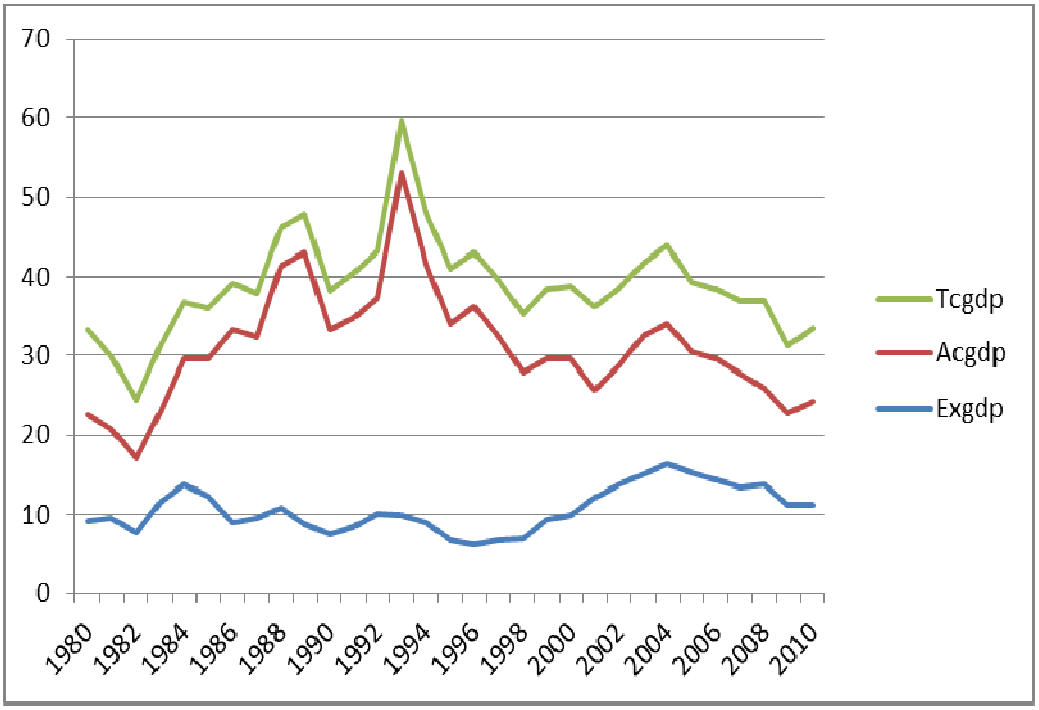
Summation in export of agriculture production is the most important source of growing earnings, increasing agriculture in many courtiers like developing countries compensate their budget deficit buy flourishing export instead of import meanwhile they can get high rate of foreign exchange according to international trade but the import thing here is rate of their currency compared to the popular currencies like US dollar and Euro. Today's developing countries expand their agriculture facilities to increase export sectors.

3.6 Agriculture Credits and Economic Growth

Agriculture includes many parts such land cultivation, raising fishery for society. Development of the agriculture sector has been very slow in economic growth, because agriculture production has some issues, the role of agriculture producing for population, supplying raw materials to grow industrial sector, source foreign exchange earnings. Role of credit is one of the key factors, which have important

role in agriculture progress, it is necessary to know that credit can support agriculture sectors. In addition, ground level credit to agriculture sector has had positive impact on growth rate and increase during 1996 to 1997.

3.7 Graphic Presentation on Export Agricultural Credit and Total Credit



A glance at the Brazilian export to GDP, total credit to GDP and agricultural GDP to statistics based on the figure above illustrates 60 percent ratio of total GDP, this shows that this ratio reached the highest point throughout the time interval. This ratio starts with 35 percent in 1980 and decreased to 30 percent in 2010. The ratio of agriculture to GDP almost shows the same pattern with the previous one. However the ratio of export to GDP determines consistent pattern between the relevant time intervals.

Chapter 4

THEORETICAL MODELLING AND DATA DESCRIPTION

4.1 Theoretical Modelling

In this study, I adopt the frameworks introduced by Marc D, 2006, Enoma AI, 2001, and Isedu M, 2008 to investigate the role of agricultural economy on economic growth. I conduct the model in the following form:

$$GDPW_t = a_1 + a_2 IR_t + a_3 ER_t + a_4 CTEX_t + a_5 ACTC_t + u_t \quad (4.1)$$

The important things that are reminded in Equation 4.1 display the original and exclusive form of whole role agriculture in economy. Equation 4.2 illustrates long-run period relationship in the other hand in Equation 4.3 it shows short-run period dynamics[2] for the function of agriculture in economy.

$$\ln GDPW_t = \alpha_1 + \alpha_2 \ln IR_t + + \alpha_3 \ln ER_t + \alpha_4 \ln CTEX_t + \alpha_5 \ln ACTC_t + \varepsilon_t \quad (4.2)$$

$$\Delta \ln GDPW_t = \alpha_1 + \alpha_2 \Delta \ln IR_t + + \alpha_3 \Delta \ln ER_t + \alpha_4 \Delta \ln CTEX_t + \alpha_5 \Delta \ln ACTC_t + \varepsilon_t \quad (4.3)$$

Where;

GDPW was the output and measured by real GDP per number of workers, IR, interest rate; ER; exchange rate, CTEX, agricultural credit to total export. ACTC: agricultural credit to total credit. a1, a2, a3, a4, and a5 are estimated parameters; u_t is

[2] Framework of this disequilibrium the log of GDP per worker on the role of agriculture economy adjustment use for both actual and desirable amount.

serially uncorrelated random disturbance term. In some cases, trend factor was conducted to see whether there exist its effects due the effect of technology.

4.2 Data Description[3]

The data I employ in this study are time series data[4], covering the period 1980-2010. I use four variables for the Brazilian economy and the variables are measured as follows. Output is measured by real GDP per number of workers, GDPW.

Where[5]; Explanatory variables are explained as follows: IR, interest rate; ER; exchange rate, CTEX, agricultural credit to total export. ACTC agricultural credit to total credit (see also Marc D, 2006, Enoma AI, 2001, and Isedu M, 2008) using the period between 1980 and 2010. It is also important to emphasize that the results of the Augmented Dickey-Fuller (ADF) test point out that all variables in this question – LGDPW, LIR, LER, LCTEX and LACTC– all non-stationary in different levels except stationary in first variation (see appendix 4 for the results). (See also Fethi, S. (2002) for more details).

[3] Data used in this study, were obtained from the World Bank. www.worldbank.org

[4] I tested the stationary of the data using the Augmented Dickey-Fuller (ADF) unit root examined offered by Dickey and Fuller (1979; 1981) respectively.

[5] The 'ADF' suggested in Microfit contained the intercept term in the ADF equation. so the corresponding critical values have to take the intercept term into account. Moreover, we included all trend in all levels which we excluded it in first difference (Pesaran and Pesaran, 1997).

Chapter 5

ANALYSIS AND INTERPRETATION

5.1 Test Results of Diagnostic[6]

Some assumptions in this framework of Ordinary Least Square (OLS) should be calculated; if not some biases may happened in our assumption output. In this framework, the following titles should be taken to account by; the multi-collinearity, the serial correlation, the normality, the heteroscedasticity and the functional form.

These tests should be analysed one by one to make sure that there is no problem in residuals.

5.1.1 Multicollinearity

Multicollinearity contains tough relation referring to explanatory variables of regression. This alternative does not have an influence on the greatest unbiased calculation of OLS, but sometimes coefficients have greatest standard error and its trend to insignificant. It is hard to predict precisely in future and we have also predicted to get high level of correlation among GDP per worker and the exchange rate, the interest rate, the ratio export and, the ratio of agriculture credit to total credit; whereas there is a small amount of this correlation between the explanatory variables (see Table 1).

[6] See Gujarati (1999) for more details about the diagnostic analysis.

Table 1: Correlation Matrix

	LGDPW	LER	LIR	LCTEX	LACTC
LGDPW	1.0000				
LER	-.657	1.0000			
LIR	-.197	.711	1.0000		
LCTEX	.861	-.613	-.176	1.0000	
LACTC	.832	-.645	-.0294	0.965	1.000

The prediction of output shows us that we have low level correlation among the explanatory variables such (LER, LIR, LCTEX, LACTC and LGDPW) and we have great level of correlation through the relevant variables (LGDPW) and the explanatory variables.

5.1.2 Autocorrelation (Serial Correlation)

The auto-correlation is the most popular test for investigation which was created by Darwin and Watson, popular Durbin-Watson (DW) statistics. So Darwin-Watson applied for this method:

According to 31 observations and 4 independent variables the tabular value is D_L= 1.16 and D_U= 1.73. When calculated value is more than D_U (1.09>1.72), we have one evidence existing here which, autocorrelation pointed at the 5% level is significant.

5.1.3 Normality

According to this topic we will understand that degree of distribution of residuals may be normal distributed or may not? Due to our assumption:

H_0: $\alpha_t = 0$ (normally distributed)

H_1: $\alpha_t \neq 0$ (not normally distributed)

Tables 2 and 3 show the output results for normality

5.1.4 Heteroscedasticity

While the residuals variance is constant, it has become homoscedastic. on the other hand if they are not, they will be pronounced as a heteroscedastic situation. In the case of heteroscedasticity, hypothesis testing is very casual and routine and it is not trustworthy so this makes results to be biased. The below assumptions tests whether the errors variances are constant or not;

H_0: ß = ß (Homoscedasticity)

H_1: ß ≠ ß (Heteroscedasticity)

Tables 2 and 3 illustrate the output results for heteroscedasticity.

5.1.5 The Functional Form of Hypothesis

Below hypotheses are reinvestigated for demonstration role of misspecification:

H_0: $\gamma = 0$ (no misspecification)

H_1: $\gamma \neq 0$ (misspecification)

Tables 2 and 3 illustrate the output results for factional form.

5.2 Empirical Results[7]

Previous analysis examined results of sequential correlation normality, functional and the last item heteroscedasticity. Eventually, the solution is assessed by regression equation and utilizing both tests of t-test and f-test for both long-run and short- run period.

[7] I used microfit 4.0 for all estimates of my thesis (seen Pesaran and Pesaran (1997) for more details).

Period[8]and in the short-run[9] period are obtainable in the following Tables 2 and 3 for Brazilian's economic growth and its containers as follows:

Actually, the OLS describes the results in the following Tables, which exists in last part of outcome, which approximately tells that dropped insignificant variable from estimation model and after all calculation can be the best estimated model . Simply, every single variable shown in the model is observed, however the results show that some estimated variables are insignificant, so the most insignificant variables are eliminated from the model.

[8] I employ a residual-based cointegration technique to test the existence of a long-run relationship among the variables. A sufficient condition for joint co-integration among the variables in a long-run regression is that the error term should be stationary. The residual based ADF test statistics for the error term ensure that we reject the null hypothesis of non-stationary (or no co-integration) at 5% significant level for the model in table 2 (also see appendix 5) (See Fethi (2002) for more details).

[9] Note that if two or more time series variables are co-integrated, then there exists an error-correction mechanism (ECM). Empirically, in small samples, statistically significant error-correction terms provide further evidence in favour of the presence of a 'genuine' long-run relationship. Since the existence of joint co-integration among the variables in long-run regressions Equations 4.2 is confirmed, the next step is to model the short-run dynamics with the use of ECM. I therefore employ an ECM to test for short-run adjustment towards long-run equilibrium, and to explore the relationship between growth (or output) and its determinants (if any) for the model in the short-run. The results of the parsimonious dynamic models, using the error terms from OLS regressions are in Table 3 (also appendix 6).

Table 2: OLS Estimation Long-Run Results.

Dependent Variable	LGDPW
Variable/ Sample Period	1980-2010
Constant	8.93 (52.93)
Trend	- .024 (6.86)
LER	-.013 (-4.42)
LIR	-.081 (-2.10)
LCTEX	.19 (4.15)
LACTC	-.1658 (-4.84)
R^2	.925
F-test	61.96
SER	.0307
CRDW	2.08
ADF*	-5.31
CV	-3.38
X_{SC}	5.91 [.15]
X_{FF}	0.033 [.854]
X_{NORM}	0.015 [.992]
X_{HET}	4.04 [.05]

Table 3: OLS Short-Run Estimation Results.

Dependent Variable	DLGDPW
Variable/ Sample Period	1980-2010
Constant	0.019 (3.58)
ECT (-1)	-0.67 (-3.67)
DLER	- 0.011 (-2.79)
DLIR	-.034 (-0.85)
DLCTEX	.185 (4.67)
DLACTC	-.175 (-5.27)
R^2	.59
F-test	6.86
DW	1.40
SER	0.024
X_{SC}	7.84[.005]
X_{FF}	1.97 [.160]
X_{NORM}	1.78 [.411]
X_{HET}	.32 [.995]

5.3 The interpretation of Estimated Coefficients

If increasing occur for each separate unit in exchange rate, the estimation prediction output is declined by approximately .01% keeps all constant; a rise in the interest rate, decreasing the calculation output is occurred around .08 % holding the others constant. A rise in the ratio of agriculture credit to export credit by every 1 % point causes an increase for the output by almost 0.20 %. It is means that the estimation of

short-term is elasticises and have different magnitude and also has an exact mark related to matching long-run elasticises.

5.3.1 t-Statistics

The explanation of this significance, we use t–values for each variables and it has relation to these hypothesis pointed below:

The hypotheses are H_0: $B_s = 0$ (not significant)

H_1: $B_s \neq 0$ (significant)

T-distribution may be pointed whether estimation of individual values are significant or insignificant. Statistics for both periods can be long-run or short-run are shown in Tables 2 and 3.

Referring to long-run period, LER (-4.42<- 2) -comparing exchange rate is very important to the remaining parameters. LIR (-2.08<-2) – interest rate five percent significant ,LCTEX and LACTC are ratios of agriculture credit to total export-(4.15>2) and ratio of agriculture credit to total credit show that these variables are statistically significant at 1 percent level respectively. In the short-run period, except interest rate LIR (-0.85<- 2) the other powerful determinants are significant.

5.3.2 F-Statistics

F-test displays overall significance of regression estimation equation. When calculation of F-values is bigger or smaller we have different response. So when F-value is bigger we reject the null hypothesis and that regression equation is significant for the case. According to Brazilian Economy, the relationship between economic growth and its determinants explains overall significance since 61.96>2.84 (F-tabular=3.01 and F calculated= 61.96) whereas in the short run, the F-value holds overall significance for the Brazilian case.

5.3.3 R^2

R^2 is defined as the proportion of the total variation or dispersion in the dependent variable that explained by the variation in the explanatory variables in the regression. This means that 92.05% of the total variation in growth can be explained by the explanatory variables.

5.4 An Overview of the Empirical Results

This method practically explores and shows the relationship among interest rate (LIR), exchange rate (LER), ratio of agricultural credit to export credit (LCTEX), ratio of agricultural credit to total credit (LACTC) and their relationship with Brazilian economic growth (LGDPW).

The report of correlation matrix was given in low correlation linking variables, combination of both explanatory and high correlation depending on both variable and explanatory, due to just long-term. Explain the behaviour of Brazilian's economic growth (LGDPW), and also we understand that the all achievements useful for this thesis apparently to fix the model are consistent with forecasting Brazilian consumers behaviour. The estimation of coefficients for both-long and short-run have correct evaluations. It is very important to state that the estimated coefficient for the ratio of agricultural credit to entire credit (LACTC) has not accurate mark. At last found that ratio of agricultural credit to export credit (LCTEX) has positive impact on the Brazilian output growth, which stimulates economic development for both long and short-run periods. The exchange rate and interest rate utilized for both of the area long and short which have a negative and reveres impact on the output growth. This advises that an increase in the exchange rate and interest rate cause a decrease in GDP per worker. It is also found that negative significant nexus exists between output growth and the ratio of agricultural credit to total credit (LACTC). This

evidence suggests that an increase in the ratio does not contribute to the Brazilian's economic growth due to wrong sign. When I compare my estimates results for the Brazilian economy, our estimation relevant literature; the results of this thesis are show a range of estimates which are reported in the previous research. My estimation is nearly different from that estimation issued by Anoma (2010) (who studied for Nigerian's agricultural growth), Isedu (2008) (who investigated for Nigerian's non-oil sector), Longe (2008) (who studied for Nigerian's agricultural production). On the other hand, my calculations of the both period short and long run economic growth are vaguely different from the findings mentioned in the other researches. This indicates that the people who have increase in their income, but there exists high range. According to Brazilian economy all prices in local area related to market places.

It is important to mention that EC measures the (speed of adjustment) or speed of which prior deviations from equilibrium are corrected. The speed of growth returns to equilibrium after a deviation has occurred. Coefficient estimated ECT (-1) in table 3 suggests that deviation from equilibrium are corrected at almost 68% per year.

Chapter 6

CONCLUSION, RECOMMENDATIONS AND POLICY IMPLICATIONS

6.1 Conclusion

Within this dissertation, I adopted the frameworks introduced by Marc D, 2006, Enoma AI, 2001, and Isedu M, 2008 to investigate the role of agricultural economy on the Brazilian's economic growth. Particularly, I found out that the relationship between influence of agricultural credit and economic development since (1980-2010) using annual data and information. The practical information illustrated which ratio of agricultural credit to total export has positive impact on growth of GDP per worker, which stimulates agricultural production as well as economic development for both of periods, long-run and short-run. I applied exchange rate for all periods has a negative pressure on growth of GDP for each worker. My suggestion is when an increase in the exchange rate due to a decline in agriculture development as well as economic development, we understand that reveres relation between significant nexus exists between interest rate and agricultural development. This evidence suggests that interest rate does not have any influence on agricultural development in short-run for the Brazilian's economic development. The final variable identified as LACTC, which was used to take into account as the positive effects of the agricultural credit as a percent of total credit on the economic development. This suggests that a decrease in this variable favourably make the output growth to decline which is against the empirical model for the Brazilian economy. On the whole, my findings of periods (short and long run) output like its determinants support the

findings reported in the other studies. Especially, ratio of agricultural credit to export credit (LCTEX) has positive impact on the Brazilian's economic growth in both short run and long run. This indicates that the role of agricultural credit on economic growth is so crucial for the Brazilian economy.

6.2 Policy Implications

Due to final output state that these data used for this research to match our model and are reliable for forecasting behaviour. Our estimation is coefficients for both periods long and short run have right measurement and the accurate all signs except interest rate and total agricultural ratio. My estimates for all periods such as relative are nearly different than the findings reported in the other articles and researches and possibly its exploration may show the model and data utilized for this research are consistent with the assumption.

6.3 Recommendation

More beneficial time series techniques like: bound test, causality techniques can be use for the same area under discussion for advanced research in order to get more perfect output. The model used in this investigation can be promoted by using the concept of cobweb models instead of standard models shows the simple relationship between agricultural credit and economic growth.

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APPENDICES

Appendix 1: Correlation Matrix

Estimated Correlation Matrix of Variables

	LGDPW	LER	LIR	LCTEX	LACTC
LGDPW	1.0000	.65703	.19755	.86070	.83236
LER	-.65703	1.0000	.71111	-.61308	-.64504
LIR	-.19755	.71111	1.0000	-.17662	-.29440
LCTEX	.86070	-.61308	-.17662	1.0000	.96503
LACTC	.83236	-.64504	-.29440	.96503	1.0000

Appendix 2: Long-Run Period

Ordinary Least Squares Estimation

Dependent variable is LGDPW
31 observations used for estimation from 1980 to 2010

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	8.9387	.16886	52.9370[.000]
T	.024328	.0035432	6.8662[.000]
LER	-.013180	.0029799	-4.4229[.000]
LIR	-.080419	.038176	-2.1065[.045]
LCTEX	.19657	.047359	4.1507[.000]
LACTC	-.16587	.034258	-4.8417[.000]

R-Squared	.92533	R-Bar-Squared	.91040
S.E. of Regression	.030758	F-stat. F(5, 25)	61.9656[.000]
Mean of Dependent Variable	8.9617	S.D. of Dependent Variable	.10276
Residual Sum of Squares	.023652	Equation Log-likelihood	67.2766
Akaike Info. Criterion	61.2766	Schwarz Bayesian Criterion	56.9746
DW-statistic	1.0095		

Diagnostic Tests

Test Statistics	LM Version	F Version
A:Serial Correlation	CHSQ(1)= 5.9107[.015]	F(1, 24)= 5.6541[.026]
B:Functional Form	CHSQ(1)= .033980[.854]	F(1, 24)= .026336[.872]
C:Normality	CHSQ(2)= .015303[.992]	Not applicable
D:Heteroscedasticity	CHSQ(1)= 4.0481[.044]	F(1, 29)= 4.3557[.046]

A:Lagrange multiplier test of residual serial correlation
B:Ramsey's RESET test using the square of the fitted values
C:Based on a test of skewness and kurtosis of residuals
D:Based on the regression of squared residuals on squared fitted values

Appendix 3: Short-Run Period

```
                    Ordinary Least Squares Estimation
*******************************************************************************
 Dependent variable is DLGDPW
 30 observations used for estimation from 1981 to 2010
*******************************************************************************
 Regressor              Coefficient       Standard Error         T-Ratio[Prob]
 C                         .019735           .0055060             3.5842[.001]
 ER(-1)                   -.67261             .18310            -3.6735[.001]
 DLER                     -.011803           .0042177            -2.7985[.010]
 DLIR                     -.034419            .040388            -.85221[.403]
 DLCTEX                     .18543            .039653             4.6762[.000]
 DLACTC                   -.17533            .033233            -5.2758[.000]
*******************************************************************************
 R-Squared                    .58848   R-Bar-Squared                    .50275
 S.E. of Regression          .024092   F-stat.    F(  5,  24)    6.8642[.000]
 Mean of Dependent Variable .0094809   S.D. of Dependent Variable     .034165
 Residual Sum of Squares     .013930   Equation Log-likelihood        72.5555
 Akaike Info. Criterion      66.5555   Schwarz Bayesian Criterion     62.3519
 DW-statistic                 1.4018
*******************************************************************************


                            Diagnostic Tests
*******************************************************************************
*    Test Statistics  *        LM Version        *         F Version
*******************************************************************************
*                     *                          *
* A:Serial Correlation*CHSQ(   1)=   7.8462[.005]*F(   1,  23)=   8.1459[.009]
*                     *                          *
* B:Functional Form   *CHSQ(   1)=   1.9749[.160]*F(   1,  23)=   1.6208[.216]
*                     *                          *
* C:Normality         *CHSQ(   2)=   1.7803[.411]*       Not applicable
*                     *                          *
* D:Heteroscedasticity*CHSQ(   1)= .3266E-4[.995]*F(   1,  28)= .3048E-4[.996]
*******************************************************************************
   A:Lagrange multiplier test of residual serial correlation
   B:Ramsey's RESET test using the square of the fitted values
   C:Based on a test of skewness and kurtosis of residuals
   D:Based on the regression of squared residuals on squared fitted values
```

Appendix 4: Unit root test (ADF) Test results

```
                    Unit root tests for variable GDPW
     The Dickey-Fuller regressions include an intercept but not a trend
**********************************************************************************
 27 observations used in the estimation of all ADF regressions.
 Sample period from 1984 to 2010
**********************************************************************************
        Test Statistic      LL           AIC           SBC           HQC
 DF          1.0982     -236.6294     -238.6294     -239.9253     -239.0148
 ADF(1)       .60077    -236.1713     -239.1713     -241.1150     -239.7492
 ADF(2)     -.15893     -235.5448     -239.5448     -242.1364     -240.3154
 ADF(3)     -.12954     -235.5447     -240.5447     -243.7843     -241.5080
**********************************************************************************
 95% critical value for the augmented Dickey-Fuller statistic =  -2.9750
 LL  = Maximized log-likelihood      AIC = Akaike Information Criterion
 SBC = Schwarz Bayesian Criterion    HQC = Hannan-Quinn Criterion


                    Unit root tests for variable GDPW
    The Dickey-Fuller regressions include an intercept and a linear trend
**********************************************************************************
 27 observations used in the estimation of all ADF regressions.
 Sample period from 1984 to 2010
**********************************************************************************
        Test Statistic      LL           AIC           SBC           HQC
 DF         -.17015     -235.8235     -238.8235     -240.7673     -239.4015
 ADF(1)     -.54378     -235.1868     -239.1868     -241.7784     -239.9574
 ADF(2)     -1.5203     -233.5321     -238.5321     -241.7717     -239.4954
 ADF(3)     -1.8471     -232.8256     -238.8256     -242.7131     -239.9815
**********************************************************************************
 95% critical value for the augmented Dickey-Fuller statistic =  -3.5867
 LL  = Maximized log-likelihood      AIC = Akaike Information Criterion
 SBC = Schwarz Bayesian Criterion    HQC = Hannan-Quinn Criterion
```

Unit root tests for variable DGDPW

The Dickey-Fuller regressions include an intercept but not a trend

26 observations used in the estimation of all ADF regressions.
Sample period from 1985 to 2010

	Test Statistic	LL	AIC	SBC	HQC
DF	-3.0836	-228.1088	-230.1088	-231.3669	-230.4710
ADF(1)	-2.0160	-227.3164	-230.3164	-232.2036	-230.8599
ADF(2)	-1.7737	-227.3124	-231.3124	-233.8286	-232.0369
ADF(3)	-2.2500	-226.2285	-231.2285	-234.3737	-232.1342

95% critical value for the augmented Dickey-Fuller statistic = -2.9798
LL = Maximized log-likelihood AIC = Akaike Information Criterion
SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Unit root tests for variable DGDPW

The Dickey-Fuller regressions include an intercept and a linear trend

26 observations used in the estimation of all ADF regressions.
Sample period from 1985 to 2010

	Test Statistic	LL	AIC	SBC	HQC
DF	-3.3423	-227.0565	-230.0565	-231.9437	-230.6000
ADF(1)	-2.2566	-226.6459	-230.6459	-233.1621	-231.3704
ADF(2)	-2.0289	-226.6209	-231.6209	-234.7661	-232.5266
ADF(3)	-2.4925	-225.4264	-231.4264	-235.2007	-232.5133

95% critical value for the augmented Dickey-Fuller statistic = -3.5943
LL = Maximized log-likelihood AIC = Akaike Information Criterion
SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Unit root tests for variable ER

The Dickey-Fuller regressions include an intercept but not a trend

27 observations used in the estimation of all ADF regressions.
Sample period from 1984 to 2010

	Test Statistic	LL	AIC	SBC	HQC
DF	-1.0473	-4.9832	-6.9832	-8.2790	-7.3685
ADF(1)	-1.2074	-3.7136	-6.7136	-8.6574	-7.2916
ADF(2)	-1.3631	-3.2532	-7.2532	-9.8449	-8.0239
ADF(3)	-1.2945	-3.2521	-8.2521	-11.4917	-9.2154

95% critical value for the augmented Dickey-Fuller statistic = -2.9750
LL = Maximized log-likelihood AIC = Akaike Information Criterion
SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Unit root tests for variable ER

The Dickey-Fuller regressions include an intercept and a linear trend

27 observations used in the estimation of all ADF regressions.
Sample period from 1984 to 2010

	Test Statistic	LL	AIC	SBC	HQC
DF	-.54821	-4.9792	-7.9792	-9.9230	-8.5572
ADF(1)	-1.1702	-3.4057	-7.4057	-9.9974	-8.1764
ADF(2)	-1.4315	-2.7127	-7.7127	-10.9523	-8.6760
ADF(3)	-1.4281	-2.6061	-8.6061	-12.4936	-9.7621

95% critical value for the augmented Dickey-Fuller statistic = -3.5867
LL = Maximized log-likelihood AIC = Akaike Information Criterion
SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Unit root tests for variable DER

The Dickey-Fuller regressions include an intercept but not a trend

26 observations used in the estimation of all ADF regressions.

Sample period from 1985 to 2010

	Test Statistic	LL	AIC	SBC	HQC
DF	-3.6087	-4.8246	-6.8246	-8.0827	-7.1869
ADF(1)	-2.2120	-4.6287	-7.6287	-9.5158	-8.1721
ADF(2)	-2.0834	-4.5709	-8.5709	-11.0871	-9.2955
ADF(3)	-1.5634	-4.4346	-9.4346	-12.5798	-10.3403

95% critical value for the augmented Dickey-Fuller statistic = -2.9798

LL = Maximized log-likelihood AIC = Akaike Information Criterion

SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Unit root tests for variable DER

The Dickey-Fuller regressions include an intercept and a linear trend

26 observations used in the estimation of all ADF regressions.

Sample period from 1985 to 2010

	Test Statistic	LL	AIC	SBC	HQC
DF	-3.6607	-4.4327	-7.4327	-9.3198	-7.9761
ADF(1)	-2.2273	-4.1773	-8.1773	-10.6935	-8.9019
ADF(2)	-2.0943	-4.1174	-9.1174	-12.2627	-10.0232
ADF(3)	-1.5336	-3.9174	-9.9174	-13.6917	-11.0043

95% critical value for the augmented Dickey-Fuller statistic = -3.5943

LL = Maximized log-likelihood AIC = Akaike Information Criterion

SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Unit root tests for variable IR

The Dickey-Fuller regressions include an intercept but not a trend

27 observations used in the estimation of all ADF regressions.
Sample period from 1984 to 2010

	Test Statistic	LL	AIC	SBC	HQC
DF	-1.3264	-87.1557	-89.1557	-90.4516	-89.5411
ADF(1)	-2.0773	-83.4507	-86.4507	-88.3945	-87.0287
ADF(2)	-1.4054	-82.3428	-86.3428	-88.9345	-87.1135
ADF(3)	-1.6543	-81.6015	-86.6015	-89.8411	-87.5648

95% critical value for the augmented Dickey-Fuller statistic = -2.9750
LL = Maximized log-likelihood AIC = Akaike Information Criterion
SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Unit root tests for variable IR

The Dickey-Fuller regressions include an intercept and a linear trend

27 observations used in the estimation of all ADF regressions.
Sample period from 1984 to 2010

	Test Statistic	LL	AIC	SBC	HQC
DF	-.91195	-86.8781	-89.8781	-91.8219	-90.4561
ADF(1)	-1.8019	-83.4507	-87.4507	-90.0424	-88.2213
ADF(2)	-.85489	-82.1688	-87.1688	-90.4084	-88.1321
ADF(3)	-1.1819	-81.5919	-87.5919	-91.4794	-88.7479

95% critical value for the augmented Dickey-Fuller statistic = -3.5867
LL = Maximized log-likelihood AIC = Akaike Information Criterion
SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Unit root tests for variable DIR

The Dickey-Fuller regressions include an intercept but not a trend

26 observations used in the estimation of all ADF regressions.

Sample period from 1985 to 2010

	Test Statistic	LL	AIC	SBC	HQC
DF	-3.0895	-82.9999	-84.9999	-86.2580	-85.3622
ADF(1)	-3.8614	-80.8547	-83.8547	-85.7418	-84.3981
ADF(2)	-2.5103	-80.5939	-84.5939	-87.1101	-85.3185
ADF(3)	-2.3972	-80.4117	-85.4117	-88.5569	-86.3174

95% critical value for the augmented Dickey-Fuller statistic = -2.9798

LL = Maximized log-likelihood AIC = Akaike Information Criterion

SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Unit root tests for variable DIR

The Dickey-Fuller regressions include an intercept and a linear trend

26 observations used in the estimation of all ADF regressions.

Sample period from 1985 to 2010

	Test Statistic	LL	AIC	SBC	HQC
DF	-3.1979	-82.5181	-85.5181	-87.4052	-86.0615
ADF(1)	-4.0928	-79.9393	-83.9393	-86.4555	-84.6639
ADF(2)	-2.7451	-79.8103	-84.8103	-87.9556	-85.7161
ADF(3)	-2.6501	-79.5444	-85.5444	-89.3187	-86.6313

95% critical value for the augmented Dickey-Fuller statistic = -3.5943

LL = Maximized log-likelihood AIC = Akaike Information Criterion

SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Unit root tests for variable CTEX
The Dickey-Fuller regressions include an intercept but not a trend

27 observations used in the estimation of all ADF regressions.
Sample period from 1984 to 2010

	Test Statistic	LL	AIC	SBC	HQC
DF	-.79179	77.6789	75.6789	74.3830	75.2936
ADF(1)	-.38751	78.4722	75.4722	73.5285	74.8942
ADF(2)	-.27393	78.5228	74.5228	71.9311	73.7522
ADF(3)	-.55158	79.0548	74.0548	70.8152	73.0915

95% critical value for the augmented Dickey-Fuller statistic = -2.9750
LL = Maximized log-likelihood AIC = Akaike Information Criterion
SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Unit root tests for variable CTEX
The Dickey-Fuller regressions include an intercept and a linear trend

27 observations used in the estimation of all ADF regressions.
Sample period from 1984 to 2010

	Test Statistic	LL	AIC	SBC	HQC
DF	-3.5999	83.6365	80.6365	78.6928	80.0586
ADF(1)	-3.2476	84.4244	80.4244	77.8327	79.6537
ADF(2)	-3.1438	84.7641	79.7641	76.5245	78.8008
ADF(3)	-3.2826	85.4698	79.4698	75.5823	78.3139

95% critical value for the augmented Dickey-Fuller statistic = -3.5867
LL = Maximized log-likelihood AIC = Akaike Information Criterion
SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Unit root tests for variable DCTEX

The Dickey-Fuller regressions include an intercept but not a trend

26 observations used in the estimation of all ADF regressions.
Sample period from 1985 to 2010

	Test Statistic	LL	AIC	SBC	HQC
DF	-6.6148	75.2690	73.2690	72.0109	72.9068
ADF(1)	-4.2593	75.3669	72.3669	70.4798	71.8235
ADF(2)	-2.5743	75.9374	71.9374	69.4212	71.2128
ADF(3)	-2.1123	75.9614	70.9614	67.8161	70.0557

95% critical value for the augmented Dickey-Fuller statistic = -2.9798
LL = Maximized log-likelihood AIC = Akaike Information Criterion
SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Unit root tests for variable DCTEX

The Dickey-Fuller regressions include an intercept and a linear trend

26 observations used in the estimation of all ADF regressions.
Sample period from 1985 to 2010

	Test Statistic	LL	AIC	SBC	HQC
DF	-6.7409	75.9619	72.9619	71.0747	72.4184
ADF(1)	-4.5074	76.3514	72.3514	69.8352	71.6268
ADF(2)	-2.7293	76.5426	71.5426	68.3973	70.6369
ADF(3)	-2.2898	76.5442	70.5442	66.7699	69.4574

95% critical value for the augmented Dickey-Fuller statistic = -3.5943
LL = Maximized log-likelihood AIC = Akaike Information Criterion
SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Unit root tests for variable ACTC

The Dickey-Fuller regressions include an intercept but not a trend

27 observations used in the estimation of all ADF regressions.
Sample period from 1984 to 2010

	Test Statistic	LL	AIC	SBC	HQC
DF	-.89037	61.1858	59.1858	57.8900	58.8005
ADF(1)	-.95591	61.2819	58.2819	56.3381	57.7039
ADF(2)	-.85899	61.2892	57.2892	54.6975	56.5186
ADF(3)	-.89927	61.3521	56.3521	53.1125	55.3888

95% critical value for the augmented Dickey-Fuller statistic = -2.9750
LL = Maximized log-likelihood AIC = Akaike Information Criterion
SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Unit root tests for variable ACTC

The Dickey-Fuller regressions include an intercept and a linear trend

27 observations used in the estimation of all ADF regressions.
Sample period from 1984 to 2010

	Test Statistic	LL	AIC	SBC	HQC
DF	-3.4263	66.5540	63.5540	61.6103	62.9760
ADF(1)	-3.4018	66.6816	62.6816	60.0900	61.9110
ADF(2)	-3.2495	66.6873	61.6873	58.4477	60.7240
ADF(3)	-3.1956	66.7642	60.7642	56.8767	59.6083

95% critical value for the augmented Dickey-Fuller statistic = -3.5867
LL = Maximized log-likelihood AIC = Akaike Information Criterion
SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Unit root tests for variable DACTC

The Dickey-Fuller regressions include an intercept but not a trend

26 observations used in the estimation of all ADF regressions.

Sample period from 1985 to 2010

	Test Statistic	LL	AIC	SBC	HQC
DF	-5.2467	59.1885	57.1885	55.9304	56.8262
ADF(1)	-3.9940	59.2700	56.2700	54.3829	55.7266
ADF(2)	-3.0695	59.2755	55.2755	52.7593	54.5509
ADF(3)	-2.3406	59.4242	54.4242	51.2790	53.5185

95% critical value for the augmented Dickey-Fuller statistic = -2.9798

LL = Maximized log-likelihood AIC = Akaike Information Criterion

SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Unit root tests for variable DACTC

The Dickey-Fuller regressions include an intercept and a linear trend

26 observations used in the estimation of all ADF regressions.

Sample period from 1985 to 2010

	Test Statistic	LL	AIC	SBC	HQC
DF	-5.1522	59.3011	56.3011	54.4139	55.7576
ADF(1)	-3.9135	59.4497	55.4497	52.9335	54.7252
ADF(2)	-2.9835	59.4514	54.4514	51.3061	53.5456
ADF(3)	-2.2264	59.5352	53.5352	49.7609	52.4484

95% critical value for the augmented Dickey-Fuller statistic = -3.5943

LL = Maximized log-likelihood AIC = Akaike Information Criterion

SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Appendix 5: Cointegration test (ADF) Test results

Unit root tests for residuals

****

Based on OLS regression of LGDPW on:

C LER LIR LCTEX LACTC

31 observations used for estimation from 1980 to 2010

****

	Test Statistic	LL	AIC	SBC	HQC
DF	**-5.3163**	-258.1018	-259.1018	-259.8024	-259.3259

****

95% critical value for the Dickey-Fuller statistic = **-3.3853**

LL = Maximized log-likelihood AIC = Akaike Information Criterion

SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Appendix 6: Error Correction model and term results

Error correction modelling tests for residuals

****

Based on OLS regression of DLGDPW on:

C ECT(-1) DLER DLIR DLCTEX DLACTC

31 observations used for estimation from 1980 to 2010

****

	Coefficient	Test Statistic
ECT	**-0.67**	**-3.67**

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