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尼加拉瓜農業勞動生產力之影響因素實證研究

Factor influencing Agricultural Labor productivity in

Nicaragua: An empirical approach

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Factors Influencing Agricultural Labor Productivity in
Nicaragua: An Empirical Approach

本論文係陸艾芭君 (R00627043) 在國立臺灣大學農業經濟學系完成之碩士學位論文，於 2013 年 5 月 14 日承下列考試委員審查通過及口試及格，特此證明

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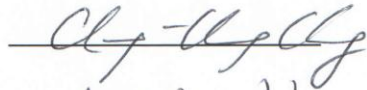
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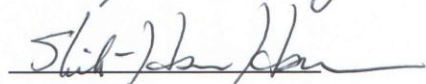
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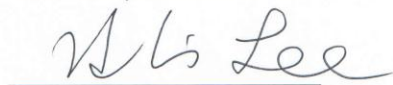
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Dedication



To my lovely son and wonderful husband

Leonidas and J.C.

Abstract



This study examines the relationship of different factors that might influence labor productivity in Nicaragua, a time series economic regression model was utilized in two separate stages, owing the number of observations varied according with availability of data. First stage is based of 28 observation where the implicated factors were; Agricultural land per-capita, Net Stock machinery, Economy environment and government regime. The second one, studied 15 observations whereas economic variables were include as foreign direct investment, health and education expenditure. Positive and negative effects were obtained on Agricultural Productivity Labor ratio. Agricultural Land Per-capita and socialist government regime showed a positive relationship on APL ratio, while Net stock machinery and the Economic context affects negatively Labor productivity. In the second stage health expenditure was the only with positive relation on APL ratio.

Key words: Labor, Agricultural productivity, Nicaragua

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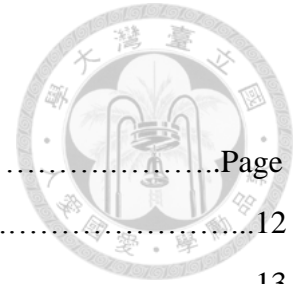


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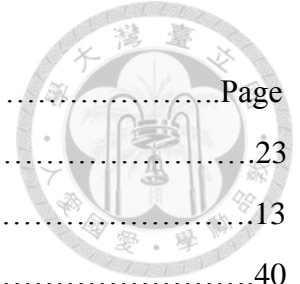
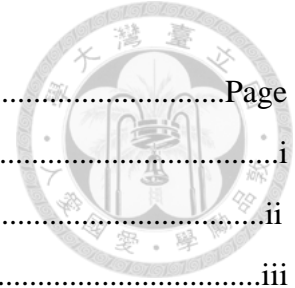
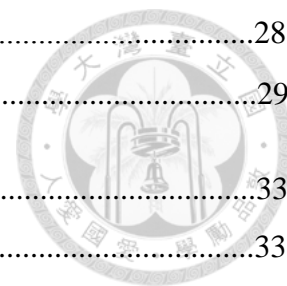


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Chapter 1

Introduction



1.1 Problem Statement and Motivation

Food security and eradication of hunger is one of the most important challenges over the world; the issue about the steady increasing of population, climate change effects, financial crisis, food price's instability, etc is the concern of many countries in the world (at least ought to be), essentially for developing countries where population under poverty line rate is high and this is a reality in Nicaragua.

According to FAO for the period 2010-2012, in the world were accounted 868 million people undernourishment and for Nicaragua specifically there are 1 million people out of 5.9 million total populations, representing a 20% of prevalence undernourishment.

It is estimated that for 2050 (FAO,2009) the food production in order to outpace the increase of population should increase 75%, hence increase on agricultural productivity is which relies this issue, due the constrain of land and other natural resources, researchers has focused on how the agricultural productivity should boost given the natural resources in a sustainable environment. By another hand agricultural based countries population is highly employed in agricultural activities and besides also are high labor intensity, becoming as a crucial point of interest in order to reduce and eradicate poverty, thus Low **labor productivity** in agriculture are mainly responsible for low aggregate **productivity** in poor countries (Restuccia et al, 2008).

Nicaragua economy has been base on agricultural production. Since 1961 to 2012 agricultural sector has contributed in 25% in average to GDP, sorting Nicaragua as according

with the definition of World Bank as *Agricultural Base country* due its share to GDP of the entire economy.



Labor force for 2010 by occupation was divided in agriculture with 28%, Industry 19% and services 53%, the rural population growth had an average of 1.6% for the last 30 years but decreasing the average of less than 1% for the last 10 years instead.

The unemployment rate in average for 30 years have been 9%, but the last 10 years an average of 6% is accounted (World Bank), the decade of the 1990's were the time, which the higher unemployment rate was reported in an average of 14.7%, this caused for the integration of the armed revolutionary forces into the economy as part of on the reforms made at the beginning of 90's.

There isn't place to doubt how important agricultural sector for Nicaragua is. Following the basic theory of production, in order to produce input usage is needed, labor is one of the most important, thus the study of factors might influence positive and negatively this ratio is significance for Nicaraguans and specially myself.

Consequently, led questions about; *what have been happening with the labor agricultural productivity during the last 30 years? Which factors have been affecting this ratio for 30 years? How these factor affect agricultural labor productivity ratio? Does the government policies address correctly the issues in Nicaragua?*

Productivity growth is a crucial source of progress in living standards. Productivity growth means more value is added in production and this is also traduced as more income is available to be distributed representing the significance of the study.

At a firm, industry or country level, the benefits of productivity growth can be distributed in a number of different ways:

- to the workforce through better wages and conditions;
- to shareholders and superannuation funds through increased profits and dividend distributions;
- to customers through lower prices;
- to the environment through more stringent environmental protection; and
- to governments through increases in tax payments (which can be used to fund social and environmental programs).

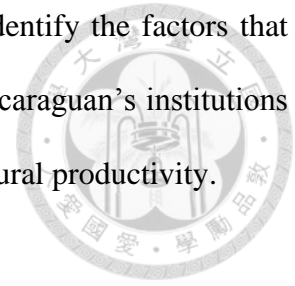


There are essentially two ways to promote growth in output, bring additional inputs into production; or increase productivity. Adding more inputs will not increase the income earned per unit of input (unless there are increasing returns to scale). In fact, it is likely to mean lower average wages and lower rates of profit, but when there is productivity growth, even the existing commitment of resources generates more output and income. Income generated per unit of input increases. Additional resources are also attracted into production and can be profitably employed.

At the national level, productivity growth raises living standards because more real income improves people's ability to purchase goods and services (whether they are necessities or luxuries), enjoy leisure, improve housing and education and contribute to social and environmental programs. Over long periods of time, small differences in rates of productivity growth compound, like interest in a bank account, and can make an enormous difference to a society's prosperity. Nothing contributes more to reduction of poverty.

This study will contribute in a critical based on the results obtained of evaluation of economic policies applied on the period of study.

This investigation looks forward be a modest contribution in order identify the factors that affects the most the labor input and thus provide recommendations for Nicaraguan's institutions responsible of seeking improvement and development of the labor agricultural productivity.



1.2 Objectives of Study

Analysis of multiple regression models based three stages. Labor agricultural productivity on function of a group of variables under the different issues as agricultural development and investment. The elasticity of each variable will be measure and its implication on Agricultural Labor Productivity will be explained.

It is an useful tool for those people responsible to make agricultural development policies, helping farmers improve their livelihood. In this study, the measurement of Agricultural Labor productivity of Nicaragua is intended to help this nation to evaluate and examine their performance and identify the most sensitive issues of affectation.

1.3 Organization of the Study

It is pretended organize the study as follows. Chapter two summarizes current studies on agricultural labor productivity for different countries and regions using similar methodology where results are examined

Chapter three will provide an introduction about agricultural sector of Nicaragua and its main and most important facts during the period of study.

Chapter four presents the theoretical framework for theory of Cobb Douglas Production Function and its derivation in order to measure its elasticity according the variables. Results obtained are discussed in chapter five; a conclusive overview for all the materials and methodology and background of Nicaragua is summarized and policy recommendations are made in chapter six.



Chapter 2

Literature Review

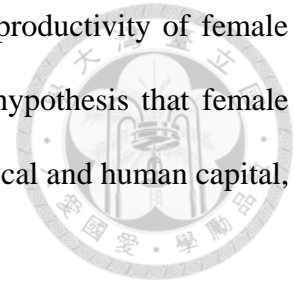
This chapter will provide a summary of the extensive literature on Labor productivity as well as agricultural productivity using different methodology and theories as Malthus, Cobb Douglas production function theories and also parametric and non-parametric approaches in order to explain agricultural and labor productivity growth and others factors impacting them.

2.1 Empirical Studies among all regions

Vollrath, Dietric (2011), in his study on rice and wheat production among two Asia and Europe prior the Industrial Revolution showed in a two-sector Malthusian model of endogenous population growth, that output per capita, population density, and industrialization depend upon the labor intensity of agricultural production. Because the diminishing returns to labor are less pronounced, high labor intensity (as in rice production) leads not only to a larger population density but also to lower output per capita and a larger share of labor in agriculture. Additionally he used a derivation of Cobb Douglas production in order to measure the elasticity of Labor within relation of production which indicate directly the Labor-intensity of agricultural production. The final conclusion he got was the origin of the difference lies in the inherent labor-intensity of crop production in tropical versus temperate regions. Rice production is labor intense, while wheat production is not.

Hassan, Aly (2010) used two approaches, the first one Labor efficiency and the second separate factors approach, as well as two production functions; a ray homothetic function and the

Cobb-Douglas production function, using them in order to estimate the productivity of female versus male farms laborers in the traditional agriculture of Nepal. The hypothesis that female laborers would be less productive than males due to the disparities in physical and human capital, originating from economic and socio-cultural discrimination was tested.

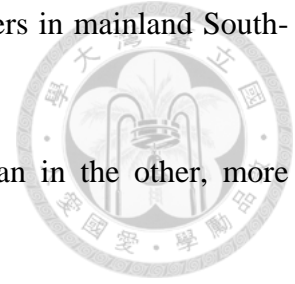


The study results confirmed that expectation. However, the study suggests that once differences in irrigation and type of seeds used by male and female farmers are included in the model, the magnitude of the difference is reduced and the estimated coefficient becomes insignificant. The ray-homothetic function does best in yielding realistic results suggesting that congestion is an important feature of Nepalese agriculture supporting the notion that there may be disguised unemployment in the sense that too much labor is used in agriculture.

Van der Eng, Pierre (2004), based his study on mainland of South-East Asia, which are long dominated by the international rice market. He measured Labor Productivity in rice production and argues that simple low-cost and labor-extensive, but low-yielding production technology allowed farmers in mainland South-East Asia to achieve significantly higher levels of labor productivity than in the more densely populated rice-producing areas in South-East Asia and Japa. High levels of labor productivity were a major source of comparative advantage in rice production for Burma, Thailand and Southern Vietnam. This study did not take any econometric approach to measure the productivity, he just used the data of labor input per hectare and output of rice yield and Area per day worked among the countries under study and to calculate the output (Rice) per day worked in a panel data characteristics of data collection and his final conclusions were Supply-side factors appear to be paramount in explaining why the countries of mainland South-East Asia dominated the prewar world rice market, because they help to define the comparative advantage of these countries in rice production. The advantage was that simple

labor-extensive, low-cost, low-yield production technology allowed farmers in mainland South-East East

Asia to achieve levels of labor productivity that were much higher than in the other, more densely populated rice-producing areas in South-East and East Asia.



Xiangfei Xin, Fu Qin, (2011), on their work investigated the determinants of regional disparities in China's agricultural labor productivity growth, using a non-parametric technique DEA, finding that during the period from 1987 up to 2005 although the growth of China's agricultural labor productivity mainly depended on the accumulation of inputs, technical changes contributed more to regional disparities in agricultural productivity growth. . It was indicated that improving efficiency to promote total factor productivity growth is important for agricultural labor productivity growth for the three regions – Eastern, Central and Western – of China. The increase in inputs for Western China, and the improvement in technical change for Central and Western China are significant aspects to promote the growth of agricultural productivity and narrow the gap with Eastern China.

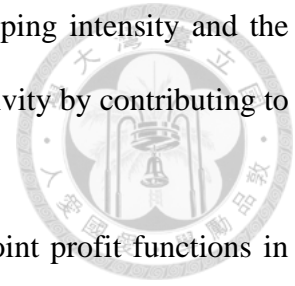
O'Gorman and Pandey, motivated due the inequality of agricultural labor productivity across the developing countries measure these disparities using a multivariate regression approach and a non-parametric approach as TFP which later on was plugged it later into a production equation in function of physical capital in agriculture, fertilizer, agricultural labor, agricultural land, The standard approach of accounting for cross-country productivity has been to estimate the log-linearised aggregate production function and to infer from the resulting input elasticities the contribution of various inputs in explaining cross-country variation in agricultural labour productivity, they found the that 22 per cent of cross country variation in agricultural labour

productivity can be attributed to the diffusion of high-yielding seed varieties across countries and capital and fertilizer has a higher impact on increasing labor productivity than land per worker.

Mugera et al (2012), used non-parametric production function methods to decompose farm-level labor productivity growth into components attributable to efficiency change, technical change, and factor intensity. The estimation is accomplished using balanced panel data drawn from the Kansas Farm Management Association for the period 1993 to 2007. They found that labor productivity growth is primarily driven by factor intensity and technical change. Efficiency change is declining with increasing productivity growth, and technical change is not Hicks-neutral and occurs at high levels of factor intensity, suggesting that innovation is embodied in factor intensity.

Raju Das (1998), take in to account the impact of Green Revolution has having on the increase of labor productivity and land productivity in India, indeed in total agricultural productivity. One important way in which the use of GR inputs has been argued to have caused higher wages is through its impact on productivity. The use of these inputs has indeed been responsible for a rise in land and labor productivity. The use of GR inputs has contributed to higher land productivity because of three factors; the first one biological structure of the HYVs (High yield of varieties of seeds). As Lipton (1989) says, HYVs are more efficient in converting soil nutrients into grain and thus produce more per unit of land than traditional varieties; second one The development of non-agricultural activities occurs due to the increased expenditure of the large farmers. This increased expenditure in tum creates new job opportunities and the third one as farmers' income is raised by the use of HYVs, they tend to substitute leisure for income and use hired labor instead of family labor. Labor productivity is treated as the most important indicator of the development of the productive forces and of the income (wages). In the context

of agriculture, labor productivity is a function of land productivity, cropping intensity and the land-person ratio GR technology can contribute to increased labor productivity by contributing to an increase in land productivity and also in multiple cropping.



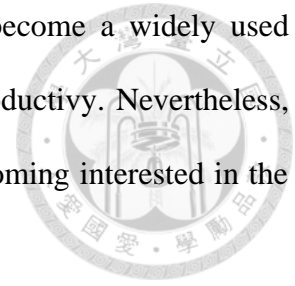
Chand and Mountain (1987), used a Tylor series approximation of joint profit functions in order to quantify interregional differentials in the Canadian agriculture sector by region and to quantify to contributing factors to regional labor productivity differences. These contributing factors are output price differentials whereas Crops and Livestock and also differentials on land and buildings capital deepening, energy prices, other materials and efficiency. They showed by each region, how these variables has different effect in the same country but different regions.

Gutierrez, Luciano (2000) on his conference made at Tampa, Florida talked about why agricultural labour productivity is higher in some countries than others, indeed using recent economic theories found some empirical regularities between agricultural labor productivity growth among investment and education as also for environmental factors for 44 countries during the period 1980-1993. He found that strong evidence that where agricultural investment and educated people rates are higher, agricultural labour productivity growth faster. Geographical factors as well as freer trade influence growth. Additionally he found evidence of conditional converge, which means that cross- country agricultural productivity does not converge to the same level of steady state but that productivity in each country converges to its own long run equilibrium.

2.2 Finals Thoughts on empirical researches

Empirical research on agricultural labor productivity at different economics levels (micro and macro) has been discussed in this chapter. From this review, four specific points are summarized as follows.

1. Recently DEA and other non-parametric as TFP methods has become a widely used technique in order to measure the decomposition of agricultural labor productivity. Nevertheless, there is a growing literature on macro issues as more researchers are becoming interested in the subject.



Nonparametric analyses are praised for not relying on parametric specification of the production, cost or profit functions and therefore, not imposing a priori parametric restrictions on the underlying technology. In addition, the Malmquist productivity index technique has the advantage of decomposing productivity into efficiency and technical changes. However TFP is unable to make statistical inferences from derived results. One has to add an additional step which consists of a statistical approach in order to derive statistical inferences.

2. Theories of Malthus, Cobb- Douglas production functions and its derivations for use the exponents as coefficients of elasticities is highly measurable technique and one of simplest practice.

3. The use of multivariate, time series and panel data analysis is widely use, sometimes mixed of techniques among non-parametric approach making inferences on parametric ones is commonly used.

4. Researches are more advised to measure agricultural labor productivity using almost agricultural factors affecting Labor productivity ratio, therefore other factors have been also involved in the analysis of its impact on it, making more accurate the economic policies.

Indeed this brief study will contribute to the policy makers of agricultural sector of Nicaragua as a motivation and as giver of interest about the impact of different factor over agricultural labor ratio in order to contribute on the increase of production thru improvement of productivity in a sustainable framework and the improvement of farmer livelihood and empowerment of them.

Chapter 3

Nicaragua Agricultural Background



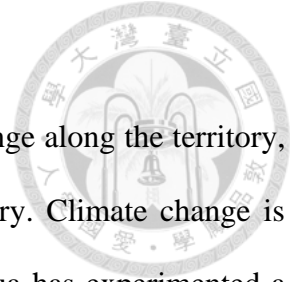
This chapter will provide a summary a brief overview about Nicaragua agricultural sector over the period of study in this investigation. It will contain the main issues about population and economic policies matters.

3.1 Nicaragua's Geography

Nicaragua is a country located just in the middle of Central America (called the hearth of CA) and is the biggest one among them. It border both the Caribbean Sea and the North Pacific Ocean, between Costa Rica and Honduras and has a total area of 130,373.4 km² where 9,240 km², recently a ruling last month by the International Court of Justice (ICJ) – which resides in The Hague, Netherlands – granted Nicaragua almost 100,000 square kilometres of maritime territory in Caribbean waters that were previously under the control of Colombia, indeed increasing the maritime territory available. It ranks for World Bank as ease doing business, 2012 at 119 out to 185.

Nicaragua is an agricultural country, it has very fertile soil due the volcanic deposits, the land (130,373.4 km²) is distributed as follow; mainland: 120,339.2, Insular territory: 517.4, Lakes: 10,407.6, Hydrographic basins: 21, Lagoons: 47, Mountains (higher than 1,000 mts):61, the number of volcanoes: 28, (active 7 and not active 21).

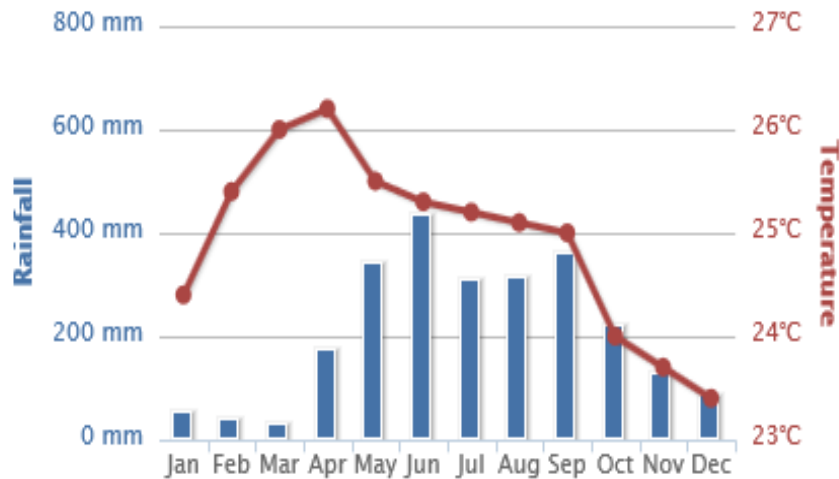
3.2 Land Utilization



The weather of Nicaragua is mostly considered as humid, but this change along the territory, encouraging different agricultural activities and crop along all the country. Climate change is wide observable (Figure #3.1) during the period of 1900 -2009, Nicaragua has experimented a drastic low of rainfall levels, affecting main permanent crops as coffee, rice and pasture to feed cattle, causing severe droughts and soil erosion.

**Average monthly rainfall and temperature for Nicaragua
1900-2009**

Figure # 3.1

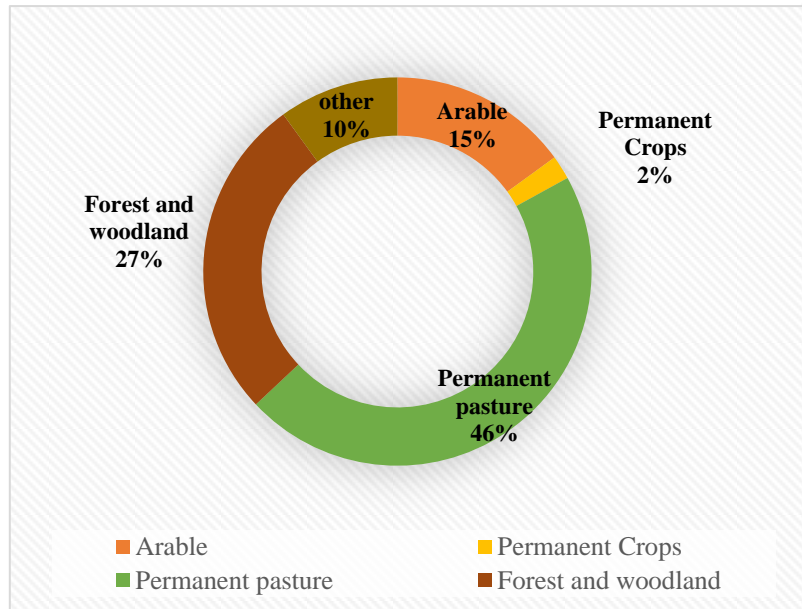


Source: World Bank

There is a consensus that Nicaragua has large abundant of land, for 2005 was reported the land utilization been distributed as arable land with 15%, permanent crops 2%, permanent pasture 46%, forest and woodland 27% and other with 10%.

Figure # 3.2

Nicaragua Land Utilization



Source: Made by the author based on Nicaragua's Central Bank 2005 statistics

The land is mostly utilized by permanent pasture, where the level of labor is very low in this agricultural practice, for other side, for instance the permanent crops where coffee, the most important export product and labor absorbed is include, only occupy the 2% of the total land. In the pacific area used to be dry with a few rain, the central and mountainous zone is a warmer and humid temperature and the Caribbean zone is humid and tropical with lots of rain.

Nicaragua has an extent of hydrographic resources, whereas the most productive and used area is the pacific coast, although the Atlantic coast are more vast and has larger rivers. Freshwater resource as is Xolotlan Lake and Lake of Nicaragua o Cocibolca, provides only a resource for domestic consumption in very small and artisan level, which constitute the main resource of income and food supply for the families living in the nearest places of coast under extreme poverty conditions.

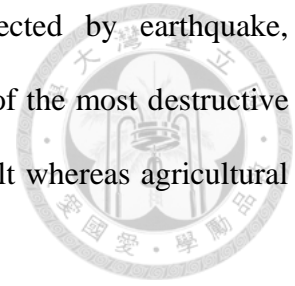
3.3 History

The Pacific coast of Nicaragua was settled as a Spanish colony from Panama in the early 16th century, whereas almost the half of indigenous people died as a consequence of infectious diseases spread out by Spanish and the resistance commanded by the indigenous chiefs of Nicarao and Diriangen.

The Caribbean cost was occupied by British by the first half of 19th century. During the American Revolutionary War, Central America was subject to conflict between Britain and Spain, as Britain sought to expand its influence beyond coastal logging and fishing communities in present-day Belize, Honduras and Nicaragua. Horatio Nelson led expeditions against San Fernando de Omoa in 1779 and the San Juan in 1780, which had temporary success before being abandoned due to disease. In turn, the Spanish colonial leaders could not completely eliminate British influences along the Mosquito Coast. Britain gradually ceded control of the region in subsequent decades.

Independence from Spain was declared in 1821 and the country became an independent republic in 1838. Nicaragua has experienced several military dictatorships, the longest being the hereditary dictatorship of the Somoza family, who ruled for 43 years during the 20th century, as a consequence violent opposition to governmental manipulation and corruption spread to all classes by 1978 and resulted in a short-lived civil war that brought the Marxist Sandinista guerrillas to power in 1979. Nicaraguan aid to leftist rebels in El Salvador caused the US to sponsor anti-Sandinista contra guerrillas through much of the 1980s. After losing free and fair elections in 1990, 1996, and 2001, former Sandinista President Daniel Ortega Saavedra was elected president in 2006 and reelected in 2011.

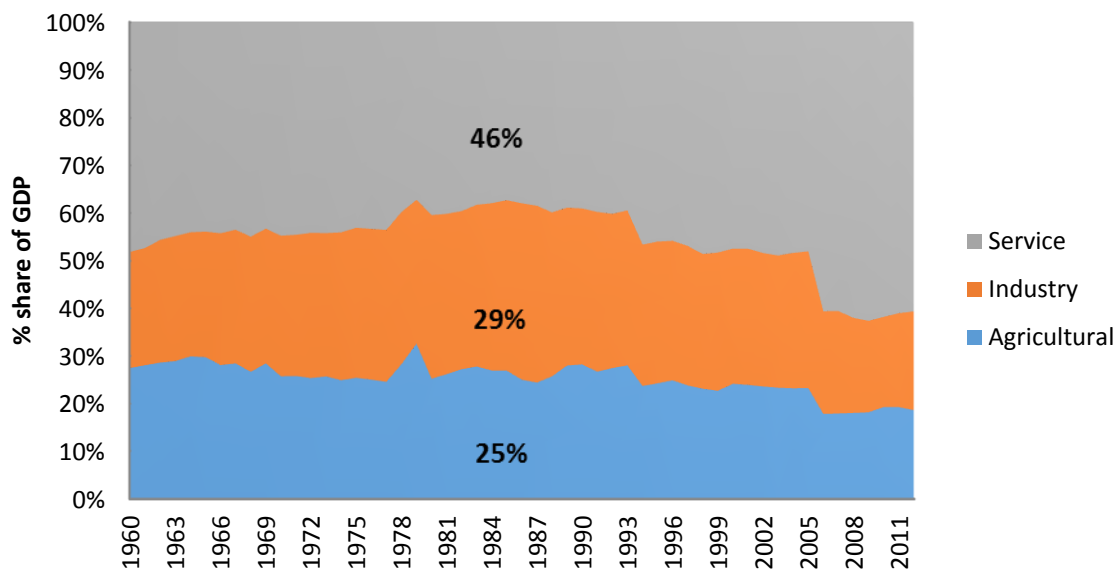
Nicaragua's infrastructure and economy have been hardly affected by earthquake, dictatorships, civil war and by many natural disasters as drought and one of the most destructive registered in the history Hurricane Mitch in 1998, are slowly being rebuilt whereas agricultural products are still the main exports contributors.



3.4 Nicaragua's economy structure

Nicaragua is classified as lower middle income and developing country as well. Also due its GDP share with agriculture, contributing in an average to total GDP from the years 1961 up to 2012 with 25%, industry and service and commerce sector with 29% and 46%, respectively (Figure # 3.3) sorting Nicaragua as agricultural base country (World Bank).

Figure # 3.3 **Nicaragua's average GDP by sector (%)**
1960-2011



Source: Made by the author based on Nicaragua's Central Bank statistics

For 2012, the total GDP was structured by Agricultural sector with 19%, Industry with 21% and Service and commerce with 61%.

3.4.1. Farming Crops



Agricultural activities grew 2.6 percent due added value of coffee crop, cane sugar and activity group composed of banana, soybeans, peanuts, sesame, snuff and other agricultural products. Moreover, we observed decrease crop basic grains Figure #3.4.

The added value of coffee cultivation grew 13 percent, influenced by upper-year cycle, which was presented at 2011-2012 cycle and favorable climatic conditions that led to good flowering. However, from the third quarter was expressed unusual outbreak of rust and anthracnose¹, which was increasing in incidence and involvement, especially in older plantations or with little or no application of good agricultural practices. This resulted in minor that resulted yields per acre of production cycle 2012 - 2013. For its part, the cultivation of sugarcane, grew 4.1 percent.

This result was due to higher planted area, favorable weather conditions for luminance, performing mechanized planting and increased efficiency through the increased use of combine harvesters.

The aggregate value of other agricultural products grew 8.6 percent, as a result of increased production banana; higher harvested area and yield in the soybean and peanut crops, higher yields per acre in sesame and greater value added vegetable, vegetables, fruits, other products and agricultural services.

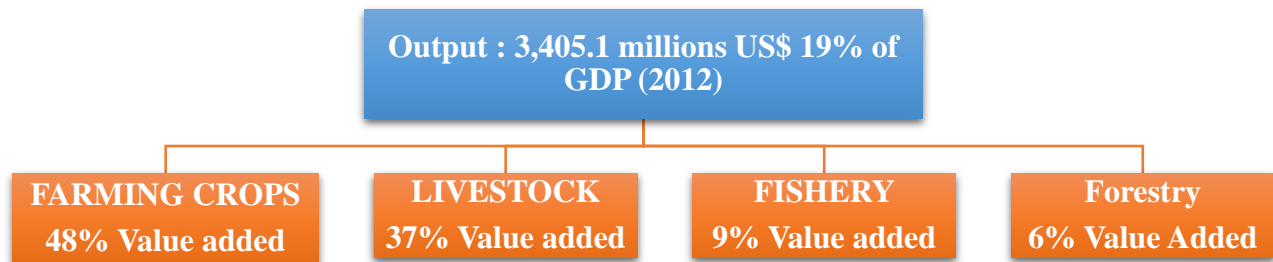
Meanwhile, basic grains showed a trend down, with the exception of Sorghum, so that the aggregate production decreased by 13.3 percent. These results were a result of climatic effects.

¹ Diseases of coffee crops that caused severe damage on production

During the first was recorded over of rainfall, which caused losses for the abundance of moisture causing fungal diseases. While postrera that the lack of rain caused water stress in established areas. Other factors bearing on the drop in production were lower harvested areas, poor quality of seed, animal damage wild rat pest attacks, especially in the Matagalpa and Rio San Juan.

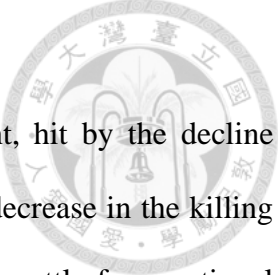
It is worthy to mention that the results of basic grains were muffled by a group of public policy broadly benefited the agricultural sector bonds as delivering food production; delivery food for work; CRISSOL program for finance the purchase of seed and other inputs, assistance training and technical production producers seed, and activities related to water conservation; and basic seed production and registered.

Figure # 3.4 **Nicaragua Agricultural Sector structure**



Source: Made by the author based on Nicaragua's Central Bank 2012 statistics

3.4.2 Livestock



The added value of livestock activities recorded a fall of 2.8 percent, hit by the decline vaccine slaughter, exports of live cattle and other livestock products. The decrease in the killing vaccine was recorded from May, associated with decreased in demand for cattle from national slaughterhouse, which is a consequence of the reduction of sales to destinations like U.S., Puerto Rico, El Salvador and Russia partially offset by increased sales to Venezuela. Note that between efforts policies that the government has made progress, it is the incorporation of a greater number of system properties cattle traceability, which provides opportunities for export to various countries.

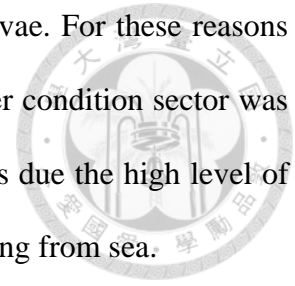
Meanwhile, milk production growth recorded during the year, which is attributed to the increased demand internal and external (especially El Salvador) derivatives of milk. Additionally, the expansion of value added poultry, eggs and increased production of pigs for butchering is due to increased domestic demand.

3.4.3 Fisheries

The added value of fisheries and aquaculture grew 15.6 percent, accelerating 15.3 percentage points growth in 2011. This dynamism was the result the contribution that had the catch of fish, production farmed shrimp and lobster catch, as result of an increase in the volume of exports of these products.

The main conditions that led the production by farmed shrimp meet demand, were, in hand, good weather, and that uniformity of the rainy season was favorable for production in the shrimp farms. Another factor that favored the production was high productivity through breeding

through the application of advanced technologies in the production of larvae. For these reasons and also due technical program provided by government and good weather condition sector was favored, but also it was also affected by the reduction of capture fisheries due the high level of prices of diesel, which constitute a main input of transportation for extracting from sea.

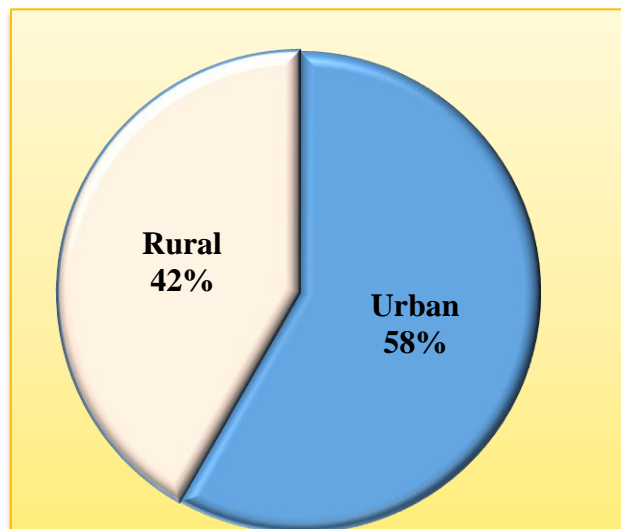


3.5 Population and Employment

For 2012 population was estimated be 5,888.9 thousands with a birth rate of 23.1 per thousand inhabitants with a population density 42/km² or 114/Sq mill.

Nicaragua is on the top 10 poorest country in Latin America (CEPAL, 2012). Poverty is largely a rural problem in Nicaragua, close to half (43 per cent) of the people in Nicaragua live in rural areas. Two out of three of them (68 per cent) struggle to survive on little more than US\$1 per day.

Figure # 3.5 **Nicaragua's population structure**

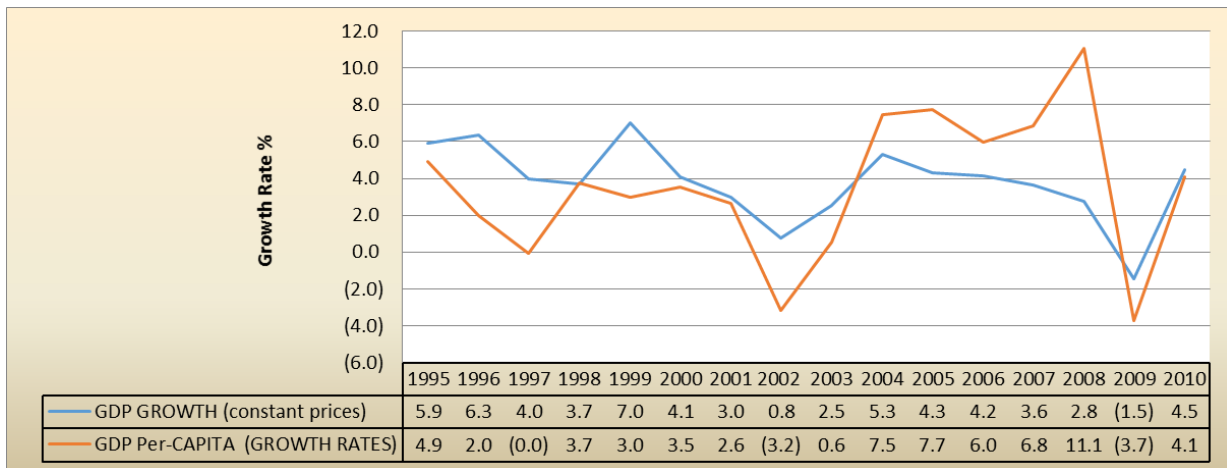


Source: Made by the author based on Nicaragua's Central Bank 2012 statistics

Overall, poverty in Nicaragua has decreased in recent years, dropping from 50.3 per cent in 1993 to 45.8 per cent in 2001, but natural disasters and distortion of commodity prices in the international market led to an increase in poverty in several regions make increase the poverty line at rural areas to 70.3% for 2005. One of those regions is the coffee-dependent central region but later on dropping the index in 2010 to 58%.

For the decades of 90's and the first three years of 2000's GDP percapita growth less than GDP and decreased more than GDP for the moments of contractions of the national economy (Figure #3.6). Since for 2004 the increase of GDP percapita was owing an increase in international prices of the main export products as coffee and an important adjustment in government salary wage rate of 10%.

Figure # 3.6 GDP and GDP percapita Of Nicaragua (Growth Rates)



Source: Made by the author based on Nicaragua's Central Bank statistics

The GDP percapita of Nicaragua compare to the other Central America countries is the lower one accounting 1.239 US\$ per year (Figure #3.7). Worth to mention that Nicaragua is the largest country of Central America, therefore possessing more productive resources.

Figure # 3.7

GDP –Per capita among Central America region



Source: Made by the author based on CEPAL database statistics

Job opportunities seems to be reduced for agricultural population (Figure # 3.8). Previously we saw that for the decade of the 1990's the 42% of the total population employed was rural, but for the last decade the 30% of the total population occupied is from agricultural sector. According to INSS² reports the sector who more participation has for the affiliation of works insurance is the manufacturing with mainly foreign capital investment.

Year by year central government make revision on the minimum salary for every sector and activity of the economy. Agricultural and industry sector, mainly mining and manufacturer workers registering the lowest salary index level.

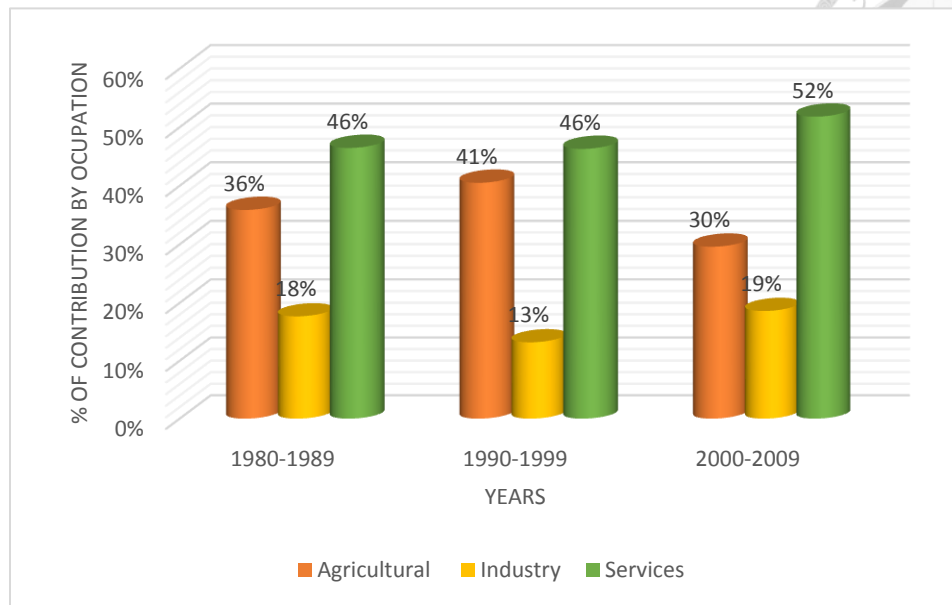
For instance, for the period of 1991 to 2012 livestock sector had a nominal salary average of 1,000 Cordoba³ equivalent to US\$42, meanwhile fishing sector accounted from 1991 to 2012 with an average of US\$58.

² INSS, Social Insurance National Institution of Nicaragua

³ Cordoba is the name of the currency of Nicaragua that since 1990 has had a devaluation of 5% annual.

Figure # 3.8

Nicaragua's employment share by economic activity

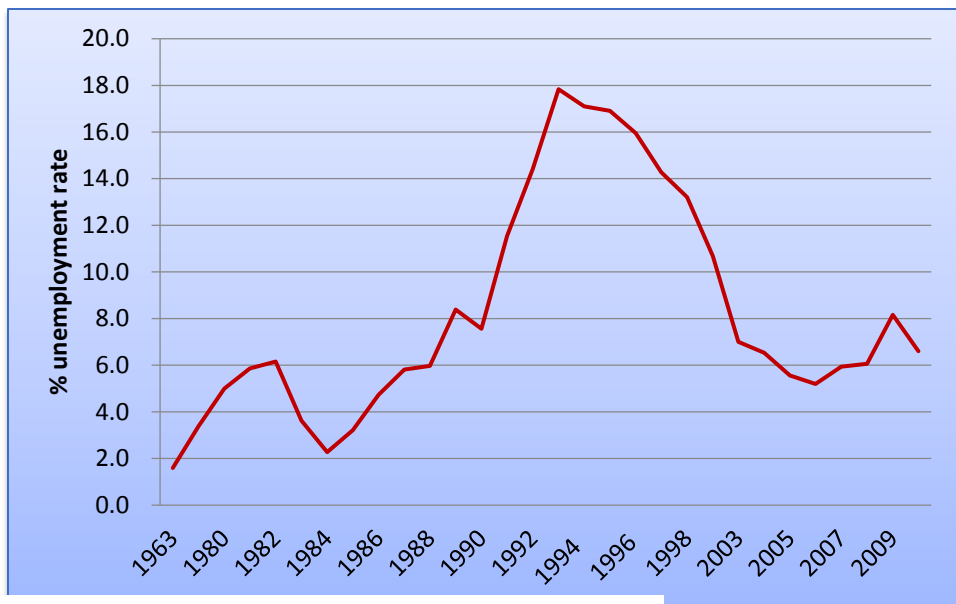


Source: Made by the author based on Nicaragua Central Bank database

The unemployment rate registered for 2011 was for 6.6% the highest reported unemployment rate was for the 90's (Figure # 3.9). This was a period of adjustment for post-civil war effects as well and a consequence for the hurricane Mitch affected the whole economy by 1996.

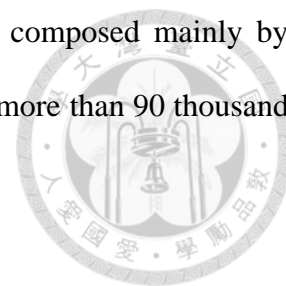
Figure # 3.9

Nicaragua's unemployment rate 1960-2009



Source: Made by the author based on Nicaragua Central Bank database

The sector addressing reduction of unemployment is service sector, composed mainly by government employment which has increase from 62 thousand persons to more than 90 thousand for 2009.



3.6 Nicaragua: An agricultural exports country

As related for agricultural based economy that Nicaragua possess, the top products of exportation are agricultural commodities.

The product that has been top export product during all the times, it's coffee, meanwhile other agricultural products has been replaced as top exported products for others in different economics context that has been taken place during time.

During the years 1960 to 1989 the exportation were constituted agricultural products by 75% followed by manufactured products by 21% and gold with 4%. Cotton at that time, constituted one of the most important agricultural exports and production commodities, later on this product was replaced by beef.

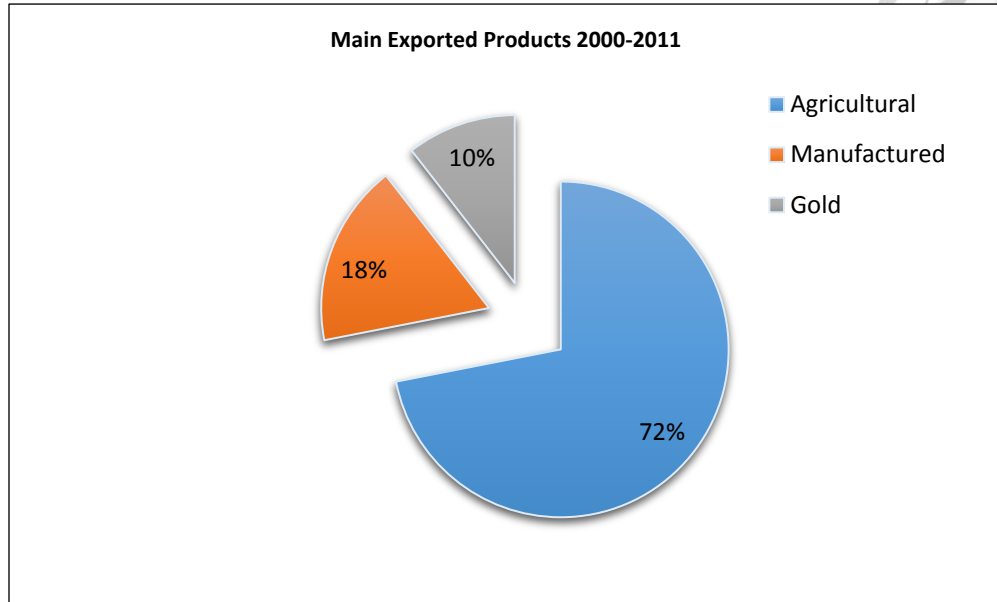
Table # 3.1 Nicaragua top exports products list

Main Exported Products	1960-1989	1990-1999	2000-2011
Periods averages (Million US\$)			
Coffee	77.60	92.9	196.46
Cotton	72.30	0.00	0.00
Manufactured products	58.30	58.6	146.7
Beef	25.6	47.8	182.72
Gold	9.70	14.2	88
Sugar	16.80	30.9	63.32

Source: Made by the author based on Nicaragua Central Bank database

Figure # 3.10

Nicaragua's exports share by activity



Source: Made by the author based on Nicaragua Central Bank database

For the decade from 1990 to 1999, coffee continued as a top export product and manufactured products composed mainly by chemicals as a raw material and plastic and rubber, wood and furniture goods and exportation of textiles and clothing. Therefore, the exportation during this decade was still constituted by 77% by agricultural products, followed by manufactured products with 19% and gold with 4%.

For the years from 2000 up to 2011, the scenario for agricultural products is almost the same, except for dairy products and livestock which increased and became in important products of exportations.

For dairy products in 2011 were exported 139.4 million dollars, our main and important export destination country was Venezuela, due the political and economic relationship between Nicaragua and that South America Country thru ALBA⁴ (Alianza Bolivariana de las Americas).

⁴ Alianza Bolivariana de las Americas, (Bolivarian Alliance of the Americas), Economic and political union among some South America countries and Nicaragua.

The value for coffee and gold were sharply increase owing increases in international market prices.



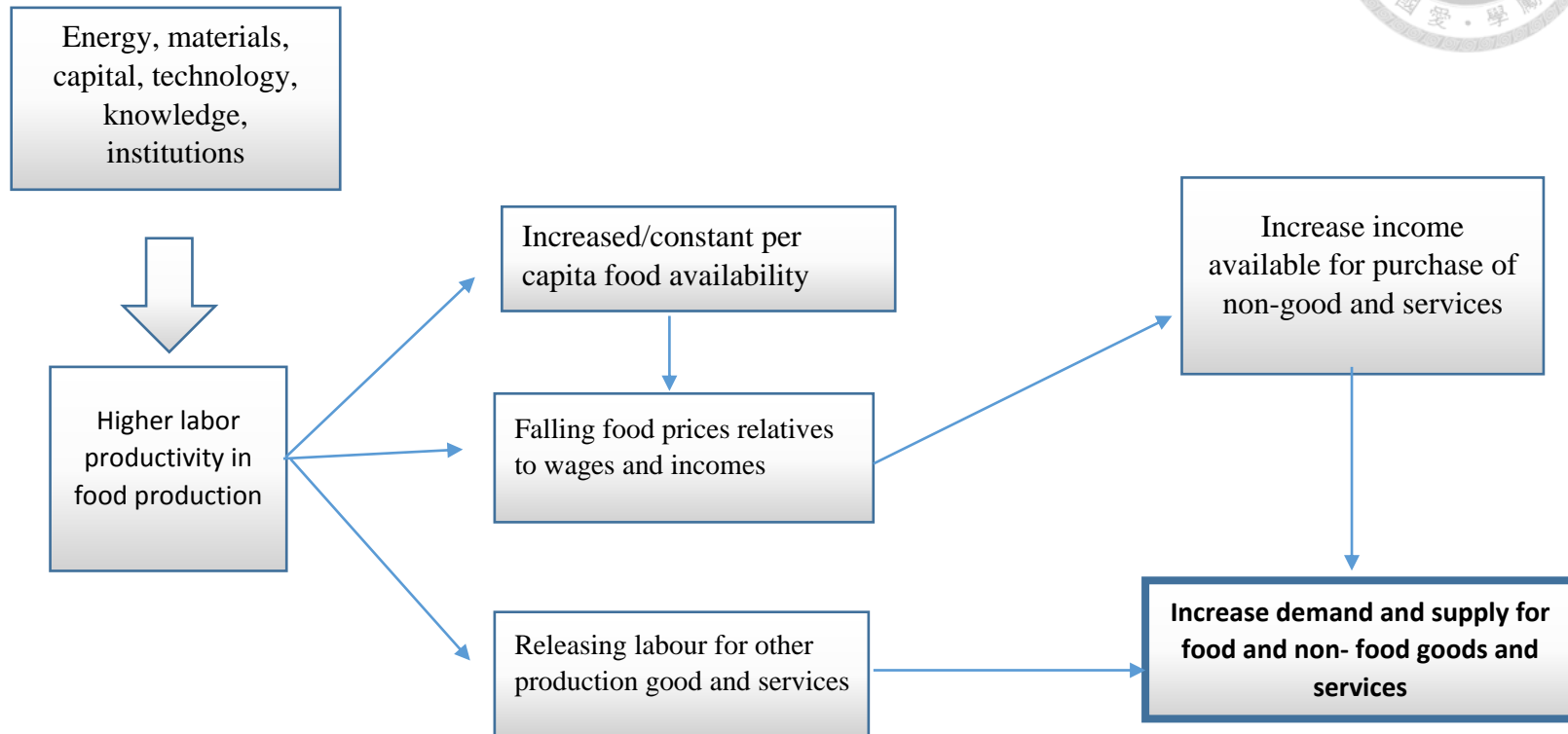
3.7 Nicaragua Agricultural Labor Productivity Ratio

Historically, successful economic development and growth have been stimulated and sustained by rising productivity of agricultural labour and hence falling real food prices. This is illustrated in Figure 3.11, which shows how agricultural labour productivity plays a foundational role within wider economic development processes (Dorward, 2012).

Figure 3.11 shows how agricultural revolutions that raise agricultural labour productivity in poor agrarian economies can play multiple foundational roles in wider development processes, as increased production per worker leads to increasing food availability per worker. This then (a) lowers the cost (and price) of food relative to agricultural worker incomes, (b) this raises agricultural workers' budget surpluses after food expenditures and hence increases their real incomes, (c) this stimulates demand for non-food goods and services and (d) simultaneously releases agricultural labour from food production to production of other goods and services (as fewer workers are needed to produce the food that society requires). Agricultural labour productivity growth in poor agrarian economies thus simultaneously raises productivity of poor countries' and poor people's abundant and critical resource (agricultural labour), raises their real incomes, and stimulates both supply and demand of non-food goods and services (Dorward, 2012).

Figure # 3.11

Agricultural Labour revolution flow



Source: Made by the author based on paper of Brief Policy by Dorward A.

Nicaragua Agricultural Labour Productivity ratio, from 1980 up to 2007, presents a negative average growth rate of -2.64%. Several turning and influencing point might influence this important and crucial key of development for Nicaragua, further each explanatory variable will be explained and a regression model will demonstrate the impact of each of them.

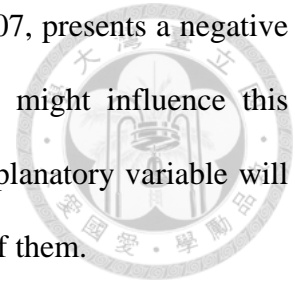
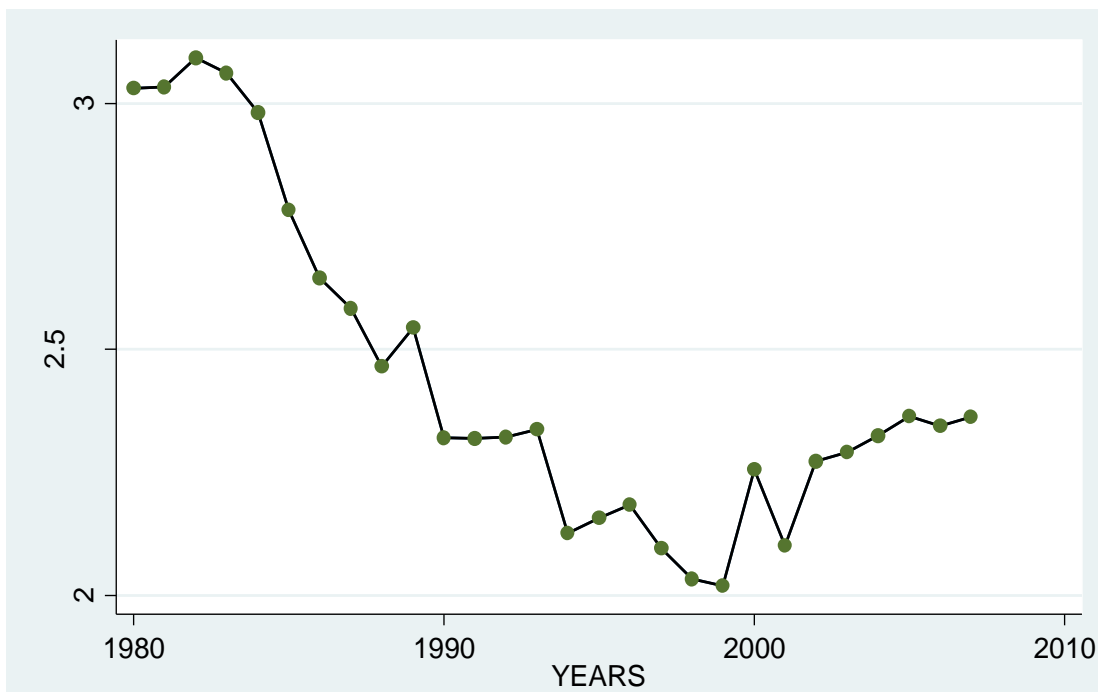


Figure # 3.12 Agricultural Labour Productivity Ratio 1980-2007



Source: Made by the author based on World Bank Database statistics

Nicaragua agricultural labor possess a sharp disparity among gender, for instance in 2006 only the 11% of employed agricultural labor force was constituted by Women. Owing the limitation of available data for the time of study this factor was not include on the regression model.

According with World Bank statistics data base for 2012, Costa Rica lead the CA countries group of agricultural value added per worker, Nicaragua is the second on the group, but with a wider gap among Costa Rica, which has 65% more of value added per worker compare to Nicaragua.

Table # 3.2 Agricultural Value added per worker among Central America

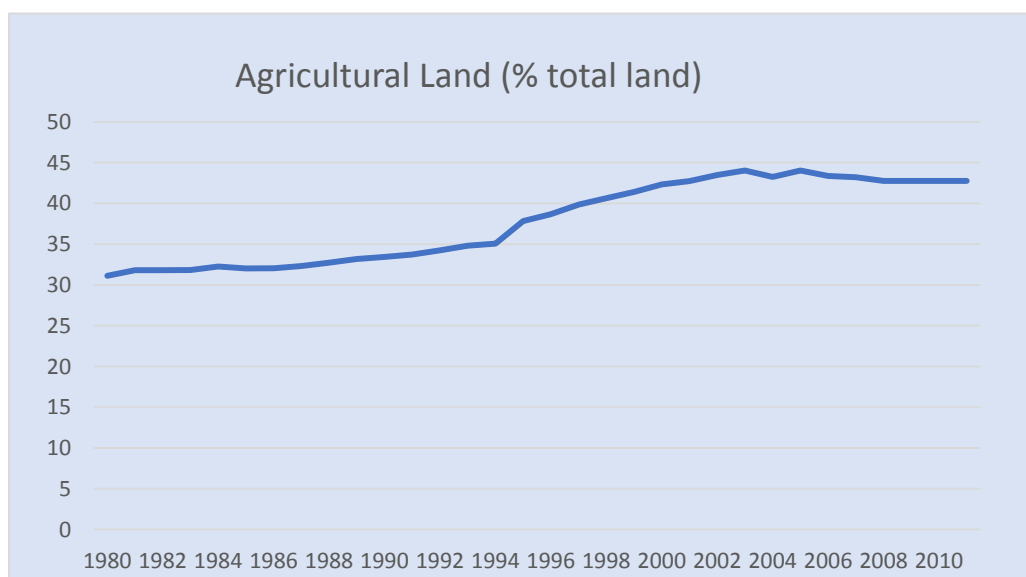
(constant 2005 US\$)	2008	2009	2010	2011	2012
Nicaragua	3,260.40	3,278.00	3,539.30	3,662.00	3,815.80
Costa Rica	5,749.90	5,608.90	6,007.30	6,131.50	6,293.60
Honduras	2,092.60	2,069.40	2,116.20	2,242.30	2,331.10
El Salvador	3,278.70	3,221.10	3,361.10	3,317.70	3,440.40
Guatemala	1,834.50	1,871.30	1,832.20	1,860.60	1,858.00

Source: Made by the author based on World Bank Database statistics

3.8 Nicaragua Agricultural land per capita

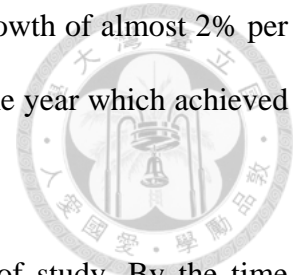
Nicaragua possesses an extended agricultural land, for 2011 a 42.8% out of total land was constituted by agricultural land.

Table # 3.13 Nicaragua Share of Agricultural land of total land (1980-2011)



Source: Made by the author based on World Bank Database statistics

For the last 30 years, agricultural land has accounted an average of growth of almost 2% per year for agricultural land share out of total land of Nicaragua. 1995 was the year which achieved the highest growth rate.



Agricultural land has experimented several strikes from the period of study. By the time before the civil insurrection against Somoza dynasty, cotton was the product which was more cultivated along all the pacific area, after the insurrection, strong issues about the distribution of land took place.

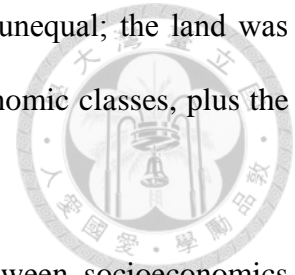
By at that time, cotton industry was displacing by manufactured products, due the decapitalization of the farmers and the redistribution of land and reforms in a socialist framework. For the year after that, beef and cattle took place as the second largest agricultural commodity of exports, thus pasture constituted nowadays as the major share with 46% out of total agricultural land.

3.9 Government Regimes

In the 1950s, Nicaragua experienced some agricultural diversification. With the help of foreign advice, production figures increased: bananas, sugarcane, livestock and cotton. By the mid-1950s, cotton had become the nation's second largest source of income, after coffee.

It's observable that Nicaragua's economy is based in agricultural production. During the period of from 1960 up to 1989 , cotton was one of the most important main export products, for these years mainly at 30's ~ 50's the industry experimented an industrial expansion promoted at that moment by the highs international prices, which caused the exportation got expanded.

The issue was the “expansionist” of land for cultivating cotton was unequal; the land was confiscated from small farmers to big land owners favoring a certain economic classes, plus the pressure the stagnant rural labor force.



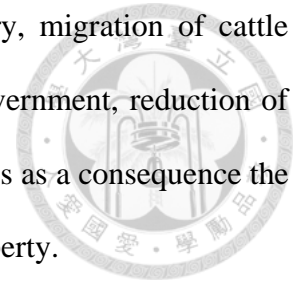
The unconformity with the capitalist system that led deep gap between socioeconomics classes, regions and economics sector class led to revolution; but the previous and after situation before the insurrection were negative, the outflow of capitals before and, after of ½ billion US dollars, extreme public debt (it was 1,6 billion US dollars heritage during the dictatorship, which in order to finance the army due conflict make short term loans, accompanied with contractive fiscal and monetary policy), Sharply production falls, exportations, Active’s destructions, GDP decreased a lot (’78 with -7.2%, ’79 with -12.2%), according with world bank the private investment was reduced virtually to zero, for the months of June and July of 1979 the national output was zero and for last, the expenses for the direct damages were 1 year of GDP.

From agro-exporter model, which the Nicaraguan economic logics adopted after revolution was a mixed economy, which the key point was the diverse property forms; first a government and social property, private property and public and private property.

The revolutionary reform was characterized in two stages; the first one between 1979 and 1981 where diverse nationalizations of economics sectors and confiscations of capital were made, for instance, only the Somozas family were owner for 850,000 hectares of land, one the decrees made during the agrarian reform was forbidden the large owners for more 350,000 hectares per person, which at that moment were reduced to not more than 680 owners.

The second state took place from 1981 and onwards, the production goals were not reached and the landlords were afraid that governments confiscate their lands and as a consequence the

decapitalization of the productive capital took place. Sells of machinery, migration of cattle (mostly Honduras and Costa Rica), not correct use of loans made by government, reduction of the cultivated land and the dismissal of workers and laborers and this brings as a consequence the complete decapitalization of the farmers passing direct to government property.



Therefore the fail of the agrarian reform showed the disunion facing the crisis situation which led the civil war during the 80's and this further accentuated the economic backwardness with hyperinflation and negative rates of GDP.

When the first democratic election took place were on the 90's and she became the first female president with Mrs. Violeta Barrios de Chamorro, the economy at that moment was in a deep backwardness, therefore the reform of private bank, stabilization of currency, reduction of government expenses were ones of the measures taken.

Besides that the already delay in economic issues and development, at the 96's one of the most harmful and destructive natural disaster took place, and Nicaragua were not prepared where the agricultural sector was the most affected adding that the president at that moment was accused as one of the most corrupted presidents for all Latin American Countries, taking advantages of the international donations in order to face the disaster for personal interest.

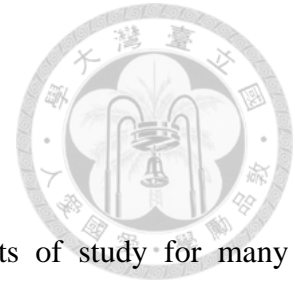
After that, president for the 2001~2005 some "goals" were accomplished where Nicaragua could get in HIPC countries initiatives (where the 80% of the public debt was condoned), but the public price was a contractive fiscal and monetary policy mandatory by FMI. From 2006 to nowadays the current president (president also in the 80's), has implemented large social work, establish the rural financing by government and established the insertion of Nicaragua at ALBA which led the increase of exports for dairy products, therefore the loans and importation of oils

from Venezuela are not presented in national accounts and not figure as donations in the national budget, for this stage of economics history not good information is handled, despite that Nicaragua has reached stabilization in macroeconomics indicators.



Chapter 4

Data and Methodology



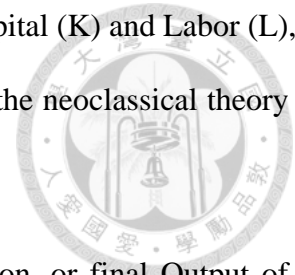
Labor, Capital and technology have been one of the most interests of study for many economist and researches over the world. Following different economic theories of production, marginal productivity and growth, this chapter will provide an overview of the use and description of variables the economic theories as well as the instruments and methodology in order to reach our objectives of study.

4.1 Theoretical Framework

A fundamental task of macroeconomics is to determine the sources of economic growth. By economic growth we usually mean the growth rate of real GDP per person (or percapita). The achievement of rapid economic growth is one of the most (if not the most) important distinguishing features of a successful economy.

The traditional theory of economic growth, often called the “neoclassical” theory, this theory divides output growth into two categories: (1) growth of factor inputs, such as **Labor** and Capital and (2) growth in output relative to growth in factor inputs. Thus the theory converts the question of how achieve faster output growth into two sub questions: How to achieve faster growth in factor inputs, and how to achieve faster growth in output relatives to inputs.

The total available output depends on the two main factor inputs as Capital (K) and Labor (L), and also the behavior of output per average available factor input, which the neoclassical theory calls A, that is the autonomous growth factor⁵.



Therefore the production states the relationship between Y (production, or final Output of GDP), A, K, and L as follow:

$$Y = A f (K, L) \tag{4.1}$$

Output per person and the capital labor- ratio:

Isolating those factors that determine the increase in person real GDP, which can be written as follows when the production function is divided through by the amount of labor inputs (L).

$$Y/L = A f (K/L) \tag{4.2}$$

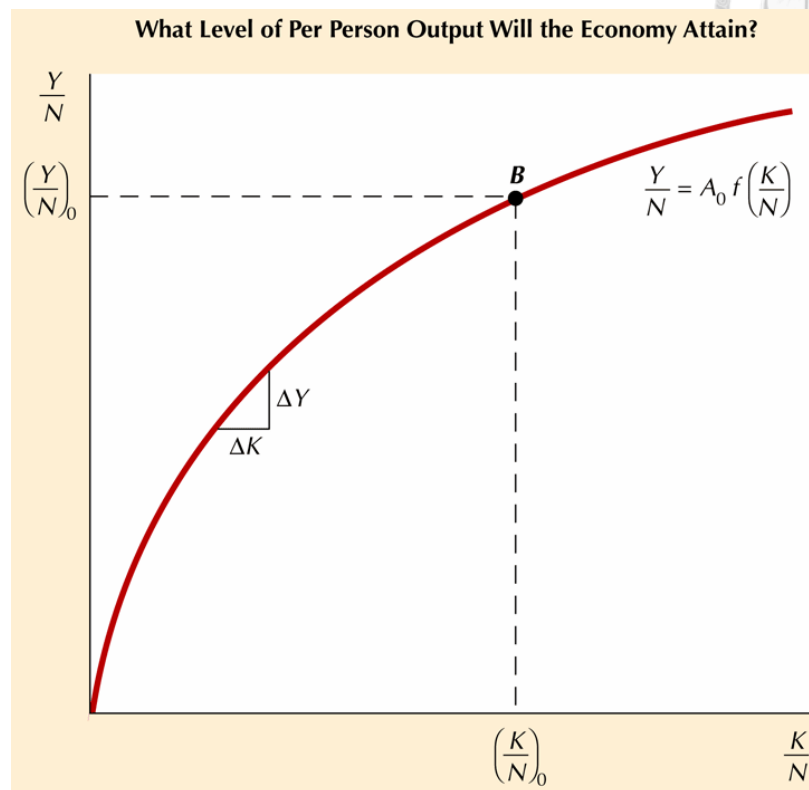
The important relationship states that there are just two sources of growth in the standard of living, or real GDP per person (Y/L). These are the autonomous growth factor A, and the ratio of capital to labor input (K/L) or capital per person.

Equation (4.2) is the person version of production function, it's illustrated in figure # 4.1⁶. This production function is drawn by assuming that the autonomous growth factor are fixed at A₀, each successive addition to the person stock of capital (K/L) yield less and less of an increase in person output (Y/L).

⁵ The use of the symbol A in this context and the decomposition of real GDP growth into growth in labor, capital and the "residual" A date back to the seminal paper by Robert Solow, "Technical change and the aggregate Production function".

⁶ N is equivalent to L.

Figure # 4.1 A Production Function Relating per Person Output to per Person Capital Input



Other way to describe is that, Productivity is an average measure of the efficiency of production. Productivity is a ratio of production output to what is required to produce it (inputs of capital, labor, land, energy, materials, etc.). The measure of productivity is defined as a total output per one unit of a total input for our case; Output/ Labor.

Labor Productivity (OECD 2008), is the value of goods and services produced in a period of time, divided by the hours of labor used to produce them. In other words labor productivity measures output produced per unit of labor, usually reported as output per hour worked or output per employed person.

Labour productivity is a revealing indicator of several economic indicators as it offers a dynamic measure of economic growth, competitiveness, and living standards within an economy. It is the measure of labour productivity (and all that this measure takes into account) which helps explain the principal economic foundations that are necessary for both economic growth and social development. (Freeman 2008, 5)

Although the ratio used to calculate labour productivity provides a measure of the efficiency with which inputs are used in an economy to produce goods and services, it can be measured in various ways. Labour productivity is equal to the ratio between a volume measure of output (gross domestic product or gross value added) and a measure of input use the total number of hours worked or total employment (Freeman 2008,5).

Therefore in this investigation is measured as follow;

Labour productivity = volume measure of output / measure of labor input use

In our study focusing only on the agricultural labor productivity, we express it as follow:

ALP = AGRGDP/AGRIEMPLOY

ALP: Agricultural Labor Productivity

AGRGDP: Agriculture GDP

AGRIEMPLOY: Agricultural employment

In its most standard form of Cobb-Douglas for production of a single good with n factors, the function is:

$$Y = A L^\alpha X_1^\beta \dots X_n^\gamma \quad (4.3)$$



Where:

Y = total production (AGRGDP)

L = labor input (Agricultural employment)

X_1^β = Input 1

X_n^γ = Input N

A = Total factor productivity

α , β and γ are the output elasticities of labor and the other inputs used, respectively. These values are constants determined by available technology.

Output elasticity measures the responsiveness of output to a change in levels of either labor or input used in production, *ceteris paribus*. For example if $\alpha = 0.45$, a 1% increase in capital usage would lead to approximately a 0.45% increase in output.

Further, if $\alpha + \beta = 1$, the production function has constant returns to scale, meaning that doubling the usage of capital K and labor L will also double output Y . If $\alpha + \beta < 1$, returns to scale are decreasing, and if $\alpha + \beta > 1$ returns to scale are increasing. Assuming perfect competition and $\alpha + \beta = 1$, α and β can be shown to be capital's and labor's shares of output.

The inputs into agricultural production in country i are the list that will be describe further and total factor productivity in agriculture, A is assumed be fixed (*ceteris paribus*). The parameters α , β and γ are the income shares of the different variables ($X_1, X_2, X_3 \dots X_n$) respectively. Given this production function, labour productivity in agriculture in country i (Nicaragua) is given as:

$$(Y/L) = A (X_1/L)^\alpha (X_2/L)^\beta \dots (X_n/L)^\gamma \quad (4.4)$$

The standard approach of accounting for country productivity in the literature has been to estimate the log-linearised aggregate production function given by (4.4) and to infer from the resulting input elasticities the contribution of various inputs in explaining country determinant influencing in agricultural labour productivity (O’Gorman & Pandey) and because our interest is to measure the impact of each in our independent variables, leave the regression equation as follow:

$$\text{Ln}(Y/L) = \text{Ln} A + \alpha \text{Ln}(X_1) + \beta \text{Ln}(X_2) + \dots \gamma (X_n) \quad (4.5)$$

4.2 Data and Variables

Agricultural labor productivity is defined as an output of agricultural products per agricultural worker. Agricultural output (Y) measures the gross value of agricultural output, which includes farming, forestry, animal husbandry and fishery. Gross value of agricultural output is measured at 1980 constant price to eliminate the influence of price inflation.

4.2.1 Data

The data set are of Nicaragua macroeconomic statistics comprising a period of 30 years (1980-2009). As the objectives are to measure the impact of different determinants that affect agricultural labor productivity, only take into account data from Nicaragua, without making comparisons across- country.

Two stage were made using 2 models of time series regressions, plugging into, variables defined under the category of agricultural development and investment. This practice was made

due the availability of data. First stage comprises 28 observations and the second one comprises 15 observations.



4.2.2 Variables

The data set collection correspond to Nicaragua's macroeconomic statistics from World Bank, FAO and Nicaragua Central Bank covering a period of 30 years (1980-2009). Due one explanatory variable, does not have available data for the last two year (2008, 2009), they were omitted, leaving 28 observations for the first test and for the second test were studied in a second stage of regression were include with 15 observations.

The variables used for the analysis were; Agricultural land per-capita (AGRILANDPER), which is the share of land area that is arable, under permanent crops, and under permanent pastures divided by rural population, Net stock machinery (NETSTOCKMACH), refers all the machinery and equipment used in agriculture in net value, Economy environment context (ECONENVIR) is a dummy variable, where the period of the observed years were strongly affected by economic and social instability and natural disaster as well, Government regime (GOVREGI), is also a dummy variable which consist in mark the difference among the two types of strong political parties in Nicaragua, we categorized at 1, the time under the FSLN.

The second part of the model, 3 explanatory variables were include; Foreign direct investment (FDIIF) which refers to Foreign direct investment are the net inflows of investment to acquire a lasting management interest, in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital, Health expenditure (HEALTHEXPD) refers to the percentage of GDP expensed on health issues, Education expenditure (EDUCEXPDT) refers to the current operating

expenditures in education, including wages and salaries and excluding capital investments in buildings and equipment.



4.3 Methodology

4.3.1 Time Series

The relationship between agricultural labor productivity ratio is examined in models that control other important determinant for its growth. A time series data set consist of observations on a variable or several variables over time. An obvious characteristics of time series data that distinguishes it from cross sectional data is temporal ordering.

A basic regression analysis using Ordinary Least Square (OLS) is estimated for linear regression model used in this investigation into three different scenarios further in next chapter will provide the equations of each combination of variables.

There are two empirical Time Series Regression analysis Models examples estimated thru ordinary least squares; *Static Models and Finite Distributed Lag (FDL) models*.

The model going to be used is a Static Model; where the estimation of elasticity of Labor productivity ratio (Y/L) with respect to variables under 4 different categories ($X_1, X_2 \dots X_n$).

In this way, from equation (4.5), we transform into:

$$\text{Log (ALP)} = \beta_0 + \beta_1 \text{Log (X}_1\text{)} + \beta_2 \text{Log (X}_2\text{)} + \dots \beta_n \text{Log (X}_n\text{)} + u_t \quad (4.6)$$

Hypothesis for each independent variable are summarized in Table 4.1

Table 4.1 Relationship among APL ratio and its factor of influence

Independent Variables	U/M	Variable name	Relationship
Agricul land Percapita	Sqm/Person	(AGRILANDPER)	<i>Positive</i>
Net Stock Machinery	Millions of US\$, Constant	(NETSTOCKMACH)	<i>Positive</i>
Economy Environm.	Dummy	(ECONENVIR)	<i>Negative</i>
Government regime	Dummy	(GOVREGI)	<i>Negative</i>
Foreign direct invest.	% GDP	(FDIIF)	<i>Positive</i>
Heath expenditure	% GDP	(HEALTHEXPD)	<i>Postive</i>
Education expenditure	Current US\$	(EDUCEXPDT)	<i>Positive</i>

Chapter 5

Results and Discussion



5.1 Empirical Results

Ordinary correlation coefficients were conducted to test the relationships among independent variables. Table 5.1 and 5.2, shows the results derived from the correlation coefficient test for the first and second stage respectively. The study found no strong correlations for the overall variables, Net stock machinery showed a little more than 0.80 among agricultural land percapita and Economy environment, therefore a strong relationship among these variables were found, but it's still acceptable (Karemera, Oguledo and Davis, 2000).

Variables	LNALPR	LNAGRI	ECONEN	GOVREGI	LNNETSTOCKMACH
LNALPRATIO	1.0000				
LNAGRILAND	-0.2637	1.0000			
ECONENVIR	0.6822	-0.5313	1.0000		
GOVREGI	0.7932	-0.2777	0.6408	1.0000	
LNNETSTOCKMACH	-0.8355	0.5474	-0.8198	-0.6604	1.0000

Table 5.1 Correlation results of independent variables, 1st stage

Table 5.3 illustrates the empirical results of APL ratio regression equation for both stages. The conducted first results show a high R^2 value at 83.95%, indicating that the regression model of APL ratio fit the data well.

Table 5.2 Correlation results of independent variables, 2nd stage



Variables	LNALPR	LNFDIIF	LNHEALTHEXPD	LNEDUCEXPDT
LNALPRATIO	1.0000			
LNFDIIF	0.1017	1.0000		
LNHEALTHEXPD	0.7869	0.1130	1.0000	
LNEDUCEXPDT	0.0467	0.7806	0.2085	1.0000

5.1.1 First Stage

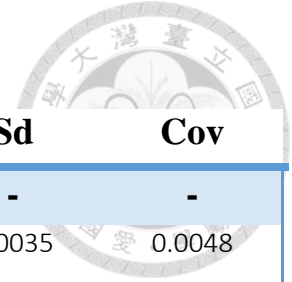
For the hypothesis test, the results (Table 5.3) can be described in terms of t-value. The *Agricultural land percapita* has an expected positive relationship on APL ratio with a statistically significant coefficient estimate of 20.44 at $\alpha = 5\%$. That is, hypothesis is accepted, meaning as more the land per person more the Agricultural productivity labor ratio.

Net Stock Machinery shows a negative relationship with APL ratio with a statically significant coefficient estimate of -3.3075 at $\alpha = 1\%$, which declines its hypothesis, this may be explained by

poor quality equipment used in agriculture which provides an unproductive return on its investment, hence having more equipment does not necessarily will increase APL ratio.

Economic environment has a negative impact on APL ratio with a statistically significant coefficient estimate of -0.0508 at $\alpha = 10\%$, therefore its hypothesis is accepted. This outcome indicates that having strikes in the economy external and domestically, cause a lower APL ratio when it increase.

Table 5.3 Empirical Results of APL ratio of Nicaragua model

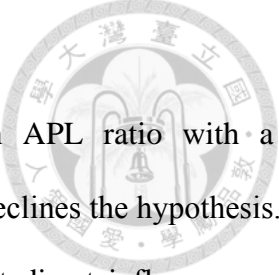


Variables	Coefficients	t-value	Mean	Sd	Cov
Constant	1.5966	0.23*	-	-	-
LNAGRILAND	20.4439	2.12**	0.7358	0.0035	0.0048
ECONENVIR	-0.0508	-0.51*	-	-	-
GOVREGI	0.2700	3.52***	-	-	-
LNNETSTOCKMACH	-3.3075	-4.69***	4.3196	0.0752	0.0174
R-square			0.8116		
Adjusted R- square			0.8395		
F (4, 23)			30.08		
Prob > F			0.0000***		
Number of observations			28		
Constant	1.9764	1.41*	-		
LNFDIIF	0.0489	0.97*	18.9574	0.6779	0.0357
LNHEALTHEXPD	0.8400	4.60***	2.0687	0.1199	0.0579
LNEDUCEXPDT	-0.1289	-1.18*	18.8021	0.3197	0.0170
R-square			0.6624		
Adjusted R- square			0.5703		
F (3, 11)			7.19		
Prob > F			0.0061		
Number of observations			15		

Note: *, **, and *** denote significance at the 10%, 5% and 1% respectively

Government regime, this variable reveals a positive influence over APLRATIO with a statically significant coefficient of 0.23% at $\alpha= 1\%$. This result point to given every shift of regime in Nicaragua under the rule of Daniel Ortega ALP ratio become better or improves. Therefore hypothesis is rejected, hence the performance under the government headed by FSLN seems be more efficient than others parties.

5.1.2 Second Stage



Foreign direct investment; has an expected positive influence on APL ratio with a statistically significance coefficient estimate of 0.0489 at $\alpha = 10\%$, which declines the hypothesis. This might be explained by inefficient foreign direct investment and not direct influence on agriculture. Also, labor skills may be low to receive foreign technology improve, forcing private and foreign investment hired labor from abroad, causing displacement of agricultural labor that at the end become on unemployment or cause migration to other less productive area as neighbors countries as well. Hence labor seems not be productive by it. So, APL ratio are less likely to increase or improves for every increase on foreign direct investment.

Health Expenditure shows a positive relationship on APL ratio, with a statistically significance coefficient of 0.8400 at $\alpha = 1\%$, this results indicates that an increase on health expenditure would increase the agricultural labor productivity, by increasing health infrastructure and service, the health of people in rural areas will improves as well, hence encouraging them be more productive and periods of works don't be interrupted and longer, therefore its hypothesis is accepted.

Expenditure on Education (share of GDP) has a negative influence on APL ratio with a statistically significant coefficient estimate of -0.1289 at the significance $\alpha = 10\%$. The results indicates that increasing education expenditure APL ratio are less likely to increase or improve, this outcome has relationship with the statement explained on foreign direct investment results, thus meanwhile education level is inefficient and insufficient APL ratio would decline. Therefore its hypothesis is declined.

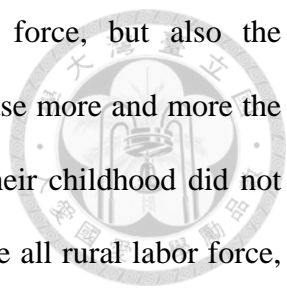
5.2 Discussion

This study clearly displays that there are factor influencing positive and negatively Agricultural Labor Productivity ratio of Nicaragua. Recommendations are given from this study for the purpose of alleviating negative influence on APL ratio, taking into account the results previously obtained.

Labor rural force, should try to their best to solve some negative influence by increasing production level, the higher the production they obtained, the higher the income would get, therefore investment on its own production thru to access to a good education and improvement of skills is highly needed. The creation of unions or association among producers is very helpful to be able to promote their products and improve the competitiveness by adding more value to the agricultural products and not only work for gathering for big company but also sell products by its own trading mark. The efficient of the association is crucial, not corruption, hard work culture and not discrimination by gender is highly advised in order to reach competitive and efficient level of association institutions.

To policy makers should promote and develop a suitable and sustainable agricultural system in rural areas and contribute to improve APL ratio levels thru the creation of policy that incentives the increasing of it. This policy might be focus on:

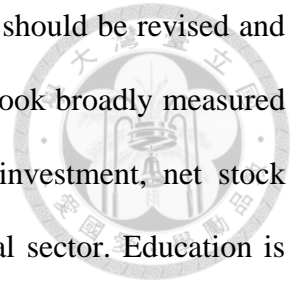
- Enforcement of strong institutional framework for the creation of association or unions of farmers
- Encourage the inclusion of female work force on agricultural activities, not gender discrimination should be promoted
- An expansionist fiscal policy thru the increasing of health expenditure

- 
- Investment in education improvement of skill rural labor force, but also the continuous supervision of education quality, focusing on increase more and more the inclusion of children into school. Besides, the adults that in their childhood did not receive a good education level, promote a policy that encourage all rural labor force, being continuously receiving capacitation in how to improve production and be more competitive in the domestic and international market.
 - Policy on the legal and correct distribution of land is advised.

Nicaraguan government should support small farmers and large farmers by integrating policies into the practical strategies which are able not only increasing the APL ratio but also by increasing the wellbeing and improvement in livelihood on agricultural rural population. Economic environment negative influence can be constrained by government actions thru the development and improve of market access by the creation of a national plan suitable for each productive area. Actually current government conducts a series of national plan, with several sub programs, the supervision and accomplishment of goals is a must do. The correct and productive distribution of land would affects highly positive on APL ratio, also the investment in health must be following by creating more quality health service and more access to it.

The results of this study reveals that Economy strikes affects adversely the APL ratio, however government thru the creation of a mitigation plan against unpredicted causes of disturbance as Natural disaster, financial crisis, international crisis; mainly in the exports destination countries in order to mitigate the negative impact on agricultural production, hence APL ratio would not be so strong and not affect the labor rural force by decreasing the demand of it.

By another hand, foreign direct investment and education expenditure should be revised and measure the level on agricultural sector specifically, because the statistic took broadly measured due the lack of availability specifically on the sector. Foreign direct investment, net stock machinery and education, has to improve the effectiveness on agricultural sector. Education is the core and is the starting point for that foreign direct investment and the equipment used in agriculture could be highly competitive in order to increase major level of productions and give more value added to exportation products.



Chapter 6

Conclusion and Recommendations



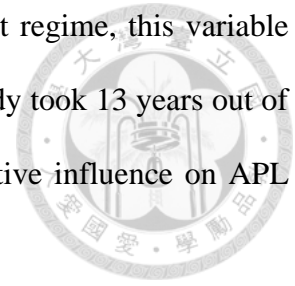
6.1 Conclusions

Agricultural labor productivity ratio reveals a downward trend over time, a sharp decrease is observable, from the 1990's to the beginning of 2000's was characterized by downs and up but doesn't achieves a stable growth pattern is until after the year 2000 showing a steady upward trend, but very slowly one.

Seven variables were chosen dividing them into two stages; the first one on agricultural development which content, net stock agricultural machinery, agricultural land percapita as an explanatory variables and two dummy variable were included Economy strikes environment and Government regime. In the second stage, were focus in the investment issue with three explanatory variables; education expenditure, foreign direct investment net inflow and health expenditure.

In the first stage, results we obtained a good level of significance for all variables, revealing that agricultural land percapita has a positive impact on agricultural labor productivity, agricultural land has showed upward trend during the period of study, but for the years of 2000's this growing has been stagnating. These results implies that the available agricultural land become scarce for over use in some areas and also due the impact of some other externalities that are not measured in this research like climate change. Therefore the positive influence that agricultural land percapita on agricultural labor productivity is traduced as the sustainable use of it, that is to say, the increase of use of agricultural land percapita more the agricultural labor productivity.

Another variable with positive influence on APL ratio is government regime, this variable was include in order to evaluate the party of FSLN that for the time of study took 13 years out of 28 (46%) of time addressing agricultural policies. The results were positive influence on APL ratio.

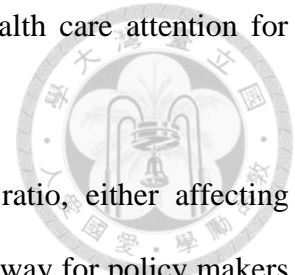


Economic environment and Stock machinery, shows a negative influence on APL ratio, requiring a conductive integrated policy by government, by mitigation plans and the improvement of equipment and technology used in agriculture.

For the second stage of regression, three other variable were used; foreign direct investment, education expenditure and health expenditure. Education is a core for development in any country, but instead has a positive influence on APL ratio, it showed a negative influence on APL ratio. This might reflects education expenditure has focused in other areas outside of agricultural labor productivity, thus implying that the rural education expenditure is not large or effective enough on rural areas require then more investment on the construction of more school, more incentives to rural population to enroll to school.

Foreign direct investment revealed an increase on its level showing a flatter path, but with sharp decrease of the end of the 1990's beginning recovery after 2000 year, but with a slow pace, reaching a peak and decrease at 2009 due the international financial crisis. Foreign direct investment reflects a negative influence on agricultural labor productivity, meaning that the rural infrastructure and rural labor skills don't absorbed productively the impact of foreign direct investment could have on it. Relating this results also with education expenditure results, or this variable does not address enough agricultural projects or effectively as well. By other hand health expenditure with a good significance on agricultural labor productivity ratio, has a

positive influence in increasing it, therefore the investment on more health care attention for farmers and all rural population will increase productivity.



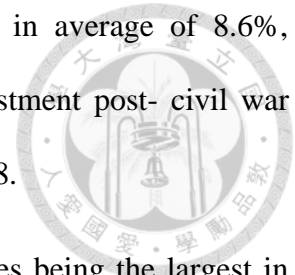
This study has revealed the influence of several factors on APL ratio, either affecting production levels or living standards of rural people. This study paves the way for policy makers and government institutions to determine practical and effective policies that could mitigate or reduce the negative impacts on APL ratio and improve even more the positive ones.

Nicaragua characterized as agricultural based country due its agricultural output share in total GDP, over the period 1980 and 2009 the average share has been 25%. Agricultural output present a fluctuated behavior during this time of period, revealing the deepest lower peak at the beginning of 1980's, due the civil war which was occurred mainly in rural areas, by this year the agricultural production experimented a decrease of almost 20%.

The agricultural structure is composed predominantly by farming crops and the number one is coffee, which is the top number one export product since 1960 (were statistics of Nicaragua exist). Followed by cotton until the 1990's were manufactured products took place and for the last decade beef has displace manufactured products taking place of second most important export product.

Agricultural commodities has contributed during the period of study more than 70% of total exportation of the whole country, by the years of 1950's Nicaragua adopted an agro-exporter model, basing the economy on coffee and cotton production, but the capitalism system adopted favored big tenant landlord, causing a very sharp disparity in rural areas, small farmers were expropriated take them from them land and production, this led the civil war by FSLN.

The unemployment rate has been during the period of time of study in average of 8.6%, registering the highest rate during the 1990's as a consequence of adjustment post- civil war effects and additionally the severe damages of Mitch hurricane during 1998.



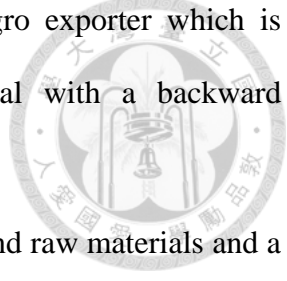
Nicaragua possess the lowest GDP in the Central America region, besides being the largest in territory across the CA countries, our near neighbor Costa Rica, accounts with 7 time higher GDP percapita than Nicaragua, therefore this issue constitute the high rate of migration that agricultural and construction labor force emigrate to that country. For instance, the payment that coffee cutter receive is 2 time more than the one received at Nicaragua. For the last decades in average the total supply of occupied people was absorbed principally by the services sector with 52% followed by agricultural sector with 30%.

The reasons that led this investigation focus precisely being based in Nicaragua's history and economic structure the high important of rural population labor force take place in the country, the instability in this sector led severe consequence to the entire economy.

That's why the study focused in to identify the factors which affect negatively and positively in order to increase the agricultural labor productivity due if Nicaragua continue with the decreasing that has shown over period of time, history shows how people react. Besides having in mind that the current government precisely is the one who took the control in the 1980's and lead the civil war in behalf of this entire people whom were oppressed under the dictatorship of Somoza's rule.

6.2 Policy Recommendations

All the previous background and regressions results led me to establish the following statements:

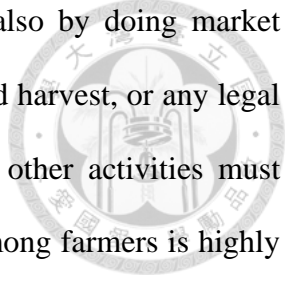
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- There are a deep duality between the agricultural sector and agro exporter which is relative modern and an agricultural production very traditional with a backward technology.
 - Industrial sector extremely dependent of imports of capital goods and raw materials and a very low capacity of exportation extra regional and regional.
 - Exist inadequate relationship between agricultural sector and industrial sector.
 - Exist a robust dependency in the exportations of agricultural outputs which are subject to the fluctuation of international prices and stability of our main export destinations USA.
 - High dependency of external loans and donations.
 - There is not significance investment in agricultural sector.
 - Unclear land reform in rural areas that for me is one the most important issues.
 - Farmers and small farmers are still not properly technical gifted, which it is very important to face market and production constrains.
 - Strong disparity among rural and urban areas, accentuating the poverty line at rural areas whereas the poorest people is concentrated.

The objectives of this study were to identify and evaluate the factors influencing agricultural labor productivity in Nicaragua, some policies may be suggested from this study.

In order to improve the agricultural labor productivity which has perform a decreasing growth rate over period of study must evaluate first the negative factors influencing it.

Economy environment, net stock machinery, foreign direct investment and education expenditure were the factors influencing negatively agricultural labor productivity.

To farmers, to create strong farmer associations, seeking to improve the livelihood of farmers thru the increase of productions. The schema it may address should include the further possibility



of increase income also by doing nonagricultural production activities also by doing market undertakings. The seeking of work when there is no season of cultivate and harvest, or any legal measure, for instance, fishermen when lobster and shrimps are in ban, other activities must replace and take place during that time. The union and common wealth among farmers is highly advise, can thus mitigate the effect the negative impacts of economy environment, foreign direct investment, education and net stock machinery, also thru the inclusion of women as labor work force, for instance by market and finance task.

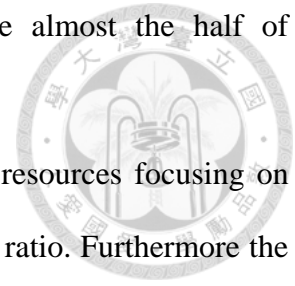
To policy makers and government; working in an integrated system of agricultural development issue as a national priority, the following task as recommending:

Since foreign direct investment showed a negative influence on APL ratio, may be revised about of the investment is made into the agricultural sector. Previously author demonstrate by statistics how agricultural sector is crucial for food security and also as the key for the development of the country, therefore direct investment must take place in order to increase the value added per worker in agricultural products, which brings as a consequence the increase of productivity in labor as the whole country as well.

Education expenditure, must improve in rural areas, were the investment in school infrastructure, the enrollment of children in elementary school is a must, but it is no enough in order to reach the technical and science knowledge that production and market demand for reaching the necessary competitive levels.

Net stock machinery is still insufficient, the level of agricultural machinery is inefficient by labor, the agricultural labor task are still manual, therefore influencing negatively the productivity, foreign and direct investment must address the issues on influencing directly

education and machinery and equipment in agricultural sector, where almost the half of population is concentrated and poverty is highly remarkable.



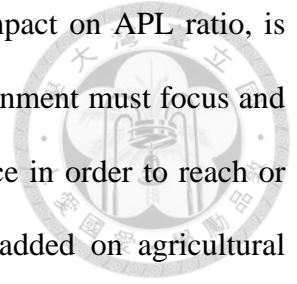
Encouragement of programs in order to facilitate the production resources focusing on agricultural land percapita and health, is a large positive influence in APL ratio. Furthermore the items, FSLN government shows a good performance on agricultural sector issues. Currently government conducts programs focusing by region and product according with the priority, encouraging also female labor work force, reducing in that manner the gap among genders.

Policy must be supervised and continuously revised and evaluated, according to the objective and goal that pursuit each of them. From the three most important national programs on agricultural sector, none of them contains mitigation plans in order to face the externalities as climate change effects, natural disasters, international market prices fluctuation of export products (affecting merely gold and coffee), inputs international market prices fluctuations as petroleum, which affect the whole economy. Thus, a mitigation program, is highly advised and recommend.

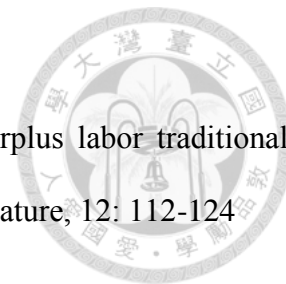
The encouragement of policies for reducing informal work rates, which does not secure the livelihood of labor force on its old ages is also an important factor to improve. Despite, the efforts of government into reduce the number of people working under this conditions, still a lot work remain.

Health expenditure exerts a positive relationship, however the level of expend is still low which is translated as a low quality health system (Bolnick, 2006). Access to an improved water source is substandard in Nicaragua, with only 75.8 percent of the population having access to clean potable water (World Bank Stat). Nicaragua does perform well, however, on access to improved sanitation, with 87.1 percent of the population in 2004.

Machinery, foreign direct investment, education, all with negative impact on APL ratio, is traduced on a poorly technologic labor skill, it is recommended that government must focus and conduct program with goals for reaching at least levels of skill labor force in order to reach or overpass its homogeneous country Costa Rica, with 65% more value added on agricultural products, exportation of raw agricultural products must be less and as more value added agricultural is produced, the more is APL ratio achievement.



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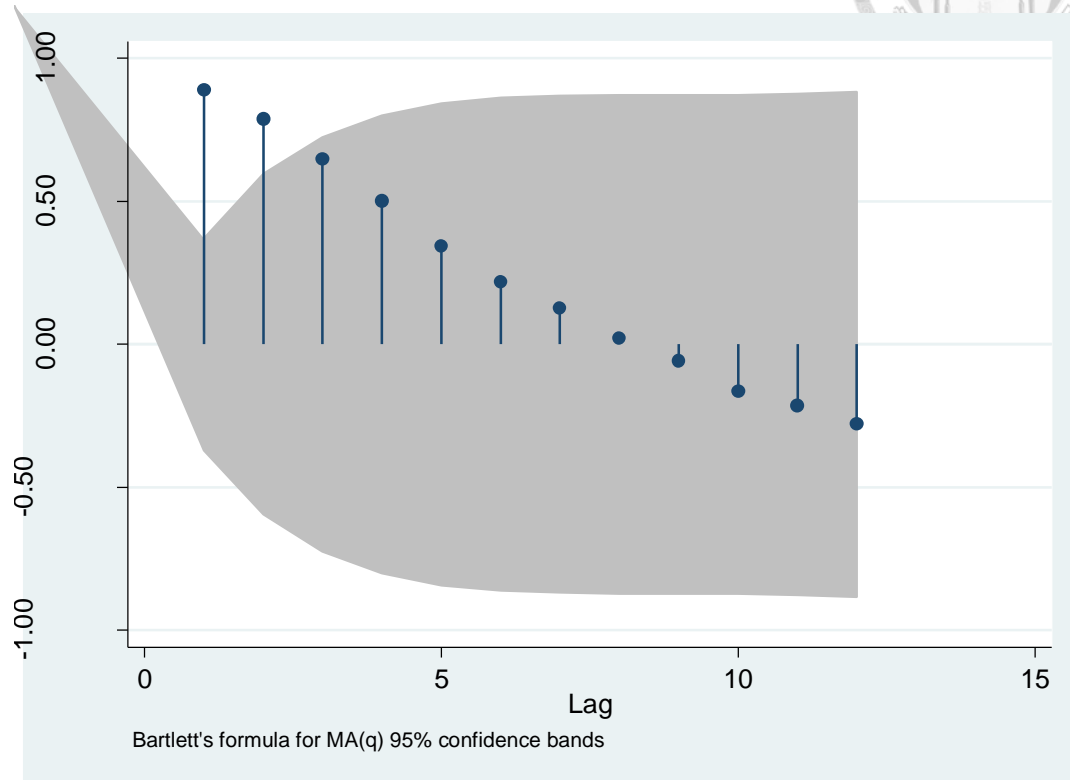
Solow, R.N. (August 1957). "Technical Change and the Aggregate Production Function". *The Review of Economics and Statistics* (NATIONAL BUREAU OF ECONOMIC RESEARCH) 39 (3): 312–320. DOI:10.2307/1926047



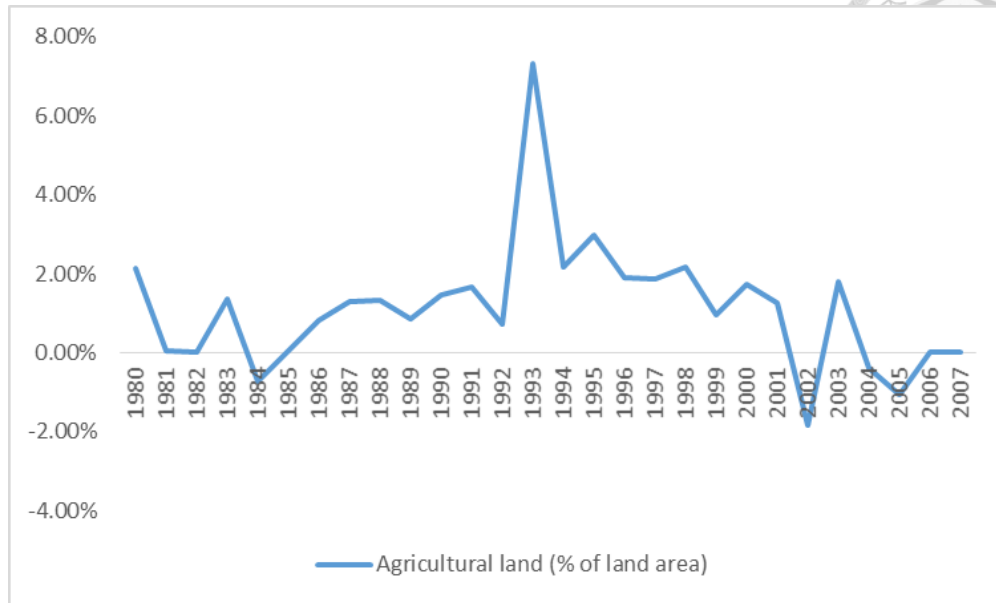
Appendix



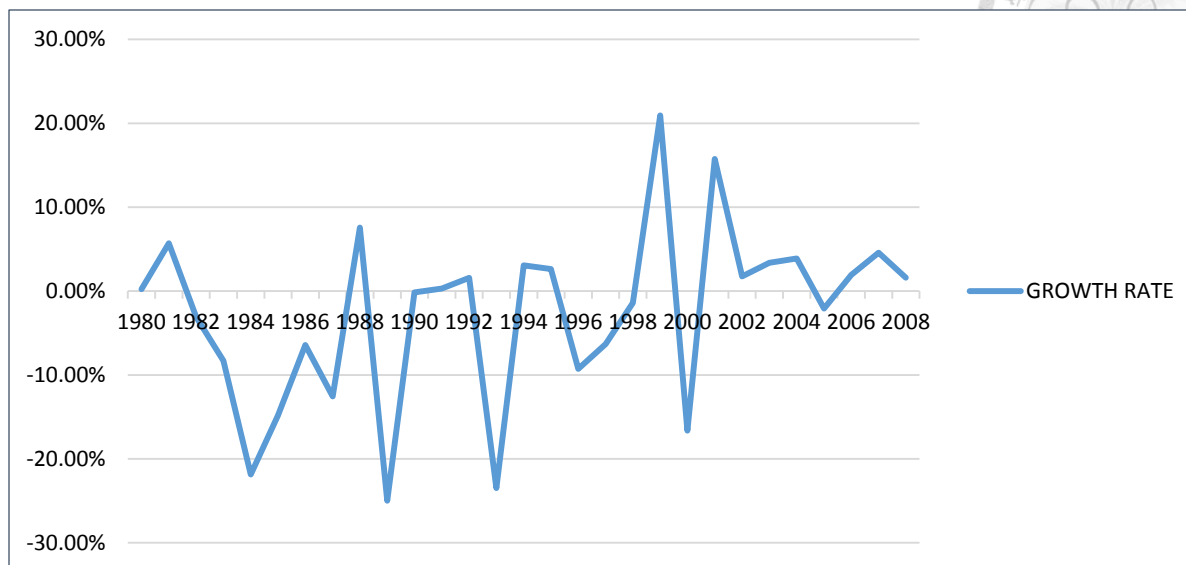
Appendix A: Autocorrelation of APL ratio



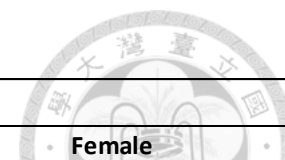
Appendix B: Agricultural Land of Nicaragua



Appendix C: Nicaragua agricultural labor productivity ratio growth



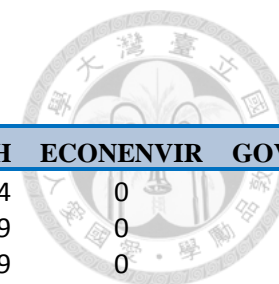
Appendix D



Labor Force of Nicaragua												
	Total M & F				Male				Female			
Thousands of persons	2003	2004	2005	2006	2003	2004	2005	2006	2003	2004	2005	2006
Total	1917	1973.1	2080.9	2089.8	1178.5	1239.3	1296.6	1303.5	738.4	733.8	784.3	786.3
Agriculture, Hunting and Forestry	568.3	586.3	588.1	593.6	492.6	509.2	523.6	528.7	75.6	77.2	64.5	64.9
Fishing	17.1	11.6	13.1	15.5	15.9	11	12.2	14.5	1.2	0.6	0.9	1
Mining and Quarrying	4.6	5.6	5.4	6.7	3.8	4.8	4.2	5.9	0.8	0.8	1.2	0.8
Manufacturing	254.5	254.8	302.3	289.2	134.4	135.5	157.5	153.1	120.1	119.3	144.8	136.1
Electricity, Gas and Water Supply	12.5	6.9	9.2	6.5	10	6.1	7.4	5.3	2.5	0.7	1.8	1.2
Construction	72.6	95.3	92.6	100.8	70.6	94.3	90.9	99.1	2	1	1.7	1.7
Wholesale and Retail Trade; Repair of Motor Vehicles, Motorcycles and Personal and Household Goods	388	392.6	419.3	409.1	183.7	199.1	201	195.6	204.3	193.5	218.3	213.5
Hotels and Restaurants	60.4	73.9	61.7	72	16.7	20.9	16.3	18.1	43.7	53	45.4	53.9
Transport, Storage and Communications	73.4	80	88.1	89	68.6	74.6	80.6	82.3	4.8	5.4	7.5	6.7
Financial Intermediation	14.9	16.8	17	15.9	7.3	8.1	8.8	7.5	7.5	8.7	8.3	8.4
Real Estate, Renting and Business Activities	36.2	43.9	53	54	26.1	33.9	40.4	42.1	10.2	10	12.6	11.9
Public Administration and Defence; Compulsory Social Security	57	68.3	70.8	73.7	37.7	44.5	47.4	44.6	19.3	23.8	23.4	29.1
Education	85.2	86.6	89	94.5	23.9	26.8	28.6	28.5	61.3	59.7	60.4	66
Health and Social Work	50.8	55.8	51.4	54.3	18	19.5	18.7	19.6	32.9	36.4	32.6	34.7
Other Community, Social and Personal Service Activities	92.8	84.9	91.8	89.2	50.2	32.3	34.4	33	42.6	52.6	57.3	56.2
Households with Employed Persons	123.5	106.2	118.7	117.4	16.7	16.7	18.4	22.6	106.8	89.6	100.3	94.8
Extra-Territorial Organizations and Bodies	5.2	3.6	9.2	8.1	2.6	2.1	5.9	3.1	2.7	1.5	3.3	5

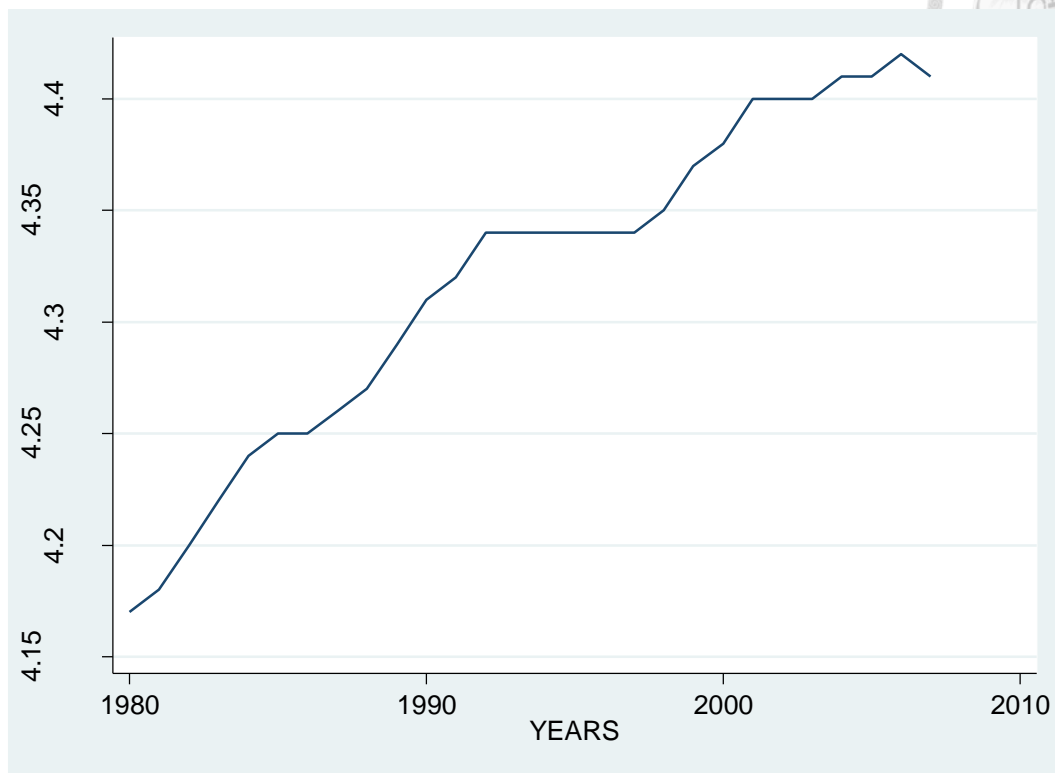
Source: International Labor organization Stat

Appendix E. Regression model variable value

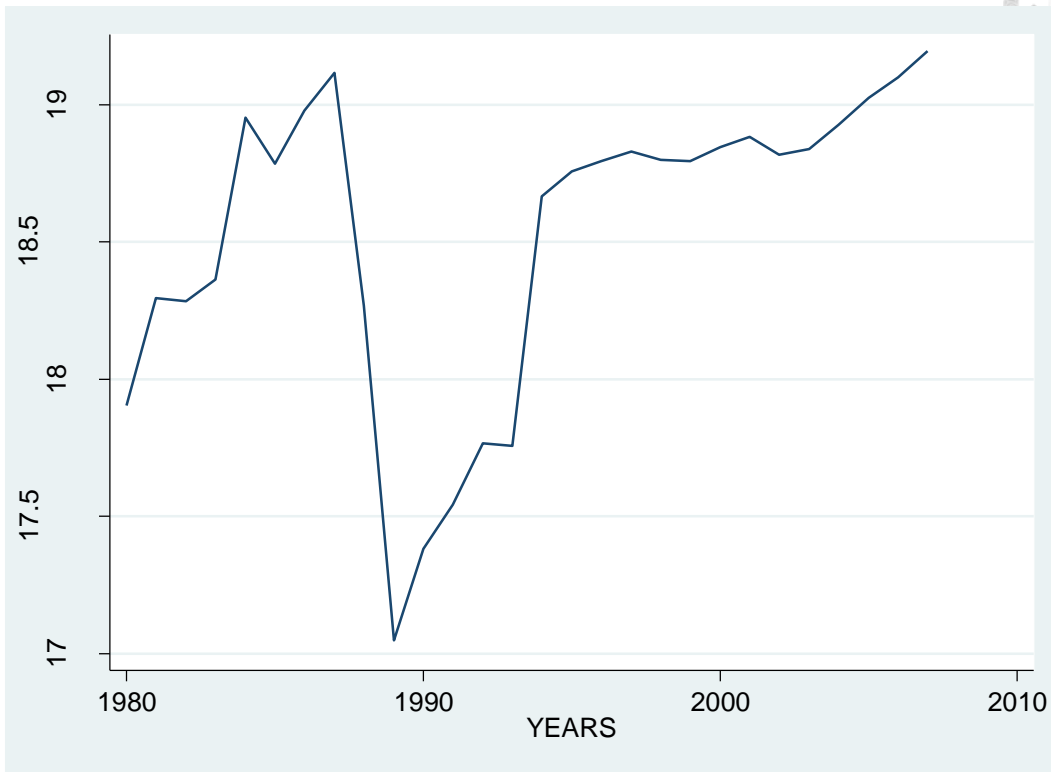


YEARS	LNAPRATIO	LNFDIIF	LNHEALTHEXPD	LNEDUCEXPDT	LNAGRILANDPER	LNNETKSTOCKMACH	ECONENVIR	GOVREGI
1993	2.3379193958	17.473931	2.1295876614	17.757333540	0.731593446	4.336911584	0	0
1994	2.1270256905	17.659255	2.1180940007	18.666583658	0.731156649	4.336506119	0	0
1995	2.1582301049	18.303023	1.9223075724	18.756386117	0.735515711	4.335707789	0	0
1996	2.1848434647	18.603002	1.9879364900	18.795182422	0.736246475	4.336911584	0	0
1997	2.0961086951	19.130685	1.9309808097	18.830013458	0.737614360	4.336911584	0	0
1998	2.0347991904	19.200923	1.9448686075	18.798251266	0.738289634	4.352391830	1	0
1999	2.0207664211	19.636483	1.9203932895	18.795133768	0.738999165	4.367648767	0	0
2000	2.2556271202	19.400885	2.0034452416	18.846713501	0.739979293	4.382676424	0	0
2001	2.1017090895	18.827478	2.0713632923	18.882222015	0.740173070	4.396348584	0	0
2002	2.2730747378	19.133140	2.0729650438	18.817914726	0.740932566	4.403641345	0	0
2003	2.2907552169	19.120307	2.0705938644	18.838802663	0.741398218	4.402135588	0	0
2004	2.3249524317	19.336971	2.1060225477	18.928206629	0.739795188	4.409471554	0	0
2005	2.3646674132	19.300722	2.2090491988	19.024938209	0.740660883	4.407986736	0	0
2006	2.3441072349	19.474296	2.2305584522	19.100609192	0.739289532	4.415376784	0	1
2007	2.3635305141	19.760146	2.3123999642	19.194342748	0.738694262	4.414263886	0	1

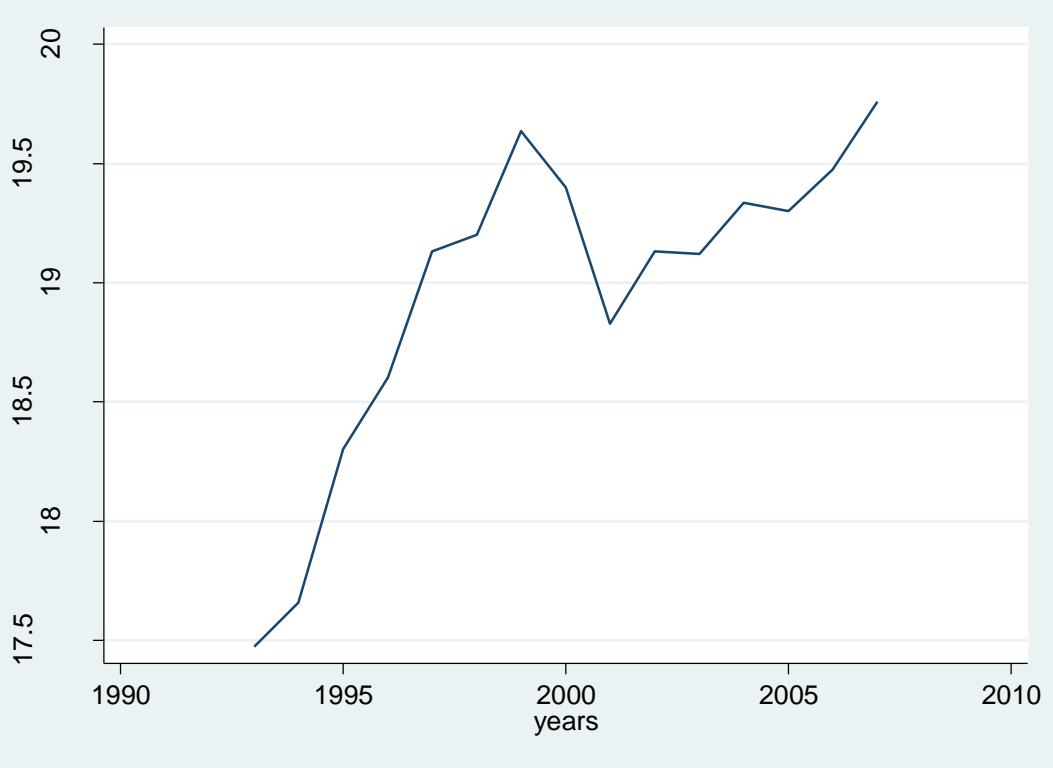
Appendix F. Time series trend: Net stock machinery



Appendix G. Time series trend: Education Expenditure



Appendix H. Time series trend: Foreign Direct investment



Appendix I. Time series trend: Health Expenditure

