War, Aid and Dutch Disease in Nicaragua, Bouncing Periods and Drawbacks from Development

Running Title: War, Aid and Dutch Disease in Nicaragua

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Abstract

After more than half a century of development aid and development research, it has been proved that it is very difficult to show a positive and statistically robust effect of aid on development in recipient countries. In general the economic theory predicts that foreign aid causes "Dutch Disease".

This paper contributes to the literature in Dutch Disease with a tested approach that finds a robust and significant relationship between (lagged) aid and real exchange rate (RER), as well as in government expenditure and income per capita. Moreover, a structural break was detected at the end of the 1990s, indicating the likely effect of the end of a war period. The efforts to fight against poverty are still under stress as Nicaragua continues to be the second poorest country in Latin America.

Keywords: Macro-Stability, Development Economics, Aid, Dutch Disease, economic problem, Nicaragua

"Economic doctrine
is not a body of concrete truth,
but an engine
for the discovery of concrete truth"
(Marshall, 1948)

I. INTRODUCTION

The World Economy (2006) states that any country that is provided with huge amounts of aid is likely to suffer from some degree of "Dutch Disease" as *"Other things being equal, the real exchange rate will be more appreciated than it would be in the absence of aid, thereby discouraging the export sectors, which are frequently considered the leaders of growth"* (World Bank 2004: 20).

The World Economy (2006) sees the most common manifestation of Dutch Disease as the appreciation of the real exchange rate (RER). It is defined as the relative price of tradable goods versus non-tradable goods, and the stagnation or decline of export activity. Since the prices of tradable goods are externally given for small economies, the prices of non-tradable goods will be bid up to the extent that an increase in aid will cause a spill over and, higher demand for non-tradable goods. The appreciation of the RER, as an effect, has a negative influence on export growth given that domestic producers respond by shifting production towards non-tradable goods. Effects can be seen in the rapid increase in private investment in certain non-tradable sectors, especially in construction.

Nicaragua in per capita terms, during the 1990s was among the top ten foreign aid recipients in the world. It still remains highly dependent on international cooperation which represents 20 percent of the nominal GDP, 83 percent of the value of exports, and 28 percent of the value of imports. By adding up the value of family remittances, which totaled US$335.7 million in 2001 alone, and foreign aid, we find that these two amounts combined represent 32.7 percent of the nation's GDP during this period. On this sense, the decomposition of foreign capital inflow is analyzed under different schemes: remittances separated from foreign aid as main subject.

International cooperation is one of the main pillars in the Nicaraguan economy;if this was suspended, the country would fall into a deep economic prostration with unpredictable consequences. However, Nicaragua continues to resemble a family who always consumes

more than they can pay for, with the resulting predicament being that in the long run the problem will become more chronic.

One result of the flow of foreign aid in Nicaragua is the presence of the symptoms of Dutch Disease.. In most Dutch Disease empirical literature variable contractions are only casually studied without systematically estimating the relationship between the variables performance and RER. This study pretends to fill this gap by considering how the variables interface with macroeconomic performance. Therefore, this study adds to current works on the real exchange rate (RER) in Nicaragua in a distinctive manner.

II. FOUNDING THEORIES

Many countries have no choice but to rely on Foreign Aid (ODA) to finance their investments because they have insufficient domestic resources. Although the assistance has been diminished in many countries, in some others it has been increased. On a simplistic level one might assume that an increase in the level of aid would lead to increased effectiveness; however according to Nkusu (2004:14): *"The large government spending that aid allows tends to create macroeconomic management problems that raise concerns of undermining prospects for long-term growth through Dutch-disease-type effect."*

Nkusu (2004) also added that this concern means that some countries may be receiving "too much aid" under the premise that aid is needed to implement programs essential for boosting economic growth and that, with regard to export promotion and private sector development, they would be better off with less aid.

Krugman (1987) explained that "Dutch Disease" first called the attention of economists in the 1950s when natural gas was discovered in the Netherlands and it eventually hurt the competitiveness of the Dutch manufacturing sector.

The term is now used by countries facing similar conditions in order to explain their economic performance. These conditions refer to special situations where a resource boom is experienced due to a tradable resource discovery or to an increase in a resource price. This usually has an effect on the appreciation of the RER and as a result of this appreciation the international competitiveness on other tradable sectors is reduced. Edwards (1988), Levy (1988), and White (2001) have identified the possibility that capital

inflows could cause the RER to appreciate and that one, cause of capital inflow is foreign aid.

There is broad literature on the Dutch Disease such as: Hansen and Tarp (2000) who present surveys of the literature on aid effectiveness; Younger (1992) and Sackey (2001) who analyze the impact of aid on macroeconomic performance and the RER in Ghana; White and Wignaraja (1991) carried out similar study for Sri Lanka; lastly and Vos and Johansson (1994), Adenauer and Vagassky (1998), and Nyoni (1998) who amongst them analyzed the macroeconomic problems associated with large aid inflows to Nicaragua, various african countries and Tanzania. These studies have presented diverse conclusions to the question of that whether aid has originated Dutch Disease in these countries. Alguieri (2004) manifested that resource boom affects the rest of the economy through two channels: the resource movement effect and the spending effect[1]. Additionally, his study on transitional economies also provides three hypotheses linked to the external impacts of Dutch Disease: (1) the non-booming tradable sector shrinks and causes losses in competitiveness; (2) exports of primary products enlarge income unequally; (3) primary export orientation can lead to periodic growth collapses due to higher volatility of primary goods prices as compared to manufactured goods.

The empirical analysis of Dutch Disease is mostly related to the abundant resources of countries such as: Ecuador, Indonesia, Nigeria and Venezuela, and some industrial countries as the Netherlands, Norway and the United Kingdom. The results of many studies are synthesized by Gylfanson (2002) in which he argues that in the long term, naturally resource abundant countries may register a decrease in their growth rates because of Dutch Disease and, corruption in business and government.

[1] *The resource movement effect.* An increase prices raises the value of the marginal product of labor in the export sector and pushes the equilibrium wage rate up, bringing about a movement of labor from both the manufacturing and non-tradable sectors. The result is a lightening on the other tradable sectors.

The spending effect. A boom in the natural resource sector or other sources of income, caused either by a rise in the world price of the resource, by a new deposit discovery or by new capital inflows (eg: remittances or foreign aid), leads to increased income for the country which, in turn, brings about increased imports and domestic absorption for both tradables and non-tradables. In as much as the prices of tradables are set internationally, this effect results in increasing prices (and wages) of non-tradables relative to tradables, i.e. a real appreciation of the exchange rate. In addition, it bids labor and capital out of the manufacturing sector. (Alguieri 2004)

III. THE SYMPTOMS & MODEL (AID – DUTCH DISEASE)

Alguieri (2004) studies and models on Dutch Disease assume a notion of equilibrium real exchange rate (RER) at the start of an economic boom. Regarding this initial point Alguieri's study acknowledged the symptoms of Dutch Disease as:

A) RER appreciation caused by either one or a combination of boost in foreign capital income (e.g. Aid), a change in relative prices, an increase in the price of non-tradable goods or an upsurge in domestic absorption and permanent income.

B) GDP changes as a result of changes in the prices of natural resource products or foreign capital inflow. This can produce two effects on the GDP. It can produce a rise in GDP growth rate and an appreciation of RER. On the other hand, an appreciation of RER can lead to a drop in the GDP growth rate.

C) Output loss in the non-booming sector, leading to a fall in other exports.

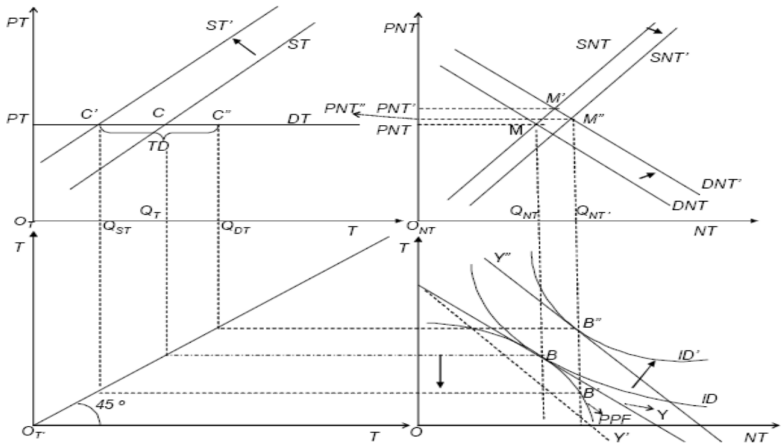
D) Some manufacturing sectors are hampered by changes in prices caused by the appreciation of RER.

Aid and the Dutch Disease: The Model

Nkusu (2004) based his diagnosis on the impact of aid on the RER and output on the analysis performed in a Salter-Swan framework under the assumptions of the core Dutch Disease model (Corden and Neary, 1982).This assumes full and efficient employment of production factors, a mobile production factor transferable between sectors and a perfectly elastic demand for tradable goods associated with a small country.

Graph 1

The Dutch Disease Model



Box 1

The model assumes an economy endowed with units of labor used to produce two types of commodities, tradable and non-tradables. Large aid inflows, as any resource boom, entail an increase in aggregate expenditure that goes to tradable as well as non-tradables goods, thereby influencing the RER. In Figure 1, the economy produces and consumes at *B* on the production possibility frontier, *PPF*, and on the indifference curve *ID*, in the lower-right quadrant. The upper-left and –right quadrants illustrate the market for tradable and non-tradables, respectively. In the tradable sector, the demand, *DT*, is perfectly elastic, in line with the small-country hypothesis. The initial trade balance is zero at point *C* where the production and consumption of tradable are equal. In the market for non-tradables, the initial equilibrium is at *M*. An increased demand for non-tradables, induced by financial inflows, translates into an upward shift in the demand for non-tradables, *DNT*, and an increase in their price a move from point *M* to *M* ' in the upper-right quadrant. With the price of tradable fixed at *PT*, the RER appreciates. The appreciation of the RER discourages the production of tradable. This is the spending effect. The literature on the Dutch disease highlights two other effects related to the appreciation of the RER: the resource transfer effect and the expenditure-switching effect. In the core Dutch disease model, there are three sectors: the booming, the lagging, and the non-tradables, with the booming and the lagging sectors producing traded goods. The Salter-Swan framework adopted here has only two sectors, producing either tradable or non-tradables. The

resource transfer effect refers to the reallocation of labor from the tradables sector to the booming non-tradables sector as a result of the rise in the marginal product of labor employed in the production of non-tradables. In the lower-right quadrant, the move from point *B* to *B*' on the *PPF* reflects the total reallocation of resources in favor of the non-tradables sector, including from the spending effect. This move is reflected also in the upper quadrants by a shift to the left of the supply schedule for tradables, from *ST* to *ST* ', and a shift to the right of the supply of non-tradables, from *SNT* to *SNT* '.The expenditure-switching effect refers to the disincentive to buy non-tradables, induced by the appreciation of the RER. Under the assumption that the tradable and non-tradable goods are not inferior, the increase in the relative price of non-tradables, coupled with the upward shift in real income (a shift from *Y* to*Y* '') brought about by financial inflows, is associated with an increase in the demand for tradables from *OTQT* to *OTQDT*, consistent with a higher level of consumption, *B*'', on the indifference curve, *ID*'. The reduced production of tradables, together with an increase in consumption at the given world price, leads to a deterioration of the trade balance, which moves from zero to a deficit of *C* '*C* '' in the upper-left quadrant. As illustrated, the increased spending on tradables that goes to imports allows the financial inflows to be absorbed through a wider trade deficit.

IMF 2004 (IMF working paper 04/49) Nkusu: Aid and the Dutch Disease in Low-Income Countries, pp 10

IV. THE DRAWBACK FROM GOOD INTENTIONS

Foreign aid on the short run has a direct positive effect on the welfare of the economy. Apparently in developing countries citizens could only consume what they produce, however, foreign aid provides an extra purchasing power on the international market. Hence, it turns feasible to run a deficit on the trade balance which does not need to be completely repaid.

Considering Dutch Disease as an externality of Capital Inflows in some special cases, specifically in countries relying on one main export product (e.g. Oil) we can arguably observe that due to RER appreciation, production shifts to non-tradable. This shift can be regarded as an efficient adoption of the flow of capital; however it could have undesirable effects mainly because of the volatility of capital (Arellano et al., 2008).

An additional drawback of Dutch Disease is related to the shift in production away from tradable goods. Advocates of export-led growth hypothesis postulate that export expansion is one of the main determinants of economic growth. Besides the accumulation of capital and labor; exports are also considered as an engine of growth. Thus, the main constraint of Dutch Disease is that the appreciation of RER in some cases could reduce the profitability of the export sector in the recipient country. (Adam 2006).

Especial attention should be given to developing countries that mainly rely on agricultural products as their export engines. The agricultural sector employs traditionally the poorest part of the population; a large negative shock might cause social and political problems, deepening economic drawbacks.

V. AN OVERVIEW OF EMPIRICAL EVIDENCE

Theory predicts that large aid surges will cause a RER appreciation and deindustrialization of the tradable sector. Despite the superlative theoretical predictions, the empirical evidence of aid induced Dutch Disease is limited and far from conclusive (Balir and Hamann, 2004; Adam 2005).

Literature on aid induced Dutch Disease can be divided in two lines of research: the early contributions mainly influenced by the work of Edwards (1989) who introduce the concentration on real exchange rate;and studies that concentrated on the investigation of aid and de-industrialization relay on the impact of aid on export performance (Arellano et al 2008).

Researchers have also demonstrated implications of short run – midterm effects of Dutch Disease on resource movement, spending effect and the increase of productivity and supply of non-traded goods (Rajan and Subramanian 2011).

The experience in different countries

Elbadawi (1999) analyzed the impact of ODA on exports on a panel of more than 62 countries, including 28 from Africa in order to support the idea of diminishing returns to

ODA. His results expressed that while the ODA-to-GNP ratio is positively associated with non-traditional exports, there is a verge beyond which ODA relates exports. Another result is a significant positive association between non-traditional exports, human capital, imports of machinery, and RER undervaluation. Additionally a negative association between non-traditional exports and RER variability was found.

Younger (1992) in his study *Assessing the Impact of Aid on Macroeconomic Management in Ghana,* suggested that the increase in ODA to Ghana from an annual average of 3 percent of GDP during 1981 – 83 to 6 percent of GDP during 1984–87 gave rise to macroeconomic management problems. These problems were associated with high inflation, tight credit to the non-bank private sector and an appreciating RER. Additionally Sackey (2001) in his study the Impact of Aid on the RER in Ghana during 1962–96 suggested that aid has a "dampening" effect on the RER. As he also suggested that appreciations in the RER affect export performance negatively.

Adenauer and Vagassky (1998) in their study *An Empirical Analysis of the Impact of Aid on the RER in Bur kina, Côte d'Ivoire, Senegal, and Togo* during 1980–93, suggested that there is a direct relationship between aid flows and RER appreciation. They also suggested that during the period when the four countries received large aid flows, their government deficits increased through high wage bills public spending and their trade balances widened. These developments appear to support the idea of Dutch Disease induced by inflows of aid.In *Aid-Induced Dutch Disease in Sri Lanka* by White and Wignaraja (1991:18) they suggested that there is a direct relationship between total aid and remittances and RER appreciation caused by massive transfers of both public (grant aid) and private (remittance) during the period of 1974-1988. On the other hand, Bandara (1995 cited in Nkusu 2004:34) suggested the non-existence for the Dutch Disease theory in his analysis of the impact of foreign capital on macroeconomic performance in Sri Lanka.

Focusing on the particular case of Nicaragua, Vos and Johansson (1994)in their study *Analysis of the Macroeconomic Impact of aid in Nicaragua* suggest that during the period of large aid inflows (the 1980s), a case of a typical aid-associated Dutch Disease is not indicated. The World Bank (2004) study also indicates a weak relationship between aid and Dutch Disease. However, Hansen and Tarp (2000) highlight the complexity of the macroeconomic implications of ODA. They argued that ODA flows have the potential of improving the macroeconomic performance in recipient countries. Although, these

countries can at certain levels and in certain circumstances, bring undesirable structural changes such as an appreciation of the RER, inflation and the decline in exports[2].

The large ODA flows that induced some of these undesirable effects on the macroeconomics of the recipient countries such as Sri Lanka and Nicaragua mentioned above have been compared with symptoms of the Dutch Disease.

Origin

Nicaragua once had the most dynamic financial sector in Central America. In 1979 a revolutionary group looking to set free the country from a dictatorship overthrew the Somoza family and replaced the 40 year regime with the Sandinista National Liberation Front Government (Sandinistas).

Box3:

Chronology of Major Events in Nicaragua 1930-2012

Somoza Regime	1930 - 1979
Managua Earthquake	1972
Nicarguan Revolution	1979
US Embargo	1983-1990
Civil War	1983-1990

[2] Theoretical analyzes of Dutch Disease effects of capital inflows in small open economies have been based largely on the dependent Salter-Swan-Corden-Dornbusch economy model. According to Acosta (2009) within this framework, the certain conditions that apply are: higher disposable income triggers an expansion in aggregate demand, which, for exogenously given prices of tradable goods, culminates in higher relative prices of non-tradable goods that corresponds to a real exchange rate appreciation. The higher non-tradable price leads to an expansion of the non-tradable sector, causing a further reallocation of resources toward the non-tradable. In this context, we have to also consider an additional transmission mechanism: the effect of foreign aid on income, and consequently on labor supply. Remittances and Foreign Aid generally tend to increase the reservation wage of recipients and, thus, could cause a decline in labor supply. A shrinking labor supply is associated with a higher wage (in terms of the price of tradable output) that, in turn, leads to higher production costs and a further contraction of the tradable sector.

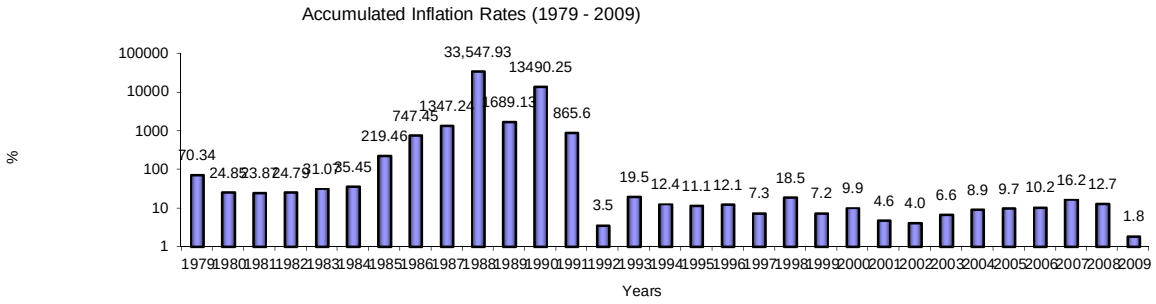
Hurricane Joan	1988
Election of Pres. Barrios de Chamorro (first woman president)	1990
Tidal Wave	1992
Volcanic Eruptions	1992-1994
El Nino	1996-1998
Hurricane Mitch	1998
Election of Pres. Ortega	2006
Hurricane Felix	2007
Food and Oil Crisis	2008
Global Financial Crisis	2009

Author's Analysis 2013

In 1985, the public sector assumed absolute leadership in national productive activity. During this period, public administration allocated approximately 60 percent of the country's economic resources.

The government turned to external debt in other to protect the national sovereignty of the country that was under attack from a military group financed by a foreign government. . In 1979 the debt was US$ 1,600 million and in 1990 was US$ 12,000 million. During this period the state apparatus grew from 35,000 employees (including the army) in 1979 to 187,929 in 1989 (Velazquez, 1998).

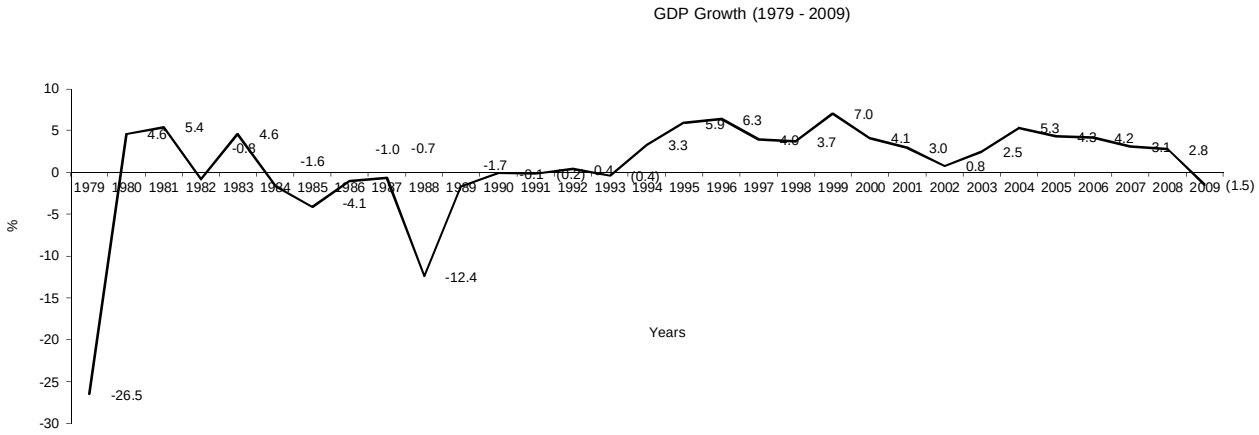
One economic metric that marked that period was inflation. The hyperinflation rate reached record marks with the highest accumulated rate being 33,547.93 percent in 1988 as observed in the following graph 2:



Source: Central Bank of Nicaragua (2013)

According to the Ministry of Foreign Affairs of Nicaragua (2004), the Nicaraguan Government received international cooperation resources totaling approximately US$7.155 billion during the 1979-1989. Of these resources, US$5.24 billion were awarded as loans and US$1.925 billion were donations. Despite this injection of assistance, the nation's GDP at the end of this period was lower than in 1967. The economic model at the time created an economic structure that relied completely on external resources.

By 1989, several factors like war and government policies led the country to economic turmoil.The graph below depicts the economic turmoil through the country;s GDPfor the periods 1979 to 1990:



Source: Central Bank of Nicaragua (2013)

In the space of 10 years the nation moved from being the one of richest country in Central America to be one of the poorest.

From War to Peace

The Sandinista government in order to free the country from war, it had to give up its ruling conditions. According to Gomez (2003) the new government led by president Barrios 1990–1996 began a process of change in the political and economic realms.known as the "triple transition." The nation was undergoing a change from war to peace, from Somoza's dictatorship to an open democracy enabled by the Sandinista fight and from an embargo to a capitalist economy..

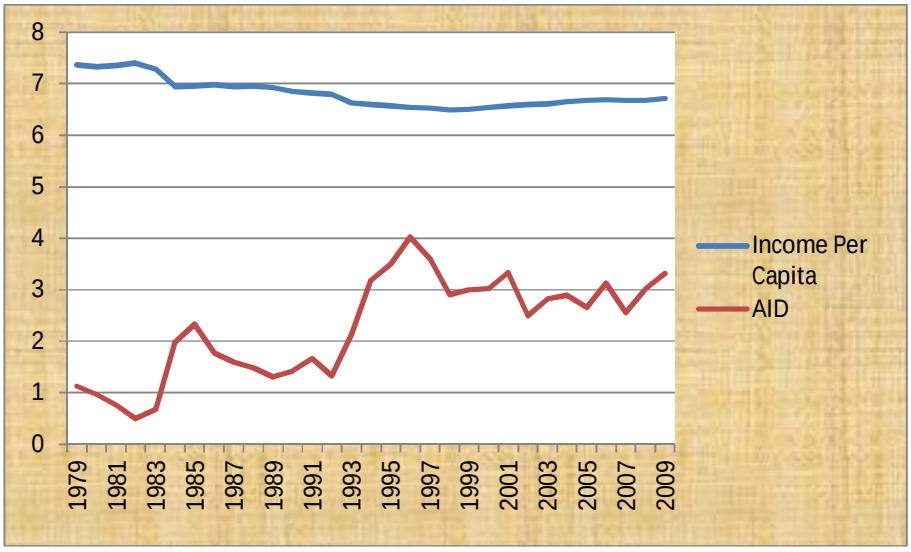
This included reforms of administrative measures in public-sector operations, such as in public organization and administration; the setting of utility fees, taxes and tariffs; privatization; and the restructuring of the financial system and the allocation of credit. Thus, a total of US$4.525 billion was received during this period, of which US$1.882 billion (41.6 percent) went to making payments towards the national debt. Some US$780 million (17.3 percent) was assigned to the social area, while US$956.8 million (21.2 percent) was channeled to the productive sector. Another US$635.3 million (14.1 percent) was allotted to infrastructure, while other programs related to the adjustment program received US$271.0 million.

During the period of 1997 to 2001, the Government of Nicaragua continued to extend the structural adjustment measures, they prioritized the modernization of the State and the national financial system, extended the privatization process, and restored economic and social infrastructure. During these years, international cooperation totaled US$2.49 billion. Some US$741.9 million (29.8 percent) were allocated to the social sector, US$594.3 million (23.9 percent) to the infrastructure sector, US$563.1 million (22.6 percent) to the productive sector, and US$425.5 million (17.13 percent) to the financial sector. The remaining US$165.5 million (6.6 percent) were assigned to strengthening the institutions involved in building good governance. Hence Nicaragua from 1990 to 2002 had received a total amount of foreign aid of US$7.525 billion from bilateral and multilateral agencies, that is 56 percent of which were donations and 46 percent loans (Ministry of Foreign Affairs 2004).

Overall, from 1981 to 2009 Nicaragua received an annual average of aid close to US$ 578 million and more than US$14,681 billion in international cooperation was provided. To

further illustrate we can observe graph 4, which captures the logarithmic trend in aid and GDP per capita in Nicaragua in contrast to the amount of Aid received since 1981 the GDP per capita, which has steadily reacted.

Graph 4: Aid and GDP per capita (in log values)



As previously stated, Nicaragua remained highly dependent upon international cooperation. Nicaragua is therefore susceptible to "Dutch Disease" with Tropical characteristics when the external cooperation and familiar remittances overestimate the exchange rate, which makes it more profitable to consume rather than to produce and export.

VI. ESTIMATION APPROACHES

In estimating the impact of external aid inflows on the RER, the model of RER determination has to be established. According to Sackey (2001) the equilibrium of RER can be conceived as the relative price of tradabletradable to non-tradables compatible with the attainment of internal and external equilibrium.

Internal equilibrium presupposes that the market for non-tradables clears in the current period and is envisaged to do so in the future. External equilibrium implies that the current account balances both in current and future periods are compatible with long-run sustainable capital flows (Elbadawi, 1994).

From a theoretical point of view RER is defined as the nominal exchange rate adjusted for the relative price level. Sackey (2001) analyzed that on the basis of the works of Nyoni (1997) and Abuka and Sajjabi (1996), and as observed by Edwards (1989), the dynamics of the behavior of the real exchange rate are given by Equation 1 as follows:

$$LogRER_t = [\beta(LogRER_t^* - LogRER_{t-1}) - \tau(MAC_t^*) + \alpha(LogNER_t - LogNER_{t-1})] \quad (1)$$

Where [3]

$LogRER_t^* - LogRER_{t-1}$	= deviation of the actual real exchange rate from its equilibrium level
$MAC_t - MAC_t^*$	= inconsistency in the macroeconomic policy framework
$LogNER_t - LogNER_{t-1}$	= nominal exchange rate devaluation
β, τ, α	= positive parameters capturing vital aspects of the adjustment process

Additionally, the main fundamentals that affect the equilibrium of the real exchange rate are represented in the following Equation 2 used by Sackey (2001) in his analysis of Dutch Disease in Ghana:

$$LogRER_t^* = \beta_0 + \beta_1 \log(TOT)_t + \beta_2 \log(AID)_T + \beta_3 \log(GCN)_t + \beta_4 \log(CPS)_t + \beta_5 \log(TEP)_t + u_t \quad (2)$$

Where

[3] MAC t - MAC *t (Macroeconomic approach) – Expansionary macroeconomic policy causes an appreciation of the RER, other things being equal.

RER = the equilibrium real exchange rate
TOT = external terms of trade
AID = external aid inflows (defined as real net ODA to Ghana)
GCN = government consumption of non-tradeables (measured by share of government consumption in GDP)
CPS = commercial policy stance (using the parallel market premium as proxy)
TEP = technological progress (proxied by index of agricultural production)

Therefore, by replacing variable RER for its fundamental in equation 1 we can obtain the following equation (#3):

$$LogRER_t = \beta_0 + \beta_1 \log(TOT)_t + \beta_2 \log(AID)_t + \beta_3 \log(GCN)_t +$$
$$\beta_4 \log(CPS)_t + \beta_5 \log(TEP)_t + \beta_6 \Delta(MAC_t - MAC_t^*) +$$
$$\beta_7 \Delta LogNER_t + \beta_8 LogRER_{t-1} + u_t \qquad (3)$$

Despite the useful methodology presented on Sackey (2001) we will not use their models given the following constraints for conducting a similar study in Nicaragua.

Critics on the empirics

According to Adam (2005) there are four reasons one should not accept the evidence on aid induced Dutch Disease at face value:

- Collecting reliable data on simple entities like the amount of disbursed aid proves difficult.
- Deriving proxies for less clear concepts (tradable – non tradable) is complicated as some product can be regarded as (imperfect) substitutes for each other, making any restriction arbitrary.
- Researching draws data from periods in the past when aid management was quite different from now. For example, aid due to political reasons (cold war 1980-1990), aid highly conditional (large macroeconomic reforms 1990-2005), aid and budget support (2005- present).
- Working with averages or either overtime or across country loses valuable information on very short term variable.

Another important factor to be considered from past empirical studies is the positive relationship between aid and RER. It is to be expected that foreign aid as by definition is considered as capital flow. At the same time this is a significant determinant of the nominal exchange rate. Therefore, finding a positive relation between aid and RER will probably have more to do with this fundamental relation that with Dutch Disease effects. However, all these effects can be controlled by using event study methods or the Vector Autoregressive Model (VAR) for Multivariate Time Series.

VII. MODELS AND ESTIMATION TECHNIQUES

In order to assess the impact of the increase of foreign assistance on the RER, we use an approach often used in financial econometrics: event studies following the VAR. Financial economics event studies are used to examine the behavior of firm stock prices after certain events have taken place, ranging from mergers to profit warnings (Kothary and Werner, 2004). A similar methodology can also be applied outside financial economics, and are also known as "before and after studies" (Durlauf et al., 2005).

Kothari and Warner (2004) offer the typical model as applied in financial economics. The model examines the behavior of the return on a specific security from a sample of a firm experiencing a common type of event which takes place at t=0, the return on each security (i) can be found in equation 4 as:

$$Rit = Kit + eit \qquad (4)$$

Where Kit is the normal return (the expected return given a particular prediction model), and eit is the difference between the observed return (that is conditional to the event Rit) and the expected return unconditional to the event (Kit). This makes the abnormal return, eit, a direct measure of the unexpected change in wealth associated with the event.

According to Kothary and Warner (2004) the vector autoregression (VAR) model is one of the most successful and straightforward to use models for the analysis of multivariate time series. It is also a natural extension of the univariate autoregressive model to dynamic multivariate time series. The VAR model has proven to be especially functional for describing the dynamic behavior of economic and financial time series. It often provides superior forecasts to those from univariate time series models and elaborate theory-based simultaneous equations models. In addition to data description, the VAR model is also used for structural inference and policy analysis. In structural analysis, certain assumptions about the causal structure of the data under investigation imposed, and the resulting causal

impacts of unexpected shocks or innovations to specified variables on the variables in the model.

The VAR can be used for a refined analysis, which includes the dynamics adjustment of the variables in the short term - when a unexpected shock causes them to deviate temporarily from their relationship with the long-run equilibrium. Additionally it provides useful information about the speed of adjustment towards balance.

This approach can be easily applied to assess how the RER is affected by foreign aid inflows. We shall use a model of the natural equilibrium real exchange rate (NATREX).[4] The NATREX is the equilibrium real exchange rate determined by real fundamental variables, assuming that RER do adjust toward their equilibrium level. This is the rate that would prevail if speculative and cyclical factors could be removed while RER is at its natural rate. Since the fundamentals evolve over time, the NATREX changes over time. It may not be stationary.

The following model has been proposed:

$$RER_t = \alpha + \beta_0 RER_{t-1} + \beta_1 RER_{t-2} + \beta_2 RER_{t-3} + \beta_3 AID_{t-1} + \beta_4 AID_{t-2} + \beta_5 AID_{t-3} + \beta_6 LYC_{t-1} + \beta_7 LYC_{t-2} + \beta_7 LYC_{t-3} + \beta_8 TOT_{t-1} + \beta_9 TOT_{t-2} + \beta_{10} TOT_{t-3} + \beta_{11} GOE_{t-1} + \beta_{12} GOE_{t-1} + \beta_{13} GOT_{t-1} + \beta_{14} GOT_{t-2} + \beta_{15} GOT_{t-3} \quad (5)$$

Where *RER* is the log of the real exchange rate (*RER*), *AID* is the log of the measure of Foreign Aid, *LYC* is the log of the Nicaragua GDP per capita, *TIT* the log of the terms of trade, and *GOE is log of Government Expenditures*. GDP per capita is included in the analysis as a conventional variable.

Real exchange rate (*RER*) is the nominal exchange rate (US$ per Nicaraguan Cordoba) deflated by the ratio of overall purchasing powers (as measured by the consumer price indices) in the two countries. According to Sackey 2001 the productivity of home country, relative to that of foreign country, is expected to change real exchange rate. When productivity advances more rapidly in home country's traded goods sector than in its non-traded goods sector, productivity growth at home in excess of that abroad will raise the

[4] This model is taken from a Ph.D. dissertation: Ramesh M. K.C., "Fundamental determinants of equilibrium exchange rates" Department of Economics, University of Colorado at Boulder, 2000.

price of non-traded goods sector relative to traded goods sector more at home, than in foreign country. Thus, by appreciating the home country's equilibrium real exchange rate, implying that β_1 is expected to have a negative sign. The model assumes a maximum of lag period of (t-1) due to the running out of observation effect with the available research data of 30 years period. A diagnostic test is conducted in order to rely on the lags periods feasibility.

The variables subjected to this analysis have been divided into three groups:

- ***Conventional Variables:*** GDP per capita (constant US$)
- ***Policy Variables:*** Official Development Assistance and Official Aid, Government Expenditures
- ***External Conditions:*** Terms of Trade
- **Response Variable:** Real Exchange Rate (Main Variable)

Estimation Issues

In order to calculate the econometric regressions for this study, several conditions have been established and some estimation issues have been encountered, as follows:

The statistical data used for this investigation was taken entirely from the World Bank World Development Indicators for the period of 1979-2009. When compared to official data from the government of Nicaragua, particularly that of Official Development Assistance and Official Aid, there appear to be discrepancies. Therefore, with the purpose of maintaining homogeneity in the information, the investigation is wholly dependent on the indicators from the World Bank.

The econometric regressions are calculated using the natural log of the variables so that all coefficients can be interpreted as elasticities. Additionally, this will guard against the fact that the variables may not be stationary or contain unit root so the regressions are run by taking the first difference (growth rate) of all of them.

An error term AR(-1) has been incorporated in the regressions to detected any serial correlations.

In regards to one of main variables in this investigation, Official Development Assistance and Official Aid, an endogenous problem may be encountered in the sense that aid could have an endogenous impact.

Definition of Variables

In order to present the results of the econometric regressions clearly, the coefficients of the changes in the natural logs of the variables used in this study have been assigned an abbreviated name and their definitions are follows:

LYC	GDP per capita (constant 2000 US$)
ODA (v11)	Official Development Assistance and Official Aid
RER (v17)	Real Exchange Rate
GOT (v13)	General Government Final Consumption Expenditure
TIT (v19)	Terms of Trade

Categorical Variables

Year Dummy Variable (1979-1990)

Interaction of the Year Dummy Variable ODA

Since the regression analysis is based on numerical values, we incorporated two categorical variables in order to reach a level in the regression where different values have no real numerical relationship with each other. The time break period is related to war and post war periods in Nicaragua (1979-1990) – (1999-2009) expressed in the following equation (6) of our model. Additionally for this equation (6) an Estimation Test is also performed in order information on the comparison validity of the level of codification of the categorical variables and its relationship with the dependent variable of the model.

$$
\begin{aligned}
&Yt = \alpha 0 * Yt - 1 / t \leq 1990 \\
&Yt = \beta_0 * t - 1 / t \geq 1990 \\
&Yt = \alpha 1 * Yt - 1 + \alpha 2 * Yt - 1 * Dt \leq 1990 + \alpha 3 * Dt \leq 1990 \\
&Etest\ \alpha 2 = \alpha 3
\end{aligned}
\qquad (6)
$$

Results

Based on previous research presented in this study we can expect that in terms of a cyclical reversion, the initial output gap is negative. This negative output gap is expected to be significant given that the growth rate should be higher in an economy than the presented recession at the start of the period. However, it is also expected that the boom will be followed by lower growth rates. In terms of the conventional indicators a positive and significant relation is expected.

Stabilization for the variables in these categories indicates that all estimated coefficients carry the expected signs and statistical significance. In the case of ODA and ODA lagged one period a positive and significant relation is expected, while for ODA and RER a negative and significant relation is expected since the overvaluation of the real exchange rate also has a negative impact on economic growth.

In terms of the external condition indicators a negative and significant relation is expected since negative terms-of-trade shocks and high external debt have the effect of slowing down the economy. Negative conditions are also expected for the period of 1980s that lead to a decrease in Nicaragua's growth rate, devaluation and increase in volatility rate during these years and the beginning of 1990s.

VIII. EMPIRICAL FRAMEWORK

The relationship between the dependent variables and the independent variable is assumed to be linear and can be calculated by using STATA. To find the relationship between an independent variable and a dependent variable the VAR technique is used.

Using the econometric model derived from VAR we can predict the equilibrium real exchange rate and determine any misalignment that will be used to assess whether Dutch disease effects can be traced to the aid surge.

Times Series Examination: The time series properties of all variables were determine prior to estimation. The variables in the model as well as tests to determine the causality between the variables were carefully conducted. The test for nonstationarity also verifies whether the series could be represented more figurative as a difference or trend stationary process Elbadawi and Soto (1995). The Augmented Dickey–Fuller (ADF) test for the existence of unit roots was performed and the Granger causality test was used for determining causality.

The causal relationships between the real exchange rate and its determinants were accordingly examined.

A *Diagnostic Test* was conducted in order to estimate the lag length used for the criteria selection. A minimum of two lags were determined for the use of the model as seen in Annex 1. The RER is regressed on its own lags and that of the fundamental.

The results of the unit root test are presented in Annex 2. As is evident from the results, the Augmented Dickey–Fuller tests point to the existence of non-stationarity for the levels of the various variables. However, these variables become stationary when the first difference is taken connection, tests to detect non-stationarity and determine the order of integration.

Causality: a Granger test was conducted in order to assess causality through a comparison of the incidence of the variables under consideration as shown in Annex 3. The results are in harmonic with the conception of the RER being caused by the fundamentals. The only exception in Nicaragua's case was that of GDP per capita which showed that causality was both ways. However, due to the importance of this variable it was included in the estimation process. In this sense, to some degree, it draws for careful interpretation of results from the empirical model.

Johansen Co-integration Test: Considering the possibility of encountering a particular situation if two time series variables are nonstationary, but cointegrated; the Johansen Co-integration test was performed and the results are presented in Annex 4. In our case, the above model is the relationship that tends to tie together the five nonstationary variables in the long run.

There may be more than one co-integrating relationship among co-integrated variables. Johansen test provided estimates of all such cointegrating equations and provided a test statistic for the number of co-integrating equations.

Autocorrelation: Any investigation working with time series should be weary of autocorrelation which occurs when the residuals are related to each other. The classic way to detect autocorrelation is the Durbin – Watson statistic, however sometimes the outcomes are inconclusive (Atkin & Carter Hill, 2000). Thus, Lagrange Multiplier test was performed showing a result of no autocorrelation at lag order (Annex 5).

Newey – West SE Test: in order to further analyze any presence of autocorrelation and similarly to Lagrange Multiplier Test it shows a result of no autocorrelation and heteroscedasticity in the study. (Annex 6)

Eigen Value Stability Test: The stability of the model was done as at least one eingen value was 1.0 therefore, the VAR Model does satisfy the stability condition. (Annex 7).

IX. RESULTS

Table 4 and 5 shows the result of the calculations including the analysis of further estimation tests explained below.

Table 4

Equations Parameters and R-sq					
Equation	Parms	RMSE	R-sq	F	P > F
RER	16	0.837078	0.9971	274.5568	0
lypc	16	0.041287	0.9856	54.7924	0
GOEX	16	0.289764	0.9555	17.17207	0
TIT	16	0.142433	0.9007	7.252697	0.0007

The variances between the dependent variable with the model in each equation are explained by the R-square which fits the econometric requirements at 1 level value

Table 5

VAR Results				
Regression	**[1]**	**[2]**	**[3]**	**[4]**
Lagged dep. Variable Beta	-3796	-1.462	2.6943	-.1389
Z	-2.007	-7.580	11.806	-2.749
Income Per Capita Beta	-1.717	-.3281	2.953	-.5883
Z	-1.920	-.2383	2.082	-.6869

Gov Expenditures Beta	-2.666	-.1002	2.405	2.126
	-4.112	-.1039	2.271	2.961
Terms of Trade Beta	.5154	-.0499**	-1.302	.2363
Z	1.136	-.0976	-2.296	.4821
ODA				
Beta	-.1462	.0302**	-.3052	-.1760
Z	-.8299	.1829	-1.884	-1.085
Year Dummy (1979-1990) Beta	13.90	3.550	-7.018	-33.85
Z	9.569	1.582	-3.716	-12.26

Table 5 (cont)

Log likelihood = 80.52658		AIC=	-1.18047
FPE = 6.75e-06		HQIC =	-0.24957
Det(Sigma_ml) = 3.73e-08		SBIC =	1.86457

Notes:

a) *** indicate that the estimated parameter is statistically significant at 5% level.

Of major interest, for the purpose of this study, is the impact of external aid inflows on the real exchange rate in Nicaragua. Generally, with the exception of the aid variable, the other variables captured in the estimation bear the expected theoretical signs.

All the variables are introduced in the analysis after we tried to avoid numerical relationships. In this sense a dummy variable is introduce and its interaction with aid in order to test for significant effects of ODA in the RER, government expenditures and income per capita. A structural time break is set at the middle of the time series (1990). The intercept can thus be interpreted directly as the end of a war period and as the initial status

of ODA paradigms after 1990. These parameters permit us to identify bouncing effect of ODA over time in Nicaragua.

Several models were computed, introducing variables one by one and testing for improvement in model fit. For the dependent variable in each regression several combinations of the substantive predictor (ODA) were used. In addition, for using yearly aid data, we included lagged period (with 1, 2, 3 and 4 lags) as explanatory variables. Moreover, the differentiation by type of epochs in which aid was received, especially on its compromising effect during war and after war periods permits us to get closer insights in the specific effect of aid modalities in general on the RER government expenditures and income per capita over time. Aid decomposition is not used in this study because of the estimate effect of reducing the significance at an aggregate level. Due to the high values of standard of errors obtained in the models, we introduced adjustments tests applying a condensed conditionality on the degrees of freedom in each model.

We report coefficient estimates at different significant levels. In addition, we also include variance and goodness of fit parameters. Second, we computed predicted values for RER and divided these on time for different levels of country development and by the level of aid received, compared to after war and actual real exchange performance, to further test the robustness of model performance. Third, we took a closer look at the time pattern of ODA and analyzed whether or not differences in RE rates can be attributed to changes in aid modalities and therefore test the presence of Dutch Disease.

RER & ODA

As postulated in theoretical real exchange models the conventional negative impact of aid on the real exchange rate of Nicaragua's experience is present. It exhibits a negative impact of (-.8299) and shows a significance at(-.1462)level. The relationship is further supported by the presence of a negative value and significance between RER and the year dummy variable (1979-1990). Additionally, a strong negative impact between RER and terms of trade is found at (-0.976) and shows a robust significance at (-.0499) level.

The symptoms of Dutch Disease during a war period in Nicaragua are found in this study. Paradoxically, in the 1980s a stress situation affected the Nicaraguan economy ; this compromised and undermined the Dutch Disease symptoms in a more conservative mode.

Thus it prevented further decline of the Cordoba pegged to the US Dollar during that specific period.

On the other hand, an opposite effect ODA on RER is found in an after war period. In other words, aid inflows leading to real exchange rate depreciations rather than appreciations. Similar findings are also found by Nyoni (1997) for the Tanzanian economy and Sackey (1998) for the Ghanaian economy. The impact of more aid interacting with the year dummy variable is a lower RER showing a positive relationship of (9.569), an insignificant relationship. An additional finding is related to the interaction of the dummy variable with ODA and the terms of trade variable. The relationship indicates a positive and significant relationship respectively. In this sense Dutch Disease is not present during this period (1991- 2009).

Accordingly, the theory that aid inflows lead to RER appreciation is contested as the Nicaraguan situation puts on display the inverse effect in a recovery phase of two decades after war.

The finding that ODA has an appreciating effect on the RER at an early stage has implications for pursuing policies. These policies should look to minimize the over-valuation of the exchange rate and to ensure that markets are well aligned under stress circumstances such war and natural disasters.

RER, RER ODA, Government Expenditure and Income Per capita

The relationship RER-RER lagged 1 period is insignificant and negative however, the relationship becomes insignificant but positive when lagged at 3 periods. Furthermore, a factor relevant for future studies is the impact that RER of the year before has on RER today; more specifically the RER of three years ago has a negative effect on the RER today.

As expected, some study control variables tended to be insignificant; the variables of government expenditures and GDP per capita bear negative signs, meaning they tend to appreciate the RER. Nominal devaluations, conversely, lead to RER depreciation as is the case of Nicaragua with fixed crawling peg of 5% per annum. However, this has also theoretical underpinnings for future relevant studies.

Inversely correlated to the effect of aid on income per capita, we found that in general the RERhad a negative significant and negative relationship with the government expenditures. This can be explained considering 60% ratio of the government expenditures on military defense schemes. Additionally, the massive fiscal deficit encountered during that period could have also led to get an addiction effect of government expenditures. Dependency on aid, as depicted in this study, and the decomposition of aid in that period was more prone to loans schemes rather than grants or project related modalities. Nonetheless, after war period we found that the relationship turns positive and this is explained by the reliance on aid in the National Budget. According to the Ministry of Finance of Nicaragua (2012) 80% of all government investments are financed by ODA under different modalities though mostly related to financing socio economic development initiatives.

The results from tests for co-integration on the residuals in the RER model indicated the existence of co-integration. All five tests showed values that compare favorably with their respective critical values to support co-integration.

The inventiveness of this study is that it interfaces RER with a policy environment variable (using aid as proxy) so as to see whether it has positive impact on RER performance. The results of the unit root test for the export model are presented which shows non-stationarity for levels of the various variables.

X. CONCLUSION & POLICY RECOMENDATIONS

This study has strived to review the impact of foreign aid in the Nicaraguan economic development from a macro-economic perspective specifically its impact on the Real Exchange Rate 1979-2009.

The study on the economic side follows of two factors: one is the dependency of Nicaragua in terms of trade on few commodities and foreign aid, and the other ones is the threat of "Dutch Disease" induced by the massive aid inflows that Nicaragua has received during the last 30 years. The theoretical review demonstrated that foreign aid is a driving force with the aim of achieving economic development. However, drawbacks of this aid can be present when aid could induce Dutch Disease.

On the macroeconomic side for the case of Nicaragua, foreign aid has contributed to a reduction in the hyperinflationary rate. It has reduced the external debt amount and reduced the deficit in the balance of payment and increased international reserves. At an operational level, foreign aid represents 80 percent of total public investment, which helps the country generate employment through the implementation of public infrastructure projects.

On the social side foreign aid has contributed to poverty reduction in percentage terms. Furthermore it has provided more access to the basic public services and financed recurrent investments in the social sector. Aid has contributed towards technical assistance to the development of human capital as well as focusing on governance, in terms of transparency and accountability.

On the other hand, negative impacts have also been depicted in this study. On the macroeconomic side, aid has been transformed into a greater fund for public consumption while compensating the lack of internal financial resources. Lack of sustainability and creation of dependency on public investments and government expenditures has been fomented by aid. On the social side, we can acknowledge that aid has also created a dependency by financing a great part of the social expenditures. Due to the budget frontiers, an increase in social investment seems for the moment, very unreliable.

A magnification on the existence of the adverse effects of Dutch Disease have been analyzed to a further scale than the studies previously presented by Vos and Johansson (1994) for the period 1980-1994. In these studies they analyzed the macroeconomic impact of aid in Nicaragua and suggested that aid is weakly but negatively correlated with export volumes. They mentioned that the simple negative correlation was stronger during years of small aid inflows (the 1970s) compared to the period of large aid inflows (the 1980s) and did not indicate a case of a typical aid-associated Dutch Disease. Furthermore, the study conducted by World Bank (2005) which relied on previous economic research indicated that none of the studies suggested the existence of a serious problem of persistent real exchange rate overvaluation during the second half of the 1990s and early 2000s.

Based on these findings, Nicaragua in statistical terms is no longer susceptible to Dutch Disease per se, as described by the insignificant real exchange rate appreciation induced by ODA. Although today these coefficients are not statistically relevant, the Nicaraguan

economy could be prone to Dutch Disease effects as encountered during the war period if prudential macro policies are underestimated in the future.

These research findings were simultaneously compared with similar low income countries emphasizing the massive negative impact of economic management in the 1980s, which positioned the country at the lowest level in economic development, and poverty reduction comparison to others. As Stiglitz (2003: 115) explains, *"Economies are like big ships: with few exceptions they cannot veer quickly. The seeds of the successes and current failures were probably sowed a long time ago".*

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Ministry of Foreign Affairs, Nicaragua

At http://www.cancilleria.gob.ni accessed April 2012

Nicaraguan Institute for Municipal Development

At http:// www.inifom.gob.ni accessed March 2012

Nicaraguan System of Government Investments

At http:// www.snip.gob.ni accessed Feb 2012

Annex 1

Diagnostic Test									
varsoc	v17,	maxlag(1) exog(lypc	v11	v13	v19	v13	yeardummy	yeardummyodi)	
maxlag()	**must**	**be at least 2**							

Annex 2

Augmented Dickey-Fuller Test for Unit Root

Number of obs = 30

---------- Interpolated Dickey-Fuller ---------

	Lags	**Test Statistic**	1% Critical Value	5% Critical Value	10% Critical Value
RER	1	**-0.957**	-3.723	-2.989	-2.625
LYPc	1	**-2.089**	-3.723	-2.989	-2.625
AID	2	**-1.619**	-3.736	-2.994	-2.628
TOT	1	**-2.582**	-3.723	-2.989	-2.625
GOT	1	**-1.698**	-3.723	-2.989	-2.625

MacKinnon approximate p-value for RER Z(t) = 0.7685; For LYPc Z(t) = 0.2488; for AID Z (t)= 0.4732; TOT Z(t) =0.0968; For GOT Z(t)=0.4320

Annex 3

Granger Causality Wald tests

Equation	Excluded	F	df	df_r	Prob > F
v17	lypc	0.37353	3	12	0.7737
v17	v13	1.542	3	12	0.2544
v17	v19	1.0547	3	12	0.4043
v17	ALL	2.2596	9	12	0.0945
lypc	v17	2.2285	3	12	0.1374
lypc	v13	1.2421	3	12	0.3376
lypc	v19	0.86136	3	12	0.4875
lypc	ALL	2.8219	9	12	0.0486
v13	v17	0.30675	3	12	0.8201
v13	lypc	7.7986	3	12	0.0037
v13	v19	2.5039	3	12	0.1088
v13	ALL	4.1765	9	12	0.0121
v19	v17	4.8099	3	12	0.0201
v19	lypc	1.8857	3	12	0.1858
v19	v13	0.28344	3	12	0.8364
v19	ALL	2.1462	9	12	0.1087

Annex 4

Johansen Cointegration Test

DF-GLS for v17				Number of obs = 22
Maxlag = 8 chosen by Schwert criterion				
	DF-GLS	1%	5%	10% Critical

[lags]	tau Test Statistic	Critical Value	Critical Value	Value
8	-1.943	-3.77	-2.835	-2.414
7	-2.145	-3.77	-2.829	-2.447
6	-2.009	-3.77	-2.876	-2.519
5	-1.809	-3.77	-2.962	-2.62
4	-1.772	-3.77	-3.075	-2.738
3	-2.471	-3.77	-3.199	-2.861
2	-2.24	-3.77	-3.322	-2.977
1	-1.747	-3.77	-3.428	-3.076

Opt Lag (Ng-Perron seq t) = 1 with RMSE 1.600754
Min SC = 1.221953 at lag 1 with RMSE 1.600754
Min MAIC = 1.357245 at lag 1 with RMSE 1.600754

Johansen Cointegration Test

DF-GLS for v13 Number of obs = 22

Maxlag = 8 chosen by Schwert criterion

[lags]	DF-GLS tau Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
8	-1.017	-3.77	-2.835	-2.414
7	-1.817	-3.77	-2.829	-2.447
6	-1.798	-3.77	-2.876	-2.519
5	-2.196	-3.77	-2.962	-2.62
4	-1.82	-3.77	-3.075	-2.738
3	-2.436	-3.77	-3.199	-2.861

2	-2.132	-3.77	-3.322	-2.977
1	-1.836	-3.77	-3.428	-3.076

Opt Lag (Ng-Perron seq t) = 8 with RMSE .3360963
Min SC = -1.413891 at lag 1 with RMSE .4285074
Min MAIC = -1.212307 at lag 1 with RMSE .4285074

Johansen Cointegration Test

DF-GLS for v11 Number of obs = 22

Maxlag = 8 chosen by Schwert criterion

[lags]	DF-GLS tau Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
8	-1.054	-3.77	-2.835	-2.414
7	-0.835	-3.77	-2.829	-2.447
6	-1.325	-3.77	-2.876	-2.519
5	-1.538	-3.77	-2.962	-2.62
4	-1.669	-3.77	-3.075	-2.738
3	-1.47	-3.77	-3.199	-2.861
2	-2.102	-3.77	-3.322	-2.977
1	-2.648	-3.77	-3.428	-3.076

Opt Lag (Ng-Perron seq t) = 0 [use maxlag(0)]
Min SC = -2.821499 at lag 1 with RMSE .2119825
Min MAIC = -2.245927 at lag 7 with RMSE .1861202

Johansen Cointegration Test

DF-GLS for lypc — Number of obs = 22

Maxlag = 8 chosen by Schwert criterion

[lags]	DF-GLS tau Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
8	-1.172	-3.77	-2.835	-2.414
7	-1.299	-3.77	-2.829	-2.447
6	-1.516	-3.77	-2.876	-2.519
5	-1.302	-3.77	-2.962	-2.62
4	-1.059	-3.77	-3.075	-2.738
3	-1.276	-3.77	-3.199	-2.861
2	-0.779	-3.77	-3.322	-2.977
1	-0.485	-3.77	-3.428	-3.076

Opt Lag (Ng-Perron seq t) = 3 with RMSE .0348137

Min SC = -6.200977 at lag 1 with RMSE .0391251

Min MAIC = -6.365687 at lag 1 with RMSE .0391251

Johansen Cointegration Test

DF-GLS for v19 — Number of obs = 22

Maxlag = 8 chosen by Schwert criterion

[lags]	DF-GLS tau Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value

8	-1.156	-3.77	-2.835	-2.414
7	-1.32	-3.77	-2.829	-2.447
6	-1.419	-3.77	-2.876	-2.519
5	-2.347	-3.77	-2.962	-2.62
4	-2.006	-3.77	-3.075	-2.738
3	-2.065	-3.77	-3.199	-2.861
2	-2.14	-3.77	-3.322	-2.977
1	-2.514	-3.77	-3.428	-3.076

Opt Lag (Ng-Perron seq t) = 0 [use maxlag(0)]

Min SC = -2.544598 at lag 1 with RMSE .2434604

Min MAIC = -1.926271 at lag 1 with RMSE .2434604

Annex 5

Lagrange-Multiplier Test

lag	chi2	df	Prob > chi2
1	10.3681	16	0.84671
2	19.2117	16	0.25784

H0: no autocorrelation at lag order

Annex 6

Regression with Newey-West Standard Errors

Number of obs = 31

maximum lag: 4

F(0, 25) = .

Prob > F = .

					Newey-West	
v17	**Coef.**	**Std. Err.**	**t**	**P>|t|**	**[95% Conf]**	**Interval**
lypc	-4.93E-14	2.15E-14	-2.3	0.03	-9.36E-14	-5.11E-15

v11	2.18E-15	4.90E-15	0.44	0.661	-7.91E-15	1.23E-14
v13	-1.30E-14	6.33E-15	-2.05	0.051	-2.60E-14	5.64E-17
v17	1	2.37E-16	.	0	1	1
v19	1.46E-14	8.41E-15	1.73	0.095	-2.74E-15	3.19E-14
cons	2.94E-13	1.36E-13	2.17	0.04	1.48E-14	5.73E-13

Annex 7 – Stability Test

Eigen Value Stability Condition

Eigen value	Modulus
1.355253	1.35525
.5781668 + .6362975i	0.859739
.5781668 - .6362975i	0.859739
.7768122 + 1 .1281793i	1.787316
.7768122 - 1 .1281793i	1.787316
.1242645 + .7470761i	0.75734
.1242645 - .7470761i	0.75734
-0.6107099	0.61071
-.4310268 + .3773685i	0.57288
-.4310268 - .3773685i	0.57288
-.2550598 + .5033981i	0.564327
-.2550598 - .5033981i	0.564327

At least one eigen value is at least 1.0.

VAR does satisfy stability condition.

Annex 8 -VAR Results - Graphs