Carlos Herrera U

Understanding poverty heterogeneity in Nicaragua

Essays on aid dependency, financial segmentation, gender segregation and climate variability

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Doctoral Thesis

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Abbreviations and acronyms

BCN	Central Bank of Nicaragua (Banco Central de Nicaragua)
CEM	Country Economic Memorandum
CIDIN	Centre for International Development Issues Nijmegen
CRI	Climate Risk Index
CUONIC	Uniform Occupational Classifier
EAP	Economically Active Population
FDI	Foreign Direct Investment
IFRS	International Financial Reporting Standards
IIED	International Institute for Environment and Development
IMF	International Monetary Fund
INETER	Nicaraguan Institute of Territorial Studies (Instituto Nicaraguense de Estudios Territoriales)
INIDE	National Institute for Information on Development (Instituto Nacional de Información de Desarrollo)
INSS	Nicaragua's Social Security System
IPCC	Intergovernmental Panel on Climate Change
ISCO	International Occupational Classification
LSMS	Living Standards Measurement Study
MIFIC	Industry and Commerce Ministry (Ministerio de Fomento Industria y Comercio)
MFIs	Microfinance Institutions
MSMEs	Micro, Small and Medium Enterprises
NGOs	Non-Governmental Organizations
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
PWA	Population in Working Age
RER	Real Exchange Rate
SIBOIF	Superintendent of Banks and Other Financial Institutions
WB	The World Bank
WDI	World Development Indicators

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1

Introduction

1 | Understanding Poverty Dynamics

Almost four centuries ago – in the year 1618 – the estimated Gross Domestic Product (GDP) per capita of the Netherlands was equivalent to that of Nicaragua in 2003 (at GK$ 1,514).[1] According to Pritchett (2018) roughly a quarter of all countries today have levels of output lower than the level approximately calculated for the Dutch economy before 1648.[2] This implies that our planet is highly heterogeneous in terms of economic development and consists of nations and regions with widely varying degrees of levels of wealth and scarcity.

Two markedly contrasting pathways are evident: on the one hand, the extraordinarily stable 2.2 per cent annual average growth for more than a century (1875-2010) as a common feature of nearly all OECD countries (and recently many Asian countries); while on the other hand, many African and Latin American countries – including Nicaragua – experienced an annual average growth rate of only 0.04-0.34 percent during the same period (Pritchett et al, 2018).[3] The latter countries can be characterized by their large poverty traps with high levels of poverty remaining over time. Low growth rates have mostly delayed economic transition, despite considerable development cooperation efforts to change the status quo.

A central aspect of studies on economic development has always been the inquiry into the 'state of wealth and poverty', where poverty within countries is often referred to as a lack of access to basic needs, or scarcity of resources to achieve a reasonable standard of living (Nillson, 2012). The notion and understanding of the dynamics of poverty has changed over time based on three main factors: (1) the broadening of the concept of poverty, (2) the expansion on the causal framework explaining determinants of poverty, and (3) the deepening of the causal structure underlying poverty dynamics.

The perception about poverty has moved from income and/or consumption measures toward models that include social and cultural deprivation, vulnerability, inequality and human rights (Shaffer, 2008). It is therefore increasingly difficult to outline a comprehensive theory of poverty. This is also due to the fact that poverty problems are difficult to capture in static models (Cellini et al., 2008). A thorough explanation of poverty would require many social, psychological and economic theories that are mutually interrelated (Burgess and Propper, 1998). Hence, there are no uniform theories about the multiple causes of poverty and there are widely diverging thoughts about possible policy solutions.

[1] *We used the Geary-Khamis (GK) method that provides – according to OECD – a commonly known comparison approach in which category "international prices" (reflecting relative category values) and country purchasing power parities (PPPs; depicting relative country price levels) are estimated simultaneously from a system of linear equations.*

[2] *Pritchett (2018) shows for example that the GDP per capita of Tanzania in 2003 (GK$610, was the same as that estimated for the Netherlands for the year 1276).*

[3] *Nicaraguan GDP per capita growth was very unstable across different periods: 1960–1970 (3.25%); 1970–1980 (-2.70%); 1980–1990 (-3.00%); 1990–2000 (1.40%); 2000–2010 (0.44%) (as reported by Solís, 2007).*

Sachs (2007) believed that it was possible to eradicate extreme poverty in a time span of 20 years. His analysis showed that the total annual cost worldwide for this endeavour would be about US$175 billion. This represents 0.7% of the total income of the OECD countries at present value from the time of launching the plan.

Therefore, by now this perpetual economic condition of poverty should be overcome, considering that – according to the OECD (2014) – since 1960 the amount of global foreign aid has already totalled about US$2.6 trillion (representing US$4.7 trillion in 2013 prices, adjusted for inflation). In addition, since late 1940s, the inflow of foreign investment capital into poor countries has surged as well (Lartey, 2008).

Despite these massive inflows of aid, investments and remittances, the reality remains that the number of people living in chronic poverty and dying from preventable disease is still frighteningly high (World Bank, 2013a). In 2014, a quarter of the world population subsists with an income of less than US$2 per day (OECD, 2014). The magnitude of poverty and inequality around the world is considered *unacceptable* (Sen, 2001). Apparently, it is not so easy to 'effectively transfer' money from places where it is concentrated to countries where it is urgently needed.

Since the creation of international development agencies in the mid twentieth century, economists and politicians have pledged to achieve the dream of eradicating poverty and attaining high and sustainable economic growth. Most attention has been given to strategies that combine economic growth with poverty alleviation (Bourguignon & Chakravarty, 2003). Thus, macroeconomic adjustments of the structure of the economy are considered of fundamental importance. Yet, even with the implementation of such development policies, the fact remains that few countries have grown rich, and the majority remain poor. Thus, it could be argued that the poverty reduction challenge is still only partially understood, and its multiple drivers have not been fundamentally disentangled.

Poverty levels tend to differ substantially, both between different countries as well as between different regions within each of these countries. The causes of poverty are considered to be both economic and noneconomic (da Costa & Dias 2014). In some cases, even though the (material) circumstances for development were broadly similar, the development outcomes still strongly differ. This differentiation in development patterns is mainly due to variability in internal market organization (e.g. internal competitiveness) and institutional frameworks.[4] This issue of *poverty heterogeneity* thus remains a key challenge to contemporary policy makers.

[4] *Apart from those nations that have been growing due to abundant natural resources (oil, gold, copper, etc.), virtually no countries exist that have improved their income status without also creating adequate institutions.*

Due to the complexity of the matter and a wide-range of possible viewpoints, Waglé (2013) divided the analytical arguments for explaining poverty heterogeneity into micro- and macro-level factors which affect poverty and inequality, either between countries or within a country. However, a consensus in the field seems to be emerging around the analysis of poverty dynamics, which show that many differences can be related to individual factors, but the latter could be further connected to diverging sector-level or macroeconomic growth patterns.

Giraldo et al. (2002) therefore suggest that the fact that households face poverty could be partly explained by such 'unobserved' (albeit: structural) heterogeneity factors. According to Dammert (2008), heterogeneous socioeconomic impacts could be found between different regions within a country, between economic sectors, and/or between households and individuals. We consider that this heterogeneity will be – at least partly – caused by four major factors: (1) foreign aid dependency and differences in (inter)national competitiveness, through its impact on the currency exchange rate, (2) differences in access to finance and its consequences for risk perceptions, (3) differences and inequality in labour incomes (mainly gender segregation), and (4) differences in vulnerability to climate and its consequences for (future risks of) poverty.

It is relevant to understand this diversity of impacts of socioeconomic processes on society, in order to be able to effectively reach out to the population and regions with policies for targeting poverty alleviation and inequality reduction.

Nicaragua, the focus of this study, has followed structural adjustment strategies for more than 20 years; yet today it is still one of the poorest Latin American countries (after Honduras and Haiti). A chain of catastrophic natural disasters marked fluctuations in commodity prices and decades of civil conflict have left the country behind most of its neighbours in terms of economic and social indicators. One out of every nine Nicaraguans lives in extreme poverty, and almost 33 per cent of the country's population is considered to be poor. Most of these poor people live in rural areas, are only marginally participating in the labour market, and lack access to credit, basic services and infrastructure. Understanding the genesis of such disparities is critical for Nicaraguans to achieve a sustainable increase in their standards of living.

Nicaragua has benefitted from considerable aid inflows and is currently receiving large-scale remittances. These foreign capital inflows could potentially lead to so-called Dutch disease effects because they tend to induce resource reallocation towards non-tradables (e.g. land, housing, real estate, etc.). Another factor to consider, however, is that Nicaraguan financial markets have a very monopolistic structure where the banks make high profits by channelling funds to certain businesses and sectors. These banks do not play their usual role of investment facilitators, but they are mere accumulators.

Additionally, at the local level, formal financial services are almost non-existent: very few smallholder farmers and small-scale businesses have access to formal credit because they are unable to provide collateral. Moreover, due to the high interest rate charged

by financial institutions, borrowing money may cause a debt trap of perpetual misery. Consequently, also labour is less productive than it might be for lack of even small amounts of complementary working capital. Furthermore, gender segregation and vulnerability to poverty due to climate variability are observed to be important endogenous and exogenous factors in reproducing scarcity. These vicious circles constrain innovation and condemn the country and its population to poverty.

Notwithstanding the extensive account of overall backwardness and poverty of the country, lately Nicaragua has experienced some moderate economic growth.[5] However, expected population growth of around 1.5 per cent a year over the current decade means a GDP growth rate of 4 per cent would translate into per capita income increases of only 2.5 per cent a year.

Even while more stable macroeconomic policies are now in place, the framework for social, environmental and income distribution policies do not produce the desired poverty reduction objectives in the long run. Hence, significant additional development efforts are required towards more structural poverty reduction. In light of this scenario, the findings of this study may provide a critical contribution to the future Nicaraguan development agenda.

The remainder of this Introduction is structured as follows. Section 2 outlines the importance of heterogeneity for the analysis of poverty dynamics, and introduces some key analytical concepts used throughout this study. Section 3 presents a summary of the research questions and their relevance. Section 4 explains how specific (micro & macro-) economic issues are interrelated in the field of development studies and places emphasis on the theoretical relevance of this research Section 5 discusses the rationale of the study as presented through the various components of its problem statement and establishes how these topics are mutually related. Section 6 deals with the methodology and data used in this study. Finally, section 7 presents an outline of the study.

2 | Heterogeneous effects

Most studies focusing on economic development, macro-economic growth or poverty reduction tend to focus on aggregate effects. This assumes that structural transmission mechanisms are in place and that causal interferences can explain the development outcomes. Usually, only average results are reported, and thus limited insight is given into the diversity of outcomes for specific categories of individuals, households or regions.

[5] *According to the World Bank (2012), recent Nicaraguan economic growth was supported by positive policy changes such as fiscal stability and sound macroeconomic management. Furthermore, the mixed debt relief when achieving the Highly Indebted Poor Countries (HIPC) culmination point in 2004 and the Multilateral Debt Relief Initiative in 2006 helped to decrease the public external debt from 124 per cent of GDP in 2003 to 44 per cent in 2011. Furthermore, the approval of several international trade agreements with the USA, Central America, Europe and countries of the Bolivarian Alliance for the Americas over the last 10 years has helped to expand external trade as a share of GDP from 76 per cent in 2004 to 122 per cent in 2010.*

In this thesis, we will focus instead on diversity in outcomes and on the likelihood of heterogeneous effects (Molina, Narayan & Saavedra-Chanduvi, 2013). Even when economic agents face similar circumstances and meet roughly equal opportunities, outcomes might still strongly vary due to different responses. Differences in initial resource endowments, unobserved behavioural preferences (risk) and path dependency are usually mentioned as key factors that explain this heterogeneity.

According to Little et al (2008), acknowledging the existence of heterogeneity makes a significant difference to how we should analyze and understand poverty. Social outcomes are not the result of a single factor. Therefore, any level of comparisons should be further decomposed into sub-groups and regions (Little et al 2013). Thus, heterogeneity is likely to become a crucial part of current approaches to development economics (Szreter et al., 2004).

Whereas we have identified considerable information about the context of poverty (poverty rates and the characteristics of the poor in any given period of time) our comprehension of the dynamics of poverty heterogeneity is still narrow (Finnie and Sweetman, 2003). In this thesis, we will discuss macroeconomic development conditions in Nicaragua (chapter 2) and analyse micro-economic effects at individual, household, sector and regional level (in Chapters 3-5). This illustrates that there are several simultaneous linkages in place between heterogeneity (or inequality) at the micro level – in terms of resources, incomes and vulnerability – which are partly conditioned by the macro outcomes of the national economy.

Main attention is focussed on three key aspects of micro-level socioeconomic heterogeneity: (a) different access to financial services and heterogeneous risk perceptions that could lead to differences in the use of financial services (chapter 3); (b) heterogeneity in labour market engagement and its implications for inequality of income generation, with particular attention for gender segregation (Chapter 4), and (c) heterogeneity between regions in terms of their vulnerability for climate (rainfall) variability and the implications for vulnerability towards (future) poverty (Chapter 5).

We exploit our insights into the underlying mechanisms that explain heterogeneous outcomes to overcome the usual constraints of having mostly only cross-sectional (or short panel) data available that permit only limited understanding of causal effects. The in-depth analysis of heterogeneous outcomes permits therefore an approximation of the structural causes of how these inter-linkages work in both directions (Ostry, Berg & Tsangarides, 2014). The proposed theoretical and methodological approach allows linking heterogeneous processes of macroeconomic, regional/sectoral and individual structures as joint determinants of poverty in Nicaragua.

The heterogeneity in the macro-economic structure is translated into diversity of micro-economic development outcomes, whereas inequalities at the micro level (heterogeneous income pathways amongst individuals and households) also have aggregate repercussions at the macro-economic level, thus perpetuating low growth and high poverty levels (Kabeer & Natali, 2013; Grimm, 2011; Easterly, 2007).

In terms of policy analysis, increased insights in heterogeneous effects allows for better targeting of public interventions (Banerjee & Duflo, 2009) towards vulnerable households (individual targeting) and towards vulnerable regions (spatial targeting). This may support consequently policies that permit improved client selection (e.g. by asking contributions by poor people) or through decentralized service provision (Ruben & Pender, 2004). The relevance of the study thus rests on providing a new outlook towards the issues and determinants for poverty alleviation in Nicaragua.

There are important gaps recognized in the literature concerning the present understanding of poverty heterogeneity. To our knowledge, there have been no efforts made to analyse the causes of poverty related to specific heterogeneous characteristics at different scale levels in Nicaragua. In perspective, this research could contribute to our understanding how individuals remain in or can move out of poverty as result of economic development activities in Nicaragua.

3 | Research Questions

We use the heterogeneity lens for identifying the appropriate theoretical framework and outlining suitable analytical models that permit in-depth understanding of poverty heterogeneity in Nicaragua. Hence, the following key question guides the research:

How can heterogeneous outcomes of economic development
for the poverty dynamics in Nicaragua be understood ?

Specific attention is given to the impact of foreign aid, financial market segmentation, gender labour market segregation and regional climate variability on the development outcomes and on the process of poverty reduction in Nicaragua. We seek to understand the linkages between the micro- and macro-level drivers of poverty dynamics and aim to understand the structural causes of heterogeneous outcomes.

The specific research questions addressed in the different chapters of the study are:

Determinants at the macro level:

1 What is the influence of foreign aid on the real exchange rate of Nicaragua and is the challenge of 'Dutch Disease' present?

Determinants at the micro level:

2 How does the market power of financial institutions create segmentation in Nicaragua and hinders the availability of credit?
3 How does labour market segregation contribute to gender and income inequality in Nicaragua?
4 What is the effect of climate variability on the persistence of poverty?

These research issues refer to key aspects of economics analysis and point towards creating opportunities for future policymaking. The specific topics discussed in our study are fundamentally interconnected in terms of concepts, applications and contributions to the international development framework.[6] The initial scope of this study is to focus on macroeconomic determinants of poverty and then to construct a framework for the assessment of the macro-micro linkages with gender segregation, financial market segmentation and access to finance, and climate variability and vulnerability to poverty as microeconomic aspects of poverty. Hereafter, individual characteristics and specific local events associated with poverty transitions for Nicaragua are considered.

Although poverty has frequently been at the forefront of Nicaraguan development discussions since the early 1990s, there has been no study attempting to address poverty heterogeneity aspects. The methodological framework applied in our study enables a more detailed and in-depth analysis of the multiple dimensions of poverty and provides insights in the complex policy framework for addressing the causal pathways of chronic poverty in Nicaragua.

4 | Analytical Framework: Linking Micro and Macro Poverty Dynamics

Economic development theory from the nineteenth and first half of the twentieth century was roughly divided between proponents of the market and followers of a planned economy. However, originally far less separation was made between macroeconomics and microeconomics. Economic science was simply acknowledged as 'economics', and researchers implicitly assumed that markets were in equilibrium and that prices adjusted to the law of supply and demand.

Whereas most natural sciences and physics showed tremendous advancements in the unification of their theoretical framework (e.g. theory of relativity as framework for physics), economics became separated between macro- and micro-economics during the 1930s.[7]

However, this division is increasingly considered artificial, as contemporary economic theory is rooted in empirical observations that need to be explained by concepts derived from both the structural macroeconomic context and from microeconomic agency behaviour.

[6] *Even while there are essential similarities in the development of countries, developing processes in themselves are heterogeneous and consequently in critical aspects rather different (Todaro and Smith, 2012:92).*

[7] *John M. Keynes is still considered central to the split of economics, particularly because of his contribution to marginalism and the rational maximizing behaviour of firms and individuals.*

The predominant focus on macroeconomics in development economics was based on cross-country studies that analysed the role of economic policies in trade, finance, currency, quality of institutions, and the effectiveness of aid in terms of economic growth (e.g. Collier, 1998; Collier & Dollar, 1999; Dollar, 2002; Easterly, 2003; Sachs, 2007). Moreover, the recent focus towards microeconomics relies more specifically on randomized field experiments to identify individual-level outcomes of social variables like education and health (e.g. Deaton, 2010; Duflo, 2003).

The debate on the basic orientation of micro- and macroeconomic analysis turns around the fact that macroeconomics places greater emphasis on (sector- , region- or country-level) data and tries to explain aggregate performance, whereas microeconomics tends to identify behavioural responses usually based on a set of empirical field data and then moves to theory. The fundamental tasks for making interaction between these economic rationales involves a dual challenge: (a) the study of economic behaviour of individuals and (b) the understanding of the evolutionary capacity of economic systems (Godelier 1972). This provides the background for analysing complex phenomena, like poverty, inequality and (lack of) sustainability.

Economic development

Many attempts for building macroeconomic models assume representative agents over time, even while this is a highly questionable hypothesis since performing economic analysis will depend on how the overall economy functions and how single markets adjust (Hooever, 2013). This is related to problems of endogeneity and multi-collinearity that tend to prevail in most macroeconomic models employed nowadays (Rodrik, 2008; Banerjee & Duflo, 2007).

In a similar vein, Pålsson Syll (2014) argues that macroeconomists seem to pledge themselves to a practical individualist view where aggregate phenomena are considered just as the sum of individual agent's effects. Explaining macroeconomic outcomes by just deriving them from their explanatory primary micro parameters is in itself for some authors a reason for being harshly critical and doubtful regarding macroeconomists' methodological framework (King, 2012).

We therefore prefer to rely on a more dynamic approach for explaining (long-term) economic development trends in Nicaragua, considering two sources of national wealth: national production (for domestic consumption and/or exports) and international capital flows (official development aid and foreign direct investments).

Economic behaviour

Conversely, at the micro level, many economists consider that communities exposed to higher levels of (social and physical) capital tend to have better educational achievements, are healthier, have a longer life expectancy and experience faster economic growth.

Consequently, they mainly focus on heterogeneous effects at micro level. This heterogeneity is related to access to specific resources and markets within a certain context.

Rodrik (2008) considers this micro-economics approach as naive, since for plausible explanations of economic behaviour we need to understand structural factors as well. To further support this view, Pålsson Syll (2014) expresses that in the real world there are many different development pathways, and these cannot be derived from microeconomic models by building on rational expectations without giving rise to inconsistencies. Even small differences in expectations would make micro-models rather unpredictable, and their results could be far away from an approximation to reality.

As an alternative, we rely on a mixed approach for analysing economic behaviour of different agents (households, firms). This is based on an analytical framework that first looks at the diversity in the performance variable (i.e. use of credit; employment ; household income) and then tries to identify the contextual factors (including physical location, e.g. urban/ rural or living in specific departments) and individual characteristics that might influence the outcome.

Convergence

Taking into consideration these fundamental dilemmas, macro- and microeconomic models are best considered as *mutually reinforcing approaches*, since we cannot ignore the fact that economic development depends on both structural and behavioural factors. In addition, a whole array of (non)economic factors are to be considered; these include: environmental, military, cultural, political, geographical and social aspects that make it necessary to acknowledge that economic analysis may miss many insights in its attempt to advance to economic development. For this reason, Rodrik (2008) states that future efforts should be made to avoid allowing prevailing methodological differences to overshadow the larger convergence in economic science.[8]

It is the common belief that the efforts of microeconomic and macroeconomic schools of thought working in good faith to approach their problems with open minds are still far from conclusive. However, our study uses different models that are flexible enough to incorporate heterogeneous aspects and that carefully consider causality and endogeneity. The main contribution consists in considering linkages between capabilities (endowments), poverty dynamics (change), and resource vulnerability for achieving greater well-being. Both macroeconomic and microeconomic approaches thus contribute complementary analytical insights to address the central question on the determinants of poverty heterogeneity in Nicaragua.

[8] *However, recently there has been an inflection point in the methodological divergence between macro- and microeconomics, in particular with the randomized field trial revolution (e.g. Banerjee & Duflo, 2007; Firebaugh, 1999) that has created new barriers between the two fields.*

In summary, micro-economic analysis provides insight in the conditions needed for enabling different local responses to (market) incentives, whereas macro-economic analysis deals with an appraisal of the structural market configuration for allocating resources and making decisions. Combining both perspectives enhances our understanding of the heterogeneity of poverty and its relevance at different scale levels. The outcome of this research is meant as a contribution to the poverty and development economics debate and embraces significant policy applicability.

Figure 1.1 provides an illustration of the key variables that are considered in each of the different levels of our analysis.

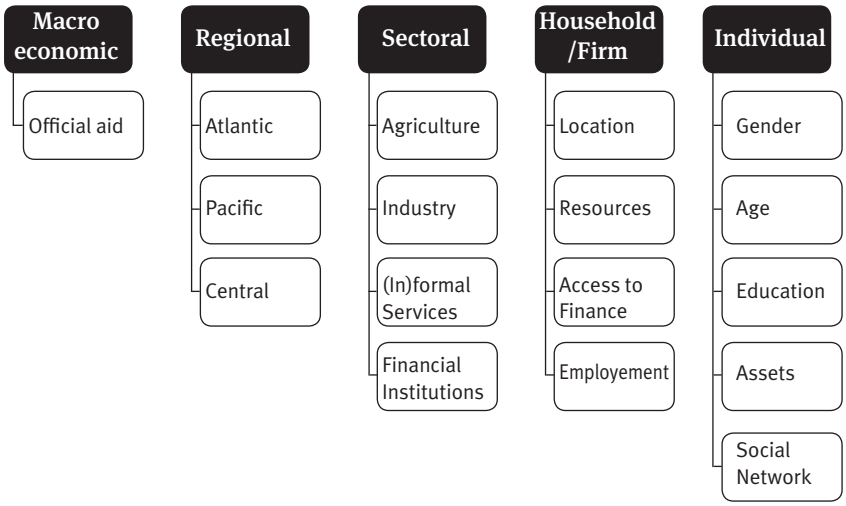

Figure 1.1 | Multiple levels and key indicators for poverty heterogeneity analysis

5 | Research Components

This study addresses some key mechanisms that explain poverty heterogeneity in Nicaragua, thus contributing to bridging gaps in current poverty analysis by providing both a novel analytical framework and empirical proof of the underlying impact pathways. Theoretically, the arguments are founded in a combination of economic development thinking and neoclassical and institutional theories. We now briefly outline the most important empirical aspects of this analysis:

Aid inflows and Dutch disease

Our first study analyses the impact of foreign aid on the real exchange rate of Nicaragua and the possibility of occurrence of Dutch disease. The World Bank (2004, p. 20) states that any country 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."

Nkusu (2004) considers the appreciation of the real exchange rate, defined as the relative price of tradeable goods versus non-tradeable goods, leading to the stagnation or decline of export activity, as the most common manifestation of Dutch disease.

Since the prices of tradeable goods are externally set for small economies, the prices of non-tradeable goods will increase to the extent that increased aid could spill over into higher demand for non-tradeable goods. Thus, the appreciation of the real exchange rate has a negative influence on export growth, as domestic producers respond by shifting production towards non-tradeable goods.

There is an extensive literature regarding Dutch disease, which will be further analysed in Chapter 2 of this study. The results of the work by Younger (1992), Sackey (2001), White and Ganeshan (1991) and Vos and Johansson (1994) lead to different conclusions regarding the question of whether aid causes Dutch disease. However, there is consensus acknowledging the possibility that foreign aid could cause the RER to appreciate.

In Nicaragua, the second half of the 1990s was characterized by fairly vigorous economic growth, averaging 5 per cent per year, and by a growing GDP share of private investment and exports. Hence, the IMF recommended that Nicaraguan authorities should counteract an aid-induced appreciation of the real exchange rate by "accumulating more international reserves, minding that injecting more liquidity into the system could unleash inflation" (World Bank, 2004, p. 36). Exceptional aid inflows that materialized in the wake of Hurricane Mitch in 1998 also appear to have contributed to the appreciation of the real exchange rate, according to the World Bank (2004). Moreover, this effect is also shown by the construction boom that took place in 1999 – 2001, which significantly raised that subsector's share of GDP.

Moreover, the World Bank (2004) observes that the Dutch disease effect of aid is linked to the macroeconomic strategy of Nicaragua, particularly as aid is given to permit more investment and therefore to encourage a more rapid development. Thus, an increase in aid, represented by an increase in net transfers, should be accompanied by an equal rise in government and/or private investment. However, this positive scenario breaks down if an increase in aid is not accompanied by a one-for-one increase in imports, but rather is accommodated by an export decline, as part of the aid increase translates into higher demand for domestic non-tradeable goods (World Bank, 2004).

To summarize, Nicaragua could be considered susceptible to Dutch disease, due to the potential impact of massive foreign aid inflows on Nicaraguan economic development, particularly through an overvaluation of the Real Exchange Rate. We therefore reviewed empirical data sets for the period of 1960 – 2009 but find few signs consistent with this assumption.

Financial Market Segmentation and Access to Finance

The second study provides evidence on the importance of heterogeneity in financial markets. Problems of financial segmentation and unequal access to finance could explain to a large extent differences in income and wealth amongst households. Given this widely recognized link between access to finance, economic growth, and income levels for poverty reduction, the empirical analysis largely relies on evidence using financial sector depth for measuring credit access (World Bank, 2012b).

However, despite the growing literature on the relationship between finance and growth, a single measure of financial inclusion that can be applied across different countries is still not available. Therefore, the use of credit by micro, small and medium enterprises (MSMEs) is frequently used as a performance proxy. Despite general credit growth, access to finance is still an important constraint to overall improvements in economic activity and productivity.

Nicaragua's banking sector is small and highly concentrated with just seven banks, the three largest of which hold close to 81 per cent of banking system assets. The Nicaraguan financial sector is perceived as being a rather elitist and 'evil' sector, managed by a select group of people known as the "Whisky Club". Furthermore, about 90 percent of financial system assets correspond to banks as seen in table 3.1, and the sector could be regarded as rather monopolistic. The second most important segment comprises insurance companies, bonded warehouses, securities trading, stock exchange and central bank deposits, which add up to a further 6 per cent. Microfinance represents the remaining 5 percent (BCN 2011). However, the three most important productive sectors of the Nicaraguan economy (agricultural, livestock and industrial sectors) together receive only 24 percent of total credit. Recent figures show a substantial reduction in credit granted to these sectors over the last 15 years.

According to the World Bank (2012a), the financial sector in Nicaragua is relatively stable, with adequate risk coverage and capitalization and showing improved profitability. Credit as a share of GDP almost doubled between 2001 (18 percent) and 2011 (33 percent). However, speedy credit growth may reduce the banks' capacity to assess risks, thus leading to a reduction in the quality of their assets. In addition, the expansion in commercial banking meant a shift towards consumer credit: less than a third of total loans provided by banks and regulated financial institutions goes to productive activities. Diagnostics have also identified substantial gaps in the national payments system infrastructure (World Bank 2012a). In addition, the microfinance sector struggled in the years 2008-2010 from a broad "non-payment" movement supported by a large group of rural producers. In mid-2011, the National Assembly approved new microfinance legislation, which helped to reverse the non-payment impact and provides a basis for improving the regulatory framework.

Segmentation and access to finance are directly related to the ability to invest, obtain new technologies, expand business operations, and mitigate economic shocks. They thus have

a direct impact on poverty reduction and economic development. It is also presented that Nicaragua shows limited performance in terms of firm-level and individual-level use of financial services (World Bank, 2012b). Many of the financial investment problem concerns small, mostly informal sector firms and households that cannot get adequate access to finance. We explore the main constraints for increasing financial access for a broad range of Nicaraguan firms and identify how this relates to the institutional organization of the financial sector, more specifically to the monopolistic power of the major banks.

Labour Markets and Gender Segregation

The third study of this manuscript (chapter four) looks at labour market segregation and income differentiation, focussing on gender. The academic literature focuses on two main bases for segregation, or the tendency to work in distinct occupations and receiving different remuneration: ethnicity and gender (Blackburn, 2009). We analyse the different factors that could explain the differences in income between males and females in Nicaragua.

According to Becker (1971), gender inequalities in the labour market occur in several forms such as: occupational segregation, stereotypes and exclusion. Women affected by occupational segregation suffer from lower incomes, fewer job opportunities and less alternatives when selecting a career. This situation prevents women from developing their skills and from being able to break the poverty trap.

Traditionally, social scientists have relied on individual level data in order to identify gender wage gaps. Some studies attribute segregation to labour market discrimination and others to demographic effects (Solberg & Laughlin, 1995; Huffman, 2004; James & Newman, 1989; Tomaskovic-Devey, 1993).

We use multilevel models to explore gender segregation by occupation and type of economic activity. This approach improves on those that rely on highly aggregated occupational categories (England, Hermsen, & Cotter, 2000), or national occupation-sector cells (Budig, 2002). Our study attempts to calculate the magnitude of the impact of gender segregation on income differences by estimating equations that incorporate different sets of relevant explanatory variables at individual, sector, locational and occupational level.

Even while previous studies examined individual factors next to occupational segregation, investigations about Nicaragua's labour market conditions and dynamics are scarce. An earlier study of the Nicaraguan labour market found that although women have the same or higher education levels than men, they earn on average still 19.8% less than men. In addition, gender segregation by occupations was one of the highest in Latin America (Vakis, 2012). On the other hand, Nicaragua has solid legal structures for access to education, access to financial assets, support in the public arena and protection.[9]

[9] *For example, in 2012, Nicaragua passed a new Law on Violence against Women that established punishment for different types of violence.*

Development strategies have been executed throughout the last three decades to enforce women's rights to education, health, credit, land and other beneficial assets. In politics, the nation is well positioned regarding female parliamentarians and government officials, and the same holds for females in managerial positions. Men comprise the greater percentage of the lower educational skills bracket, meaning that women have improved their educational capacities in relation to men. This is the result of increasing attendance, primary school completion and secondary school enrolment rates among women (Vakis, 2012). Women represent 65 per cent of microcredit recipients.

Nevertheless, Nicaragua still faces solid indications of gender inequality such as large wage variations between males and females, elevated unemployment among vulnerable uneducated adolescent girls, elevated violence rates and high-school pregnancy levels, and low female participation in the workforce (World Bank, 2012c).

This chapter provides a comprehensive investigation into whether gender income differences are related to differences in education and/or participation in sectors and occupations that offer better payments. The LSMS (2009) data is used to identify the economically active population (EAP).

Attention to gender issues could strongly contribute to inclusive economic growth in Nicaragua. According to a recent Central American gender study (Vakis, 2012, p. 15): "A 10 percent increase in female labour force participation would raise household incomes in Nicaragua by around 6 percent and reduce poverty by 8 percent and extreme poverty by 10 percent". As female labour market participation will be discouraged by gender income gaps, analysing the structural causes for perseverance of these gaps has thus also important macroeconomic implications.

Climate Variability and Poverty Vulnerability

The effects of climate change on poverty are considered important for many poor countries (Narayan, Pritchett, & Kapoor, 2009; Stewart, Saith, & Harriss-White, 2007; Alesina & Glaeser, 2004; Brady, 2009; Riad, 1998). In recent decades, temperature and precipitation have suffered notable alterations as a result of climate change. Projections indicate that variations will become more significant in coming years. In Chapter 5 we therefore analyse the potential effects of climate variability on the risk of being poor in Nicaragua.

Most developing nations have limited faculties to adjust to the harmful impacts of climate change, because they usually have restricted access to resources and technologies (IIED, 2012). Nicaragua is highly susceptible to natural disasters (dry periods, flooding, hurricanes, earthquakes) and millions of people in Nicaragua live in unprotected areas. In recent years, Central American countries have been affected by extreme weather events with significant economic costs. Nicaragua also experienced a series of alternating droughts and flooding associated with abbreviated El Niño/La Niña cycles. These conditions – together with a poor financial landscape – create large challenges for the application of development policies.

Dalal-Clayton and Bass (2002) outline that empirical approaches are required to analyse the impact of major (external) challenges on poverty and economic development. McCool and Stankey (2004) add that factors such as a household's spatial location, the opportunity cost of labour, the relative price of environmental goods, harvesting and processing technologies, and resource scarcity could also influence the outcomes. Each of these processes can in turn be influenced by changes in exogenous parameters. Cavendish (1999) argues that this constitutes the complexity of understanding 'vulnerability': a feature that characterizes the dynamic (and mutual) relationship between poverty and climate change in different contexts.

Ligon and Schechter (2003) and Basu and Nolen (2004) contribute an operational notion of vulnerability in terms of changes in expected utility, that has been frequently used (World Bank, WDR, 2001), but quite often with an ambiguous and inconsistent meaning. Calvo and Dercon (2007) therefore propose an alternative view where poverty is estimated by reduced consumption. Poverty is not considered as an individual characteristic; rather it is regarded as a transitory state (Narayan, Pritchett, & Kapoor, 2009, p. 183) and it could become a permanent state if climate change goes unchecked.

Within this context, chapter five elaborates on the impact of climate variability on increasing poverty in Nicaraguan households. In the words of Ramírez, Ordaz, Mora, Acosta & Serna (2010: p. 1): "The potential economic impacts of future changes in climate show that by the year 2100 the accumulated losses of agricultural production will represent about 22% of the Nicaraguan GDP (in 2007 values and assuming a discount rate of 2%)." Thus, policy measures and investments in support of adaptation to climate variability are likely to yield significant (short term) benefits in terms of poverty alleviation.

6 | Data and Methods

This study considers a combination of inductive analyses and deductive approaches using grounded theory practices (Glaser & Strauss, 1967). It is based on a case study on Nicaragua to provide analytical support to generate answers to the questions of the 'why?', 'what?' and 'how?' of poverty heterogeneity in Nicaragua (Saunders, Lewis, and Thornhill, 2003).

The study relies on available statistical resources and uses a mix of causal inference models and quantitative research approaches throughout each phase of research. Each of the four chapters starts with the revision of relevant literature in order to create a solid analytical framework and to identify a set of explanatory variables for the analysis. Hereafter, critical – exogenous – socio-economic drivers (like age, wealth, educational level, etc.) and geophysical factors (soil and weather data) are identified that influence poverty dynamics. Finally, important factors that shape the exchange rate terms of trade for engagement in international trade, the remuneration in national labour and financial markets, and the resilience to climate change are addressed.

Data

Four different data sets are used in this study. The macroeconomic analysis (RQ1) uses the World Bank World Development Indicators (WDI) for the period 1960–2009 for data on official aid. For the bilateral real exchange rate (RER) with the US$, economic openness, government expenditures and terms of trade, data from the Central Bank of Nicaragua (BCN) are used. For the analysis of credit markets (RQ2), information on the financial system of Nicaragua and the maturity of loans was gathered from the BCN. In addition, to address the labour market segmentation (RQ3), data from the Social Security Institute (INSS) has been used with statistical information on formal and informal business in Nicaragua. Weather data on climate and temperature (RQ4) are available from the Institute for the Development of Statistics (INIDE) that gathers annual statistics by geographical department and autonomous regions.

Furthermore, the Nicaraguan Institute of Territorial Studies (INETER) has weather stations that identify specific weather events at department level, such as changes in surfaces and biological stress and the duration of these events.

For the income and poverty estimates necessary for RQ 2, 3, and 4, we use the Living Standards Measurement Survey (LSMS) that has national statistical representativeness for all geographical regions of Nicaragua (Pacific, Central and Atlantic),[10] as well as for both rural and urban areas. Since the first LSMS publication in Nicaragua in 1993, subsequent publications in 1998, 2001, 2005 and 2009 have not significantly changed their approach.

Major information provided includes: housing characteristics, utilities, demographics, health, education, economic activities, basic food consumption, income and household assets, among others. However, the latest study (2009) did not include anymore a credit section (usually corresponded to section IX). We use the LSMS (2005) for Chapter 3 on financial market segmentation and access to finance. For Chapters 4 and 5 on labour market segregation and income vulnerability to poverty caused by climate change, data from LSMS (2009) is used.

The 2005 LSMS includes a sample of 6,882 households and 36,612 persons nationwide. This allows us to extrapolate the results to 5,142,098 people represented in the Nicaraguan census published in that same year.

[10] *INIDE (2009). General Household Survey Report for measuring the standard of living.*

[11] *The 2009 LSMS survey has a sample of 6,515 households and 30,432 persons nationwide. This enables extrapolating the results of 5,763,628 people represented in the last Nicaraguan census published in 2005 adjusted for a population growth rate of 1 per cent. We mainly used section II on the composition and characteristics of households and employment data.*

The LSMS sections most used in this study are: section II (on the composition and characteristics of households, and employment data), section V (refers to economic activities), and section IX (on access to credit).[11] Data gathered from INSS and INETER was primarily requested for the years 2012 and 2013.

Methods

Several approaches were used for analysing the incidence of factors that shape poverty heterogeneity, in such a way that key variables could be identified for subsequently modifying Nicaraguan poverty dynamics.

To address research question 1, this study performs short- and long-run analyses using Vector Error Correction Models (VECM) that provide insight in major factors that explain trends and capture interdependencies among multiple time series. We applied control variables for structural changes during various historical periods, under different assumptions on the stationary of fundamental variables, for changes in the exchange rate. In addition, several co-integration approaches were applied to test the robustness of the results.

For research question 2, we used the Lagrangian Model as the main empirical framework to estimate the effects of supply and demand factors on access to finance. In addition, Cobb Douglas and Marshallian Demand Functions are used to analyse demand elasticities under conditions of monopolistic power exercised by the Nicaraguan financial institutions.

These approaches enable new evidence on the structural determinants of limited access to credit and financial market segmentation in Nicaragua.

To answer research question 3, a multilevel empirical framework is used to disentangle how male and female income varies as a function of individual characteristics, engagement in specific economic activities and geographical location. In a similar vein, for research question 4, a set of structural equations and multilevel models are synchronized to estimate the possible effect of climate variability on vulnerability to poverty in Nicaragua.

Context is an essential factor that defines how individuals and households respond in their livelihood strategy to external challenges (firmly based in sociological theory by Weber, 1905). This idea has also influenced economics and other academic disciplines. For instance, Subramanian et al (2001) examined the influence of socio-economic factors on health, and Ali and Pernia (2003) manifested the role of infrastructure (macro level characteristics) on the process of poverty reduction. These studies have indicated that hierarchical models are most relevant for analysing the connections that occur amongst the different levels.

Table 1.1 | Overview of research questions, methods and data

Research question	Methods	Data
1	VAR, VECM	WDI (1960-2009) BCN (1960-2009)
2	Lagrangian Model, Cobb Douglas and Marshallian Demand Functions	LSMS (2005) BCN (2011)
3	Multi-level Models	LSMS (2009) INSS (2011)
4	OLS & Multilevel Models	LSMS (2009) INIDE (2012-2013) INETER (2012-2013)

We therefore rely in our analysis frequently on multi-level approaches that intend to separate analytically between structural, contextual and individual factors influencing poverty heterogeneity. In a similar vein, we carefully distinguish between exogenous and endogenous factors that shape poverty outcomes.

We used STATA statistical software for data analysis. Table 1.1 illustrates the relationship between each research question and the methods and data used.

7 | Outline of the Thesis

This thesis consists of six chapters (see Figure 1.2) that together provide a concise overview of some macro- and micro-economic dimensions underlying poverty heterogeneity in Nicaragua.

Chapter one outlines the relevance of the research, its analytical approach and the structure of the study. Chapter two examines whether massive inflows of foreign aid in Nicaragua had a damaging impact on the appreciation of the Real Exchange Rate (RER) during the 1960–2009 period, thus affecting the competitive position of its economy. We find little evidence of this effect. Chapter three presents a conceptual framework and new statistical evidence regarding credit segmentation in Nicaragua. It is based on a critical review of major factors that constrain access to financial services for the broad range of Nicaraguan households. Likewise, it presents empirical indications that reveal the monopolistic power of financial institutions in the country.

Chapter four provides estimates on how income varies in Nicaragua between males and females as a function of their economic activities and in the context of specific local labour markets. Using multilevel models, the results point out that segregation is essential for comprehending the perseverance of income gaps among individuals of both sexes. It also shows that women's progress in breaching gender stereotypes manifested by economic favouritism is still limited.

Chapter five approaches poverty and income vulnerability from the viewpoint of exogenous stress, especially forthcoming from climate variability. It emphasizes that attention must be paid not only to how wellbeing dimensions correlate over a given population, but also to how they connect with conditions of resource scarcity, particularly in Nicaragua where the poverty level decreased over the past years, whereas climate change becomes a major concern. Finally, Chapter six presents conclusions and policy implications of the study as well as some suggestions for further research.

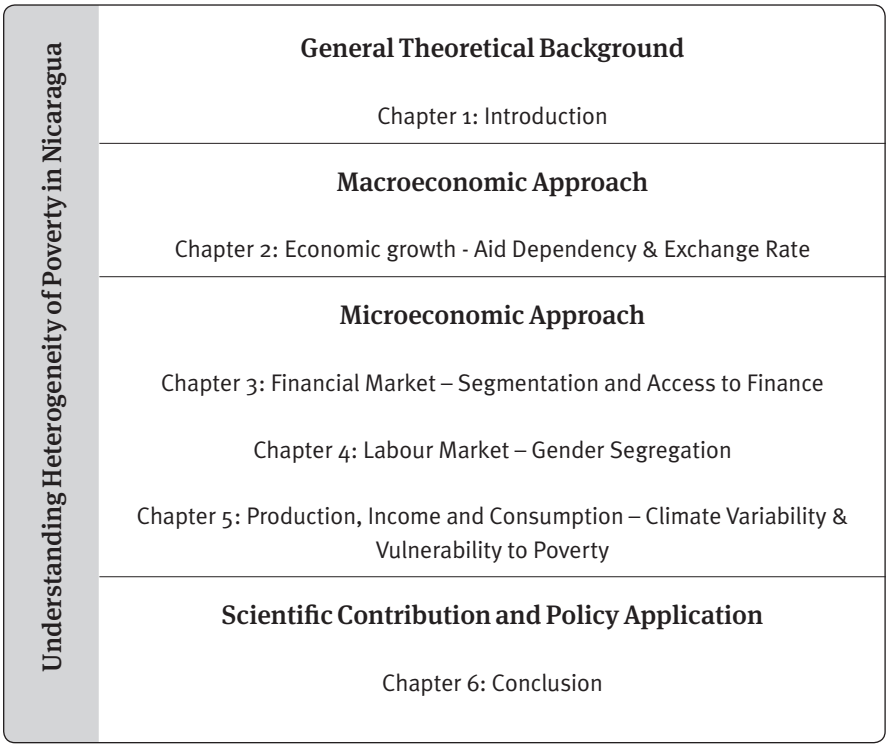

Figure 1.2 | Thesis outline

2

War, aid, and Dutch disease in Nicaragua*

* A previous version of this paper has been published by the Central Bank of Nicaragua. Working Paper #41 (Herrera., C. 2013).

Abstract

General economic theory predicts that foreign aid may cause "Dutch disease", i.e. a lower growth rate through loss of competitiveness as a result of an aid-induced appreciation of the exchange rate. This article investigates whether the massive inflows of foreign aid into Nicaragua had a damaging impact on real exchange rate (RER) during the period from 1960 to 2009. We find no consistent empirical evidence of the existence of Dutch disease in the case of Nicaragua, even after including control variables for structural changes during various historical periods, and under different assumptions of stationarity or non-stationarity of the fundamental variables affecting the exchange rate. We use several co-integration approaches to test the robustness of our conclusions.

Keywords Macro-Stability, Development Economics, Aid, Dutch Disease, Nicaragua

1 | Introduction

"Dutch disease (DD)" first attracted the attention of economists in the 1970s, when natural gas was discovered in the Netherlands. The boom in gas exports eventually damaged the competitiveness of the Dutch manufacturing sector (Krugman, 1987). The term is now used for countries facing similar circumstances. These circumstances refer to the situations in which an income boom is experienced due to a tradeable resource discovery or to an increase in the price of a commodity. This can have an effect on the appreciation of the real exchange rate (RER) and as a result the international competitiveness in other tradeable sectors could be reduced.

Several authors identified the possibility that capital inflows could also cause the RER to appreciate and that one source of capital inflows could be foreign aid (Edwards 1989, (Edwards & Van Wijnbergen 1989: 1485, Levy 1988; White and Wignaraja 1991, White 1998, Younger 1992 and Lensink & White 2001. For over a century, Nicaragua has been plagued by a combination of civil wars, natural disasters, revolutions, and political turmoil. Although the international community has assisted this country through all of its woes, today it remains the second-poorest country in Latin America, only after Haiti.

Nicaragua was, in per capita terms, among the top ten foreign aid recipients in the world during the 1990s. By 2001, aid represented 20 per cent of GDP, 83 per cent of the value of exports, and 28 per cent of the value of imports. Combining the value of family remittances, which totalled US$335.7 million in 2001 alone, with aid, the sum represents 32.7 per cent of the nation's GDP during the same year.

The World Bank (2004) estimated that the equilibrium of the real exchange rate in Nicaragua had some potential misalignments and could have been susceptible to Dutch disease (DD). More than a decade later, DD remains a potential danger for the country as the current account deficit was almost 40 per cent of the GDP and at the end of 2013 the trade deficit was over US$1 billion (BCN, 2014). Furthermore, although international cooperation has declined somewhat in recent years, and certainly relative to GDP, it is still one of the main pillars of the Nicaraguan economy.

This paper aims to analyse the macroeconomic effects of official development assistance in Nicaragua during the 1960–2009 period by examining the relation between aid and the real exchange rate. The study intends to contribute to the literature regarding the relationship between aid and DD. For this particular case, it is important to take structural breaks into account. The country suffered from civil wars in some periods, and the kind of economic policies and the types of aid received varied as well. The break time periods are related to war and post-war eras in Nicaragua (1980–1989; 1990–2000). The 1960–1979 interval serves as a base time.

The study uses the vector autoregressive (VAR) model in order to assess the effect of several fundamental variables, including aid, on the real exchange rate. It focuses not only on long-term effects but also on short-term dynamics. To this end, it estimates a vector error correction model (VECM), in order to provide robust evidence about the presence of DD in this country. As will be further explained below, aid has been provided in different forms and in different macroeconomic contexts over time. For this reason, the study allows for structural breaks in the series by comparing different periods.

The remainder of the paper is structured as follows: Section 2 discusses the phenomenon of Dutch Disease more in depth and provides an overview of the existing literature regarding the effect of official development assistance on the RER. Section 3 presents an overview the macroeconomic context in Nicaragua in the period 1960-2016 and of the aid provided in that period. Section 4 describes the model and estimation methodology, and Section 5 reports the results of the empirical analysis of the effects of aid on the RER. Finally, Section 6 presents the conclusions.

2 | Literature review

Dutch disease was originally conceptualized as the consequence of a sudden boom of the natural resources sector. The "disease" can be conceptualized as three consecutive effects: i) an appreciation of the real exchange rate, ii) a decline in the non-booming export sector, and iii) a decline in the growth rate. In the context of the aid effectiveness literature, it has been postulated that the presence of Dutch disease effects as a result of large aid "shocks" may explain the limited effects of aid on economic growth, and in particular that it can explain the often found diminishing returns to aid (Dollar & Collier 1999, Lensink and White 2001). However, the links between a sudden increase in export income and these three effects are by no means automatic.

Corden and Neary (1982) developed a model of a small open economy to analyse the macroeconomic effects of a boom in the natural resources sector. The basic assumptions include that the economy will always be in equilibrium and that full employment will be maintained due to flexible wages. There is a mobile production factor (labour) that can move between the sectors. The small economy implies that prices of tradables are exogenous. They distinguish three sectors, a booming tradable sector called "energy", a second tradable sector called "manufacturing" and a non-traded sector named "services" and analyse the effect of the boom in the energy sector on, in particular, production and profits in manufacturing.

The boom in the energy sector has two effects, a resource movement effect and a spending effect. The first is caused by the increase in the marginal product, and thus of wages, of the mobile production factor (labour) in the energy sector. This will raise the overall equilibrium wage rate and will induce a movement of labour from the other two sectors to the energy sector. This brings about some direct de-industrialisation, and also leads to a reduction of the production of services.

The overall rise in income also has a spending effect. As the prices of tradables are given, the increased demand will raise the price of services, and the more so as the output of services had already declined due to the resource movement effect. This will further increase the wage rate and lead to a movement of labour from manufacturing to services. In addition, the relative rise in the price of services will lead to a real appreciation of the exchange rate, which further affects manufacturing output and profitability. This can be called indirect de-industrialisation (Corden and Neary 1982).

Several authors have modified the original Corden and Neary model for the situation that the boom in foreign exchange income is not caused by natural resource discoveries or sudden increases in prices of these resources, but by aid (Edwards & Van Wijnbergen 1989; Neary & Van Wijnbergen 1986; Adam and Bevan, 2006, Nkusu 2004). In this case the response to the aid shock begins with the spending effect. Under the assumptions of full employment, a perfectly elastic demand for tradable goods and labour as the mobile production factor, aid leads to an increase in domestic demand and thus to an appreciation of the real exchange rate.

Nkusu (2004), for example, develops a model with two sectors, a tradable and a non-tradable sector. After the spending effect a resource movement effect follows, as labour moves to the non-tradable sector due to higher wages in that sector. A third effect is the expenditure switching effect: due to the higher prices of non-tradables, consumers purchase more tradables. This leads to a larger trade deficit and to the absorption of the aid flow, but at lower levels of domestic tradables production.

However, as Nkusu (2004) and also Adam and Bevan (2006) make clear, the assumptions of full employment and full elasticity of demand for tradable goods often do not hold in low income countries. If there is unused capacity in the non-tradable sector, the price increase will be smaller or non-existent. There may also be imperfect substitution between imports and domestically produced importable goods, so that the latter sector may gain from higher demand and cheaper imported inputs. The final outcomes for the real exchange rate and the domestic production of tradables depend on income and price elasticities in the economy.

The presence of Dutch disease effects also depends on how the aid is spent. In the extreme case, when all aid is used for imports, aid is fully absorbed and there is no Dutch disease at all. This is usually not the case. But the spending of aid can also help to mitigate Dutch disease effects in other ways. If aid helps to solve supply bottlenecks in the non-tradable sector, for instance by building rural roads, output in that sector increases, reducing the tendency for real appreciation (Adam and Bevan 2006, Nkusu 2004).

Furthermore, Dutch disease effects may also be mitigated by policies of the recipient countries. In the short run, governments may take fiscal and monetary policies to counteract a possible real appreciation. In the longer term, public investment and other reforms that benefit the supply side may mitigate these effects (Adam 2013).

And finally, the Dutch disease is only a "disease" if the last link holds, so if growth is affected. This is based on the – often reasonable – assumption that the non-booming export sector, manufacturing or non-traditional exports, embodies technological progress and thus that a decline in that sector harms long-term growth (Adam 2013; Elbadawi 1999).

All in all, it means that the actual occurrence of Dutch disease effects as a result of aid depends on many country-specific circumstances. Not surprisingly, the empirical evidence is not conclusive either. The empirical evidence can be broken down into country case studies and cross-country studies. Many empirical studies start by estimating a model for the real exchange rate based on Edwards (1989).

White and Wignaraja (1991) estimated such a model for Sri Lanka in order to explain the overvaluation of the currency after around 1978. This overvaluation was accompanied by disappointing performance of manufacturing and manufacturing exports. As these authors do not find autocorrelation, they use OLS regressions. They find that total transfers, the sum of aid and remittances, had a significant impact on the appreciation of the real exchange rate, in particular during 1978 and 1984. Other variables of influence proved to be the change in the nominal exchange rate and the terms of trade (both leading to depreciation) (White & Wignaraja, 1991).

Younger (1992) suggests that the increase in Official Development Assistance (ODA) to Ghana from an annual average of 3 per cent of GDP during 1981–1983 to 6 per cent of GDP during 1984–1987 gave rise to macroeconomic management problems that were associated with high inflation, tight credit to the non-bank private sector, and an appreciating RER. He did not conduct econometric analysis.

Nyoni (1998) examined the presence of Dutch disease in Tanzania for the period 1967 to 1993. He estimated a model for the real exchange rate, including both the so-called fundamental variables such as openness, government consumption and aid, and short-run factors such as nominal devaluations and change in domestic credit (the latter as proxy for macroeconomic policies). As most series were cointegrated, he applied OLS on the cointegrated series and then an error-correction model in order to estimate the short-run effects. Contrary to expectations, he finds that foreign aid had a depreciating effect on the exchange rate, along with openness of the economy and a nominal devaluation. Government expenditure (as proxy for consumption), on the other hand, had an appreciating effect.

Sackey (2001) estimated the factors influencing the real exchange rate in Ghana for the period 1962-1996. All variables proved to be cointegrated. He finds no evidence of Dutch disease, as aid turns out to have a dampening effect on the real exchange rate. He also examines the determinants of real export growth, in order to assess the role of the real exchange rate on exports. Exports are indeed fostered by depreciations.

Bourdet and Falck (2006) look at the effects of aid and remittances in Cape Verde. Foreign aid has always been large in that country, but remittances were sizable as well and from 1999 onward the volumes were about equal. Applying the same methodology as the previously mentioned authors, they find evidence for Dutch disease. Both remittances and aid have an appreciating effect on the exchange rate, but the effect of remittances is larger than that of aid. They also include an interaction term of the two and find that aid has a mitigating effect on the appreciation of the real exchange rate. They explain this by pointing to the fact that aid has increasingly been spent on strengthening the supply capacity of the economy.

Martins (2013) examined whether Dutch disease is present in Ethiopia. He uses quarterly data for the period 1995-2008 and applies several cointegration approaches as well as structural time series. He finds that an improvement in the terms of trade leads to appreciation, and openness to depreciation of the real exchange rate. However, the effect of aid on the real exchange rate was not significant, while remittances proved to have a weakly significant appreciating effect.

Insisienmay et al. (2015) apply cointegration for estimating the real exchange rate in Laos. The relevant independent variable in their study is the sum of all capital inflows, which includes aid. This variable proves not to have a significant effect on the real exchange rate. Amin and Murshed (2018) investigate whether aid, remittances and foreign direct investment led to appreciation of the real exchange rate in Bangladesh. They also include terms of trade, openness, and government expenditure, and find that all variables are integrated of order one. By applying Granger causality tests, they find that none of these variables has an influence on the real exchange rate.

Continuing with the cross-section studies, Adenauer and Vagassky (1998) examine Dutch disease effects of aid in four West African countries: Burkina Faso, Côte d'Ivoire, Senegal and Togo. They look at the period 1980-1992 when all countries were in the CFA zone and there were no devaluations (yet). They apply pooled regression analysis and find that aid has led to an appreciation of the real exchange rate. They reveal that this happened in particular during the mid-1980s, after increases in wages and in public deficits, possibly facilitated by large aid flows.

Another early cross-country study is the one by Elbadawi (1999). He analyses the impact of ODA on the real exchange rate and on exports using panel data for 60 developing countries, including 28 from Africa. He finds that aid indeed led to an appreciation of the real exchange rate. This was mitigated by net foreign capital inflows, in particular because the average developing country had more outflows than inflows between 1984 and 1995. Openness has a clear depreciating effect.

With respect to the effect of aid on exports, he finds a Laffer curve: while the aid-to-GNP ratio is first positively associated with non-traditional exports, when aid surpasses around 22 percent of GDP, it decreases these exports. He also finds a negative association

between non-traditional exports and variability of the real exchange rate. Arellano et al. (2008) examine the impact of aid and of aid volatility on the real exchange rate and on manufactured exports. They develop a model and calibrate it for Côte d'Ivoire, showing that aid leads to a real appreciation and to a shift to non-tradable production. They then test empirically the main prediction of the model, which is that aid reduces the share of manufactured exports in total exports. They analyse panel data of 71 countries for the period 1981-2000 by applying OLS and by instrumenting through General Method of Moments (GMM). They find that aid reduces manufactured exports. Aid volatility does so as well, but this effect is less robust.

Table 2.1 | Findings of empirical studies of Dutch disease; case studies and cross-country studies

Case studies	Key findings	Methodology	Countries
White and Wignaraja (1991)	Aid (and remittances) lead to appreciation of RER	OLS	Sri Lanka
Nyoni (1998)	Aid leads to depreciation of RER	UECM (OLS)	Tanzania
Sackey (2001)	Aid leads to depreciation of RER	UECM (OLS)	Ghana
Bourdet and Falck (2006)	Aid leads to appreciation of RER but less so than remittances; aid mitigates appreciation caused by remittances	OLS, Engle-Granger tests	Cape Verde
Martins (2013)	Aid does not have statistically significant effect on RER; weak appreciating effect of remittances	UECM (OLS), plus structural time series	Ethiopia
Insisienmay et al. (2015)	Capital inflows, including aid, no significant effect on RER	OLS	Laos
Amin and Murshed (2018)	Aid, remittances and FDI no effect on RER	Granger tests	Bangladesh
Cross-section studies			
Adenauer and Vagassky (1998)	Aid leads to appreciation of RER	Pooled GLS	West African countries (4)
Elbadawi (1999)	Aid leads to appreciation of RER	Pooled OLS with lags as instruments	Developing countries (60)
Arellano et al. (2008)	Aid reduces manufactured exports	Pooled OLS and GMM	Developing countries (72)
Rajan and Subramanian (2011)	Aid reduces growth rates of exportable industries	Pooled OLS, IV analysis	Developing countries (32 + 15)
Fielding and Gibson (2013)	Aid appreciates RER in many countries but not always; explain by type of peg, investment rate and institutional quality	Country-specific VAR	Sub-Saharan Africa (26)
Uddin and Murshed (2017)	Remittances lead to appreciation but no robust effect of aid	Pooled OLS and IV, but the latter not for aid	South Asian countries (8)

Rajan and Subramanian (2011) also focus on the effect of aid on manufactured exports, and in particular on the growth of manufactured exports. They use annual growth rates by industrial sector for 32 countries for the 1980s and 15 countries for the 1990s and examine whether aid leads to lower growth rates for those industrial sectors that are more sensitive to the real exchange rate. They find that indeed, these "exportable" manufacturing sectors have lower growth rates if aid is higher. They also provide some evidence that exchange rate appreciation is the mechanism through which this occurs.

Fielding and Gibson (2013) build on the work by Adam and Bevan (2006) in assuming that there will be heterogeneity in the exchange rate effects of aid. They first carry out time series analysis with Vector Auto Regression (VAR) for 26 African countries, and show that there is real appreciation in all countries with a fixed nominal exchange rate, although this effect is not always statistically significant. Among the countries with flexible exchange rates there is just one country with statistically significant appreciation and one with statistically significant depreciation. When examining several possible causes for this heterogeneity, they find that the type of exchange rate is indeed of influence. Both the investment rate and the institutional quality in a country (government effectiveness and regulatory quality) are able to reduce the appreciation, while there is no effect from productivity (measured by GDP per capita and openness) or the level of aid dependence.

In summary, and as also shown in Table 2.1, there are no consistent results for the effect of aid on the real exchange rate or on the growth of (manufactured) exports. From the theoretical models and empirical evidence presented, heterogeneous effects can be explained by the type of aid and how aid is spent, the aid volume relative to GDP, supply and demand elasticities in the country, government policies, and possibly also the type of exchange rate. Some of these factors are discussed in the next section.

3 | AID and country context

Volumes and types of aid have been different in different political and economic periods in Nicaragua. Until 1979 the country was ruled by dictator Somoza. Apart from the last two years, when the country suffered from civil strife, this was a period of high economic growth but also of very high inequality. Aid was limited, although it increased after the devastating earthquake that hit Managua in 1972, and also later in the decade as the country's needs increased due to the civil war and accompanying capital flight (Vos and Johansson 1994). The US was the main donor but there were also large loans from the World Bank (IBRD) and the Inter-American Development Bank.

In 1979, the armed opposition under the leadership of Daniel Ortega came to power. Improving the unequal distribution of income and of access to services was the main objective of this government. It hugely increased health and education expenditure and also gradually centralized the economy. At first, aid flows from many bilateral and multilateral donors increased to help the country recover from the destructions of the civil war. After

a few years however, the increasing centralization of the economy met resistance, both in and outside the country.

The US began to finance the armed opposition and imposed a trade embargo in 1985. Many western donors withdrew - with a few exceptions like Sweden and the Netherlands. While the new civil strife and increasingly inappropriate macro-economic policies caused a breakdown of production and exports, the country became mainly dependent on aid from socialist countries. This aid was mostly in the form of oil and imported inputs and equipment – often at very high prices. The state apparatus (including the army) grew from 35,000 employees in 1979 to 187,929 in 1989 (Velazquez, 1998). High government expenditure in combination with reduced supply and lower tax income fuelled inflation. It turned into hyperinflation later in the decade. The highest rate was achieved in 1988 with 33,548 per cent. A stabilization attempt reduced it somewhat, but hyperinflation flared up again in 1990 reaching 13,490 percent. Economic growth was highly negative in those years (Figure 2.1).

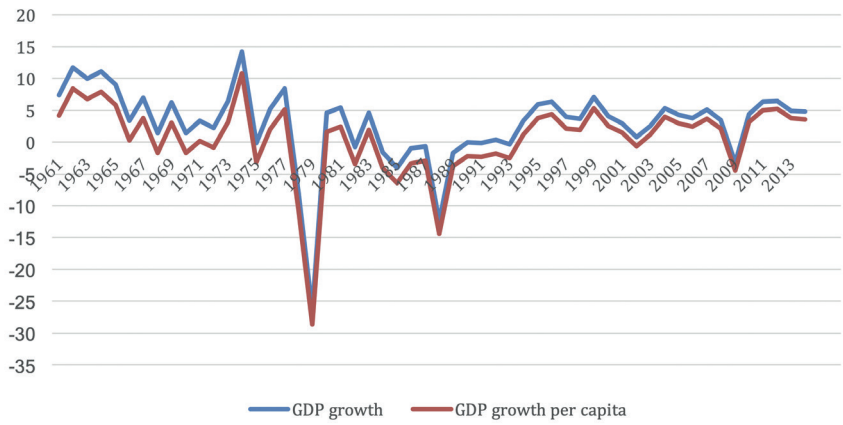

Figure 2.1 | GDP growth (1960-2014)
Source: World Bank, World Development Indicators

In 1990 elections were held and President Ortega lost to united opposition forces under Ms Chamorro de Barrios. The civil war gradually came to an end. The new government began a political and economic process of change, known as the "triple transition" (Gómez 2003). The nation underwent a change from war to peace, from a military regime to an open democracy, and from a centralized economy to one regulated by the laws of the market. After some failed attempts to stabilize the economy, the government finally managed to reduce inflation in 1991.

Foreign aid played a large role in this stabilization, as the exchange rate could serve as a nominal anchor. In 1991, a large part of this high aid flow (Figure 2.3) was in the form of debt relief. This did not bring actual money but mainly cleared the arrears on the World

Bank and IDB loans taken in the 1970s, allowing these institutions to provide new loans to Nicaragua. Many bilateral Western donors also began to provide aid again (Gómez, 2003).

The economic reforms included administrative reforms in public sector operations, such as improvements 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. The exchange rate system also changed in this period. Before 1993, Nicaragua had a fixed but adjustable peg in relation to the US$. This rate was at 7 for a long time, until inflation rates began to increase in the 1980s and the Córdoba had to be devalued many times. From 1993 onward, a managed float rate was established.

Subsequent governments led by President Alemán (1996-2002) and President Bolaños (2002-2007) continued the market-oriented reforms. From 1991 onward, the country has mostly complied with the structural adjustment programmes established by international aid organizations, and its financial and economic sectors saw some significant improvements compared with conditions in the 1980s. While economic growth was still very low in the early 1990s, it started to pick up from the mid-1990s onward (Figure 2.1). Nevertheless, in real terms, GDP per capita was and is still below the 1977 level (Figure 2.2). Aid flows continued at a high level although with large ups and downs. The peaks in 1996, 2001 and 2004 are due to debt relief, like the one in 1991 before. In 1996 many former socialist countries cancelled their debt stocks, while in 2001 and 2004 Nicaragua obtained large amounts of debt relief from bilateral and multilateral donors in the context of the Heavily Indebted Poor Countries Initiative (HIPC) and the Multilateral Debt Relief Initiative (MDRI). Most debt relief from bilateral donors did not lead to additional resources, because it meant cancelling debt stocks or debt service payments that would not have been paid in the absence of debt relief (Dijkstra & Evans, 2003).

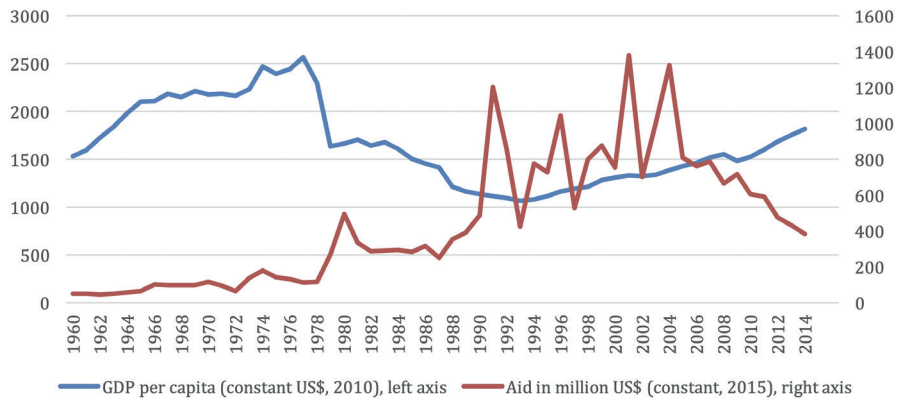

Figure 2.2 | Aid and GDP per capita, 1960-2014
Source: World Bank, World Development Indicators

During the reign of President Alemán, aid relations deteriorated somewhat but due to hurricane Mitch (1998) aid was high in 1998 and 1999. Under the more technocratic President Bolaños, aid relations improved again, although his economic policies did not achieve a lot in poverty reduction or improved much the income distribution (Dijkstra, 2013). This government aimed to prioritize the modernization of the state and the national financial system, to extend the privatization process, and to restore economic and social infrastructure.

Many donors provided freely spendable funds in the form of general and sectoral budget support. However, the President's lack of support in Parliament made it very difficult to implement several development projects.

From 2007 another change occurred when President Ortega was (again) elected. He is still in power. Aid from western donors began to decline gradually. The fact that Nicaragua obtained the status of middle-income country played a role, but also the increased political and economic centralization. Venezuela and other emerging donors replaced the traditional donors, but this often meant less grants and more loans (Dijkstra & Lobbrecht 2016; Walshe Roussel 2013). While economic growth remained positive, the ODA/GNI ratio declined (Figure 2.3).

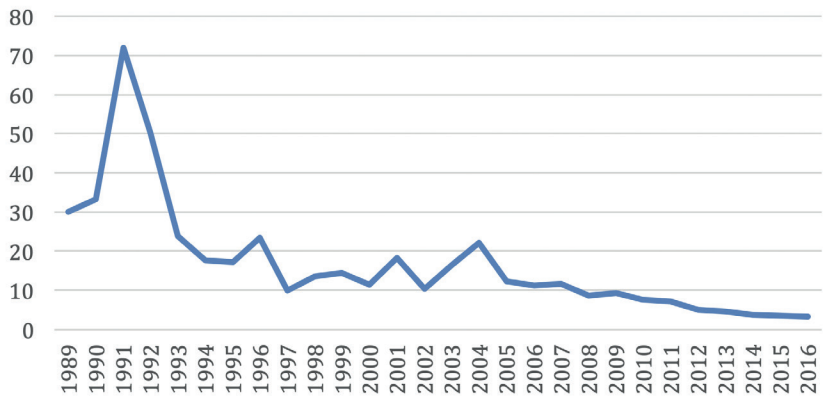

Figure 2.3 | ODA/GNI 1989 – 2016, in percent

ODA: Official Development Assistance

Source: World Bank, World Development Indicators

Overall, from 1981 to 2009, Nicaragua received annual average aid close to US$578 million. In total more than US$14.68 billion was provided in international cooperation (Gomez 2006). This made Nicaragua the largest recipient of aid in the Central American region and thus highly dependent on aid as well, since during this period the ODA/GNI ratio was estimated at 21 per cent, the ODA/GDP ratio was roughly 25 per cent, and the ODA/current account deficit ratio was 50 per cent.

In the period 1990-2002, total foreign amounted to US$ 7.525 billion from bilateral and multilateral agencies, some 54 per cent of which was in the form of grants and 46 per cent as loans (Ministry of Foreign Affairs of Nicaragua, 2008 & 2009).

With respect to the sectoral allocation of aid, the following figures are available. Of a total of US$4.525 billion received during the period of 1990-1996, US$1.882 billion (41.6 per cent) was allocated to payments on the national debt, Some US$780 million (17.3 per cent) was assigned to the social sector, while US$956.8 million (21.2 per cent) was channelled into the productive sector.

Another US$635.3 million (14.1 per cent) was allotted to infrastructure, while other programmes related to the adjustment programme received US$271.0 million. During 1997-2002, international cooperation totalled US$2.49 billion. Some US$741.9 million (29.8 per cent) was allocated to the social sector, US$594.3 million (23.9 per cent) to the infrastructure sector, US$563.1 million (22.6 per cent) to the productive sector, and US$425.5 million (17.13 per cent) to the financial sector. The remaining US$165.5 million (6.6 per cent) was assigned to strengthening the institutions involved in building good governance.

Furthermore, during the 2003- 2009 period, Nicaragua received US$4.37 billion in foreign aid and the debt relief amounts totalled US$17.48 billion. During the following years (2010 – 2016), the country received US$1.65 billion in ODA.

It is clear that Nicaragua has had periods of very different economic and political governance. Aid has also come in many different forms and served different roles. This has consequences for the analysis of the presence of Dutch disease effects. During the 1980s, a significant portion of aid was in kind (oil and other inputs and equipment). Arguably, this could not have had any DD effects. In the 1990s and 2000s, a large part of aid was in the form of debt relief. This probably did not have effects on the real exchange rate either, as no financial flows entered the economy. Yet, in relation to its national income Nicaragua has been the largest aid recipient on the Western Hemisphere and the effects on economic growth appear to have been limited. This justifies an analysis of possible Dutch disease effects.

Comprehensive long-term analyses of the presence of Dutch disease in Nicaragua have not been carried out so far. Some studies on Nicaragua do mention the possibility of Dutch disease effects. Vos and Johansson (1994) examine the macroeconomic impact of aid in Nicaragua. They observe that large aid inflows in the 1980s and early 1990s were accompanied by lower exports. But they argue that typical Dutch disease effects are not likely for this period. Supply constraints due to the civil war, and unfavourable external conditions (for instance the trade embargo imposed by the US) were the main causes for the export decline in this period.

The World Bank (2004) analyses the period of the 1990s and early 2000s. Although there was some appreciation of the Córdoba in the years 1999-2001, mainly due to exceptional

aid inflows after hurricane Mitch that led to a construction boom, this did not affect economic growth. However, by looking at correlations between macro-economic variables over the years 1990-2002, the study concludes that Nicaragua is susceptible to Dutch disease. For example, the correlation between aid and the real exchange rate is positive (meaning appreciation), and that between the real exchange rate and exports is negative. In addition, there is a strong negative correlation between aid and exports. Nicaragua's high dependence on agricultural exports makes the country vulnerable for exchange rate appreciation. Furthermore, the agricultural export sector employs the poorest share of the population, so negative shocks in this sector do not only cause economic but also social and political problems.

4 | Methodology and empirical analysis

In estimating the impact of external aid inflows on the real exchange rate, a model for real exchange rate determination must be established. According to Sackey (2001), RER equilibrium can be conceived of as the relative price of tradeables to non-tradeables compatible with the attainment of internal and external equilibrium.

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

In order to address possible different effects in different periods and in the short versus the long term, we use event study methods or the vector autoregressive model (VAR) for multivariate time series for the long-run and a Vector Error Correction Model (VECM) for the short-run effect, respectively.

Our model for the real exchange rate includes variables that are used in most other studies. It includes the terms of trade given the fact that Nicaragua exports primary commodities whose prices are determined in the international commodity market. As a result, the RER will be affected by the movements in the relative prices of exports and imports. Usually, it is assumed that the income effect of terms of trade change dominates the substitution effect, so that an improvement in the terms of trade leads to an appreciation. The openness of the country can also affect the RER. With fewer restrictions to trade and thus more demand for imports, the RER is expected to depreciate. Changes in government expenditure can also affect the RER. As governments are assumed to spend more on non-tradable goods and services, higher government expenditure is usually associated with RER appreciations (Adam and Bevan, 2006; Elbadawi and Soto, 1994).

Hence, for this study, the following model is proposed:

$$(1)\ RER_t = \alpha_o + \beta_1 AID_t + \beta_2 AID_t + \beta_3 TOT_t + \beta_4 TOT_{t-1} + \beta_5 GOE_t + \beta_6 GOE_t + \beta_7 OPEN_t + \beta_8 OPEN_{t-1} + \mu_t$$

Where,

RER = The log of the *real exchange rate*. It is the response variable.
AID =The log of the measure of *official development assistance* (AID). It is a policy variable.
TOT = Terms *of trade* (TOT). It is an external condition variable.
GOE= The log of *government final consumption expenditure* (GOE). It is a policy variable.
OPEN = Openness (OPEN). It is a policy variable.

Variables and data

The dependent variable RER is defined as the ratio of the price level of U.S. and the domestic price level times the nominal exchange rate, measured as US$ per Nicaraguan Córdoba. This means that an increase in the RER implies depreciation. It is an index with a base year of 1994. The government final consumption expenditure is at constant prices base 1994, and Openness is measured as the sum of exports and imports divided by GDP. Terms of trade is the ratio of an index for average export prices and an index for average import prices; the base year is 1995. Official aid is Official Development Assistance AID at current USD, converted into national currency at the corresponding exchange rate of each year and divided by the deflator to convert it to constant prices.

The analysis covers the period 1960-2009. Data for calculating the RER, Government expenditure, openness and terms of trade are taken from the statistics of Nicaraguan Central Bank. The Official Development Assistance data is taken from the World Development Indicators of the World Bank.

Additionally, for the three recent Nicaraguan historical periods, three categorical variables were incorporated as a representation of the structural changes in the external sector of this country's economy. In calculating the RER index, Edwards (1989) suggests that the weighting method, in particular the choice of trading partners and of price indexes, does not have a significant impact on the values of the RER. The fundamental decision lies between computing a bilateral rate and computing a multilateral rate.

For most countries the multilateral rate is preferred to the bilateral rate since it tends to provide a better representation of overall competitiveness. However, for Latin American countries there proves to be hardly any difference between the bilateral and the multilateral real exchange rate indices. For this reason, we calculate the bilateral exchange rate index with the US using as base year 1994.

Empirical framework

In order to identify the optimal number of lags we applied several criteria. As Table 2.2 shows two (the Akaike Information criterion and Hannan-Quin criterion) out of three tests conducted indicate that 4 lags are optimal for our model. On the other hand, the Schwarz's Bayesian Information Criterion (SBIC) rather suggests using one lag. Our used criterion is the SBIC because it tends to choose a more parsimonious specification (Pesaran & Smith 1998).

Table 2.2 | Schwarz's Bayesian information criterion, Akaike, and Hannan-Quin criteria and the likelihood ratio

Lags	LL	LR	df	P	FPE	AIC	HQIC	SBIC
0	-56.9587				0.000012	2.8818	2.95732	3.08659
1	72.9993	259.92	25	0.000	9.40E-08	-1.99997	-1.54684	**-.771222***
2	86.1085	26.218	25	0.396	1.70E-07	-1.4469	-0.616179	0.805793
3	116.788	61.36	25	0.000	0.00000015	-1.71108	-0.502753	1.56557
4	176.007	118.44*	25	0.000	**4.0e-08***	**-3.30266***	**-1.71673***	0.997943

Note: LL: log-likelihood test. LR: Likelihood ratio test. df: degree of freedom.
p: p-value.
FPE: Final prediction error.
AIC: Akaike's information criterion.
HQIC: Hannan and Quinn information criterion.
SBIC: Schwarz Bayesian information criterion.
** indicates the optimal lag*

Next, the time series properties of all variables were determined prior to estimation. Estimation of variables in the model as well as the tests to determine the causality between variables was conducted carefully.

The test for non-stationarity also verified whether the series could be represented more figuratively as a difference or trend stationary process (Elbadawi & Soto, 1994).
For each variable type, three stationarity assessments were applied: Dickey-Fuller, Phillip-Perron, and Zivot-Andrews, as shown in Table 2.3. The terms of trade, openness and aid proved to be stationary.[12] The real bilateral exchange rate proved to be stationary as well, which was rather unexpected. Government expenditure is the only variable that presents unit root, for both the constant and the trend.

[12] *Even though for Terms of Trade and Openness this does not hold anymore when a break is included (the Zivot-Andrews test), we still consider them stationary given the other two tests.*

Table 2.3 | Dickey-Fuller, Phillip-Perron, and Zivot-Andrews examinations

Variable	Specification[1]	Lags	D.-Fuller[2]	P.-Perron[2]	Zivot–Andrews		
					t-Statistic	Break Point	Critical Value
Gov. Exp	Constant & Trend	1	0.921	0.935	-3.506	1988	1%: -5.34 5%: -4.80
Terms of Trade	Constant	1	**0.012**	**0.000**	-4.515	1983	1%: -5.34 5%: -4.80
Open	Constant	1	**0.051**	**0.082**	-3.803	1982	1%: -5.34 5%: -4.80
AID	Constant & Trend	1	**0.071**	**0.011**	**-6.238**	1988	1%: -5.34 5%: -4.80
Real Exchange Rate	Constant	1	**0.033**	**0.006**	**-6.331**	1988	1%: -5.34 5%: -4.80

[1] *From inspecting the graphs, Terms of Trade, Openness and RER did not prove to have a trend.*

[2] *The P.-Perron and D.-Fuller tests show the p-values for the null hypothesis of non-stationarity*

In light of the found stationarity, the real exchange rate variable appears to comply with the law of one price, best known in the field of international economics as purchasing power parity. Thus, under the assumptions of arbitrariness or under the pressure of competitive market conditions, the prices of related goods will tend to be equal once the nominal exchange rate is accounted for. After using the Johansen test (to test trace), the number of co-integrated equations is set to one. The co-integration of the bilateral real exchange rate shows that the coefficient is adjusted and that the alpha is negative, as expected. In other words, any deviation of the variables in the short-term fundamentals will be corrected as the years progress, as shown in Table 2.4.

Table 2.4 | The Johansen test and VECM diagnostic

Null Hypothesis No. of CEs	Eigen values	Trace Statistics	5% Critical Values
None	.	84.8728	68.52
At most 1	0.58826	**44.9418***	47.21
At most 2	0.36441	24.5475	29.68
At most 3	0.32788	6.6682	15.41
RER Alpha		**-0.974*** **	

*Note: ***p<0.01, **p<0.05, * p<0.10.*
Bold figures are significant results.
CEs: cointegrated equations

To determine the effect of official development aid on the appreciation of the exchange rate, Granger tests were implemented to assess the short-term causality with different numbers of lags (Table 2.5). Foreign aid proves to have no statistically significant impact on the real bilateral exchange rate regardless of the number of lags introduced. The significance of the causality of economic openness, terms of trade and government expenditure depends on the lags number. Furthermore, the bilateral real exchange rate has a significant effect on openness, government expenditure, terms of trade and aid, although it depends on the number of lags.

Table 2.5 | The Granger test

Equation	Excluded Variable	Lags			
		1	2	3	4
RER	AID	0.684	0.210	0.486	0.498
	TOT	0.642	0.699	**0.002**	**0.005**
	Gov. Expend.	**0.013**	**0.000**	0.130	0.925
	OPEN	**0.002**	**0.004**	0.494	0.344
AID	RER	**0.083**	**0.063**	0.976	0.437
TOT	RER	**0.000**	**0.000**	**0.822**	0.692
Gov. Expend.	RER	**0.405**	0.980	**0.026**	**0.027**
OPEN	RER	**0.025**	**0.043**	**0.212**	0.214

Granger tests (p-values)

The impulse response function consistently shows that the impact of AID on the real exchange rate is not different from zero at the 95 per cent level of certainty, as shown in figure 2.4. Given the different results for different numbers of lags, the effects of government expenditure, openness and terms of trade on the RER are smaller (and not shown).

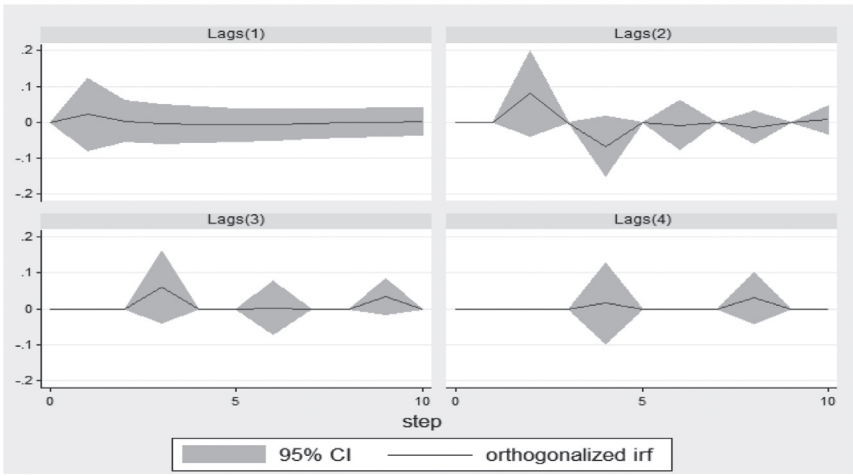

Figure 2.4 | Impulse response function: Impulse variable (AID) and response variable (RER)

5 | Results

Several models were computed, introducing the variables one by one and testing for improvement in the model fit. In each ordinary least squares (OLS) regression, several combinations of the substantive predictor (AID) were used. In view of the earlier expectations of structural breaks, we added three dichotomous variables for the most important recent historical periods in order to represent the structural changes in the external sector of Nicaragua (1960–1979, 1980–1989 and 1990–2000[13]); namely the industrialization policy of import substitution in the 1960s and 1970s, the embargo and civil war of the 1980s and the openness strategy from the 1990s onwards.

In line with the findings above, the exchange rate is presented as a stationary variable. The first model gives no evidence of Dutch disease (a negative effect on the real exchange rate) and even presents a positive effect, significant at the 95 per cent level. The dichotomous variables for the three periods are shown not to have a significant and greater structural effect on the appreciation of the real exchange rate.

Second, model 2 includes an interaction term of official development assistance with the period of the 1980s, the civil war years. The purpose is to verify whether during the 1980s AID affected the exchange rate more negatively than it did in the other periods. However, this hypothesis must be rejected. The effect is positive, reflecting depreciation. Third, model 3 assumes that AID followed a stationary process, hence AID is not differentiated. The results do not differ from the previous models.

Given these outcomes, there is no empirical evidence of the existence of Dutch disease in Nicaragua, even while including control variables for structural changes during various historical periods, and under different assumptions on stationarity of the fundamental variables influencing the exchange rate.

This study attempted to analyse the correlation between RER and AID – if a sudden and significant change in the flow of aid, either an increase or a decrease in the amounts of aid received, could result in a significant rise or reduction in real exchange, respectively.

However, an opposite effect of AID on RER is found in Nicaragua. In other words, aid inflows led to real exchange rate depreciations rather than appreciations. The impact of more aid interacting with the war dummy variable is a lower RER. Accordingly, the Nicaraguan situation contests the theory that aid inflows lead to real exchange rate appreciation. Similar results were also found by Nyoni (1998) for the Tanzanian economy and Sackey (2001) for the Ghanaian economy.

As expected, openness affects the real exchange rate positively, while government expenditure and an improvement in the terms of trade have a negative (appreciating) effect on the real exchange rate. However, the coefficients for terms of trade and openness appear to be less robust, as they are not significant in model 2.

[13] *The period 2001-2009 presented collinearity, and was therefore excluded.*

Table 2.6 | Results OLS regressions

Independent Variables	Dependent Variable ln(RER)		
	Model 1	Model 2	Model 3
D.(OPEN)	0.011***	-0.004	0.009**
	0.004	0.005	0.004
L.(OPEN)	0.006	-0.004	0.004
	0.004	0.003	0.004
D.ln(GOE)	-0.128	-0.273	
	0.324	0.289	
L.ln(GOE)	-0.551***	-0.530***	
	0.126	0.136	
ln(GOE)			-0.523***
			0.111
D.(TOT)	-0.008*	-0.003	-0.008**
	0.004	0.004	0.003
L.(TOT)	-0.008**	-0.007*	-0.008**
	0.003	0.003	0.003
D.ln(AID)	0.288*	0.154**	
	0.093	0.071	
L.ln(AID)	0.198**	0.267***	
	0.086	0.091	
ln(AID)			0.271***
			0.088
[1960-1979]	-0.398	-0.216	-0.165
	0.243	0.237	0.238
[1980-1989]	-0.117	-0.067	0.011
	0.255	0.269	0.208
[1990-2000]	0.016	-0.031	0.005
	0.082	0.067	0.083
War:[1980-1989]* D.ln(AID)		0.384**	
		0.167	
Constant	5.737***	5.289***	5.303***
	0.978	0.876	0.978
N	46	46	46
BIC	21.91	13.08	16.73
R^2	0.888	0.915	0.882

*Note: ***p<0.01, **p<0.05, * p<0.10*

D: Difference operator.

L: Lag operator.

BIC: Bayesian information criterion (the model with the lowest BIC is preferred)

6 | Conclusion

This paper analyses the impact of foreign aid on Nicaraguan economic development from a macroeconomic perspective: specifically, its impact on the real exchange rate between 1960 and 2009.

The theoretical review demonstrates that drawbacks to aid inflows may exist, as aid has the potential to lead to an appreciation of the real exchange rate, in turn causing lower competitiveness and hence, lower economic growth. However, it also shows that this Dutch disease effect may depend on several factors such as the type of aid, how aid is spent, macro-economic and exchange rate policies, and supply and demand elasticities in the country. The empirical evidence on the existence of aid-induced Dutch disease effects proved inconclusive. Nicaragua has been very dependent on foreign aid for a long time, while growth rates have been disappointing. The country therefore makes an interesting case to study the possible Dutch disease effects of aid.

This study analyses the existence of the possible adverse effects of aid on the exchange rate on a greater scale than the studies previously presented by Vos and Johansson (1994) for the period 1980–1994 and by the World Bank (2005). The findings of this study offer a basis to conclude that Nicaragua was not susceptible to Dutch disease. In part, this can be explained by the aid modalities Nicaragua has received over the years. In the war period of the 1980s, a large part of aid was in the form of direct imports of commodities (oil, equipment). From the early 1990s, debt relief proved to be an important component. A large part of debt relief was on debts that were not serviced or repaid, so that this "aid" did not imply a flow of fresh resources to Nicaragua.

Given that in countries with a history of war and natural disasters, investments, both private and public, would be expected to affect the real GDP per capita growth rate positively, the fact that ODA inflows were connected to RER depreciations in Nicaragua may suggest that public investments were redirected to restore the country's economic and social infrastructure. Although this discussion is beyond the scope of this paper, it may be inferred from this result that direct capital inflows, private or public, were and continue to be important for Nicaragua's economic development.

In macroeconomic terms, a large part of aid has apparently been used for purchasing imports, thus compensating for the scarcity of internal financial resources. At the same time, aid has perpetuated a high level of dependency of public investments and government expenditure and has thus fomented a lack of sustainability.

However, the Nicaraguan economy could be prone to the effects of Dutch disease if the need for prudential macro policies is underestimated, for example when dealing with the impact of massive capital inflows for the planned construction of a new canal. To ensure the stability of the exchange rate system, monetary policy should continue to be based on the accumulation of sufficient international reserves to cover the monetary base twice over.

3

Credit market segmentation and access to finance: the monopolistic power of financial institutions in Nicaragua*

*This is based on a paper published by Herrera, C., Ruben, R., & Dijkstra, G. (2014). Segmentation, Access to Finance Constraints and the Credit Monopolistic Power of Financial Institutions in Nicaragua, *Journal of Economics and Development Studies*. 2 (4): 101-123; http://dx.doi.org/10.15640/jeds.v2n4a8

Abstract

Access to finance has been severely limited in Nicaragua and low investments tend to have adverse effects on economic growth, macroeconomic stability and poverty. Credit market segmentation and unequal access to finance are illustrated by interest rate differentiation and loan size constraints. These may reduce factor productivity. Therefore, credit market segmentation is considered a major cause for poverty traps.

Using data on credit use, borrowing conditions and household characteristics derived from the Living Standards Measurement Study (LSMS, 2005), this study elaborates a novel conceptual framework for analysing differences in access to credit and features of financial segmentation in Nicaragua. In addition to providing a critical analysis of some major constraints for financial access across the broad range of Nicaraguan households, this chapter looks at the institutional structure of the financial market. This latter analysis produces empirical indications that reveal the high monopolistic power of financial institutions in this country.

Keywords Financial Market Development; Segmentation, Access to Finance, Bank Concentration.

1 | Introduction

Strategic concerns about limited and highly differentiated access to finance are increasingly supported by empirical data that show how resources and services provided by financial systems are not readily and equally available to all people (World Bank, 2012b). Consequently, financial development is not fully correlated with economic growth whenever concerns for financial deepening are not sufficiently addressed (Stiglitz and Weiss, 1981). Moreover, lack of competition, non-price-based operations, as well as loose banking policies and regulations impair the banking sector's progress in many developing countries (Le, 2012).

Improving access to finance has generally been identified as a pathway for using financial products and credit services at reasonable costs (Claessens and Tzioumis, 2006). For this reason, many countries have adopted the policy goal of reaching universal financial access. Since 2006, the United Nations (UN) has insisted on countries and their central banks to add the goal of 'universal financial inclusion' to the traditional goal of prudential regulation.[14] Inclusive finance represents a shift beyond the earlier 'microcredit' perspective that embraced an array of products and services targeted especially to poor and low-income people' needs (Bebczuk, 2009). Financial inclusion refers to broad access by households and enterprises to reasonably priced and appropriately delivered financial services that link the supply and demand of financial products (Leon, 2014).

Despite a large and growing literature on financial markets, no single measure of financial inclusion has emerged that can be applied across different settings. Although there is an extensive body of literature on cross-country finance-growth relationships (see Rajan and Zingales, 1998 for an overview), only few empirical studies assess differences in financial access within countries. This is mainly due to a lack of data on major access variables for different types of households and/or enterprises. Furthermore, there is an ongoing debate in empirical research concerning access to finance on the stratification of clients (e.g. indicators used for defining micro, small and medium-sized enterprises or MSMEs).[15]

In neighbouring Central American financial markets, there appears an apparent 'harmonic' market segmentation[16] where formal and informal lenders seem to "co-exist" using different interest rates charged to different types of users (see: Moll, Ruben, Mol, and Sanders, 2000). Other studies on developing countries provide evidence of substantial credit biases, where small-scale household loans are far more difficult to obtain compared to credit provided to larger firms (e.g. Beck, Demirgüç-Kunt & Maksimovic, 2003 and 2005).

[14] *Her Majesty Queen Máxima of the Netherlands has served since 2009 as the UN Secretary-General's Special Advocate for Inclusive Finance for Development (UNSGSA).*

[15] *MSMEs are categorized by the number of employees. According to the Enterprise Survey (2010) for Nicaragua a micro enterprise has 1 to 5 employees, small have 6–20 employees, medium 21–99 employees, and Large 100 or more. MSMEs are commonly used because household credit obtained tends to be channelled into financing MSME initiatives.*

[16] *Market segmentation involves dividing a broad target market into subsets of consumers who have common needs and priorities (Moll, Ruben, Mol & Sanders, 2000).*

This segmentation could be occasioned by differences between financial supply and demand market conditions (particularly related to riskiness perceptions and differences in wealth and collateral) but could also be conditioned by institutional factors related to the ability of financial agents to impose a differentiated interest rate in order to (artificially) restrict demand.

This chapter will address the extent of financial market segmentation in Nicaragua from both perspectives. We use databases from the World Bank Nicaragua Living Standards Measurement Study (Word Bank/LSMS, 2005) to analyse the relationship between access to (household) finance and segmentation in the financial market of Nicaragua. Determinants for loan size and interest rates are empirically assessed using probit and credit demand models.

Medium, small and micro enterprises (MSMEs) contribute more than 30% of the gross domestic product of Nicaragua (BCN, 2011) but they receive only 12% of credit operations due to laborious borrowing procedures and distorting bank policies, causing the actual interest rate to be very high. Credit is granted primarily for the acquisition of inventories and machinery for semi-industrialized businesses. Even though the government and international development agencies have launched economic incentive programs for the promotion of financial services since 1991, it continues to be difficult for the business community to obtain access to finance. Nicaraguan banks also face difficulties in mobilizing savings and are thus hindered in facilitating micro investment expansion.

As mentioned, the participation of micro enterprises in the financial system is still incipient: only 12% of MSMEs-households report being able to access capital (BCN, 2011). Amongst those with no access to credit, 63% report that they did not request a loan because it was considered too expensive and 37% because they expected that it would not be granted due to income variability and lack of collateral. Understanding access and use of credit at household level provides insights into the drivers and constraints for business development.

This chapter investigates the factors that influence access to credit. It intends to make three contributions to our understanding of financial market segmentation in Nicaragua. First, it provides empirical evidence of the determinants of differential access to finance. This complements the existing literature – that is mostly focussed on credit use – with additional insights on factors that influence access to credit. Second, we assess the occurrence of financial market differentiation based on LSMS (2005) household data that are robust in terms of the number of observations and permit an empirical assessment of differences in credit use correlated with household, firm, and loan characteristics.[17] Third, we look at the institutional structure of Nicaragua's financial market and try to identify how differences in borrowing conditions and interest rates are related to the monopolistic power of financial agents.

[17] *The Nicaraguan Enterprise Survey only provides data on credit that are mainly based on self-reporting and therefore focus on perception measurements.*

This chapter is organized as follows: section 2 provides a summary of available evidence regarding the causes and consequences of financial market segmentation. Section 3 presents an overview of the Nicaraguan financial system and the access to finance for different types of firms. Section 4 outlines the data sources, explains the methodology for robust estimations, and defines the key variables used in the empirical part of our research. Section 5 presents the results of the econometric model simulations and identifies the key factors that influence credit segmentation. Finally, section 6 presents the conclusions regarding the institutional causes for the limited credit availability in Nicaragua and indicates some possibilities for pro-poor finance strategies.

2 | Financial market segmentation

The large body of literature regarding the linkages between financial market development and economic growth agrees on the fact that limitations in access to finance are detrimental for achieving broad-based development. Major constraints for getting access to finance include both demand-side factors (like remote geographical location, absence of collateral and high costs) as well as supply side factors (lack of appropriate products and services, and requirements for minimum solvability balances).

Credit supply and demand

Different structural and behavioural factors may explain credit constraints. At the supply side, credit access is mainly limited due to asymmetric information that makes it difficult for banks to provide loans to resource-poor households without a proper collateral (Aliou and Zeller, 2001; Bebczuk, 2009; World Bank, 2012b).

The lack of registered and legal property titles (on houses and/or land), the high costs for business formalization and inadequate institutional support mechanisms are, among others, key limitations that prevent financial institutions from reaching out credit to a larger segment of MSME-households. Consequently, high interest rates are charged to account for default risks and to enable strict loan evaluation and monitoring.

At the demand side, high risk investment portfolios and high borrowing costs are limiting household engagement with credit operations (Garegnani, 2006). Entrepreneurs prefer to engage into businesses with a low risk profile and high profit prospects. However, given the lack of access to credit and the high interest rates for MSME loans, some are tempted not to take any risk at all and refrain from credit (Bastiaensen and Marchetti, 2011).

Furthermore, small and informal enterprises have problems in meeting the many accounting and administrative requirements. Credit demand may therefore become too demanding if borrowers have to spend a considerable amount of time and money without having the certainty of getting credit at the end of the process.

Economic theory suggests that prices adjust in order to meet market equilibrium, enabling credit supply to equal credit demand. However, credit markets largely differ from other markets, since excess demand will meet unbalanced supply. According to Stiglitz and Weiss (1981) this can be explained by the direct relationship between the interest rate and the risk of loans, in the presence of imperfect information on borrower characteristics. Since the interest rate (price) affects the nature of financial transactions, a market equilibrium may not occur, and credit rationing becomes the rule. This implies that banks restrict credit availability through price and other rationing mechanisms. In addition, no uniform price is registered, and multiple interest rates may coexist in different credit market segments.

Financial markets

Financial markets are characterized by different types of formal and informal lenders that offer differentiated credit contracts to specific borrower segments, usually involving mechanisms designed to internalize transaction costs and to reduce risks and information constraints. Figueroa (2011) outlines a useful theoretical and empirical framework for predicting that credit markets basically function on the basis of collateral requirements and rationing mechanisms. High spread between deposit and loan interest rates is an indication of limited market integration. Credit market segmentation starts with differences in asset ownership. Differences in assets and collateral are even more important than the assessment of the quality or feasibility of the project and creditor history. In addition, the characteristics of borrowers and their mutual connections (social capital) are likely to be more important determinants for the likelihood of collateral commitments and loan protection compared to simple loan and lender characteristics (Ayyagari, Thorsten, and Demirgüç-Kunt, 2007).

Credit rationing takes place within segmented financial markets. Small-scale firms principally borrow funds at the informal financial market (usually at high interest rates), whereas larger firms can obtain funds in the formal market and at lower tariffs. In some cases, larger firms that access credit in the formal market might convey (part of) the loan to smaller firms at a higher interest rate, thus taking advantage of interest arbitrage (Le, 2012). This may further reinforce financial market segmentation trough differentiated interest rates charged to specific types of clients.

Bank competition

Coexistence of supply- and demand-side drivers of credit constraint has serious implications for the structure of the financial sector and the operations in the real economy (World Bank, 2012b). If lending costs are high, entrance of financial agents is severely constrained, and few banks can exercise monopolistic power. In such setting, demand for loans becomes volatile to interest rate variations, thus firms' expenditures and investments have to be mainly self-financed. Firms confronted by these financial constraints tend to adopt measures to cut spending on employment, innovation and marketing, and may reduce capital investments as well (Campello, Graham, and Harvey, 2010). This will eventually lead to constrained productivity and further contraction of production capacity.

On the other hand, Love and Martinez (2014) and Leon (2014) show that more competition in the banking system reduces the cost of finance and could increase the availability of credit. In such competitive markets, the probability that firms apply for a loan and banks do not turn down their application becomes higher. Banks will have more incentives to invest in information acquisition and are therefore building up long-term relationships with their borrowers. Additionally, better cost management structures and lower risk of borrowers defaulting on their credits could be achieved. In a similar vein, it could be argued that a banking system with more effective competition, credit information sharing, and a higher branch penetration can be helpful also to reduce the informality of enterprises and contributes to a lower spread in interest rates and a reduction in transaction costs.

At an empirical level, there is no consensus on how to measure 'access to finance'. Different researchers have relied on a wide variety of data sources and different methodologies to identify which households or enterprises have access to financial services. For example, whereas Love and Martinez (2014) measure credit constraints by determining the number of people actually using credit, Leon (2014) also looks at the potential demand for credit compared to actual supply as a better measure to determine the lack of financial services. This implies that a firm or household is classified as 'constrained' if demand for credit cannot be fulfilled by the existing supply of credit due to risks or market imperfections.

Regarding data sources to assess access to credit market, Beck, Demirgüç-Kunt, and Maksimovic (2003), Kumar and Francisco (2004), Tejerina (2004) and Schulhofer-Wohl (2004) use household-level data as a proxy for finance for micro and small enterprises, based on the assumption that MSMEs in developing countries are to a large extent household (self-employment) business activities. This has also been applied by cross-country studies on differences in access to financial services that are based on household surveys data (Peachey and Roe, 2004; Claessens and Tzioumis, 2006). An interesting common finding from these studies is that only access to consumer credit appears to be widening, whereas access to production and investment credit generally remains highly segmented.

3 | Access to finance for Nicaraguan firms and households

According to the composite indicator of access to finance, only 6% of the Nicaraguan adult population has regular access to banking and financial services (World Bank, 2010a). The country is positioned at a very low level even compared to other nations with a comparable income status. In 2012 the total number of bank branch offices reached 311. In terms of coverage or financial breadth (e.g. bank branches + ATMs), the indicator for the Nicaraguan banking system reaches 2.61 service points per 100,000 inhabitants. The country is still far below the Latin American average (23.5 service points per 100,000 inhabitants).

A recent assessment reports, however, some gradual improvement in access to finance in Nicaragua (SIBOIF, 2013). Some progress is made with the creation of private credit bureaus

and the rapid enlargement of the microfinance sector. While the Nicaraguan banking system has undergone significant institutional reforms[18] since its new beginning in the 1990s, many structural challenges regarding the scarce mobilization of internal savings and the limited allocation of resources to the financial sector remain to be addressed (World Bank, 2012b).

The structure of the financial sector

Nicaragua's financial system is dominated by international banking groups and ownership is extremely concentrated compared to neighbouring countries. Most of the financial services in Nicaragua are provided by formal banking institutions (commercial banks and finance companies) and a whole range of quasi-formal nonbank institutions (like microfinance institutions, insurance companies, other financial agents). Table 3.1 shows that more than 90% of the financial system assets correspond to the formal banking sector, followed by the microfinance agencies as second most important segment that represents approximately 5% of financial assets. Insurance companies, bonded warehouses, securities trading agents, stock exchange companies and central bank depositories account for the remaining 6%. The aggregate financial sector controls a total portfolio of US$ 4.5 billion that is equivalent to 69.5% of GDP.

Table 3.1 | Nicaragua´s financial system (assets in US$; December 2010)

Financial Entities	US$ million	% GDP	% system
Banks	4,189.7	63.95	92.09
Microfinance	233.5	3.56	5.13
Insurance companies	108.3	1.65	2.38
Bonded warehouses	11.6	0.18	0.25
Securities trading	4.4	0.07	0.10
Stock exchange	1.7	0.03	0.04
Central depository	0.3	0.01	0.01
Total	**4,549.5**	**69.44**	**100.00**

Note: Information on microfinance institutions affiliated to the Nicaraguan Association of Microfinance Institutions (ASOMIF).

Source: Authors' estimate using World Bank (2012) data based on SIBOIF and ASOMIF information.

Three large banks (Banco Proamerica, Banco Lafise and Banco de America Central) are in command of more than 70% of assets, loans and deposits of the financial system. Together with two intermediately sized banks (Banco de Finanzas y Banco Ficohsa), the five major banks together control 90% of the market. Moreover, the securities market in Nicaragua is one-dimensional since practically all securities (96%) are issued by the government. These figures provide already an important indication of the dominant position of the financial services sector in the Nicaraguan economy as they account for more than two thirds of the country's GDP.

[18] *The financial liberalization during the 1990s consisted of eliminating interest rate control and eliminating the participation of state banks. In addition, the SIBOIF (Superintendency of Banks and Financial Institutions) was created to regulate the financial system.*

On the other hand, the microfinance industry in Nicaragua includes a diverse set of institutions that can be classified into three groups: (i) commercial banks and finance companies that offer small and micro loans (supervised by SIBOIF); (ii) for-profit microfinance companies and microfinance by non-governmental organizations (NGOs); (iii) credit unions and financial cooperatives. These together are called microfinance institutions (MFIs) that share a focus towards the lower end of the borrower spectrum, even while serving a large variety of clients.

Credit unions tend to be rather small atomized institutions that lack expertise and scale to operate in a cost-effective manner. The microfinance sector attained a loan portfolio that accounts in 2013 already for 16.7% of total financial system assets (as compared to 11% in 2003).[19] However, this rapid expansion of the microfinance sector has not been accompanied by a regulatory structure and MFIs are currently facing severe stress with respect to their sustainability. In addition, the microfinance sector has also been deterred by the lack of transparent governance, legal constraints and unfavourable external market conditions such as the global financial crisis of 2008.

Credit portfolio

Loans to the commercial sector amounted on average to almost 36% of the total credit portfolio in 2012/13 (SIBOIF, 2013; see Figure 1). The remaining share of loans was directed to other key activities, namely productive credit (14% for agriculture and livestock, and another 15% for industry loans and corporate investments) and 35% of credit is devoted to consumptive purposes (i.e. mortgage, personal loans, credit cards and extra personal[20] loans). Roughly one-third of all loans were thus allocated to individuals and households and another one-third of loans went to short-term commercial operations (usually loans to natural persons supported by physical collateral).

Current regulations for evaluating and classifying credit risk in Nicaragua give banks and finance companies discretion in how to evaluate and classify loans.[21] This allows excessive risk-taking on the one hand and overly tight credit rationing on the other hand. Banking institutions could technically classify a US$25,000 loan to an entrepreneur as 'consumer lending', for example, just by authorizing an increase in the borrower's credit card limit based on a relatively simple assessment of the borrower's cash flow and credit card repayment history. Such credit could also be classified as a commercial loan, for which banks often require collateral guarantees and apply strict documentation requirements.

[19] *During 2008-2011, the Nicaraguan microfinancing crisis (Movement No Pago – Do not pay movement) led to a considerable reduction of credit. The net reduction of portfolio was – 52% of private MFI. This is the reason of the slump showed in table 3.1*

[20] *"Extra personal loans" are loans that banks provide to clients who cannot pay the debts on their credit cards.*

[21] *Resolution N° CD-SIBOIF-547-1-AGOST20-2008.*

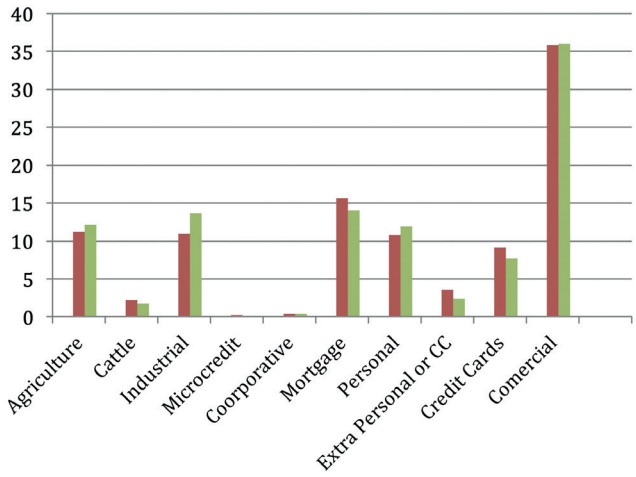

Figure 3.1 | Credit supply by sector (in % of loan portfolio; 2012 (red) and 2013 (green))
Source: Author's analysis based on the "Informe del Sistema Financiero Nacional" (SIBOIF, 2013)

Note that commercial loans are sometimes also avoided by larger firms in order to overcome limits on leverage.[22]

Personal loans account for only a small share of total bank credit. Understanding how trends in the provision of these loans have affected the development of small- and medium-size firms is difficult due to limited available information on the use of loans. However, SIBOIF (2013) collected data on the size of household loan portfolios provided by different financial institutions. All banks and most other financial companies presented data for the period 2008 to 2011. While the total loan portfolio of supervised financial institutions changed very little in this period, SMSE lending contracted slightly in the wake of the global economic slowdown but has since recovered and became somewhat higher in the 2011 portfolio.

Demand for financial services

The universe of Nicaraguan firms includes a considerable number of informal and unregistered production units. Fortunately, the Social Security Institute (INSS) has tried to track a larger number of small-scale firms. The large majority of Nicaraguan firms operate informally: 82% do not pay taxes and 90% of the Nicaraguan firms are not even registered in the Unique Tax System (BCN, 2011).[23] Amongst the formal firms, small and micro enterprises account for more than 93% of the total number of units, while medium-sized and large firms only represent slightly more than 7% (Table 3.2). In terms of employment generation, the latter sectors are far more important.

[22] *Larger corporations generally have more alternatives to (short-term) debt, for example by issuing bonds or raising quasi-equity.*

[23] *In terms of accounting, 90% of Nicaraguan MSMEs do not keep records of their operations, 9% maintain some basic records and only 1% maintain formal records (BCN. 2011).*

Taking into consideration the significance of the informal sector of the Nicaraguan economy, a study based on information from household income and expenditures sources (LSMS, 2005) can be considered more representative and robust for analysing the determinants of access to finance than one based on data from enterprise surveys with far more limited coverage.

Table 3.2 | Formal and informal enterprises in Nicaragua

Formal Businesses (INSS)	Number of firms	Number of firms %	Number of employees	Number of employees %	Main financing sources
Large	1,133	0.4	396,750	52.4	Local and international banks
Medium	2,390	0.8	125,393	16.6	Private banks and cooperatives
Small	12,913	4.5	156,304	20.6	Some private banks and cooperatives
Micro	35,824	12.4	78,502	10.4	MFIs, NGOs and financial companies
Informal	237,000	82.0	n.a.	n.a	NGOs, informal lenders, credit cards
Total number of businesses	289,260	100.0	756,949	100.0	

Source: Authors' analysis based on INSS (2011)

Financial segmentation

Nearly 25% of micro-businesses report that access to finance is considered a major constraint, but Nicaraguan banks are not willing to lend more to this segment of the economy. This may be either due to constraints in credit availability (due to low savings mobilization) or because lending to the small-scale and informal sector is considered too risky.

In addition to these market-related factors, another reason for limited loan supply might be related to institutional constraints. Nicaragua's banking system lacks rigorous competition and thus banks are hardly compelled to engage into this informal market segment and tend to avoid engagement into markets that require making investments in client-tracking technology and/or specialized outreach staff. Other current deficiencies in the financial sector infrastructure, particularly related to the lack of credit information sharing (i.e. on defaulting clients) and inefficient systems for securing unmoveable property (i.e. cadastre system[24]) also create significant barriers to lending operations.

[24] *There are in Nicaragua several types of property titles and the cost of determining and certifying ownership can be onerous. The operations of the Real Property Registry are inefficient, and its information is often outdated and not integrated with cadastral data. Improving information and certainty about land tenure is critical for enabling access to finance for smallholders that only have land as their valuable asset for collateral purposes (World Bank, 2012b).*

Moreover, current regulations create uncertainty about how to evaluate and classify loans and thus tend to hinder financial deepening (Federación Latinoamericana de Bancos -FELABAN, 2011). Consequently, financial institutions and other providers of financial services refrain from offering credit to the SMSE/household segment and rely on prohibitively high interest rates and complicated regulatory requirements (that lead to high transaction costs) to discourage credit demand.

The deposit distribution shows an extreme focus on a few clients, as 85% of the portfolio of deposits in Córdobas belongs to 4% of the customers universe, while 85% of dollar deposits is held by 14% of the customers (BCN, 2011). Another limitation of the depth of the financial sector is the relatively scarce availability of credit funds for medium- and long-term loans, since half of all deposits are pegged to a 12-month term of indenture.

4 | Data and methods

Most studies on access to credit in Nicaragua rely on data drawn from the Enterprise Surveys conducted in 2006 and 2010 or on micro-household data from the LSMS (2005). The main constraint of the Enterprise Surveys is that they only focus on registered enterprises and do not provide consistent data on informal firms, despite the enormous size and importance of the informal sector in the Nicaraguan economy. Therefore, the Enterprise Survey measurement of credit use and availability is rather limited. In contrast, the LSMS dataset covers a large sample of households and the questionnaire design is closely linked to the objective of assessing finance for self-employment activities.[25]

Thus, the rationale for using the information from household surveys rather than enterprise surveys in this study is based on two reasons: (i) the lack of sufficient information in the Enterprise Surveys to undertake a detailed analysis on the use and allocation of credit, and (ii) the lack of information concerning the decision-making criteria for the demand of credit by micro, small- and medium-size enterprises in Nicaragua. In addition, LSMS data is used because it has national statistical representativeness in all geographical regions of Nicaragua (Pacific, Central and Atlantic), as well as in rural and urban areas.[26]

Estimation approach

For the development of our analytical framework, we relied on other studies that include data and methodological approaches for distinguishing between credit supply and use motives, using both bank-level and household data. Earlier studies on credit demand focused either on bank-level supply data (Bernanke and Blinder, 1992), on bank lending

[25] *According to the LSMS (2005), the request for credit are is highly influenced by the family context, and this influence is so great that it is very difficult to separate business management from the household economy. According to the BCN (2011), micro enterprises are usually owned by households. A relatively large number of MSMEs can be found in the capital city of Managua (34.1%), while the remaining 65.9% is in the rest of the other 16 departments of the country.*

[26] *INIDE (2007) General Household Survey Report for measuring the standard of living.*

survey data (Hempell and Sorensen, 2010), or on firm-level credit use data (Kashyap, Stein, and Wilcox, 1993). The latter analyses recognize the impact of high interest rates on the demand for finance.

Moreover, since we also want to test for the role of bank concentration on the segmentation of the credit market, household-level data can be used to assess institutional impediments to welfare improvement (as shown by Kruger, 2007, Narvaez and Meza, 2010 and Chica, 2007).

Microeconomic theory supposes a certain functional form – in line with Marshallian demand theory – that describes consumer preferences and tastes, assuming these are complete, transitive and continued (Nicholson et al, 2002).[27] Therefore, to study the determinants of household demand for credit, an analysis of opportunities (income) and preferences based on individuals' choices and the measurement of their satisfaction (utility) has to be performed. These analyses should be compared to the amount consumed in a given basket of commodities. This inquiry is represented by the utility function.

The choice of how much credit to demand is given when the utility function interacts with the budget constraint (i.e. the total available income – or wealth – to buy different goods in the basket). Thus, in a maximization process, the optimum consumption point for credit in the expenditure pattern can be analysed.

According to Nicholson and Snyder (2011), the usual approach for solving such constrained maximization problem is the Lagrange multiplier. This involves a mathematical method for welfare optimization that can be used in a variety of economic circumstances. We start by setting up the following Lagrangian expression:

$$\mathcal{L}=U(x_1,x_2,...,x_n)+\lambda(m-P_{X_1}-P_{X_2}-P_{X_3}-...-P_{X_n}) \quad (1)$$

where the parameters of the model are defined as follows:

x: is a decision variable which defines the amount of credit.
P: represents the interest rate.
m: represents the income.
U: is the set of loans.
$\mathcal{L}$: represents the Lagrange multipliers.

Following the Lagrangian method ($\mathcal{L}$), a utility function $U(x_1,x_2,...,x_n)$ is subject to a budget constraint $(m-P_{X_1}-P_{X_2}-P_{X_3}-...-P_{X_n})$. This is usually considered as the primal problem, where the optimal consumption of each good $x_1^*,x_2^*,.....,x_n^*$ allows the consumers to obtain the greatest possible satisfaction given their income. Hence, the optimal consumption of credit is a function of income and the price of capital respectively (Nicholson and Snyder 2011).

[27] *Following the usual axioms of rational choice.*

Furthermore, it is assumed that the amount consumed by each individual passes through an iterative process for maximization of utility. Therefore, the optimal consumption of any good is prearranged by the primal problem. This relies on the patterns of consumption where individuals reveal their utility function and therefore their preferences, given their income and the prices of all the goods in the basket. These consumer preferences allow us to estimate the parameters of the model. In other words, the model utilizes the consumer surplus and the revealed preferences to observe the utility functions indirectly and calculate the welfare changes that affect consumer satisfaction with respect to shifts in prices or income.

The LSMS survey contains relevant information on consumption and access to finance. It presents information for rural and urban households and it also reveals the amount of a loan that an individual household obtained from a given source. It also reflects the interest rate of the loan, which represents the price of the good (Stiglitz and Weiss, 1981). This allows us to estimate the Marshallian demand function we need for our analysis.

From the Cobb-Douglas utility (U) function,

$$U=x_1^{\alpha}x_2^{1-\alpha} \tag{2}$$

where x is the amount of loan and α is the constant return to scale, the following Marshallian demand function can be derived:

$$x_1^* = \frac{\alpha m}{P_{X_1}} \tag{3}$$

where x_1^* should represent the optimal consumption of credit, α is the constant return to scale, m is the individual's income and P_{X_1} is the price of the good or interest rate. This function can be linearized by using its natural logarithm and is estimated through an ordinary least square (OLS) methodology (Villa, 2004).[28] Furthermore, we can include individual client variables, such as area of residence, sex and age, among others, as a procedure for capturing the structural environment of the household, as well as to reflect the individual background and household composition into the empirical analysis (Demirgüç-Kunt and Maksimovic, 2012; Guiso, Sapienza and Zingales, 2006).

Once the Marshallian demand and the optimal consumption functions are estimated, a method for assessing changes in welfare is employed, based on the analysis of consumer surplus variations (Beck, Demirgüç-Kunt, and Maksimovic, 2005). The consumer surplus reflects the difference between what consumers should pay for the amount of the loan and what they actually pay on the credit market. The change in this surplus is based on the difference between the initial surplus before the price change, and the final surplus after the price change.

[28] *In the case of using a Cobb Douglass production function equivalent, the parameter "A", referring to total factor productivity (TFP) is also included, but with OLS linearization its estimates are ceteris paribus.*

The variation in the consumer surplus (VCS) is calculated with the mathematical theory on integrals for the initial and final rates:

$$VCS = \int_{P_{initial}}^{P_{final}} x_i^* f(m, P_{X_i}) dP_{X_i} \quad (4)$$

Where: $\int$ is the integral, x_i^* is optimal consumption, m is individual's income and P_{X_i} is the price of the good. The dP_{X_i} at the end of this expression indicates that it is P_{X_i} (and not m) that is varying.

The Marshallian demand function estimation allows us to calculate the price of credit (or interest rate) and income elasticity of demand for credit. This provides insight into the sensitivity of credit use subject to changes in prices or income, respectively. The income elasticity gives evidence of the type of good (preferred, inferior, etc.).

The price elasticity reflects the sensitivity of demand with respect to price movements and illustrates the degree of monopolistic power at the credit market: the lower the price elasticity, the greater the monopolistic power of the credit provider tends to be. This also explains why a rise in the interest rate may not be converted into a decline in the consumers' request for credit. In this study, we consider that the monopolistic power is the ability of a lending institution to fix the interest rate. To test for the presence of credit monopolistic power (MP) in the credit market, the Lerner index[29] (i.e. the relationship between elasticity and price margins for a profit-maximizing firm) is modified so that the maximum value could be 1 and not infinite.

Hence, the following equation is used:

$$MP = \frac{1}{1+|\in_{pd}|} \quad (5)$$

where $|\in_{pd}|$ is the absolute value of the elasticity of demand for credit.[30]

In summary, the Lagrangian model is used as the main empirical framework to estimate the effects of supply and demand factors on access to finance. In addition, the Cobb Douglas and the Marshallian demand functions are used to analyse demand elasticises in terms of monopolistic power of Nicaraguan financial institutions.

[29] *The Lerner index measures the monopolistic power of a given firm by calculating the excess in price that is charged to consumers, taking the perfect competition assumption (P=MgC) as benchmark. The index is thus an approximation of the price elasticity: a value close to 1 represents high power concentration.*

[30] *The Lerner index measures the monopolistic power of a given firm by calculating the excess in price that is charged to consumers, taking the perfect competition assumption (P=MgC) as benchmark. The index is thus an approximation of the price elasticity: a value close to 1 represents high power concentration.*

Controlling for selection bias

The problem of selection bias is present when working with data from non-random samples (Heckman, 1979). Within the framework of consumer theory, it is assumed that the problem with selection bias is caused by the auto-selection process in the individual's decision whether to borrow or not. If the individual obtains a loan, the survey reflects information on the credit amount and the interest rate. But if the individual decides not to request a loan the survey does not indicate whether the individual was possibly interested to obtain credit but his/her willingness to pay for the credit was finally below the market interest rate. Effective credit use is based on the comparison of the reserve rate (which is the price he or she is willing to pay) and the prevailing market interest rate.[31]

To control for selection biases the most recommended approach is the Heckman method, which consists of estimating two models simultaneously. The first part comprises the use of a probit model where the likelihood of obtaining credit depends on certain intrinsic (individual, firm and household) variables; the second (OLS) model explains the amount actually borrowed (according to the aforementioned socioeconomic variables as determinants of Marshallian demand). This permits to control for biases stemming from reverse causation and omitted variables.

Hence, in line with Heckman (1979), the inverse Mills ratio is introduced as a variable to the loan amount in the OLS model to eliminate selection bias. This also takes into consideration the fact that a person may not have obtained a loan even if the income and other requirements to acquire a loan were met. With the purpose of attaining the variance of the regressions in the first stage of this process, the model of the loan amount and the probit model are estimated simultaneously by using the maximum likelihood method (Greene, 2003). Consequently, the variances of the regressions can be adequately estimated.

Data

Since the first LSMS publication in Nicaragua in 1993 and subsequent publications in 1998, 2001, 2005 and 2009, the sections have not changed to any great extent. The main information provided by the surveys include: housing characteristics, utilities, demographics, health, education, economic activities, basic food consumption, income and household assets. However, the latest survey conducted in 2009 did not include a credit section. Therefore, in this study we use the LSMS (2005) survey data.

[31] *One drawback found in section IX of the 2005 LSMS is the lack of a question requesting whether or not the individual has applied for credit. Instead, the following question is used to filter respondents: "In the last 12 months, did any of the household members receive a loan from an institution, company or individual?" Therefore, the analysis of the determinant of the probability that the person potentially wants credit requires another variable.*

The LSMS 2005 survey included a sample of 6,882 households and 36,612 people nationwide. Accordingly, this allows us to extrapolate the results to 5,142,098 million people represented in the last Nicaraguan census published in the same year. The main LSMS sections used in this study are: section II (on composition and characteristics of households), section V (economic activities), and section IX (access to credit).

Household and Firm characteristics

Whether or not a firm obtains credit is usually analysed as function of the firm characteristics (firm size, age, machinery, assets, land). However, other enterprise properties (such as gender, legal status and number of bank relationships) are not frequently used. We include these control variables into the probit model that considers as its independent variable the question "whether or not credit was obtained".[32] To determine some causes for differences in the likelihood of obtaining a loan once having applied for one, access to credit is subsequently used as the main outcome variable (in the OLS regression). However, the LSMS dataset does not include detailed information on the economic performance of the borrower.

We therefore relied on a methodology for scaling the dependent variables between the 0 and 1 levels (Leitner and Stehrer 2012):

$$y_i^* = \chi_i' \beta + e_i \qquad (6)$$

where the likelihood to obtain a credit is a latent variable, y_i^* is determined by a set of observable characteristics χ_i'. and e_i is the disturbance term,

Then the following holds:

$y_i = 0$ if $y_i^* \leq \lambda_o$
$y_i = 1$ if $y_i^* > \lambda_o$

With 0 not receiving a credit and 1 receiving a credit, and λ_o as an unknown parameter that will be estimated together with β. The control variables reflect collateral requirements.

This is important because borrowers with insufficient internal funds and no collateral may face considerable credit constraints from the banking sector and therefore need to look for other external sources (Leitner and Stehrer, 2012).

[32] *The value of the probit coefficients is difficult to interpret; hence we derive the function and focused on the parameter sign. We interpret the signs as an indication of the direction of causality and compare them to our a priori formulation.*

The key purpose is to highlight correlations between access to credit and credit supply conditions as well as debtor demand attributes. Therefore, the following set of explanatory variables at household level are used: gender (Sex), whether or not the person lives in a rural region (Rural), age (Age and Age squared), years of education[33] (Educ), number of people living in the home (Fam. Size), distance from home to the road (Distance in km.), monthly household income (Income), marital status (dummy for single or married). For the loan characteristics, we rely on the variables loan term (Maturity), collateral (assets) and interest rate (in %), and dummies for the sources of loans (Private Banks, Cooperatives and NGOs).

Descriptive Statistics

The LSMS (2005) was conducted nationwide and Table 3.3 presents the descriptive statistics used in our analysis.

Average credit demand of an individual is C$4,897, whereas monthly household income equals C$ 5,589. This suggests that credit flows to a large extent might be devoted to household expenses. Interest rates show a large spread, with an average rate of 17.5%. Regarding maturity, most loans are short-term and provided for a period less than a year.

Many variables exhibit a high degree of variability, so the proposed model has to consider possible credit market segmentation caused by the credit-providing institutions. Within this portfolio, 58% of all loans were delivered in urban areas, and 52% of the loans were delivered to women, although this differs by area of residence. For example, in rural areas 60% of bank loans and 54% of informal credit were allocated to men.

Only 25% of the total households in Nicaragua received at least one loan during the year, mainly taken by the head of the household. The loan portfolio by source (see Appendix A) indicates that over 50% of all credit received were obtained from informal sources (i.e. friends, family, merchants or moneylenders), followed by 30% of loans provided by financial institutions (including cooperatives and microfinance agencies). On the other hand, the participation of private banks in the household loan portfolio reached only 5%. This provides strong evidence that household access to formal credit is severely restricted. Regarding credit use (see Appendix B), 37% of loans are for household consumption (home expenses) and 28 % of credit was used for primary production (materials, business investment and purchase of vehicles or machinery). The remaining 35% was channelled to emergencies or illnesses, housing, or purchases of household goods. Most credit to males was used for agricultural expenses, whereas women asked more credit for merchandise business.

[33] *It is considered that the basic technical requirement for education is to have at least eight years of formal study. For the average technical level, the period is nine years of formal education, for senior technicians 12 years, for university level 16 years, and for masters and doctoral levels 17 years and 22 years respectively.*

Table 3.3 | Individual, household and loan characteristics (Descriptive statistics; N= 36612)

Indicator	Mean	Std. Dev	Min	Max	Units of Measurement
Credit demand	4,897	18,675	0	501,000	Cordobas
Interest rate	17.57	12.33	5.00	86.12	Percentage
Household Income	5,589	9,588	8.33	329,332	Cordobas
Education	5.45	4.63	0	23	Number of years
Maturity	0.87	0.73	0.01	5	Number of years
Collateral	0.53	0.49	0	1	Dummy (1=house owner)
Age	40.45	13.85	21	95	Number of years
Marriage	0.6	0.49	0	1	Dummy (1=married)
Distance	43.29	89.06	0	650	Km
Household size	6.05	2.87	1	21	Number of members

Source: Authors' calculations based on the LSMS (2005)

Finally, the use of credit is also related to transaction costs. Lowest transaction costs (defined as: registered expenses and commissions) in absolute terms are charged for credit for home goods purchases. Conversely, in percentage terms of the amount invested agricultural activities and business expenses face highest costs (see Appendix C). This is due to the fact that returns to investments from these activities are less certain and also depend on external conditions (climate, economic stability, etc). Consequently, banks require detailed insights in asset reserves and entrepreneurial capacities of the borrower, using information formats and personal meetings.

5 | Results

We estimated the Marshallian demand function for credit derived from consumer theory (equation 3), using different functional form specifications. The dependent variable is the natural logarithm of the loan amount received and was conceived as a function of the interest rate (considered as the price for credit) and the income of the individual (in natural logarithm). The two coefficients are always significant at 0.1% as expected, as shown in Table 3.4.

A positive elasticity in the case of income and a negative elasticity for the interest rate are registered. The magnitude of the (in)elasticity parameter for both differed substantially, with higher values for the income variable.

In the first model specification, an increase in interest rates causes an (expected) reduction in credit demand, which is, however, less than proportional to the amount of credit provided. This represents an advantage to the credit providers. For the income elasticity, a parameter of 0.49 was found, while the interest elasticity is -0.26. Hence, the credit response is more sensitive to income than to the interest rate.

This specification disregards that possible differences in individual characteristics (e.g. age, education, gender, residence) and borrowing attributes influence credit demand. It implies that all differences in demand are channelled through differences in household income. Disadvantages for women to obtain credit are thus the result of their lower salaries. In a similar way, differences in education and area of residence are reflected by income differences.

In the second model, with the explicit inclusion of individual socioeconomic variables, the price and income elasticities of demand become lower and thus more inelastic. Therefore, when including these socioeconomic variables and loan characteristics, price elasticity of credit demand shows less responsiveness.

The variable of maturity (loan period) and the dichotomous variable of whether or not the household has collateral now appear to be highly significant. Maturity had the largest coefficient of all the variables introduced and attained the expected positive sign. This suggests that longer loan terms are usually related to requests for a higher loan amount (i.e. investment capital).

The collateral variable is highly significant and reflects a positive effect on the demand for credit. It is important to notice that with the inclusion of socioeconomic variables, the demand elasticities of price and income are reduced. However, none of the individual and household characteristics (apart from income) show significant impact on the amount of credit that is requested. This seems to suggest that most credit rationing takes place from the supply side (using different lending conditions) and that financial agencies pay little attention to intra-household variation.

For the third and the following model specifications, a two stage (Heckman) procedure for the estimation of credit was implemented, the first stage relating to the probability of obtaining credit and the second stage identifying the variables explaining the loan amount.[34] The inverse Mills ratio (ath-rho and ln-sigma) were introduced in these models to identify self-selection. It shows significance at the 5% interval, rejecting the hypothesis that there is no self-selection problem in the model. Therefore, the two-stage specification with correction for self-selection is applied in the subsequent models to correct for selection bias.

Table 3.4 | Determinants of demand for credit (Heckman regression results)

Variables	Dependent variable = amount of credit (OLS analysis)				
	1	2	3	4	5
Ln (Interest Rate)	-0.262***	-0.094**	-0.098**	-0.098**	-0.148***
	(-6.96)	(-2.68)	(-2.83)	(-2.82)	(-4.11)
Ln (Income)	0.489***	0.433***	0.397***	0.397***	0.410***
	(11.75)	(10.8)	(9.48)	(9.49)	(9.85)
Sex		0.006	0.061	0.066	0.033
		(0.07)	(0.79)	(0.82)	(0.41)

[34] *This refers to the method of obtaining the maximum likelihood parameters.*

Education		0.003	-0.017	-0.017	-0.014
		(0.39)	(-1.54)	(-1.55)	(-1.26)
Rural		0.068	0.087	0.084	0.059
		(0.8)	(1.01)	(0.96)	(0.67)
Age		0.03	-0.032	-0.033	-0.026
		1.86	(-1.19)	(-1.21)	(-0.94)
Age2		0	0	0	0
		(-1.18)	(1.53)	(1.55)	(1.23)
Collateral		0.360***	0.353***	0.353***	0.167
		(4.3)	(4.25)	(4.25)	(1.81)
Ln (Maturity)		0.636***	0.640***	0.639***	0.655***
		(13.42)	(13.65)	(13.62)	(14.06)
Ln(interest rate)*Private Banks					0.099***
					(4.09)
Ln(interest rate)*Cooperatives					0.116***
					(3.71)
Ln(interest rate)*NGOs					0.076*
					(1.69)
Constant	5.795***	4.549***	7.434***	7.465***	7.138***
	(14.86)	(9.35)	(6.65)	(6.68)	(6.25)

Probit analysis (likelihood of obtaining credit)

	1	2	3	4	5
Income			0.000***	0.000***	0.000***
			6.22	6.23	6.15
Sex			-0.095*	-0.095*	-0.096*
			(-2.49)	(-2.49)	(-2.51)
Education			0.040***	0.040***	0.040***
			8.93	8.93	8.92
Age			0.130***	0.130***	0.130***
			17.1	17.09	17.1
Location			-0.037	-0.037	-0.036
			(-0.85)	(-0.85)	(-0.84)
Age2			-0.001***	-0.001***	-0.001***
			(-15.09)	(-15.09)	(-15.09)
Distance			-0.001***	-0.001***	-0.001***
			(-5.00)	(-5.01)	(-5.01)
Married status			-0.277***	-0.277***	-0.275***
			(-6.41)	(-6.42)	(-6.33)
Household Size			-0.036***	-0.036***	-0.036***
			(-4.94)	(-4.91)	(-4.89)
Constant			-4.483***	-4.484***	-4.485***
			(-25.75)	(-25.75)	(-25.74)
Ath-rho			-0.589**	-0.596**	-0.519*
			(-3.01)	(-3.05)	(-2.50)
Ln-sigma			0.017	0.02	-0.025
			0.20	0.23	(-0.30)
Chi-squared	0.228	0.429	454.105	454.187	486.832
R-squared					
Observations	28258	28258	28258	28258	28258

*Note: * p<0.05, ** p<0.01, ***p<0.001, Standard errors in brackets*

The probit models show high significance for almost all socioeconomic household variables (except location), even when the income effect was considered. For example, higher age shows an increased probability of accessing credit (but it also exhibits significant diminishing returns for the age-squared variable). The number of people living in the household negatively affects the probability of accessing credit. The gender variable shows a negative sign, meaning that women are less likely to gain access to credit. Another result presented by the model is that for those living in a rural area the probability of obtaining credit is not directly lower, but the selection for the distance variable (from home to the nearest road) reduces the possibility of obtaining credit. As might be anticipated, the more education an individual has, the greater the possibility of getting credit. However, it should be noted that a higher level of education usually entails that the individual is older. Similarly, the marriage condition also absorbs certain effects of the age variable. In these models, the price elasticity is relatively stable and household income shows a considerable effect on the amount of credit.

Whereas individual and household characteristics now play a key role in the likelihood of obtaining credit (initial selection of clients), they still appear with limited incidence for the amount of credit that is provided. This may point to the importance of age, education and gender for being accepted as a client, but – once accepted – the household should respond for the full amount of the loan through the accumulated income flows of all members.

Regarding the age variable, an additional remark can be made. Age positively influences the likelihood of obtaining credit. Results show that for each year of age an individual advance, the chance of obtaining a loan increase by 13%. This represents a challenge given the population composition in Nicaragua. According to the World Bank (2012b), 53% of the population is below 25 years old (30% aged 4–14 years old and 23% aged 15–25 years old). The relationship observed in the model shows that as an individual grows older, (s)he tends to face better access to the credit market.

In the fourth model, we include individual income to test whether this matters for model outcomes. The results show that price elasticity for credit demand is relatively stable as compared to model 3 in which household income is included. This suggests that financial institutions do not consider household incomes but rather individual incomes since requests for loans are usually done individually.

Finally, in the fifth model credit supply conditions from different financial agents are differentiated. This permits to address specific barriers to entry for households for accessing certain financial market segments. There are four types of financial agents in Nicaragua[35]:

– Formal private institutions (commercial banks and micro-financial institutions),
– Cooperatives and credit associations (rural credit unions, producer associations and cooperatives),

[35] *Government loans were also included in the data. This was the clientelist "Usura Cero" program with aid from Venezuela. Due to the fact that the interest rate in this program was zero, we excluded the government in the further analysis.*

– NGOs or social projects and
– Informal private lenders (informal credit lines, neighbours, friends, traders, etc.).

Interestingly, the coefficient on collateral requirements now loses its significance. Outcomes indicate that the demand for loans from cooperatives is least interest sensitive. The price elasticity is highest for the private informal lenders (the reference category).

For a further understanding of these credit rationing mechanisms, it is important to look at both supply- and demand-side motives (as well as their mutual relationships). At the supply side, Nicaraguan financial institutions tend to offer a restricted array of services. The requirements to get access to those services ask for substantial security (collateral) provisions. For this reason, only more wealthy or medium-income households can get credits at acceptable cost from formal banks. In addition, other financial institutions might attend also some of the poorer households that have the capacity to present formal collateral requirements, but these poorer households tend to prefer less-binding borrowing conditions because of the fear of losing their properties (World Bank 2012b). In this case, it is the subjective risk averseness of the borrower that constrains credit use.

In addition to wealth-based credit rationing, interest rates represent another important supply-side constraint. Interests rate can become prohibitively high, especially for informal lending during pre-harvest periods. Bank interest rates are usually in line with expected returns on investments, but microfinance agencies tend to charge high interest rates in order to reduce credit demand and overloading. In practice, however, this led to a portfolio of clients and projects with relatively high risks. In Nicaragua, after the initial wide appreciation for MFIs offering finance to low-income clients, the resistance is growing against the payment of high interest rates, as demonstrated by the Nicaraguan "*No Pago*" movement (Bastiaensen and Marchetti, 2011).

There is a further supply-side constraint related to the maturity of loans. If most lending is for covering operational business costs, loans tend to be relatively short-term. Consequently, loan recovery could be done from other income sources not directly related to the investment (like off-farm income, remittances or asset sales).

Therefore, repayment capacity for such short-term loans is strongly related to individual characteristics of age, education and residence that explain the likelihood of generating regular income streams. As indicated before, demand side variables to a large extent influence credit use. Given the high degree of informality in the Nicaraguan economy, most loans are for personal or commercial purposes. Informal enterprises are not registered legally as businesses and the household finance of their owners and other (extended) family members are often intertwined with personal expenses.

Informal businesses have scarce documentation on revenues and expenditures and lack basic accounting systems. Thus, credit officers have to compose their financial statements based on assumptions and inferences about the mixed set of activities. In the absence

of credit surveillance mechanisms, reliance on individual attributes provides most useful insight in creditworthiness.[36] Education is particularly relevant as proxy for financial literacy.

Finally, credit demand is likely to be rationed by directly observable variables like location (remoteness), household size (dependency rate) and age (experience). While location provides an indication for access to markets, household size refers to the family life cycle and the availability of labour force. Age provides insight in work experience. Together, these variables provide useful indications on the payment capacity of the household.

Financial market segmentation

From the Marshallian demand function, we can extract the price elasticities of credit from different financial institutions and thus identify their relative power position. Credit demand is fragmented and we want to identify barriers to entry for households. We examine the same four categories:

- Formal private institutions
- Cooperatives and credit associations
- NGOs or social projects
- Informal private lenders.

Based on this segmentation, we calculated the monopolistic power using the methodological approach stated in equation (5).

Table 3.5 | Price elasticity and monopolistic power of Nicaraguan financial institution

Financial Institutions	Price elasticity	Monopolistic power
Private/formal banks	-0.049***	0.95
Cooperatives & Credit unions	-0.032****	0.96
NGOs/social projects	-0.072	0.93
Private/informal	-0.148***	0.87

*Note: * p<0.05, ** p<0.01, ***p<0.001*

Source: Authors' calculation based on the LSMS (2005)

Results of this calculation show that most financial agencies in Nicaragua can exercise significant monopolistic power. Formal private lenders face more price-inelastic demand compared to informal credit providers, and therefore banks (and even microfinance agencies) can usually exercise greater monopolistic power.

[36] *Several private credit bureaus and the public credit bureau managed by the SIBOIF are operational, but data on debtors with amounts overdue are not available. MSMEs find it hard to comply with the full set of International Financial Reporting Standards (IFRS), which are mostly conceived for larger enterprises.*

The fact that all segments of lenders possess monopolistic power suggests that there is hardly any competition amongst institutions, since they attend different segments of clients.[37] Nicaragua's financial sector is highly segmented and has an oligopolistic structure.

These findings are different from De la Torre's (2012) study of 45 banks in 12 Latin-American countries, characterizing the degree and determinants of bank involvement in credit operations. He found that the competitive pressure faced by private banks is one of the main factors for explaining why some have moved aggressively and in a sustained fashion toward new types of customers. This competitive pressure is largely absent in Nicaragua. On the other hand, cooperatives and credit unions are more closely tied to their basic stakeholders; hence they demonstrate greater economic commitment to the provision of credit to their constituency.

As outlined before, one of the most important determinants of the amount of credit requested is the interest rate. In line with the demand law, we observe that higher interest rates tend to reduce the amount borrowed. This is further reinforced by differences in distance as an important factor in whether households borrow or not. Moreover, most consumers only have few options to choose, given that microfinance agencies and banking institutions have limited instruments for client screening and thus rely on rationing through high interest rates and complicated procedures.

The empirical finding on significant borrowing constraints is congruent with our analysis that the returns and operating margins of credit providers (especially private banks) are particularly high in Nicaragua, also compared to the rest of Central America. Except for the period 2009/10, when these institutions were adjusting to stricter loan classification norms issued by the SIBOIF, Nicaraguan banks have been the most profitable in Central America.

Nicaraguan banks have consistently earned a high return on assets (ROA) despite being among the most inefficient banks in the region (Central American Monetary Council - CAMC, 2015). While administrative costs have recently come down, they remain the second highest in Central America (as seen in appendix D). High returns among Nicaraguan banks have been driven by greater margins. There is a trend toward high implicit interest margins, which represent the percentage difference between interest income on loans and interest expense on deposits. The interest margin in Nicaragua (12.6% in 2011) is substantially higher than that of neighbouring countries and it is one of the highest implicit intermediation margins in Central America (CAMC, 2015 as seen in appendix E). The fact that Nicaraguan banks are able to maintain such high profitability levels implies that they can maintain inefficient operations and face few incentives to invest in new product development, such as information technology, risk management techniques, or staff training programmes (World Bank 2012b).

[37] *This provides support for the fact that the Herfindahl Hirschman Index (2011) of Nicaragua (estimated at 2.588) is far beyond the critical level of concentration (0.18). (Morales & Canales 2016).*

Estimation Fitness

The models presented initial problems with heteroskedasticity and functional form specification. For this reason, and in order to retain significance, the robustness was enhanced using the robust standard errors approach[38]. In addition, the functional specification challenge was addressed by using a quadratic function to return the data to their original scale. The interest rate and income variables remained as linear functions in a logarithmic form for theoretical and mathematical reasons.

Despite the fact that a negative log-likelihood does not have a probabilistic interpretation, a numerical optimization for the parameters was used until it met values that minimized the negative log-likelihood of the data set. Hence, if the errors are normally distributed, then the maximum likelihood is virtually identical. According to theory, there may be variation in some estimates, but these are usually trivial, especially if sample sizes are sufficiently large. It is important to note that the variables' fitted values are consistent, and their density distributions are normal, as shown in Appendix F.[39]

6 | Conclusions and implications

The analysis carried out in this chapter confirms that limited access to finance is still an important constraint for economic development in Nicaragua. Both demand and supply side factors contribute to low borrowing and investment levels. At the supply side, different types of credit are offered by formal, semi-formal institutions and informal agents (relatives/friends) at different interest levels and under varying contractual conditions (size and maturity). This leads to segmentation of the financial market. At the demand side, individual differences in income, wealth, background and experience (in terms of age, education, location, marriage status, etc.) further reinforce the differentiation with respect to the likelihood for obtaining a loan.

Credit market segmentation in Nicaragua is essentially based on imposing strict collateral requirements and prohibitively high transaction costs (information provision) that respond to differential risk profiles of borrowers. Consequently, given these asymmetric information constraints, most loans are small in size and provided under rather short-term conditions.

The lack of information about the ability of debtors to pay back the loan is compensated by reducing the maturity of loans (shorter lending period) which at the same time results in a reduction of the loan amount. This credit ´rationalization´ can lead to investment levels far under the optimum value, thus affecting the growth perspectives of, in particular, small- and medium-sized firms.

[38] *The White standard robust error method uses a covariance matrix estimator which is consistent in the presence of heteroskedasticity.*

[39] *The fitted values and the bell-shape of density distributions demonstrate that the assumptions of linear regression are met; hence, our results are statistically robust/consistent.*

The high monopolistic power of financial institutions in Nicaragua suggests that there is little to no competition within the sector, leading to relatively high interest rates as a key mechanism for credit rationing. This supports the earlier reported findings by Love and Martinez (2013) and Leon (2014) stating that competition should be in place to reduce the costs of finance. However, in Nicaragua this competition is still limited, and credit screening costs remain high, thus reinforcing institutional foundations for credit market segmentation.

Credit provided by banks (formal institutions) is mainly allocated to the segment of large farms, firms and business-oriented households. Semi-formal institutions (MFIs, NGOs and cooperatives) focus their credit lines more towards the segment of medium-sized farms and firms and small-scale (family) business operations. Credit provided by informal agents (relatives and friends) usually falls within the short-term framework for consumption smoothing as a financing mechanism used by the majority of poor Nicaraguan households. Whereas limited scale of operations, lack of adequate client information and regulatory bottlenecks are typically raised by financial institutions as key impediments for lending from the supply side perspective, complicated loan application procedures, high fees and interest rates, and excessive collateral requirements lead to high transaction costs and important barriers to borrowing from the demand side.

This paper breaks from the literature that focusses on credit segmentation based only on market failures, and points – in line with Stiglitz and Weiss (1981) – towards structural and institutional limitations related to the demand for finance and the allocation of credit in Nicaragua. Our analysis provides evidence on how (observable) firm and household characteristics are conditional for acceding different lending channels. Given differences in income, individual factors may reduce the willingness to borrow and tend to constrain the likelihood of applying for loans. This attitude is directly related to household risk-aversive behaviour which is further reinforced through the high interest rates that financial agents charge. The latter are therefore far less the outcome of market forces (e.g. there is hardly any excess demand for credit) but are created through self-selection from rather shallow market segments at the supply side.

In policy terms, this implies that the Nicaraguan financial system needs more competition and that the current segmentation between financial agencies and amongst clients is not functional. Current high demands for collateral and guarantees regarding income provide a double guarantee to the repayment capacity and tend to reduce potentially viable credit demands. Better use can be made from other procedures to guarantee trust and reliability, like the previous credit history or the risk-taking capacity of the household.

Finally, it is important for future research and policy making to consider actions that can have a significant impact on the functioning and integration of the Nicaraguan credit market in the short term. Therefore, it would be a meaningful first step to require banks to report on loans that have been repaid on time, and to adjust the disclosure requirements regarding credit interest rates, thus contributing to greater transparency that can foster market competition regarding credit regimes. Subsequent measures related to the establishment of credit rating agencies and looser requirements for foreign banking operations could also be helpful to reduce the institutional finance market constraints.

4

Gender segregation and income differences in Nicaragua*

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Abstract

Despite having higher average education levels than men, Nicaraguan women still earn much less than men. Furthermore, the country has one of the highest levels of occupational gender segregation in Latin America. This paper aims to explain gender income differences in Nicaragua, taking into account individual characteristics, engagement in specific occupations and sectors, and geographical location. Using a multilevel framework, we find that a considerable part of the income gap can be explained by women's employment in occupations and sectors with low remuneration, while another substantial part of this gap is attributable to a person's sex – so cannot be explained by human capital factors. These results imply that women's progress in breaching the gender stereotypes is still limited. In addition, understanding labor market segregation is vital for comprehending the perseverance of the gender income gap.

Keywords Labor market segregation, gender inequality, income, Nicaragua.

1 | Introduction

In almost all societies women are still earning less than men. Explaining this difference has been an important challenge. Traditionally, lower female incomes were ascribed to their lower education and shorter work experience. Women's (assumed) preferences to stay at home for the children led to shorter careers, less experience and lower investment in education (Becker 1991; Mincer and Polachek 1974). Yet, next to these individual characteristics, explanations have also been sought in job attributes such as occupations, job level, and firm size. Many authors have found that occupational segregation, or the fact that women tend to work in other jobs than men, is an important reason for their lower earnings. Women tend to work in occupations that are on average lower paid. This may be the result of "preferences", in turn possibly determined by social norms or practical constraints, or of discrimination or exclusion by employers (Blau and Kahn 1996; Coelli 2014; Cohen and Huffman 2003b; Solberg and Laughlin 1995). Furthermore, occupations dominated by women may suffer from undervaluation as a result of cultural norms about values of men's and women's work (Baron and Newman 1990; Karamessini and Ioakimoglou 2007; Nelson and Bridges 1999).

Thus, occupational segregation may be related to fewer job opportunities and lower incomes for women. This situation prevents women from developing their skills and from being able to break the poverty trap. Moreover, labor markets and overall economic performances of countries are strongly related (World Bank 2013b). The effectiveness with which a country's labor market allocates the supply of workers (across sectors, geographic areas and education levels) with firms' demand for workers (across occupations and skill levels) can enhance productivity. Conversely, labor market inefficiencies lead to suboptimal use of human resources, occasioning lower returns and income generation.

By 2006, Nicaragua had the largest gender income gap in Central America (World Bank 2012c). A large part of the labor force works in the informal sector, and women are overrepresented in this sector (Tinoco and Agurto Vílchez 2003). Female ownership of agricultural assets, participation in agricultural activities and use of credit, are all quite low. In addition, the gender segregation by occupations is one of the highest in Latin America (Monroy 2008). Nicaragua is therefore an interesting case to study the relationship between occupational segregation and the gender earnings gap.

This study aims to investigate the effect of a range of relevant factors on income differences between men and women in Nicaragua. We examine the effect of type of income (formal versus informal sector), of occupational segregation, and of branch of activity and region on earnings differences. We use the 2009 Living Standard Measurement Survey to identify the population in working age and their incomes.

In order to examine the effect of job or labor market characteristics next to that of individual characteristics on the gender earnings gap, most studies use individual data. However, these models assume that there are no relationships between factors at the

individual level and factors at aggregate levels. This may result in biases, for example when investments in human capital are influenced by the work environment or when work in certain occupations is undervalued (lower paid) due to discrimination.

This study uses multilevel models to explore gender segregation by occupation. Although multilevel models have been applied earlier for examining the effect of occupational segregation (Cohen and Huffman 2003a; Cohen and Huffman 2003b; Haberfeld, Semyonov, and Addi 1998), to our knowledge this method has not been applied yet for explaining the gender income gap in developing countries.

2 | Explaining the gender income gap: literature review

Traditionally, social scientists have explained the gender income gap by pointing to differences in productivity. According to Becker (1991), the fact that women stayed at home to care for their children led to comparative advantages for men in the labor market. Women have lower human capital as a result of the opportunity costs of children (Mincer and Polachek 1974). Expecting a shorter career, women were also assumed to invest less in formal education. Lower education and less work experience resulted in lower productivity and thus in lower wages. Later, researchers also began to adjust differences in pay levels for job characteristics such as occupations, job levels, firm size and types of industries (Plantenga and Remery 2006). If women turn out to receive lower salaries even at the same job type and job level and with the same human capital features as men, this was considered discrimination.

However, it is not so easy to determine the actual level of discrimination. On the one hand, there may be unobserved productivity differences between men and women leading to an overestimation of discrimination (Plantenga and Remery 2006). On the other, it is necessary to look at the reasons why women and men are occupied in different types of jobs. This occupational segregation may be a result of different preferences, but more likely these "preferences" are caused by gendered norms or practical constraints, like the need to combine paid with unpaid work. In addition, segregation may be due to the fact that women are excluded from higher paying sectors and jobs ("crowding"), or that jobs that are mainly performed by women attract lower wages as a result of cultural norms ("devaluation") (Gunderson 1989, Huffman 2004). In all these cases, the extent of discrimination will be underestimated.

Many empirical studies found that a large part of the gender pay gap can be explained by women working in occupations or sectors with lower salaries (Baron and Newman 1990; Blau and Kahn 1996; Espino 2013; Groshen 1991; Solberg and Laughlin 1995). Tam (1997) concludes that if controlling for specific occupational training this difference in pay between occupations disappears. However, England et al contest this (England, Hermsen, and Cotter 2000). When adding general education as control variable they find, with exactly the same data, that the sex composition of jobs does matter.

For Australia, Coelli (2014) found that contrary to other studies on this country, occupational segregation does explain part of the gender pay gap, but he concludes that this finding is influenced by using a more disaggregated occupational structure. Kim and Shirasase (2014) found that higher gender wage gaps in Japan and South Korea than in Taiwan are due to both more occupational segregation and more within job inequality.

A further question is whether the penalty for female dominated jobs is more severe for women in these jobs. Budig (2002) found that men are earning more in jobs dominated by women but also in jobs dominated by men or jobs with an even distribution (Budig 2002).

On the other hand, Cohen and Huffman (2003a) and Huffman (2004) find that there is more gender wage inequality in jobs dominated by women. Some authors have explored one possible explanation for this, namely that women tend to be overeducated for jobs while men are more often undereducated. Johansson and Katz (2007) find that this is indeed the case for Sweden, especially in the private sector. The part of the gender pay gap that is explained by this "skill mismatch" is about the same as that explained by industrial segregation, and larger than the part explained by human capital factors (Johansson and Katz 2007).

Espino (2013) finds that next to labor market segregation (by occupations and sectors), the over education of women and under education of men also explain part of the wage gap in Uruguay. This implies that gender wage inequalities may persist despite higher education levels for women, because women tend to have lower returns to education. This also seems to be the case in Brazil, where the unexplained part of the gender wage gap is higher at higher levels of education (Ben Yahmed 2018).

Yet studies, and in particular comparative ones, also found that there is a third factor of influence on gender inequality in wages, and this is the general wage structure. This general wage structure is determined, for example, by supply and demand factors, technological developments, and labor market institutions (Plantenga and Remery 2006). Blau and Kahn (1996) compared several western countries and found that more wage inequality in general leads to higher gender wage gaps. In another study, these authors found that the rewards for skills and employment in particular sectors have a huge effect on the gender income gap in the US (Blau and Kahn 2000).

Over time, the share of the wage gap that can be explained by human capital factors has decreased in most western countries, while the share due to segregation and the particular wage structure has increased (Goldin 2014; Plantenga and Remery 2006). Goldin (2014: 1097) points out that the remaining wage gap in the US is mostly due to differences *within* occupations, and only for between 22 and 30% a result of occupational segregation.

Common explanations for the pay difference within occupations are discrimination or women's lower ability to bargain or lower desire to compete. However, she argues that there is a more important explanation, and this is based on the observation that the gender gap

in hourly wages widens with age and is much larger in some occupations and sectors than in others. In the corporate, financial and legal sectors, for example, the number of hours worked is remunerated highly and, in these occupations, and sectors women continue to suffer from a child penalty. This again points to the relevance of the institutional structure of the labor market.

A further, fourth, factor that may influence the size of the gender wage gap is the geographic location or the regional labor market (Gunderson 1989). Kee (2006) includes geographical variables as controls in an analysis of wage gaps in Australia, but the effect of adding them on the wage gap is limited. Cohen and Huffman (2003a) examined the effect of regions in a multilevel framework and found that if the local labor market is more integrated (meaning that there is less occupational segregation), wages in female dominated occupations are higher, but only for men. Yet, average wages in more integrated labor markets also proved to be higher, so women also benefit from this.

In conclusion, several factors have proved to be important for empirically explaining the earnings gap between men and women. First there are individual human capital related factors such as education and experience, second there are factors related to type of job, occupation, and sector, third, the general wage structure and institutional factors may be of influence and fourth, there may be differences by geographical location. All these factors can be expected to play a role in the gender earnings gap in Nicaragua. Nevertheless, it is unlikely that they can fully explain the gap as cultural factors and discrimination will probably also plays a role.

3 | Earnings differences in Nicaragua

Nicaragua is the highest ranking Latin American country in the Global Gender Gap index of the World Economic Forum, achieving a sixth rank overall (World Economic Forum 2017). The country scores well on the indicators included for health (relative life expectancy and sex ratio at birth) and in political representation. In education, female enrolment in all types of education is higher than male enrolment.

Over the past decades, women's educational achievement has grown faster than men's, but the level is still low. In 2006 women had on average 7.5 years of education while men had 6 years (World Bank 2012c: 24). Furthermore, the illiteracy rate among women is still above that for men. The female labor market participation has increased steadily over the years. According to modeled estimates of the International Labor Organization, it increased from 39 percent in 2000 to 47 percent in 2010 and then to 50 percent in 2016. However, this contrasts with around 85 percent for men.[40]

[40] *World Bank, World Development Indicators Database, accessed 9 February 2018.*

The increases in education and in labor force participation have hardly been accompanied by a change in gender norms on paid and unpaid work. According to the 2008 Latinobarómetro survey, more than half of both men and women in Nicaragua think that women should only work if the income of the household is not sufficient (OIT et al. 2013: 92-93). No matter whether women are engaged in paid work, they still have the main responsibility for reproductive activities. Furthermore, they suffer from sexual harassment and violence at work, while traveling to and from work, and often also in the household (Prieto-Carrón 2014).

Bradshaw (2013) examines the role of income versus ideology in decision-making power in households based on a large number of interviews in one rural and one urban low-income community. Ideology, that is, traditional gender norms, prove to play an important role, and they also influence the decision to participate in the labor market. Especially in rural areas gendered norms on household work are strong. Engaging in paid work is seen as "helping men". Almost half of the urban women see paid work as an opportunity for becoming less dependent, but they indicate that the absence of childcare is a severe constraint.

This background influences the labor market choices of women. Most Nicaraguan women work in the tertiary sector (Table 4.1). All branches of economic activity in which women are overrepresented (based on 2005 data) are in the tertiary sector, in particular Education, social services and health, where the female share is 71 percent, Communal, social and personal services (share of 70 percent), and Commerce, hotels and restaurants (53 percent). In terms of numbers, the third is quantitatively most important, occupying 35 percent of all women on the labor market, as compared with 19 percent working in communal and personal services, and only 11 percent in education and health (Monroy 2008: 11). To the extent women work in the secondary sector they are often employed in the Special Economic Zones, implying that their jobs are precarious with high levels of uncertainty, low wages, and severe health and safety risks (Fernández-Pacheco 2006; Prieto-Carrón 2014).

Table 4.1 | Distribution of the Economically Active Population by Sector and Sex (in %)

Sectors	Primary	Secondary	Tertiary	Total	Share in employment
Male	41	12	47	100	63
Female	7	15	78	100	37
Total	40	13	46		100

Source: Authors' Calculations based on the LSMS (2009)

Like in other Latin American countries, women are overrepresented in the informal sector (Chant & Pedwell 2008). Although work in this sector may give more flexibility, for example for combining productive and reproductive activities, it also brings higher job insecurity, lower wages and lower quality of other working conditions. In addition, the gender income gap is larger in the informal sector than in the formal sector (Chant and Pedwell 2008, OIT et al. 2013).

The definitions of what constitutes the informal sector vary, however. Sometimes the emphasis is on the lack of regulation, so absence of taxes and of social security, and in other cases it is defined by the size of the firm, with own account workers and workers in firms of up to five employees being included.

According to the Nicaraguan Social Security Institute (INSS 2011), and combining both definitions, the informal sector covers 80.6 percent of total employment in Nicaragua. Using data from Living Standards Measurement Survey (LSMS) and operationally defining informal sector as the persons working in domestic services, in small enterprises and as self-employed, Tinoco and Agurto Vilchez (2003) show that the size of the informal sector has increased from 52 percent in 1985 to 62 percent in 2001, and that women are overrepresented in this sector.

The World Bank (2012c) found that Nicaragua, Guatemala and El Salvador registered the highest levels of informality in the Central American region around 2006, of almost 60 percent. In all these countries, women were overrepresented in this sector. This reflects serious barriers for women for accessing the formal sector (see also Gamboa, D'Angelo and Kries 2007).

As in other Latin American countries, the earnings gap between men and women is larger in the informal than in the formal sector in Nicaragua (Fernández-Pacheco 2006; Monroy 2008:15). Fernández-Pacheco (2006) also shows that the gender income gap in Nicaragua increases with age in both the formal and the informal sectors.

For Latin America in general, the gender income gap has decreased over time. The relative income of women as compared to men increased from 59 percent in 1990 to 76 percent in 2000, and then further to 78 percent in 2010 (OIT et al. 2013). A similar trend is visible in Nicaragua. For non-agricultural incomes, women earned on average only 56 percent of men's hourly income in 1993, and this increased to 69 percent in 1999 (Fernández-Pacheco 2006). Monroy (2008) calculated the gender earnings gap in Nicaragua by computing the ratio of hourly male and female wages based on the Living Standard Measurement Survey (LSMS) of 2005. She found that men earn on average 19.8 percent more than women (implying that women's relative income increased to 83 percent). There are large differences by occupation and by sector. In agriculture and fisheries, the income gap is largest, while it is smallest among unskilled workers.

While Nicaragua proved to have the largest gender income gap by 2006, the country also has the highest sectoral gender segregation in Central America (World Bank 2012c: 22). In particular, the level of occupational segregation is one of the highest in Latin America (Monroy 2008). The Duncan Index[41] calculated in Monroy's study uses the classification of occupation and industrial activity.

[41] *Duncan Index of Occupational Segregation is defined as the percentage of female workers who would have to change jobs to equalize the occupational distribution (Duncan and Duncan, 1955).*

It proves to be 68 percent in the 3-digits classification, indicating that in order to achieve gender parity in the distribution of occupations and industry groups, 68 percent of workers would need to change jobs. Interestingly, the occupational segregation is much less at higher levels of education. While the Duncan index is 71 percent for workers with only primary education, it is 39 percent for workers with a university degree. It also varies by age, with higher segregation levels at higher ages, but the differences are much smaller than in the case of education (Monroy 2008: 13).

Previous studies that have attempted to decompose the gender earnings gap in Nicaragua (Enamorado, Izaguirre, and Ñopo 2009) use a matching procedure for this decomposition, based on Ñopo (Ñopo 2008). When controlling for area, education, head of household, marital status and occupation, women still earn less than men. This unexplained part of the earnings gap proved to be 16 percent. Hoyos and Ñopo (2010), cited in World Bank (2012c) used the same method in order to decompose the gender earnings gaps in Central America. After controlling for age, education, presence of children in the household, presence of another wage earner, urban/rural location and occupation, they find that Nicaragua had the largest unexplained part of the gender earnings gap, at 20 percent.

Although the studies carried out so far throw some light on the extent of gender income inequality, its sectoral variation and its components, they do not provide an in-depth analysis of the effect of individual characteristics like education and age on male and female incomes. More importantly, there is no systematic analysis yet of the effect of gender segregation in occupations and industries on the gender wage gap. We aim to analyze all these possible determinants of the gender earnings gap.

In line with the previous studies on Nicaragua our first hypothesis is that after controlling for individual characteristics such as education and age, women's incomes will be lower than men's incomes. Second, and in keeping with Monroy's (2008) finding that the unadjusted income gap in Nicaragua is smallest for unskilled workers, and Ben Yahmed's (2018) conclusion for Brazil, we assume that the unexplained gender income gap will rise with education. Third, the gender income gap will vary according to type of income (whether a person is employer, dependent wage worker, self-employed or cooperative member). In particular, we expect that the gender income gap will be larger among informal sector workers.

Fourth, we expect that part of the gender income gap can be explained by occupational segregation: wages are lower when the share of women in an occupation is larger. Fifth, we expect that, in line with Cohen and Huffman (2003a), the gender income gap will be larger in occupations with a larger female share. Finally, we expect that location (region) and sector (branch of activity) are of influence on incomes, and also on income differences by sex. These are hypotheses six and seven.

4 | Analytical approach and data

The gender income gap is usually conceptualized as the difference between male and female hourly wages as a percentage of male wages. In order to isolate the gender effect from other factors explaining differences in wages, like human capital factors or job characteristics, a dummy variable can be included in a standard wage regression. In most studies, the gender pay gap is analyzed by estimating male and female wages separately and then decomposing the difference into an explained and an unexplained part.This method follows Oaxaca (1973) and Blinder (1973) and is therefore called the Oaxaca-Blinder decomposition. While in the early studies human capital factors only were included, later studies also included characteristics related to occupation, type of jobs, sector or firm size (Gunderson 1989; Plantenga and Remery 2006).

In order to capture the effect of the labor market structure, researchers have used the Juhn-Murphy-Pierce decomposition (Juhn, Murphy, and Pierce 1991).These authors decompose the gender pay gap difference between countries into four components. Next to inter country differences in observable characteristics and in relative positions of men and women in the wage structure after controlling for measured characteristics, gaps can also be explained by inter-country differences in returns to observable and unobservable characteristics (Plantenga and Remery 2006: 62).

In all these studies, factors related to type of job or type of industry are measured at the individual level in the same regression analysis, implying that variables at aggregate level were combined with individual level variables. However, individual features may be influenced by factors at a higher level such as occupation and industry. This may produce biased significance tests because standard errors could be discrete. For these reasons, researchers have proposed multilevel or hierarchical models for estimating the effect of occupational segregation (Haberfeld, Semyonov, and Addi 1998; Cohen and Huffman 2003a; Huffman 2004).

The first uses of hierarchical models were in the field of education where they tried to link the academic performance of students not only to individual variables such as hours of study and family environment, but also to the context of the school in which they were enrolled (Burstein 1980; Leeuw 2011). They attempted to solve several limitations imposed by the neoclassical econometric models, especially those derived from the assumption that observations are independent and identically distributed. For example, considering all classmates as independent subjects even when they share a teacher and other experiences together in the educational process is not realistic.

Multilevel models are very effective for assessing cross-level interaction effects, like the interaction between teacher effects and individual variables or, as in our case, between individual features and the gender composition of occupations. The reason is that they simultaneously estimate micro- and macro level models (i.e. individual level wage models and job-level equations).

The regression coefficients corresponding to the association between individual level characteristics and wages become the dependent variables in the job level model. This also has the advantage of estimating the micro level model separately for each job. Hence, hierarchical models can eliminate possible problems that stem from correlated error terms resulting from nested data. They do so by using corrected standard errors (Bryk and Raudenbusch 1992; Guo and Zhao 2000; Hox 2002). Therefore, multilevel models explicitly consider the hierarchical data structure and allow both micro- and macro-levels to be represented simultaneously in the same model without erring on the assumption of independent observations.

The present study attempts to identify the effect of occupational segregation on male and female incomes by adding a second level of analysis. In addition, we examine the effect of branch of economic activity (industry) and region in addition to the effect of occupational segregation, by adding a third level that represents either region or branch of activity.

The Model

We start with a set of Mincerian equations to examine all possible factors that may influence income. In these equations, sex is a dummy variable and we include dummies for type of income. In separate models we include interaction terms for sex and education, and for sex and type of income, in order to test hypotheses 2 and 3.

The general model at the individual level (level 1) is

$$Inc_{ijk} = \beta_{ojk} + \beta_{1jk} Sex_{ijk} + \beta_{lijk} X_{lijk} + u_{ijk} \quad (1)$$

Inc_{ijk} is the logged income of person i in job j and sector k, and β_{ojk} is the Level-1 intercept. β_{lijk} is the re gression coefficient associated with gender, which represents the average income difference between men and women in job j and sector k. X_{lijk} is a set of l control variables at the individual level, for example education and age, but also type of income and the above-mentioned interaction terms, and β_{1jk} are the associated regression coefficients. Because all the individual-level independent variables except sex are grand-mean centred, β_{ojk} is the predicted logged income of a man with mean values on all the control variables. Finally, uijk is an error term, assumed to be normally distributed with a mean of zero and variance σ^2.

In order to assess the effect of occupational segregation, a second level is added in which the level 1 intercept, β_{ojk}, and the coefficient for the sex dummy, β_{1jk}, are allowed to vary across occupations. They are modeled as the outcomes of equations (2) and (3).

$$\beta_{ojk} = \alpha_{ook} + \alpha_{o1k}\ Pctage\_women_{jk} + average\_education_{jk} + \in_{ojk} \quad (2)$$

$$\beta_{1jk} = \alpha_{1ok} + \alpha_{11k}\ Pctage\_women_{jk} + \in_{1jk} \quad (3)$$

As before, β_{ojk} is the average income for occupation j in sector k, and α_{ook} represents the average income for all occupations in sector k. *Pctage _women*$_{jk}$ is the percentage of women in occupation "*j*" and sector "k", as a measure of occupational segregation, and α_{o1k} is the marginal effect of segregation on male income in occupation j and sector k. If hypothesis four is true for men, this coefficient should be negative. On this second level, one control variable is added namely the average education level of occupations, *average_ education*$_{jk}$. This can be expected to influence incomes as well, over and above individual education levels. β_{1jk} is the effect of being a woman on occupation j and sector k on income. α_{10k} represents the average effect of being a woman on income in sector "k". α_{11k} is the marginal effect of an increase in female occupancy on the income gap between women and men in sector "k". If hypothesis 4 is true for women, we should find that the sum of α_{o1k} and α_{11k} is negative. Furthermore, if we find that α_{11k} is negative, hypothesis 5 is true: the gender income gap increases with occupational segregation. $\in_{ojk}$ and $\in_{1jk}$ are level 2 errors terms.

On a third level, we allow α_{ook} and α_{10k} to vary across sectors (branches of activity) or regions.

$$\alpha_{ook} = \gamma_{ooo} + \varphi_{ook} \tag{5}$$

$$\alpha_{10k} = \gamma_{10o} + \varphi_{10k} \tag{6}$$

γ_{ooo} is the average income for all economic activities, and γ_{10o} is the average female income for all occupations and all sectors. φ_{ook} and φ_{10k} are the level 3 errors. At this level we do not include interaction terms. This means the relevant statistics are the variances of α_{ook} and α_{10k}, as well as the computed percentage of explained variance that this level may add.

Variables and data

The dependent variable is the logarithm of individual income which takes into consideration all payments that are mandatory by national labor law (commissions, vacations, thirteenth month, etc.), as well as the monetized edible goods or any other kind of earning that is given in form of payment, also goods that are taken from own businesses and used for self-consumption. Individual level variables included in the model are those normally used in the Mincer equation: years of education, age and age squared as proxies of experience, sex which is a dummy that takes the value of 0 when the respondent is a man or 1 when she is a woman, and the logarithm of hours worked in a month. We added a dummy for rural versus urban, as this may be important in the Nicaraguan context. Rural incomes are expected to be lower. We also include dummies to distinguish between types of income: whether the respondent is employee, business owner/self-employed, employer or member of a cooperative.

In this study, the category of business owner/self-employed is considered a proxy for gaining an income from the informal sector.[42] In order to test the second and third hypotheses, interactions between sex, education and type of income are added as well. On the job level, the main variables are the percentage of women occupied in a given job as a measure of segregation and the mean level of education within occupations given by the average of years studied among workers in a specific job. Third-level variables include sectors and regions.

We use the LSMS (INIDE 2009) because it has national statistical representativeness in all geographical regions of Nicaragua (Pacific, Central and Atlantic), as well as in rural and urban areas. Since the first LSMS publication in Nicaragua in 1993 and subsequently in 1998, 2001, 2005, and 2009, its sections have not noticeably changed.

The main information provided by the surveys includes: housing characteristics, utilities, demographics, health, education, economic activities, basic food consumption, income, and household assets. However, previous LSMS do not contain the working category variable (employer, worker, self-employed, or cooperative member), so we cannot carry out a comparative analysis over time.

The 2009 Survey covers 6,515 households and 30,432 people nationwide. It allows us to extrapolate the results to 5,763,628 million people represented in the last Nicaraguan census published in 2005. The survey data are adjusted to account for the annual population growth rate of 1 percent.

The LSMS section mainly used in this study is section II on the composition and characteristics of households and employment data. Although more recent employment and gender surveys are available, they do not have national or regional representation signifying a constraint for the development of a hierarchical model.

We use data from the Uniform Occupational Classifier[43] (CUONIC) to define the occupations. The CUONIC was published for the Seventh Population and Housing Census 2005 and based on International Occupational Classification (ISCO-88) standards. For separating occupations, we chose only two digits because they already contain a large number of specific activities.

[42] *In the LSMS 2009 no questions were asked on access to social security or firm size. However, the data from LSMS 2001 show that 98% of the self-employed work on their own or in firms with up to 4 persons. So most self-employed will probably be working in micro-enterprises and/or with no social security.*

[43] *The classifier contains 5 groups or digits; the first digit represents the major groups; the second digit represents the main groups within the major groups and so on until it reaches the final subgroups.*

In one of the analyses, we combine these two digits of occupations with digits representing regions to generate different categories in the same level. The study regards that being an unskilled worker in the Central region where agricultural activities are most important is different from being an unskilled worker in the Atlantic region where fishing activities are dominant.

For branches of economic activity or sectors, we use the 17 sectors as defined in the Classification of Nicaraguan Uniform Economic Activities published by INEC in July 2005. These categories are based on uniform economic activities according to international industrial classification (ISIC), see Annex 1.

Because of the debate about whether hierarchical models can obtain good estimates if using groups that do not have sample representativeness, this study only uses regions with robust statistical representation. The most statistically representative household survey disaggregation was divided into seven regions: rural Atlantic areas, urban Atlantic areas, rural Central areas, urban Central areas, rural Pacific areas (excluding the department of Managua, capital of Nicaragua), urban Pacific areas (excluding the department of Managua) and Managua. Furthermore, each division represents a local labor market context.

5 | Results

Descriptive statistics

As can be observed in table 4.2, the variables with the greatest disparities are income and education showing a high coefficient of variation.

For women and men, despite maintaining the range of wages among occupational positions, men generally are shown to have 13 percent higher income than women, with the largest differential represented in members of cooperatives as shown in table 4.3.

Table 4.2 | Descriptive statistics for individual level variables

Statistic	Income (cordobas)	Education (years)	Age (years)	Sex (1=female)	Work time (Hours per month)
N	10910	10910	10910	10910	10910
Average	3860.576	6.94	37.04	0.37	185.23
Coefficient of Variation	1.224	0.707	0.390	1.299	0.364
Median	2737.714	6	35	0	192
Maximum	80550	23	97	1	392
Minimum	6.666667	0	10	0	4
Range	80543.33	23	87	1	388

Source: Authors' calculations based on the LSMS (2009)

Table 4.3 | Descriptive Statistics for Type of Income

Occupation	Percentage	Average Income	Average male Income	Average female Income	Difference in %
Employee/Worker	36.81	C$ 4,598.43	C$ 4,928.41	C$ 4,188.89	-15%
Laborer/Peasant	11.3	C$ 2,307.40	C$ 2,332.15	C$ 2,074.69	-11%
Employer	1.02	C$ 14,390.54	C$ 15,578.63	C$ 9,564.74	-39%
Self-employed	37.05	C$ 3,305.52	C$ 3,626.72	C$ 2,797.64	-23%
Cooperative Member	0.02	C$ 8,578.34	C$ 9,655.99	C$ 4,880.00	-49%
Family worker with payment	13.67				
Family worker with no Payment	0.13				
Total/Average	**100**	**C$ 3,860.58**	**C$ 4,056.24**	**C$ 3,530.29**	**-13%**

Source: Authors' calculations based on the LSMS (2009) in Nicaraguan Córdobas. 2009 Exchange rate is USD1=20.88COR

Multivariate results

In order to fully analyze all possible factors that influence income, a set of Mincerian equations was executed. The results are presented in table 4.4. To explain differences in the incomes between genders and to test our hypothesis on the relation with segregation, we used multilevel analysis. The results summarized in table 5 show changes in the model's hierarchical structure in order to test occupations, geographical and sectorial differences.

Normally a model for the determinants of income uses hourly earnings as a dependent variable, but it implicitly assigns a restriction on the coefficient associated with hours of work, giving it a value of 1. By taking income as the dependent variable, such a restriction can be checked as shown in models 1 to 10. In none of the models the coefficient takes values close to 1. Instead it is found to be around 0.47, meaning each 1 percent increase in working hours leads to an increase of around 0.47 percent in income. The possible interpretation offered by some authors for finding a coefficient of less than 1 is the presence of diminishing marginal returns.

The variable sex in Model 1 shows that the difference in income between a man and a woman of the same age, education and working hours is 17 percent. For model 2, the same model is performed, but a correction is made for selection bias,[44] and the coefficient rises from 17 percent to 23 percent.

[44] *Even though we are using the LSMS that covers all households, we only consider women that are economically active. Thus, the sample could suffer from selection bias.*

The variables age and age squared are a proxy for the work experience of the individual. As usual, experience has a positive effect on income, while the squared term is negative reflecting diminishing returns. The coefficients are quite stable across the different models. Similarly, the coefficient for the education variable is rather constant; each year of education yielding about 6.1 percent additional income. Incomes in rural areas prove to be about 13 percent lower than urban incomes.

With respect to types of work, the dependent variable is the reference category which embodies employee/worker and laborer/peasant from the occupation categories in Table 4.3. As stated above, we consider the self-employed variable as a proxy for informality. Even if controlled for education and experience, self-employed workers have by far the lowest earnings, which would point to lower earnings in the informal sector than in the formal sector. Nevertheless, these results should be interpreted carefully as informality is also to some extent present among dependent workers.

In models 3, 4, 5, 6, 7 and 8, interactive variables are included to test the relationship between sex and education, and sex and types of income. The coefficient for years of education*sex is not significantly different from zero. This means we cannot confirm hypothesis 2, that the gender income gap is smaller at lower levels of education.

With respect to hypothesis 3, that gender income gaps may vary with type of income, we do find some evidence. All coefficients are negative, indicating that the gender income gap is spread across all occupation categories harming women´s well-being, at least at a 10% significance level. More interestingly, the unexplained part of the income gap remains large when we add information to the model.

In the models that correct for selection bias, the unexplained part of the income gap slightly drops from 23 percent to 19 percent. We can conclude that taking into account possible variations in the gender income gap across types of income is relevant, and that the unexplained gender difference in Nicaragua is large, namely around 20%. The addition of the extra variables also improves the models by decreasing the log likelihood, hence resulting in a better model fit. In models 9 and 10, an interactive variable among education and sex is added again. This slightly lowers the magnitude of the unexplained gender income gap to 17 percent.

Finally, it is worth mentioning that the selection bias correction (rho) only has major significance in model 2; in models 4, 6, 8 and 10 it is only significant at a 90 percent confidence level (as shown in Table 4.4). However, it is also important to highlight that the gender income gap increases by around 4-5 percentage points when correcting for selection bias. This point to a larger gender income difference if we include all women, and not just those women who self-reported to be “economically active”. The model accounts for women whose reserve wage is higher than the market price for labor. This is important because it suggests that segregation reduces productivity in the economy by keeping women away from work.

Table 4.4 | Results of individual characteristics effects on individual income

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Ln (hours)	0.466***	0.467***	0.466***	0.466***	0.462***	0.462***	0.462***	0.462***	0.462***	0.463***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Age	0.051***	0.064***	0.051***	0.065***	0.051***	0.062***	0.051***	0.062***	0.051***	0.061***
	(0)	(0.01)	(0)	(0.01)	(0)	(0.01)	(0)	(0.01)	(0)	(0.01)
Age^2	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Years of education	0.061***	0.062***	0.061***	0.062***	0.060***	0.062***	0.060***	0.062***	0.061***	0.062***
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Sex	-0.174***	-0.226***	-0.175***	-0.234***	-0.141***	-0.186***	-0.142***	-0.186***	-0.122***	-0.169**
	(0.01)	(0.04)	(0.03)	(0.05)	(0.01)	(0.05)	(0.01)	(0.05)	(0.03)	(0.07)
Rural	-0.132***	-0.132***	-0.132***	-0.132***	-0.136***	-0.136***	-0.137***	-0.136***	-0.135***	-0.135***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Employer	0.744***	0.743***	0.744***	0.744***	0.846***	0.845***	0.846***	0.845***	0.846***	0.845***
	(0.09)	(0.09)	(0.09)	(0.09)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)
Self employed	-0.222***	-0.221***	-0.222***	-0.221***	-0.192***	-0.193***	-0.192***	-0.193***	-0.191***	-0.192***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Cooperative member	0.432**	0.432**	0.432**	0.432**	0.478**	0.476**	0.440**	0.440**	0.442**	0.442**
	(0.2)	(0.2)	(0.2)	(0.2)	(0.23)	(0.23)	(0.2)	(0.2)	(0.2)	(0.2)
Years of education*sex	-	-	0	0.001	-	-	-	-	-0.002	-0.001
			(0)	(0)					(0)	(0)
Employer*sex	-	-	-	-	-0.348*	-0.343*	-0.348*	-0.343*	-0.348*	-0.344*
					(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)
Self employed*sex	-	-	-	-	-0.074**	-0.072**	-0.074**	-0.071**	-0.080**	-0.076**
					(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Cooperative member*sex	-	-	-	-	-0.226	-0.211	-	-	-	-
					(0.24)	(0.24)				
Cons	4.240***	3.904***	4.240***	3.898***	4.254***	3.971***	4.253***	3.970***	4.247***	3.989***
	(0.1)	(0.29)	(0.1)	(0.28)	(0.1)	(0.33)	(0.1)	(0.33)	(0.1)	(0.36)
Athrho Cons	-	0.173*	-	0.178*	-	0.145*	-	0.146*	-	0.134*
N	10910	23755	10910	23755	10910	23755	10910	23755	10910	23755
R^2	0.332	-	0.332	-	0.333	-	0.333	-	0.333	-
Log likelihood*-2		47491.20		47491.12		47479.90		47479.98		47479.76

*Figures in parentheses are robust standard errors; ***p<0.01, **p<0.5, * p<0.10. 10 The model included a correction for selection bias. The models used for the generation of the inverse Mills were: Sex, Age, Age2, marital status, years of education, number of people in the household and the number of dependents in the household.*

Continuing with the multilevel analysis, a first model does not include any variable in order to observe if there is a need for hierarchical specification.[45] The intraclass correlation coefficient ICC (rho1 in table 4.5) shows that 33.6 (0.28/(0.28+0.55)) percent of income variation can be explained by differences between occupations, and the remainder, or 66.4 percent, by individual differences. This suggests that a second level is necessary, and 33.6 percent is actually quite a high percentage. The second model takes the second level of analysis further by introducing two second level variables: percentage of women (as proxy of segregation) and average education level.

The coefficient for percentage of women is negative and significant (at 10 percent level), showing that hypothesis 4, that gender segregation leads to lower incomes for men, is true. When summing that coefficient to the one on percentage of women*sex, a negative figure results, proving that this hypothesis holds true for women as well. Furthermore, the coefficient on percentage of women*sex is negative and significant, implying that higher levels of segregation are associated with larger gender income gaps. For example, a ten percent increment in segregation (defined as percentage of women in a specific occupation) results in a 2 percent (-0.002) reduction in the income of females, while male incomes remain the same. This means that hypothesis 5 is also confirmed. A large part of the gender income gap in Nicaragua can be explained by occupational segregation, and women suffer more than men from working in female-dominated jobs.

It is also worth noting that the average level of education in occupations has a large and significant influence on incomes, even after controlling for all individual characteristics and for occupational segregation. Therefore, the relevance of introducing this second level in explaining incomes is also due to the effect of average education per occupation.

The third specification takes into consideration the differences amongst regions as its third level of analysis. This is based on the premise that occupations are not equal between regions due to different labor market conditions. Finally, the fourth model takes as its second level a combination of occupations and regions and incorporates as its third level the economic activities (sectors), assuming that the potential income generation across sectors is not similar.

Model 3 does not add much explanatory value: the change in the X^2 is minimal, and the variance of α_{00k} and α_{01k} are small and zero, respectively. Taking into account all the other variables in the model, the addition of regions only adds 0.4 percent to the explanation of income variations. Hypothesis 6 can therefore not be confirmed.

[45] *The ICC (intraclass correlation coefficient) presents the percentage that is explained by a second level of analysis "level 2"; usually when the value is greater than 10 percent, the use of an explanation of the dependent variable in more than one level is required.*

Table 4.5 | Hierarchical linear models for assessing the effect of gender segregation on log incomes

	Model 1	Model 2	Model 3	Model 4
Variance				
Level – 2				
Var (Intercept)	0.28	0.064	0.066	0.006
% of explained variance	0.337	0.124	0.131	0.014
Var (Percentage of women)	-	0.000	0.000	0.000
Level -3				
Var (Intercept)	-	-	0.021	0.066
% of explained variance			.0046	0.137
Total Variance	0.55	0.452	0.439	0.416
Group characteristics – Coefficients				
Percentage of women	-	-0.004*	-0.005**	-0.003***
		(0)	(0)	(0)
Average years of education	-	0.095***	0.093***	0.069***
		(0.01)	(0.02)	(0.01)
Percentage of women*sex	-	-0.002**	-0.002**	-0.001
		(0)	(0)	(0)
Cons	8.033***	4.751***	4.709***	5.107***
	(0.05)	(0.18)	(0.19)	(0.12)
Control Variables	Not included	Included	Included	Included
Goodness of Fit				
-2*Log likelihood	24505.82	22393.42	22198.78	21596.8
X2 Change comparison - previous models	-	-2112.4	-194.64	-601.98
AIC	-	22431.41	22238.78	21638.8
BIC	-	22570.06	22384.73	21791.75
Level 2	-	OCCUP (2)	OCCUP (2)	REGION + OCCUP (2)
Level 3	-	-	REGION	SECTORS
N	10760	10910	10910	10760
N (occupations)	29	120	29	120
N(sectors/region)			183	612
rho1	0.366	0.125	0.125	0.013
rho2	-	-	0.046	0.137

*Figures in parentheses are robust standard errors; ***p<0.001, **p<0.01, * p<0.05.*

For the definition of Regions, Sectors and Occupations please refer to Appendix 1.

Model 4, which includes branches of economic activity (or sectors) as third level, does provide more explanation. The variation by sector explains 14 percent of income differences overall, but the variance of the variable percentage of women is zero, indicating that there is no variation in gender income gaps by sector. Furthermore, only 1 percent of income differences are due to the variance in regional occupations, confirming the relative unimportance of regions as in model 3. This, we can confirm hypothesis 7 partly, in the sense that sectors do explain part of income differences in Nicaragua.

The models 3 and 4 confirm the negative effect of gender segregation in occupations on both male and female incomes, as well as the larger gender income gaps in more segregated occupations. In model 4 the impact of gender segregation on income is slightly lower, but still highly significant. It is possible that by including sectors as a third level variable, the sector effect already captures part of the occupational characteristics at the second level. This assumption becomes more plausible when analyzing the random part: the variance of β_{ojk} (level 2) drops as compared to model 3, while that of α_{ook} (level 3) increases.

Adding the random effects of occupations and sectors (last specification) results in the fittest model among all; the deviance improved by 601.98 compared to the previous model. Also, the results of AIC and BIC tests are the lowest 21638.8 and 21791.75 respectively. This, along with the intraclass correlation rho2 (14 percent), supports the validity of including three levels in our model.

6 | Conclusion

Our review of empirical studies concluded that there are four groups of factors that may influence income differences between men and women: individual, human-capital-related factors such as education, factors related to type of job or sector, the general wage structure in a country, and geographical location. Yet, part of the income gap always remains unexplained, and is thus due to social norms, discrimination or unobserved productivity differences.

Nicaragua proved to have the largest gender income gap of Central America and one of the highest degrees of occupational segregation in Latin America. For this country, we have analyzed the effect of human capital and other individual features, of type of income in order to conclude on the effect of the large informal sector, of occupational segregation, and of possible regional and sectoral influences. In order to analyze the effect of occupational segregation and of regions and sectors on incomes, we applied multilevel modelling.

On the basis of the literature including that on country context, we formulated seven hypotheses. The results are the following. When controlling for education, experience, rural versus urban residence, and type of income (employer, dependent worker, self-employed/informal sector, cooperative member), and controlling for selection bias, the unexplained gender pay gap is around 23 percent.

We also find that workers in the informal sector (proxied by the self-employed category) prove to earn significantly less than all other income categories.

While Monroy (2008) found that the raw (unadjusted) income gap was smaller for unskilled workers, we cannot confirm that the gender gap rises with education levels when we control for the above mentioned factors. On the other hand, we do find evidence that women earn less than men in almost all income categories: dependent worker, self-employed and employer. Moreover, if we add these interaction terms, the unexplained part of the income gap falls only slightly, and remains high at between 17 and 19 percent.

All in all, our conclusions on the unexplained income gap are broadly in line but slightly higher than the ones found in earlier studies on Nicaragua, in particular by Enamorado et al. 2009 (16 percent) and Hoyos and Ñopo (2010) (20 percent). This high unexplained gap may be partly due to unobserved productivity differences between men and women, but more likely reflects persistent social and cultural norms and/or serious discrimination in the country. The latter two possibilities are in keeping with the more sociological studies on the country showing that patriarchal gender norms are still dominant, and particularly in rural areas (Bradshaw 2013; Prieto-Carrón 2014). All this also implies that Nicaragua's high ranking in the Global Gender Gap Index is somewhat misleading.

We also found that occupational segregation has a significant influence on incomes, meaning that occupations dominated by women tend to have lower incomes. This is in line with many other studies, for example Baron and Newman (1990), Blau and Kahn (1996), Espino (2013), Solberg and Laughlin (1995), and Coelli (2014). Moreover, we found that the gender income gap is larger in occupations with higher gender segregation. This means that women suffer more from occupational gender segregation than men. This contradicts Budig (2002), but is in line with Cohen and Huffman (2003a) and Huffman (2004).

Johansson and Katz (2007) and Espino (2013) provide evidence for an explanation of this phenomenon, namely that women tend to be overeducated for their jobs, while men are often undereducated. Given that on average, Nicaraguan women have more years of education than men, this explanation probably holds for Nicaragua as well.

When we added a third level of analysis, we found a significant effect of sectors on the variation in incomes but that of regions was not confirmed. Adding sectors proved to reduce the effect of occupational segregation at the second level, so it is plausible that the effects of occupations and sectors are to some extent substitutes. The lack of evidence for an effect of regions on income variations confirms the weak evidence for this phenomenon in the literature.

The results indicate that gender occupational segregation is an important phenomenon for understanding the persistence of income differences between males and females in Nicaragua. These income differences are probably to a large extent an expression of gender inequality and are linked to a variety of non-market factors.

Most likely, these factors work on both the supply and demand sides of the labor market. Women may have lower access to higher paying sectors and jobs due to persistent gender norms, discrimination, practical constraints, and other barriers. On the other hand, there may be good reasons for women to feel attracted to tertiary sector activities in which they are overrepresented. Some of them offer women the flexibility that is necessary for combining productive with reproductive work (small-scale commerce, catering industry, to some extent domestic services). Others, like employment in health care or education, offer access to social security including maternity benefits. But it is clear that these benefits come at the price of lower hourly wages.

Our paper also shows the benefit of using a hierarchical level approach for examining gender earnings differences. We overcome the aggregation bias problem by recognizing that the influence of being a man or a woman on wages is clearly different in different types of occupations and sectors, also in a developing country like Nicaragua. Omitting occupational-level variables and running a standard regression analysis would lead to biased estimates of standard errors and possibly also of coefficients. The proper specification of the error structure in hierarchical models solves the problem of misestimated results; hence the presented results are more robust.

Some implications for public policy can be derived from our findings. First, in order to reduce the gender earnings gap, it is important to enhance female labor market participation in all sectors and occupations so as to decrease the high level of occupational segregation. In order to achieve this, it is important to reduce practical constraints for women's access to higher paying sectors and jobs, for example by offering childcare. It would also be good to expand the coverage of social security so that women have more occupational options for obtaining these important benefits. Moreover, expanding social security would also limit the number of women (and men) working in precarious informal jobs with the accompanying penalty on female labor.

Second, the fact that the gender income gap does not increase with education is promising and means that expanding education for women will have positive effects on their incomes, while not increasing the gender income gap. Finally, a change in gender norms would probably be most conducive for reducing the income gap between men and women. This is something that public policies cannot easily accomplish. Ideally, all public policies and public communications should attempt to become gender-neutral, avoiding male bias and the spreading of traditional values.

The current Nicaraguan government clearly does not have the political will to do this and instead leans heavily on the Catholic Church with its conservative gender norms. Yet, Nicaraguan NGOs like Puntos de Encuentro have found innovative ways to promote gender-neutral values. Among other things, this NGO has produced two attractive television series to this aim. In addition, it can be expected that higher education levels will also contribute to changing patriarchal values and norms.

5

Climate variability and vulnerability to poverty in Nicaragua

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Abstract

This study considers the effect of climate variability on vulnerability to poverty in Nicaragua. It discusses how such vulnerability could be measured and which heterogeneous effects can be expected. A multilevel empirical framework is applied, linking per capita consumption to household, regional and climate characteristics. Results confirm a negative effect of climate variability on consumption per capita of Nicaraguan households. This suggests the need for stronger public policies and more resources in order to adapt to the effect of climate change. Furthermore, the poverty reduction attainments reached since the 1990s could be jeopardized if this vulnerability persists.

Keywords Poverty, Vulnerability, Economic Development, Climate Variability, Nicaragua.

1 | Introduction

Much of the recent literature on poverty assumes that human well-being is jeopardized by severe consumption crashes, as well as by the absence of a wide variety of other essential resources. The predicaments of the poor may often be owed not only to consumption shortfalls but to disease, illiteracy, or malnutrition. This study focuses on the role of climate variability, which is defined as variations in the mean state and other statistics of the climate on all temporal and spatial scales, beyond individual weather events (WMO, 2017),[46] as an important source of vulnerability to poverty in Nicaragua.

Nicaragua holds fourth place in the global long-term climate risk index (CRI)[47] for 1993 to 2012. The country's susceptibility to natural disasters remains a key concern. Distressing climate events such as hurricanes, severe storms, floods, and droughts occur frequently, and the country is also at risk for earthquakes. Following Hurricane Mitch in 1998, an additional 165,000 people fell below the poverty line in the country; the 'poorest' lost 18 per cent of their assets. There was a 19 per cent loss of crops and 20 per cent of hospitals and education centres were affected (World Bank, 2008).

Over the last few decades, effects of El Niño in Nicaragua have been present every 2.6 years (2002/03, 2004/05, 2009/10 and the latest 2014/15) (World Bank, 2015). These events seem to deepen mainly during the August-March period, thus primarily affecting the agricultural production cycles of basic grains. Considering such events, we refer to climate variability within the spectrum of two key variables: precipitation and temperature mean value change during the 2001–2009-time periods.

Climate variability can affect non-poor and poor households, and although risk levels might differ, exogenous shock can reverse the fortunes of both, meaning that the observed factors for estimating income and poverty levels can all too easily change over time due to unexpected external events. Those who have improved their living standards can suddenly face a reversion in their conditions due to climate shocks. Therefore, poverty should be observed from a dynamic approach as people can fall in or out of poverty during their life span.

[46] *We prefer to use the term 'variability' (short-term changes) instead of climate 'change' which refers to any long-term change in Earth's climate, or in the climate of a region or city. This includes warming, cooling and changes besides temperature.*

[47] *The Global Climate Risk Index (2014) analyses the extent to which countries have been affected by the impacts of weather-related events. The Climate Risk Index may serve as a red flag for existing vulnerability that may further increase in regions where extreme weather events will become more frequent or more severe because of climate change (Kreft & Eckstein, 2014).*

The conventional understanding of poverty[48] based on current income and wealth criterion (Ruben, 2011) has driven international development policies over the last 60 years. Nevertheless, new paradigms in the interpretation of poverty recognize that other social, economic and environmental events or shocks (like natural disasters) directly affect people's income potential and can exacerbate structural inherited and chronic poverty factors to the point of driving individuals back below their original level of poverty.

According to Gunther and Harttegen (2006), the probability of becoming poor due to specific idiosyncratic shocks[49] is higher for low-income population groups. On the other hand, covariate shocks[50] apply to all people alike, even those with high incomes and strong capital endowments such as high levels of education, fixed assets, access to basic services, technology and infrastructure. For these reasons, vulnerability assessments try to estimate ex-ante both the expected mean as well as the volatility of consumption.

Furthermore, according to Gunther and Harttegen (2006) Moser (1998) and Philip & Rayhan (2004), vulnerability should be considered a dynamic concept which recognizes and captures change in the economic situation of human beings – not being poor today does not imply that this condition will remain the same in the future. Nevertheless, vulnerability, as with poverty, should be considered multidimensional.

In this study, we define 'vulnerability to poverty' as the ex-ante risk that a household will fall below the poverty line or remain poor if it is already under the line (Chaudhuri, Jalal, and Suryahadi, 2002). This definition assumes that climate variability (in extreme magnitudes) could represent a potential threat of suffering poverty in the future by households that are not able to cope with the shock, whether or not they are currently poor. In this context, Udry (1995) manifests that even if a country is achieving economic growth and poverty reduction, it may not have reduced its vulnerability level to the extent that a shock, such as one produced by climate variability, can reverse any progress so far achieved.

Some efforts are made in the literature to empirically unravel this relationship between climate variability and vulnerability to poverty despite a lack of reliable data at country level. Jacobsen (2011) finds that the occurrence of covariate shocks, such as drought intensity, increases the probability of becoming poor for non-poor households in rural Nicaragua. Jacobsen (2012) also tries to assess the impact of Hurricane Mitch on the productive capital stock of households, but results did not confirm a direct negative link and point more to substitution effects (e.g. households protecting their productive assets base by investing less in child education). This means families transferred the shock to the longer term, jeopardizing the future of their children.

[48] *Poverty is defined as whether households or individuals have sufficient resources or abilities today to meet their needs (World Bank, 2010b).*

[49] *I.e. individual or household level shocks, such as death, illness, injury, unemployment, loss on investments, indebtedness.*

[50] *I.e. community or regional shocks, such as natural disasters, epidemics or climate change.*

This study contributes to literature in two main ways. First, we provide – despite the limitations of relying on cross-sectional data – a detailed examination of the data related to current climate and variability and its potential to change in the future (i.e. climate change) and a suitable empirical multi-level approach for analysing climate-income relationships. Second, we intend to overcome possible specification errors by using direct sub-regional climate variables instead of self-reported questions to assess the extent of climate variability. This enables us to account for the likely impact of climate variability on vulnerability in Nicaragua.

The remainder of this study is structured as follows. Section 2 reviews the existing literature and discusses predominant views regarding the relationship between vulnerability, poverty and climate variability. Section 3 presents an overview of the evidence on this topic for the country context of Nicaragua. Section 4 describes the analytical model and estimation methodology used for linking climate variability with vulnerability to poverty. Section 5 reports the results of the empirical analysis at different levels. Section 6 concludes with some policy implications.

2 | Poverty, vulnerability and climate variability: concise literature review

People, societies and ecosystems are vulnerable around the world to climate variability but with varying degrees of vulnerability in different places. Climate variability often interacts with other stresses to increase the risks from a lack of preparedness (vulnerability) and exposure (people or assets in harm´s way) overlapping with hazards (triggering climate events and trends) (UN, 2014).

Climate events are likely to generate important new inequalities in household wealth and income. Carter and Castillo (2005) note that market mechanisms for protecting and rebuilding assets are often limited in poor rural communities of Honduras, and therefore there is a growing need for informal insurance. The effects of Hurricane Mitch in that country show a drastic long-term impact of the hurricane in the poorest communities evidenced by diminished productive assets.

In a similar vein, Van den Berg & Burger (2010) use two waves of living standard surveys to analyse the impact of Hurricane Mitch on rural livelihoods in Nicaragua. Their findings show that inequity in access to production factors, degradation of natural resources and vulnerability to natural disasters are important problems that reinforce vulnerability to poverty.

One of two main research traditions linking vulnerability to poverty with climate variability regards technological adaptations, such as building flood defences or switching to drought-resistant seeds (O'Brien, et al., 2011) and sectorial adjustments as useful mechanisms *to reduce the potential impacts* and contribute to poverty reduction (Katz & Brown,

1992; Pittock & Jones, 2000; Dessai & Hulme, 2004). A second, more suitable research tradition focuses on the study of ex-post responses to climate risks and societal factors and conditions that affect people's *capacity to respond* to climate variability, including health status, education levels and employment opportunities (Chambers, 1989; Pritchett, Suryahadi, & Sumarto, 2000; Chaudhuri et al., 2002; Ligon & Schechter, 2004; Eriksen et al., 2007; Vakis & Davalos, 2011). This approach allows considering a wider range of factors and conditions that households face in dealing with climate variability.

Early contributions on climate-poverty linkages mainly influenced by the work of Udry (1995), hint at the potential impact of exogenous factors (i.e. climate variability) on poverty vulnerability. However, the vast literature has not yet assessed the effect of climate on a household's probability of becoming or remaining poor in the foreseeable future. Karfakis, Lipper & Smulders (2012) find that developing countries that rely extensively on agriculture, in sectors such as farming, animal pastoralism, fisheries and forestry, are most strongly sensitive to changes in climate variability and poverty dynamics. Thus, negative food security implications are expected to emerge in the areas of high dependence on local food production and with fewer possibilities for internal and external insurance. Furthermore, aggregate impacts on poverty at a village or regional level may reinforce insecurity at the household level, thus urging a multi-level analysis of climate variability effects (Nordhaus, 2006). Hence, the principal questions of this research are first, whether climate variability affects consumption patterns in Nicaragua, and, if so, to what extent do the probabilities of becoming poor increase due to these effects.

An approach employed to study the impacts of climate variability includes focusing on the effect of climate variability on key rural assets, mainly through land prices (Mendelsohn, Dinars & Williams, (2006); Masters & McMillan (2001); Skoufias & Vinha, (2012)). Such an analysis is based on the economic rationality that when farmers maximize profits, land prices are directly correlated to the (future) revenue capabilities of the land. Thus, changes in climatic conditions will impact revenue changes as well, and expected negative climate variability effects will influence land and asset stocks. In this line of thought, Assuncao & Chein (2007) estimate that Brazil may experience a decline in agricultural output of 18 per cent in the next decades, considering the effect of strongly varying climate variability among different communities and land use types.

The second commonly used approach for analyzing the impact of climate variability selects a well-being measure and examines the impact of climate variability directly on household revenues. This measure can consist of household consumption, income, poverty or health-related indicators. Hence, effects can be attributed to the varying returns to assets, their degree of diversification, location, and/or maintenance expenditures (Alderman, 2010; Bizikova et al., 2009; Downing & Patwardhan, 2007). Tol (2009) uses a comparative welfare model to demonstrate the effects of climate variability on income poverty in different affected regions, finding that the strongest effects are registered in regions where poverty abounds.[51]

[51] *The analysis consisted of the comparison between different temperature changes and their direct effect on GDP change.*

In summary, the literature reveals a common agreement that – in the long term – climate variability and vulnerability tend to reinforce (rural) poverty. In the following section, we will assess the direct consumption effects of climate variability (both temperature and rainfall) and identify the household and regional factors that explain differences in poverty vulnerability. This will enable us to discuss possible alternative risk coping strategies that could be helpful to mitigate the heterogeneous effects of climate on poverty.

3 | Poverty and vulnerability in Nicaragua

Statistical discussions about poverty only rarely reveal what it is like to be poor – the risks, limitations, hopelessness and pain. The gaps between poor and non-poor are generally considered to be determined by an inadequate distribution of wealth and consumption (Suryahadi & Sumarto, 2003) and a low level of educational attainment.[52] LSMS (2009) data show that the richest 20 percent of the population accounts for 47.2 percent of total consumption, whereas the poorest 20 percent only consume 6.2 percent. Consequently, Nicaragua is located in the upper quartile of countries with highest disparity in consumption (World Bank, 2012a).

Moreover, access to other infrastructure services by the poor is also limited. Investments in infrastructure mainly appear to show only modest gains in terms of population with access to services such as water, electricity and trash disposal, particularly in rural areas. Whereas 90 percent of households in urban centres have access to water and 98 percent have access to electricity, only one in four rural families have access to water supply and only 44 per cent of rural households have access to electricity.

In addition to inequality, Nicaragua is a country traditionally exposed to climate variability and with a long history of natural disasters. According to Ramirez et al. (2010), since the 1990s the country has been impacted by a number of severe climate shocks. For example, the droughts that occurred in 2001, and Hurricane Félix and the tropical waves of 2007 caused GDP losses of 1.2 per cent and 5.2 per cent, respectively. Furthermore, indicators presented in the Climate Change and Knowledge Portal (World Bank, 2014b) show that Nicaragua ranks high in Latin America and the Caribbean in terms of vulnerability. Notwithstanding adverse climatic events, Nicaragua has experienced sustained moderate economic growth over the last 15 years. The 2007-08 food price crises and 2009 global financial crisis could

[52] *According to the World Bank (2012a), educational attainment and welfare outcomes are closely related in Nicaragua. Findings show that lack of education is one of the main explanatory factors for poverty. Broadly speaking, welfare gains are associated with increased schooling. On average, households headed by individuals with secondary education are able to consume 32 per cent more per capita than similar households headed by someone with no education. Furthermore, a household head with technical education raises household consumption by 37 per cent. Households headed by individuals with a tertiary education account for only 12 per cent of Nicaraguan households and show a 93 per cent gain in consumption per capita. Additional findings show that households with heads who have attained less than complete secondary education are very likely to be living in poverty if the head is the only source of family income.*

have had a negative impact on the country's socioeconomic indicators, but a noteworthy reduction in poverty from 70.3 % to 54.4 % (see Table 1) was realized especially in the rural areas, by the end of the 2000s.

The factors of poverty reduction in rural Nicaragua have been many; among the important are the increase of efficiency and effectiveness in domestic resources of small and medium producers, improved access to internal markets and more rewarding prices (IMF 2011). According to the World Bank (2012), poverty headcounts fell from 2005 to 2009 from 48.3 to 32.9 (see Table 5.1). Nicaragua also showed a decline in inequality as its Gini coefficient fell from 40.5 in 2005 to 37.1 in 2009.

Table 5.1 | Poverty trends in Nicaragua (2005-09)

	2005			2009		
Indicators	**National**	**Urban**	**Rural**	**National**	**Urban**	**Rural**
Non-Poor	51.7	69.1	27.7	67.1	80.4	46.0
General Poverty	48.3	30.9	70.3	32.9	19.6	54.4
Extreme Poverty	17.2	6.5	30.5	9.7	4.4	18.2
Gini Coefficient	40.5			37.1		

Authors' calculations based on the LSMS (2005, 2009).

Despite recent advances in the country's macroeconomic indicators and some progress in the fight against poverty, Nicaragua remains the second poorest country in Latin America (World Bank, 2012). Furthermore, the Living Standard Measurement Survey (LSMS, 2009) shows that extreme poverty still persists in rural areas.

According to the World Development Indicators (World Bank, 2014a), Nicaragua has a Gross National Income per capita of US$1,780.00 (Atlas method), second to last position in the continent with only Haiti behind. Hence, it is no surprise that approximately one-third of the population lives under the poverty line, with almost one out of every ten Nicaraguans living in conditions of extreme poverty (see Table 5.1). Although a simple assessment of poverty trends from 1993 to 2009 may suggest that extreme poverty has fallen around 30 per cent over the longer term, what is more worrying is the persistence of this high level of poverty in the society.

Poverty mapping: Location & employment status

Various methodologies are used to categorize poverty and understanding who the poor are. A detailed poverty map[53], for instance, describes the present condition of local economies and identifies the most deprived areas of the country presented in Appendix J. It shows that the Central rural and Atlantic rural areas have the highest rate of general poverty and the highest incidence of extreme poverty in Nicaragua.

[53] *Poverty maps provide reliable diagnosis on poverty dynamics obtained by inferring consumption and income values from survey data estimations and extrapolating them to census data (Elbers, Lanjouw, & Lanjouw, 2003).*

In terms of income, the poor usually obtain income from agriculture and are employed in the informal sector (see Table 5.2).

Table 5.2 | Nicaragua - Poverty characteristics (2009)

	General Poverty	Extreme Poverty
Types of labour income		
Employed in agriculture	68.2	28.1
Self-employed in agriculture	63.7	28.1
Employed in non-agriculture	25.4	2.6
Self-employed in non-agriculture	27.5	7.3
Employment status		
Employed	42.3	14.5
Formal	18.9	1.2
Informal	46.2	16.7
Unemployed	40.6	12.7
Inactive	43.5	15.4

Note: Type of labour income and employment status correspond to the characteristics of the household head.

Data is presented as percentages of the total population considered poor.

Source: Authors' calculations based on the LSMS 2009.

4 | Methodology

Hoddinott and Quisumbing (2003) suggest there is little consensus amongst researchers on how to estimate poverty vulnerability. Gunther and Harttgen (2006) state that empirical texts on vulnerability are usually based on mix of approaches. On the one hand, several researchers concentrate their efforts on how to measure aggregate vulnerability within a population (Townsend, 1994; Dercon et al., 2005; Mourdoch, 2005). A common denominator in these studies is the use of panel data to examine if households are able to increase their consumption against income fluctuations over time. The main barrier is that panel data availability is very limited for most developing countries.

On the other hand, several studies focus on analysing the ex-post impact of shocks on household consumption (Paxon, 1992; Gertler & Gruber, 2002; Vakis & Davalos, 2011). Their similarity in terms of methodology is that they use standard regression analysis to examine the relationship between adverse shocks and consumption. The empirical limitation of these studies lies in issues regarding omitted variable bias, risk of high correlation between the variables, no clear cut causality and risks of endogeneity.

Following Goldstein (1999), multilevel analysis could help overcome some of the limitations of previous studies and enables us to make a distinction between the unexplained variance

at the household level (i.e. the impact of idiosyncratic shocks) and the unexplained variance at the community level (i.e. the impact of covariate shocks). Furthermore, Gunther and Harttegen (2006) show that multilevel analysis may correct for the inefficient estimators[54], which are likely to be observed in the results of standard regressions.

It is important to highlight the connection between theory and empirical analysis in terms of choosing relevant household categories with related individual (coping-capacity) characteristics (Filmer & Pritchett, 2001). For this purpose, multilevel analysis provides robust standard errors and significance values (Goldstein, 1999).

Additionally, Gunther and Harttegen (2006) show that multilevel models provide a breakdown of the error term; thus, decomposing the unexplained variance of consumption between household and community factors.

Model structure

Consequently, these hierarchical models address several limitations derived from the assumption of independency (Byrk, 1986; Leeuw, 2011; Greene, 2003). Hence, multilevel models are considered particularly suitable to analyse household vulnerability to poverty with reference to both idiosyncratic and covariate shocks.

For operating hierarchical models, we need to follow three essential steps:

1 Divide the variance of the dependent variable (poverty) into what it is explained by each level of analysis.[55]
2 Establish the determinants at the individual levels.
3 Establish the determinants of the secondary (regional) levels.

Gunther and Harttegen (2006) suggest that we could apply a two levels model in which the log of per capita household consumption of household i in community j is regressed on a set of household X and community/regional covariates Z. Our study tries to assess the effect of precipitation changes (years 2001-09) on the amount of goods consumed annually and ultimately on the probability of being poor.

The change in precipitation and the percentage of people employed in agricultural activities constitutes a second level of analysis. It attempts to reflect the dependency on agricultural related income that exists in Nicaragua assuming that precipitation affects food production, and food production in turn affects income, and income affects consumption. Thus, we test the rainfall-production-income hypothesis. However, we do not use the income as the

[54] *Which might occur whenever the proposed methodology is applied to hierarchical data structures, i.e. whenever variables from various levels (e.g. from the household and regional level) are introduced in the regressions (Gunther and Harttegen, 2006).*

[55] *The ICC (interclass correlation) presents the percentage that is explained by a second level of analysis "level 2"; usually when the value is greater than 10 per cent, the use of an explanation of the dependent variable in more than one level is required.*

dependent variable, instead we use consumption because consumption tends to vary less than income, and also it is less subject to error measurements. In this case, the link would be, rainfall affects production and food production affects income and income affects consumption. We consider two possible effects: i) (direct) a reduction of food production reduces the edibles good for self-consumption, ii) (indirect)a reduction of food production reduces the goods to commerce hence less income is available and consumption drops.

Irrigation effects on production are truly visible and well-thought-out, however it is important to take into consideration that climate variability can cause long periods of drought and water resources need to replenish from precipitations, hence any positive effect of irrigation could disappear in the long run as water becomes scarce. Also, according to Zegarra & Chirinos (2016) historically the share of land under irrigation has been highly unstable in Nicaragua, with 6% out of the total cultivated land as highest proportion. The high instability makes it difficult to account for the whole effect of irrigation. Furthermore, the number of farmers who have access to water is no higher than 5% and farmers with land extension less than 2 hectare have lesser access to water (see appendix K).

For the first level, the household variables used reflect three main factors: household assets, access to infrastructure and services, and demographic characteristics. Household assets include capital stock variables (savings accounts, remittances, stocks, dividends, rent and machinery). In addition, capital stock includes the valuation of household assets such as land, equipment (e.g. tractors), facilities (e.g. wells) and household goods (e.g. TV, blender, refrigerator, etc.). Households' assets are especially important to take into consideration since these variables can smooth consumption when covariate shocks are present, as savings can be used, land can be rented or equipment can increase productivity, therefore, reducing the vulnerability of the household. Proper infrastructure and services are important because they decrease the probabilities for inhabitants to get sick, allowing them to work and so increase their income. Demographic characteristics are used for control heterogeneities among households.

Infrastructure and household services include deprivation variables such as unsuitable floors, ceiling or walls, absence of basic services like water, electricity, fuel and sanitation, overcrowding (more than three people per room for sleeping) and information as to whether the household has access to communication media (televisions, newspapers, magazines, etc.).

For demographic characteristics, the variables of years of education of the head of household, household illiteracy and unemployment rate are considered. Finally, socioeconomic variables are included such as the household dependency ratio (individuals ‹ 14 years old and › 60 years old as a proportion of working age people between 15 and 49 years old) and if the main sources of household income are the result of activities that could be affected by changes in international commodities prices (e.g. engagement in tradable sector, like coffee production).

At the second (departmental level), the two main variables are the precipitation change over the past eight years per department and the percentage of people employed in agricultural activities. We also use an alternative specification with temperature change as key climate variable (included in Appendix L).

Model specification

In order to assess household vulnerability to climate variability, our study incorporates multilevel modelling based on equations that are assumed not to be correlated. First, it is assumed that cross-sectional variance can be used to estimate inter-temporal variance in consumption. Secondly, it is assumed that the impacts of shocks on consumption variances are correlated with households' characteristics whereas error measurement is not. Therefore, according to this econometrical structure, this approach is suitable for assessing the effects of climate variability on household vulnerability to poverty. Hence the models are specified as follows:

Level 1:

$$Log(Consump\_pc_{ij}) = \beta_{oj} + \beta_1 Educ_{head}ofhousehold_{ij} + \beta_k X_{ij} + u_{ij} \quad (1)$$

Level 2:

$$\beta_{oj} = \alpha_{oo} + \alpha_{o1} Climate\_variability_j + \alpha_w Z_{jw} + \in_{oj} \quad (2)$$

where:

$Log(Consump\_pc_{ij})$: logarithm of consumption per capita of household "*i*" in department "*j*".
$Educ_{head}ofhousehold_{ij}$: educational level of the head of household "*i*", in department "*j*".
X_{ij}: other variables from the first level belonging to the household "*i*", in department "*j*"
$Climate\_variability_j$: changes in precipitation or temperature over the last eight years in department "*j*".
Z_j: other variable from the second level in department "*j*" (e.g., Percentage of Agricultural Occupancy).
β_{oj}: average consumption per capita in department "*j*".
β_1: effect of education on consumption per capita of the household.
β_k: marginal effect of the X variable on consumption per capita.
α_{oo}: average consumption per capita for all departments.
α_{o1}: marginal effect of a change in precipitation of a department over the household consumption per capita.
α_w: effect of the Z variable over consumption per capita.
u_{ij}: random shocks for a household in the department "*j*".
$\in_{oj}$: random shocks for department "*j*".

The first equation (1) includes no cross-level interactions and therefore interaction terms were set to zero, following the usual procedure for multilevel models that compose the model in several steps. The second equation (2) enables to estimate the error terms. We also estimated the effects of changes in temperature instead of precipitation/temperature maintaining the other factors presented in equation (2).

This analysis assumes that the error term at the oj captures the impact of shocks over a specific area, whereas the error term u_{ij} captures the impact of covariate shocks on households (Gunther and Harttegen, 2006). Thus, coefficients of climate will account for the direct impact on households 'consumption.

Operationalization of Vulnerability to poverty

According to Chaudhuri, Jalal, and Suryahadi (2002), for estimating vulnerability it is necessary to assume first that the stochastic process generating consumption of a household h is given by:

$$lnc_h = X_h\beta + e_h \quad (3)$$

Where c_h is the per-capita consumption expenditure, X_h represents a vector of observable household characteristics, β is a vector of climate parameters and e_h is a mean-zero disturbance term that captures idiosyncratic shocks that contribute to different consumption levels for households. Equation (3) assumes that idiosyncratic shocks are identically and independently distributed over time for each household and that the parameters of β are relatively stable over time. This means that future consumption depends exclusively on uncertainty of idiosyncratic shocks, e_h (For an extended explanation see: Chaudhuri, Jalal, and Suryahadi, 2002; p. 7).

Given the limitations of dealing with only cross-sectional data to identify the parameters driving the persistence in individual consumption levels or the stochastic process generating β, we can let the variance of e_h depend upon observable household characteristics by this function:

$$\sigma^2_{e,h} = X_h\theta \quad (4)$$

Using the estimates $\hat{\beta}$ and $\hat{\theta}$, we can directly estimate the expected log consumption:

$$\hat{E}[\ln c_h \mid X_h] = X_h \quad (5)$$

and the variance of log consumption:

$$\hat{V}[lnc_h \mid X_h] = \hat{\sigma}^2_{e,h} = X_h\hat{\theta} \quad (6)$$

Assuming that consumption is log-normally distributed over households h, we can use these estimates to make an estimate of the probability that a household with some given characteristics X_h will be poor. If the cumulative density of the standard normal distribution is denoted by $\Phi(.)$, the estimated probability for poverty (or 'potential poverty') will be given by (see: Chaudhuri, Jalal, and Suryahadi, 2002):

$$\hat{v}_h = \hat{Pr}\ (\ln c_h < z \mid X_h) = \Phi\left(\frac{\ln z - X_h\hat{\beta}}{\sqrt{X_h\hat{\theta}}}\right) \qquad (7)$$

The results of vulnerability based on this model will assess the influence of climate variability on the propensity of households to become poor; whether or not climate affects significantly on households´ consumption. This will enable us to establish a link between changing climate conditions and the vulnerability to poverty, in other words, if ex-post conditions of households enable them to cope with such effects.

Thus, as presented in Table 5.5, the first two models are estimated using OLS in line with the methodology described above (the first model without the effect of change in precipitation and the second including such effects). The third and fourth model specifications are calculated with mixed effects, the latter includes an extra variable (Percentage of Agricultural Occupancy defined below) at the departmental level as a proxy for the importance of agricultural engagement in the particular geographical area, hence tracing the effects of climate variability on the income generation potential.

Data

We rely on the 2009 Living Standards Measurement Study (LSMS) to calculate the poverty and vulnerability effects.[56] The LSMS is used because it has national statistical representativeness in all of Nicaragua's three geographical macro-regions (Pacific, Central and Atlantic),[57] as well as in rural and urban areas. The main information provided by the LSMS survey includes housing characteristics, utilities, demographics, health, education, economic activities, basic food consumption, income, household assets, among others.

The 2009 Household Survey covers a representative sample of 6,515 households and 30.432 people nationwide. This allows us to extrapolate the results to the 5,763,628 people represented in the last Nicaraguan census published in 2005. The analysis is also adjusted to the population growth rate of 1 per cent. The LSMS data most used in this study are from section II on the composition and characteristics of households and employment and income data.

[56] *The World Bank (2012a) also relied of LSMS data to assess the effects of the commodities crisis on the Nicaraguan economy.*

[57] *INIDE (2009) General Household Survey Report measuring the standard of living.*

Official precipitation data (2001-2009) in Nicaragua is provided at department level, so even if a department has different altitudes, landforms and ultimately different temperatures, the geographical spatial approach corresponds to the second level (departmental level). Nicaragua is divided in 15 departments and two autonomous regions. The Institute for the Development of Statistics (INIDE) presents its annual statistics on climate data by department and autonomous region.

The Nicaraguan Institute of Territorial Studies (INETER) operates weather stations throughout the entire country, however, there are currently three departments – Boaco, Madriz and Carazo – that do not have weather stations yet, thus averages of the measures of other neighbouring departments are used to compute data for these three regions. For the specific case of Nicaragua, the drought episodes (2001-2002), extreme hurricanes (Felix in 2007, Bertha in 2008) and precipitation/temperature effects on households are included in the analysis (see appendix M).

Variables

Household's consumption per capita[58] is calculated according to the methodology of the National Institute of Development's Information (INIDE) which takes all expenditure that households incur to obtain foods, goods and services for a specified period of time (one week prior the interview, last month, 6 months before, 12 months before). The annualized amount of expenditure is then divided by the numbers of members of each household.

Temperature and precipitation change are estimated by extracting the yearly average value of two individual years. The first year is subtracted from the most recent year, so we have annual variations of either temperature or precipitation during the specified period of time (8 years). In the case of Nicaragua, it is critical to understanding how climate variability may affect the incidence of poverty among specific groups or in particular areas.

Household income takes into consideration all payments that are mandatory by national labour law (commissions, vacations, thirteenth month, etc.), as well as the monetized edible goods or any other kind of earning that is given in form of payment, as well as goods that are taken from their own-businesses to provide food for members of the household. The variable is transformed into natural logarithm for technical reasons, such as the smooth of skewed distribution. We included the unsatisfied basic needs variables found in the LSMS 2009 into our models. Variables we use therefore are: basic services, overcrowding, housing condition, illiteracy rate, dependency rate and access to information. All these variables are expected to have a negative impact on consumption.

For the departmental level, the variables are: coverage of education; which measures the percentage of households that have benefited from government programs within a department. Health´s coverage; accounts for the percentage of households that have

[58] *Some of the advantages of using the consumption rather than income as a measure of wellness are less fluctuation and information is more reliable.*

received health assistance or have participated in a disease prevention program. In both cases, when at least one person from a given household is beneficiary from one of these programs, such household was taken into consideration. Another variable is population density. This was calculated based on 2005 census´ population distribution and projected on 2009 population. It measures the number of inhabitants per km2 in each department.

Some additional variables are constructed from the LSMS data. Access to basic services is a dummy that takes the value of 0 when the household does not have proper electricity and potable water infrastructure, uses firewood as combustion or does not have access to proper sanitation, and it is 1 when all these four conditions are met. Illiteracy rate is the proportion of members older than 8 years who cannot read or write. The dependency rate is the proportion of members who are between 0 and 13 or 60 and more years old, indicating the number of household members that are sustained by household workers.

Descriptive statistics

Table 5.3 provides descriptive statistics of all major variables used in the model. The variables that show greatest disparities are: transfers, remittances, capital income, capital stock, consumption per capita and education, each showing highest variation between households.

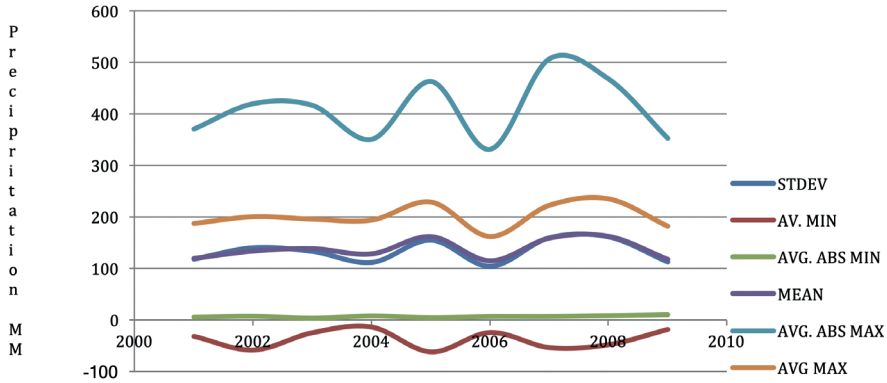
Table 5.3 | Descriptive statistics (values in Córdobas)

Variable	Obs	Mean	Std. Dev.	Min	Max
Transfers per Capita (Cord.)	6.515	2.021	14.599	0.00	813.665
Remittances per Capita (Cord.)	6.515	795	468	0.00	188,160
Capital Income per Capita (Cord.)	6.515	1.288	22.472	5,88	1,669
Capital Stock per Capita (Cord.)	6.515	2.161	125.571	0.00	999.998
Consumption per Capita (Cord.)	6.515	22.508	18.486	1,955.02	229.494
Education Household Head (yrs)	6.502	6,38	4,88	0,00	23,00
Household Unemployment Rate (%)	6.383	28,56	27,84	0,00	100
Household Dependency Ratio (ppl under 13 yrs and over 60yrs)	6.515	0,62	0,57	0,00	6,00
Household Illiteracy Rate (number of people who cannot read or write)	6.515	11,29	22,65	0,00	1,00
Lack of Access to Information (no spending on information; eg. newspapers)	6.515	0,25	0,43	0,00	1,00
Overcrowding (> 3 people/room)	6.510	0,52	0,49	0,00	1,00
Lack of Access to Basic Services	6.515	0,45	0,49	0,00	1,00
Rural Area (D = 1)	6.515	0,26	0,44	0,00	1,00
Precipitation Changes (Over 8 Years)	6.515	-3,90	7,44	-17,16	25,68
Agricultural Occupancy (%)	6.515	13,81	15,02	3,79	50,87

Source: Authors' calculation based on the LSMS 2009 and INETER 2000-2009.

Note: 2009 Exchange rate USD1= COR 20,80

Figure 5.1 presents the descriptive statistics in terms of changes in precipitation with national averages over the 2001 to 2009 period. National averages of precipitation were calculated as simple averages of all the departments. Each value was estimated by year considering the values of the 12 months. The purpose of figure 5.1 is to show that changes from one year to the other are becoming more extreme so the impact of climate variability can increase eventually.



Note: STDEV: Standard Deviation of yearly precipitation (mm).
AV. MIN: Average Minimum value of yearly precipitation (mm).
AVG. ABS MIN: Average Absolute Minimum value of yearly precipitation (mm.)
MEAN: Mean value of yearly precipitation (mm).
AVG. ABS MAX: Average Absolute Maximum value of yearly precipitation (mm).
AVG MAX: Average Maximum value of yearly precipitation (mm).

Figure 5.1 | Nicaragua - Precipitation National Averages (2001-09 periods)
Source: Author's calculation based on INETER data

Based on the historical data, the trend shows a consistent and apparent continuous performance in yearly precipitation of Nicaragua with more significant variations in the period between 2004 to 2009. Starting in 2004, the ups and downs become more frequent and intensive. From 2004 to 2005 precipitation increased by 6,822.7 - 33,430 mm[59], and from 2005 to 2006 it decreased by 9,388.2 - 46,933mm[60]. Hereafter, the pattern suggests that the country consequently started to experience a period of lower precipitation in 2009.

As a country that heavily relies on the production of agricultural raw materials, merely the agro-industry, this situation constitutes a negative picture for the future. This is because most of the agricultural practice of the country is rural and does not rely on sophisticated irrigation systems but on rainfall seasons, therefore, any variation in precipitation pattern, either floods or low concentrations of precipitation over a period of time, causes degradation of the outer layer of earth called "Humus", which contains the majority of

[59] *Calculated by Serial "MEAN" Points "2004" and "2005" From Authors Graph Calculation (161.6065062 in 2005, –161.6065062 in 2004)*

[60] *Calculated by Serial "MEAN" Points "2005" and "2006" From Authors Graph Calculation (161.6065062 in 2005, - 114.6736185 in 2006)*

nutrients that make the soil fertile and suitable for farming. Either it is slowly "washed away", thus resulting in arid and degraded land, or increases in the concentration of fertilizers is required to cope with constant washes.

Table.5.4 presents changes in temperature at department level over the same period (2001-09).

Table 5.4 | Nicaragua - Changes in temperature by department (2001-09 period)

Department	Temperature changes (2001-09)
Nueva Segovia	0.2083321
Jinotega	0.3750000
Madriz	0.2270832
Estelí	0.1000004
Chinandega	0.2250004
León	0.1333332
Matagalpa	-0.0291672
Boaco	0.2174995
Managua	0.291666
Masaya	-0.0375004
Chontales	0.4499989
Granada	0.2583332
Carazo	0.1552081
Rivas	0.1083336
Río San Juan	0.3500004
RAAN	0.2666664
RAAS	0.1166668

Source: Author's calculation based on INETER data.
Note: Temperatures are in Celsius Degrees.

5 | Results

Results of the analysis are presented in Table 5.5 and an additional review based on changes in temperatures rather than changes in precipitation is presented in Appendix L.

The majority of variables report significant coefficients at the 1 and 5 per cent level among all the models. Years of education, capital income and remittances provide a positive feedback for consumption per capita, the rest of the variables related to poverty vulnerability (not taking into consideration income variables) report negative coefficients. The high household dependency ratio along with overcrowding, and lack of access to information and to basic services lead to a decrease of at least 10 per cent in consumption per capita. It shows that whenever there are more dependent people in the household, it becomes harder to be able to provide enough food for family members. Capital income shows a higher variation compared with the importance of remittances in consumption per capita, whereas transfers (such as school lunch) are not significant at all levels of the model.

Table 5.5 | Effects of Precipitation change on households' consumption

Explanatory variables	OLS MODEL		HIERARCHICAL MODEL	
	Model 1	Model 2	Model 3	Model 4
Fixed Part				
Household Characteristics				
Rural Area	0.013	-0.055***	-0.052***	-0.053***
	(0.01)	(0.01)	(0.02)	(0.02)
Years of Education Head of Household	0.022***	0.018***	0.018***	0.018***
	(0)	(0)	(0)	(0)
Household Unemployment Rate	-0.002***	-0.003***	-0.003***	-0.003***
	(0)	(0)	(0)	(0)
Household Dependency Rate	-0.100***	-0.098***	-0.096***	-0.095***
	(0.01)	(0.01)	(0.01)	(0.01)
Household Illiteracy Rate	-0.001**	-0.001*	0	0
	(0)	(0)	(0)	(0)
Lack of Access to Information	-0.135***	-0.079***	-0.079**	-0.079**
	(0.01)	(0.01)	(0.03)	(0.03)
Overcrowding	-0.111***	-0.059***	-0.061***	-0.061***
	(0.01)	(0.01)	(0.02)	(0.01)
Lack of Access to Basic Services	-0.115***	-0.054***	-0.052***	-0.052***
	(0.01)	(0.01)	(0.02)	(0.02)
Log (Capital Income)	0.286***	0.256***	0.258***	0.258***
	(0.01)	(0.01)	(0)	(0)
Log (Remittances per Capita)	0.015***	0.011***	0.011***	0.011***
	(0)	(0)	(0)	(0)
Log (Transfer per Capita)	0.001	0	0	0
	(0)	(0)	(0)	(0)
Main source of Income from a Tradable Sector	-	-0.085***	-0.085***	-0.085***
		(0.01)	(0.01)	(0.01)
Housing Conditions	-	-0.030**	-0.028**	-0.028**
		(0.01)	(0.01)	(0.01)
Log (Capital Stock)	-	0.076***	0.077***	0.078***
		(0)	(0.02)	(0.02)
Departmental Characteristics				
Change in Precipitation (8 years)	-	-0.016***	-0.022***	-0.022***
		(0.01)	(0.01)	(0.01)
% Agricultural Occupancy	-	-	-	-0.001*
				(0)
% Education Program Coverage	-	0.115	0.117	0.105
		(0.1)	(0.08)	(0.09)
% Health Program Coverage	-	0.361***	0.340***	0.271*
		(0.09)	(0.08)	(0.14)
Population Density	-	0.054	0.059	-0.039
		(0.07)	(0.17)	(0.23)

Interactions				
% Health P. Coverage* Change in Precipitation	-	0.022**	0.029***	0.030***
		(0.01)	(0.01)	(0.01)
constant	8.344***	7.638***	7.641***	7.728***
	(0.03)	(0.09)	(0.22)	(0.21)
Random Part				
Cons (Random intercept var)	-	-	0.001	0.001
			(0.001)	(0.001)
% of explained variance			0.009	0.009
Change in precipitation (Random slope var)	-	-	0	0
			(0)	(0)
% of explained variance			0	0
Goodness of fit				
-2*Log Likelihood	-	-	123605.12	123379.42
X2 - Change in comparison with previous models	-	-		-225.7
AIC	-	4029.83	123651.1	123427.4
BIC	-	4163.28	123804.6	123587.6
N (households)	6365	5839	5839	5839
N (departments)	17	17	17	17
r^2	0.65	0.696	-	-
Potential Poverty	40.59	47.30	47.09	47.14

*Figures in parentheses are robust standard errors; ***p<0.001, **p<0.01, * p<0.05.*
Note: No multicollinearity issue was registered in the models (see: Appendix N).

When testing our hypothesis, we found a significant negative impact of both precipitation and temperature variables. Models 2-4 include a second level of analysis (at a departmental level) which shows that changes in precipitation over an 8 years period have negative effect on consumption in all the households at any given location. This result holds true for all the models meaning that variations in precipitation of 1 mm over time will reduce at least 1.6 percent of households' potential consumption[61].

The data show an increase of volatility in precipitation during the period under study (see graph 1). Departments that suffered drought episodes are those where climate variability has a negative effect on consumption. In other words, changes in precipitation have a negative impact at a departmental level by reducing average consumption. In the last model when the agricultural occupancy proxy is included, the significance of the effects of changes in precipitation on consumption is maintained even after controlling for unobserved factors. This confirms the robustness of the results.

[61] *This is in line with the Clausius-Clapeyron physical law that states that the water-holding capacity of the atmosphere increases by about 7 percent for every 1°C rise in temperature. Because precipitation comes mainly from weather systems that feed on the water vapour stored in the atmosphere, this has generally increased precipitation intensity and the risk of heavy rainfall. Basic theory, climate model simulations and empirical evidence all confirm that a warmer climate, owing to increased water vapour, lead to more intense precipitation events even when the total annual precipitation decreases slightly, and have prospects for even stronger events when the overall precipitation amounts increase. Warmer climate therefore increases the risks of both drought – where it is not raining – and floods – where it is – but at different times and/or places (IPCC 2011).*

Furthermore, the results of the departmental variables show that health programs coverage have a significant impact on households´ consumption. This is not the case for educational programs. The interaction variable suggests that in departments where climate conditions are adequate and have proper health coverage, the combined effect is positive on consumption and vice versa. When analysing the random parts of the models, we found that there are no significant differences amongst the departments' curves, since variances are close to 0 for the intercept and for the slope. Nevertheless, coefficients of the parameters are as expected (negative) and significant at 1 to 5 percent level.

One interesting finding is related to temperature. We found a negative relationship between changes in temperature and consumption per capita (Appendix L). The third model presents a significant impact on consumption, with a reduction of 55.1 percent; moreover, the coefficient increases to 74.3 per cent when we add the agricultural occupancy variable in the fourth model specification. This may imply that climate variability effects on income generation from agricultural employment does not compensate from the negative (price) effects on per capita consumption. The random slopes present variances of at least 25.8 percent which suggests presence of differences amongst departments due to temperature variability. On the other hand, the random intercept has a variance of 0, similar to the previous models.

In contrast with the precipitation models, the effect of the interaction (health program*change in temperature) on household´s consumption is no longer significant when agricultural occupancy is added. This result is expected since the program does not aim to mitigate adverse effects from climate variability.

It is also worthwhile to note the effect of climate variability on vulnerability to poverty when controlling for climate differences, as illustrated in the second model specification. Following the Chaudhuri, Jalal & Suryahadi (2002) methodology on potential poverty assessments (as outlined in Section 4), our study finds that changes in precipitation can have an adverse effect on potential poverty outcomes, estimated at 47.30 percent compared with 40.6 percent of the first model. Hence, whereas at the national level 32.9 percent of households are observed to be poor in 2009 (see Table 1), our analysis estimates that 14.4 percent more households can become vulnerable to poverty due to the effects of climate variability.

These results show a projected probability of experiencing poverty in the future, which turns out to be far greater than the current general level of poverty in the population. These estimates reveal that the observed incidence of poverty treats the data on the fraction of the population that is vulnerable to poverty too lightly. Thus, there may be some households whose vulnerability level may be low (usually the non-poor); on the other hand, there may also be households that are observed to be non-poor and whose vulnerability level is high, pushing them into a cycle of poverty (being income and asset poor and thus staying poor forever).

It is important to mention that the spatial variability is included at the department level since we present precipitation and temperature data at this level. The study itself cannot estimate the future variability of climate. However, most literature on subject forecast more extreme climate conditions as presented in our literature review. Hence, we see plausible that the variability of climate will continue or increase.

Two main messages can be derived from these analyses. First, the portion of the population that is measured as vulnerable to climate variability is significantly higher than the portion which currently faces poverty. Second, even though poverty and vulnerability are usually considered as separate albeit related concepts, important linkages that reinforce individual effects have to be considered.

Goodness of fit

We conducted a series of tests in order to provide fit statistics of the models. According to the results, the most robust model is the second specification. In this case, the variable of climatic variability is added and treated as a one level model. The effects of this variable on consumption remain significant. Both AIC (Aikake Information Criterion) and BIC (Bayesian Information Criterion) tests agree on the preferred model. Their respective tests´ results for the second model are 4029.83 and 4163.28 respectively, in comparison with 123651.1 and 123427. of the third model. In the last examination, when we add the percentage of agricultural occupancy, the model improves by 225.7 deviances. As expected, the variances explained by the existing differences at the departmental level are very low; the interclass relation in this level is 0. These results support our analysis regarding the impact of climate variability that is most visible at the individual level rather than the departmental one. The -2-log likelihood ratio test is used to see if the random slope incorporation improves the model fit in comparison to the model where it is not included. At last, the variation inflation factor (VIF) suggests no multicollinearity issue was registered in any of the models (see: appendix N).

6 | Conclusion and Policy Implications

Climate variability has important consequences for households in Nicaragua, and therefore the topic should be seriously considered. Despite the general trend of reduction of poverty in the country, evidence of climate effects is still concentrated mostly in rural areas where it is a potential threat to welfare. Results of this study show the negative impact of changes in precipitation and temperature over the last eight years on household income and consumption per capita in Nicaragua. This study shows that temperature change has a negative effect on households' consumption and there is a need for a policy to reduce its impact. We also found evidence of regional differences on the effects caused by temperature variability. For this reason, policy-makers, when executing development strategies, should carefully assign the resources to mitigate this threat. In other words,

those departments where climate variability affects the consumption of households more, should be the ones with a higher priority in both national and regional policies.

Although the results of change in precipitation suggest that there exists no such difference among departments, we did find that precipitation affects consumption of household in general. This means that changes in precipitation reduce household´s production and income generating capacity and that rising food prices may further reduce household income and consumption opportunities. For extremely poor households this implies that their future consumption possibilities also depend on today's capability to handle climate risk. If they are not able to cope with these risks, they probably have to face a sustained decline in their consumption, thus perpetuating a poverty cycle.

Furthermore, this investigation raises concerns regarding the potential threat of climate variability to a considerable share (47 percent) of Nicaraguan households in terms of vulnerability to poverty. Climate variability could thus diminish the advances in poverty reduction or worse, it can increase the poverty levels. In terms of potential poverty, our analysis confirms that 14.4 percent more households can become vulnerable to poverty due to the effects of climate variability.

Nevertheless, not all types of climate variability will increase vulnerability if prudential policies to adaptation to its effects are established at a convenient time (Eriksen et al., 2007). In some cases, these policies could focus on the reduction of the vulnerability of particular groups, e.g. through targeted investment for enhancing rural employment and non-farm income generation. Before it becomes more difficult and costly to adapt rural households to the long-term effects of climate variability, assistance programs (e.g. social protection, prevention and management of disasters, climate adaptation and land rights) for targeted regions and disadvantaged population groups (Adelman, 2010) could enhance their climate variability resilience and thus further contribute to structural poverty eradication objective.

The social programs such as education or health care have certainly contributed to improve household´s income (Osypuk et al 2014); however, it is important that adaptation decisions and policies be developed with a thorough base in the best existing knowledge on climate variability and its effects (Portier et al, 2010) . Given the long-term climate variability risk that Nicaragua holds, it is necessary to reduce the effects of temperature and precipitation change. For this reason, our study suggests that any development strategy should consider climate variability as a persistent vulnerability to poverty. Policies should aim to secure access to water and reduce global warming Furthermore, focusing on risk factors that prevail in particular regions and for specific categories of households might enable more effective and better targeted poverty reduction policies.

6

Final Conclusions

1 | Introduction

This study demonstrated that poverty cannot be determined solely on the basis of aggregate household income; analyses of heterogeneity factors are also required. Consequently, certain vulnerabilities connected to climate variability and access to finance was common to households from diverse income brackets. These findings highlight dimensions of heterogeneity of poverty in terms of vulnerability to climate variability, segmentation of financial access, gender income segregation and exchange rate estimations.

Nicaragua is not a poor country. It has a privileged geographical position for military and trade purposes, as it is positioned in the middle of Central America between Costa Rica and Honduras, and borders the Pacific Ocean and the Caribbean. It possesses immense biodiversity of natural resources – gold, silver, copper, tungsten, lead, zinc, timber, fish, water in the form of lakes, sunlight and advantageous climate conditions: tropical climate in the lowlands and cooler in highlands. It has two distinct seasons, wet and dry. In relation to its population (estimated at 6.08 million in 2013), it has an almost unrestricted territory for development. In agricultural terms, almost every kind of tropical and non-tropical product can be grown in the country (World Bank, 1953). With a successful utilization of its property assets, the country could become a critical exporter of a broadened range of agrarian, fishery and meat items (World Bank, 2012a). Moreover, if the country progressed as a producer of minerals, it would have the capacity to create a sound and balanced relationship between its industry and the natural resource base.

The World Bank (2012a) points out that many of the weaknesses in the economic structure of Nicaragua have been accentuated by conditions peculiar to the country, as it has also been overwhelmed by a combination of civil wars (civil *war* (1926–27) and 1972-1990), natural disasters (5.7 magnitude Managua earthquake in 1972, and hurricane Mitch in 1998), and political chaos (Somoza's regime 1936-1979, Ortega's regimes 1979-1990 and from 2007 onward). Furthermore, as previously discussed, poverty levels are high and the country still ranks among the top five countries most vulnerable to natural disasters and extreme climate in the world (Kreft & Eckstein 2014). Even though Nicaragua has a sorrowful and depressing history, according to the Happy Planet Index (2012), its people are notably cheerful and high-spirited, positioning it as the 8th happiest country in the world. Interestingly, despite all its social problems, Nicaragua is considered the safest of the Central American nations in terms of crime and violence.

The dimensions of poverty in Nicaragua have in general been treated as universal conditions stemming from lack of capital or deprivation of opportunities. Hence, poverty is seen as a never ending economic state. For this reason, despite several economic and social policies aiming to eradicate poverty, the results are still far from expected. However, what if poverty is not the same across regions and if the people who suffer it experience it differently? What if poverty is heterogeneous? Thus, its determinants could depend on the macroeconomic context and microeconomic characteristics, such as gender or living in areas with little infrastructure and development opportunities, or experiencing discrimination.

The heterogeneous effects that are addressed in this manuscript refer to the different underlying problems that could impact local poverty dynamics. Understanding this heterogeneity could help the design and implementation of effective interventions that target the poor in order to help them to escape poverty.

A consideration of specific issues in development economics can contribute to the application of this discipline and enhance policy discussion. Development embraces three dimensions that are examined in this study: social, environmental and economic (Lozano, 2008; Singha et al., 2012). Contrary to neoclassical economic theories, I believe that these three dimensions encompass a better approach for overcoming poverty. For this reason, the main question of this study is stated as follows: *How can heterogeneous outcomes of economic development for the poverty dynamics in Nicaragua be understood?*

Attention is given to the impact of foreign aid, credit market segmentation, gender segregation in the labour market and the variation of climate in the region on the development results and the process of poverty reduction in Nicaragua. I therefore, sought to understand the relationship between the micro and macro levels of factors producing poverty and the structural reasons for mixed outcomes.

The research was focused on and conducted in Nicaragua based on an in-depth analysis of the aspects that affect the economic performance of the country. This study analyses four topics that shape the poverty dynamics in the country in a heterogeneous way. These four subjects are:

- foreign aid and Dutch disease
- financial market segmentation, monopolistic power and access to finance
- gender segregation in the labour market leading to income differences
- vulnerability and climate variability leading to poverty

This chapter aims to summarize the main findings of the study. It is structured as follows: Section 2 outlines the main findings of the study. Section 3 explains the main contribution of the research to the scientific discussion. Section 4 presents the policy implications of this research. Section 5 deals with the limitations of the study. Finally, Section 6 proposes some suggestions for future research.

2 | Findings

This section presents the answers to the research questions proposed in the introductory chapter of this thesis. All four research questions revolve around the three dimensions in which development economics has been applied, social, environmental and economic. The main findings of the research can be summarized as follows:

Aid and Dutch disease in Nicaragua

Dutch disease is the apparent causal relationship between the increase in the economic development of a specific sector (for example natural resources) and a decline in other sectors. Chapter 2 focuses on the threat of 'Dutch disease' induced by the massive aid inflows that Nicaragua has received during the last 40 years. The main aim of the chapter was to assess the macroeconomic impact of aid in Nicaragua, specifically on the equilibrium of the real exchange rate (RER). The analysis is based on the Dutch disease literature, and follows a suitable empirical framework to validate the robustness of the results.

According to many studies, a sudden and significant increase in the amount of aid received may result in real appreciation and through this in a noteworthy reduction in exports. We did not find such symptoms of Dutch disease during the period 1960-2009 in Nicaragua. This means that aid inflows led to real exchange rate depreciations and not appreciations. Similar results are found by Nyoni (1998) for Tanzania and Sackey (2001) for Ghana.

The study found that openness affects the real exchange rate positively, while government expenditure and an improvement in the terms of trade have a negative (appreciating) effect on the real exchange rate. However, the coefficients for terms of trade and openness appear to be less robust. According to Adam and Bevan (2006), the route and degree of the effect of government expenditure on the real exchange rate depends on the sectorial distribution of spending and the marginal inclination to spend on non-tradeables. Government expenditure is mostly allocated to non-tradeable goods and tends to lead to real exchange rate appreciation. For example, the rebuilding of infrastructure after a weather-related natural disaster requires an expansion of fiscal policies or, in this case, of aid. Based on these findings, in statistical terms and under the current and past economic conditions, Nicaragua was not susceptible to Dutch disease induced by aid.

Segmentation, access to finance and the monopolistic power of financial institutions in Nicaragua

The main objective of the study presented in chapter 3 was to assess the relations between credit market segmentation, the monopolistic power of financial institutions and differences in access to finance in Nicaragua. In that respect, the analysis identified socio-economic factors that also influence the poverty dynamics in Nicaragua.

Based on Leitner and Stehrer (2012), a probit approach with heteroskedasticity-robust estimates was applied to analyse the determinants of financial market access. This chapter brings home that low access to finance, market segmentation, and monopolistic financial institutions contribute to low demand and supply in the economy and thus constrain growth. The lack of collateral, complicated procedures and requirements, and high fees and interests make borrowing less attractive and more challenging. In fact, borrowing is only accessible to a small part of the population. A positive elasticity of income and a

negative elasticity of interest rates were found. An increase in interest rates causes a less than proportional reduction in credit demand, which implies an advantage to the credit providers.

Formal private lenders face more inelastic demand than informal credit providers and therefore have greater monopolistic power. This finding is further supported by the fact that the Herfindahl-Hirschman Index (2011) of Nicaragua (2.370 in 2011) is well above the critical level of concentration (0.18). The model also shows that lower income people are less capable to and eligible for borrowing. There is a clear effect of the distance variable. The further away individuals are living from the cities and main roads, the lower incomes they have, and thus the lower their chances of obtaining borrowing or any form of credit.

One of the most important determinants for the low amounts of credit provided is the interest rate. In keeping with the demand law, higher interest rates reduce the amount borrowed. This occurs for two reasons: first, as noted above, distance is an important factor in choosing between microfinance and banking institutions. In other words, consumers opt for the most geographically accessible option.

Second, consumers have few options to choose from, giving the microfinance and banking institutions strong market power reflected in an inelastic interest rate. These findings are in line with other studies showing that banking institutions in Nicaragua have higher rates of return than those in the rest of Central America (CAMC, 2015).

Gender segregation and income differences in Nicaragua

Chapter 4 identifies factors considered as potential causes of income differences between males and females. The study aims to offer a comprehensive investigation into whether male income advantage is related to occupations that overall pay better in Nicaragua. The analysis reviews the extent of segregation by gender in the labour market and measures its impact on the gender income gap.

The results indicate that gender occupational segregation is an important phenomenon in Nicaragua for understanding the persistence of income differences between males and females. A considerable gender gap in income was explained by the overrepresentation of women in occupations and sectors with low remuneration. Yet, another substantial part of this gap remained attributable to the sex of the person. Income gaps were found to be an expression of gender inequality linked to a variety of non-market factors. The human capital approach could not explain these income gaps as women in the labour force had on average more education and had hardly less work experience than men.

The Nicaraguan labour market helped to confirm the presence of a well-built structural association between types of occupation and gender. In other words, jobs are pre-disposed by gender (Maids are usually women, and drivers tend to be men).

In order to connect economic discrimination and gender segregation, the variables percentage of women and years of education by type of occupation were incorporated, in a second level of analysis. It is observed that the occupational segregation variable, by sectors and categories, presented a negative sign, implying that sectors and occupations in which more women are working have lower average incomes. Furthermore, the gender income gap in these sectors and occupations is larger than in other sectors and occupations. The analysis performed in this study validates the evidence presented for other countries. Despite women's higher education, which typically may not always be required, their wages remain lower.

Poverty, vulnerability and climate variability in Nicaragua

Chapter 5 reviews the relationship between poverty, vulnerability and climate variability by measuring its combined impact on household consumption. Nicaragua's geographical position and poverty level make it highly vulnerable to adverse weather events, such as floods, hurricanes and droughts. Hence, climate change could exacerbate income vulnerability as a result of these phenomena.

The analysis acknowledges that the poverty headcount fell to 32.9 per cent in 2009 in comparison to 48.3 per cent in 2001–2005. Furthermore, rural poverty fell by 15.9 percentage points and urban poverty declined by 11.3 percentage points during the same period. The decline in general poverty was accompanied by a drop in extreme poverty, which fell from 17.2 per cent in 2005 to 9.7 per cent in 2009 (World Bank, 2012a). The gains were concentrated in rural areas. Yet, extreme poverty continues to be mostly a rural phenomenon.

From the coefficients in the estimated income function and their significance level, it is possible to infer that the effects of climate variability assessed through cumulative annual precipitation and mean annual temperature are significant. This implies that the probability of becoming poor as a result of climate variability is high, especially in the rural areas. This result holds true for all models meaning that variations in precipitation of 1 mm over time will reduce households' potential consumption by at least 1.6 percent.

Climate variability could thus have the potential to produce sizeable negative impacts on consumption leading to a potential poverty headcount of about 47.30 per cent. This threat could undermine the notable reduction in Nicaraguan poverty concentrated mostly in rural areas in the second half of the 2000s. Our analysis confirms that 14.4 percent more households can become vulnerable to poverty due to the effects of climate variability.

3 | Contribution to scientific discussion and major theoretical advances

Many specific findings of this study are processed and presented under a socioeconomic lens. Nonetheless its multidisciplinary focus, the study is primarily situated within the field of development economics. It is significant for the economics discipline for several reasons. First, the study focuses on universally used categories in the field –"heterogeneity", "poverty" – and the findings provide empirical evidence from Nicaragua's complexities lying underneath these categories. The study also demonstrates the interconnected consequences of climatic variability on poverty.

In contributing to the poverty vulnerability literature, the thesis highlights the importance of considering the interconnections between a range of geographic, socio-economic and regional relationships when researching vulnerability. By examining heterogeneity of poverty it is shown that: a) climatic variability can manifest itself at different levels (aggregate or individual level); hence irrespective of the current poverty line measure, a country is vulnerable to increases in its level of poverty due to the effects of this phenomenon.

This thesis also contributes to the conceptualization of gender income difference and segregation. The findings particularly show the importance of these theoretical hypotheses in exposing and understanding Nicaragua's gender income gap instead of relying on convenient oversimplifications.

It was also demonstrated that economic experiences cannot be generalized, as our findings contested the Dutch disease hypothesis for Nicaragua. Financial segmentation proved to be a severe economic disadvantage for Nicaragua. In addition, the findings of this study identified different ways in which the monopolistic power of the commercial banks created a vulnerable situation as the country lacked alternative financial products or institutions.

This manuscript also makes a contribution to the understanding of heterogeneity. The study has empirically demonstrated the results of using heterogeneity as an active lens for quantitative analysis. The thesis proposes multiple forms in which heterogeneity can be applied in order to observe the variations in economic realities and possible threats. It also suggests that a deeper understanding of heterogeneity emerges when analysing the interactions between characteristics, regions and sectors as well as the different levels at which they interact.

The first research question addressed whether large inflows of foreign aid have had a damaging impact on the Nicaraguan Real Exchange Rate (RER). In order to get more accurate results we took into account the following: Our analysis adds to the current empirical literature by: (i) compiling a set of recent studies to provide a larger academic framework; ii) enabling the computation of an empirical model based on different variable specifications; (iii) providing solid empirical approach to test the 'Dutch disease'

hypothesis; and (iv) using several co-integration mechanisms to further examine the accuracy of its conclusion.

The foremost advantage of the model we used is that a Vector Error Correction Model (VECM) is more robust for interpreting long term and short term equations. In theory, VECM is a depiction of the Granger's representation theorem (a cointegrated Vector Autoregressive Model, VAR). In practice, the number of cointegrating relationships was determined in the study. What is interesting for the reader is that this study analyses the effects based on a long-term relationship between the structural variables, thus taking advantage of the associated theory of error correction.

Additionally, whereas the VAR model determines the appropriate cointegrating rank, the use of VECM shows how deviations are "fitted" in the long-run. Hence, the VECM estimates are more efficient (as a VECM has a restricted VAR representation, but estimating VAR directly would not take this into account). Although we did not find evidence of Dutch disease, it is clear that poor households are more vulnerable than other households for adverse macro-economic conditions, and in this sense macro-economic conditions and policies also have heterogeneous effects.

For the second research question regarding access to finance, this study makes two contributions. First, it provides empirical evidence of the determinants of access to finance and segmentation. It thus complements the existing literature, recognizing that the majority of studies have based their results on the usage of credit as opposed to access. Secondly, the assessment of credit constraints based on larger data (LSMS, 2005) gives larger descriptive robustness compared to articles written on access to finance that have used Enterprise Survey data and thus have focused only on perception measurements (Beck et al., 2008; Moll et al., 2000).

The use of a robust methodology and relevant data implies further accuracy in the results. The study estimates the monopolistic power of Nicaraguan financial institutions – something new and relevant for public policy discussions. The monopolistic power of financial institutions in Nicaragua is maintained by manipulating interest rates and by extensive requirements for borrowing.

The third research question analyses income gaps between men and women as an expression of gender inequality linked to a variety of non-market factors. By utilizing a multilevel framework, this chapter offers insights into how male and female income varies, bearing in mind that the human capital approach does not explain why these income gaps persist given that women in the labour force have on average more education and that the observed gender differences in work experience are small. Therefore, the study concludes that other forms of discrimination on the supply and demand sides must be considered.

The fourth research question starts from the dearth of understanding regarding the context of vulnerability and climate variability and its influence on the dynamics of poverty.

It provides a review of the academic work on poverty, vulnerability and climate change and then measures the impact of climate variability on household consumption. It highlights a sizable effect of climate variability on increasing poverty among the rural households living in vulnerable areas of Nicaragua.

While the last two studies have each offered several avenues for measuring the impact of certain variables on income and poverty, respectively, the academic community has not endorsed any particular empirical framework as the optimum one. Nevertheless, scholars used the aggregation and disaggregation of variables restricted to one level of analysis with the purpose of measuring the effect of the interaction between an individual and different group.

This manuscript approached the third and fourth research questions differently due to the innate problems associated with using decomposition models that involve aggregation and disaggregation. Multilevel models were therefore considered appropriate, since these are very effective for assessing cross-level interaction effects given that they can be used for simultaneously estimating micro- and macro level models (i.e. individual level wage models and job-level equations).

Hence, hierarchical models could eliminate possible issues that were presented from correlation errors resulting from accumulated data by using the correct standard errors (Bryk & Raudenbush, 1992; Guo & Zhao, 2000). Multilevel models explicitly consider hierarchical data structures and allow both micro- and macro-levels to be represented simultaneously in the same model without erring on the assumption of independent observations. For these reasons, multilevel models were adopted.

4 | Policy implications

The purpose of this study is to identify concrete suggestions for strategies for poverty alleviation for both private and public sector. Its main objective is to assist policymakers in the understanding of certain aspects of the development spectrum in Nicaragua, enabling them to identify effective instruments and to outline efficient strategies towards policy reduction.

The issue of heterogeneity in poverty dynamics pointed out in this study demands for differentiated interventions for different segments of the population. Focussing on particular sectors, households, individuals or regions may be helpful to enhance the likelihood of structural poverty reduction.

We find that an exogenous increase in aid did not result in an immediate appreciation of the nominal exchange rate. However, the Nicaraguan economy could be inclined to Dutch disease if macro approaches are not carefully planned. Furthermore, given the observed beneficial effect of aid on the economy, the declining volumes in recent years are a cause for concern.

By increasing competition among banking and other financial actors under proper regulations and standardized rules, interest rate management could become more inclusive. This could lead to more transparency on costs in this sector of the economy.

On the one hand, financial institutions demand further information concerning potential customers and supply chains; on the other, customers - especially those in the rural areas - require measures for improved access to banks and other financial institutions. This study therefore recommends the introduction of more members into the "Whisky Club"[62] since it is evident that having a few has had negative effects.

On labour market segregation, the findings of this study also have implications from a policy point of view. At the end of the day, if segregation across diverse measurements is responsible for a large part of the income differences between the sexes, policies to increase employment opportunities for women in currently underrepresented sectors would be essential for closing the gap. Today, policies made for the benefit of women focus mainly on the relief from poverty. However, the results of this study show that policies should be targeted to include women in the economic circle. Hence, skill formation, job placement services and childcare could boost employment opportunities for women and reduce income differences.

Climate variability affects the distribution of poverty, and it is too expensive for the poor to access capital for adaption. However, a good development policy with investment planning could prepare Nicaraguan households for the effects of climate variability, for example through providing infrastructure for coping, establishing defence mechanisms for agriculture, securing water supply and through direct income support to vulnerable households.

In the agricultural sector, a policy to integrate the risks caused by extreme climate events in development and investment planning could be very beneficial. These suggestions may possibly offer guidelines for policy making as well as promote more research in Nicaragua on this topic. Controlling prospects for vulnerability to poverty deterioration is as important as identifying other options for poverty reduction.

5 | Limitations of the study

There are several subsequent household survey data sets on living standards in Nicaragua: 1993, 1998, 2001, 2005, 2009 and 2016. We used in this study, the 'Encuesta Nacional de Hogares Sobre Medición de Nivel de Vida' of 2009 (EMNV, 2009) which was collected by Nicaragua's Instituto Nacional de Información de Desarrollo (INIDE). The 2016 data was made available very recently and the results are still being contested by academic sectors

[62] *Nicaraguan people commonly perceived the financial system as a "whiskey club" where the elite join together. It is believed that they set the interest rate of their loans while they celebrate their future profits with a whiskey in their hands.*

and think thanks because of technical issues, so we did not use it. This means our analysis is not based on the most recent data available. Furthermore, there are several technical and methodological differences between the survey rounds of 2005 and 2009 that make some data not fully comparable across years.

The 2005 set introduced new census information that was completed in 2005 providing numerous options for poverty estimation, whereas in the 2009 round some changes were introduced in the survey and data collection guidelines (mainly due to budget constraints), e.g. the elimination of an access to finance set of questions. Nevertheless, it is important to mention that the methodology for poverty calculation in 2009 replicates that of 2005 and uses the 2005 census for population projections. Hence, these two last data sets provide comparable estimates on household consumption and many other variables.

This project began as a quest for cause-effect relationships, in expectancy of finding some answers to conventional questions that are linked to poverty, and that had particular relevance to Nicaragua. A combination of a collection of multidisciplinary literature and extensive knowledge of the country revealed the diverse and complex economic realities. During the creation of this thesis, I found that combining basic geographical information with disaggregated households' information was a daunting task.

6 | Future research

It is important that more studies be carried out that address the causes and determinants of poverty dynamics. The 1980-2018 periods could have led to an addiction effect given that subsequent governments have been very dependent on aid. Although this study shows that aid inflows in a managed exchange rate system do not generate appreciation, further analysis should be performed if sound macroeconomic policies are not followed in the future.

Additionally, in terms of access to finance, the use of non-traditional credit vehicles deserves to be further analysed. Although the framework for the use of these mechanisms has been established in Nicaragua to a large extent (for example, trust funds for providing credit to women in rural areas), it seems to be largely underutilized in practice.

More research on income differences between males and females should be conducted and should focus more on the inclusion of women into the labour market than on including women in poverty reduction strategies. A study that provides insights on this matter would probably make a great contribution to the Nicaraguan development process. Also, a deeper analysis is needed on the effect of climate variability on the probabilities of becoming poor. This should include financial simulation of its effects on the income dynamics at the household level.

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www.bcn.gob.ni
www.inide.gob.ni
www.inss.gob.ni
www.ineter.gob.ni
www.siboif.gob.ni
www.happyplanetindex.org
www.felaban.net
www.semca.org

Appendices to Chapter 3

Appendix A

Household loan portfolio

Provider(s)	No. Credit Loans	Percentage
Private bank	7,494	2.63
Government or MAGFOR Programme	1,408	0.49
Financial entities	64,934	22.76
Credit cards or credit lines	7,978	2.8
Savings and Credit Cooperative	17,254	6.05
Other cooperatives	3,409	1.2
Associations of local producers	2,635	0.92
Nonconventional banks	5,494	1.93
NGO projects	10,767	3.77
Particular moneylenders	6,130	2.15
Friends, relatives and neighbours	15,571	5.46
Rural banks (Cajas Rurales)	1,528	0.54
Merchants	49,332	17.29
Acopiador – stock keepers, collectors	1,357	0.48
Informal credit lines	85,331	29.91
Other	4,642	1.62
Total	**285,264**	**100**

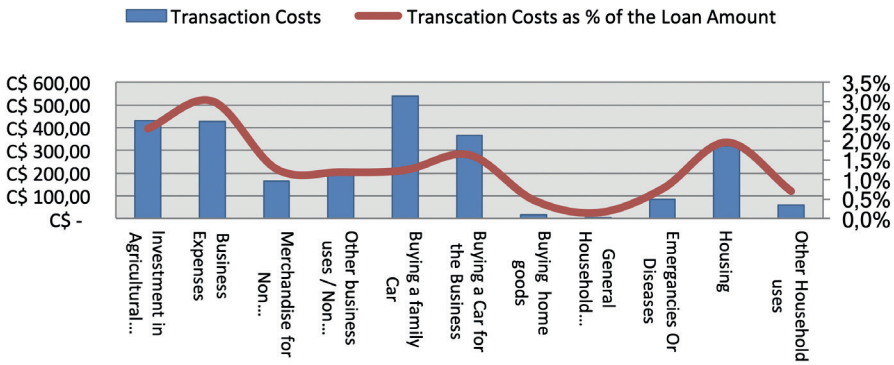
Appendix B

Credit by purpose

Credit purpose	No. credit loans	Percentage
Investment in agricultural activity	19,505	6.85
Productive Agricultural and Livestock Unit Expenses	14,014	4.91
Merchandise purchases (non-agricultural business)	37,952	13.3
Other non-agricultural business uses	7,692	2.7
Vehicles purchases	3,399	1.19
Home goods purchases	36,779	12.89
Home expenses	104,641	36.68
Emergency or illness	10,877	3.81
Housing	14,953	5.24
Other home expenses	35,452	12.43
Total	**285,264**	**100**

Appendix C

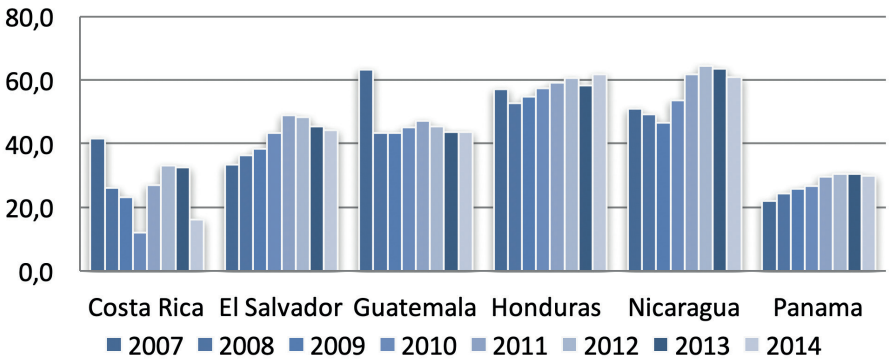
Transaction costs as % of the loan



Source: Authors' calculation based on the LSMS (2005)

Appendix D

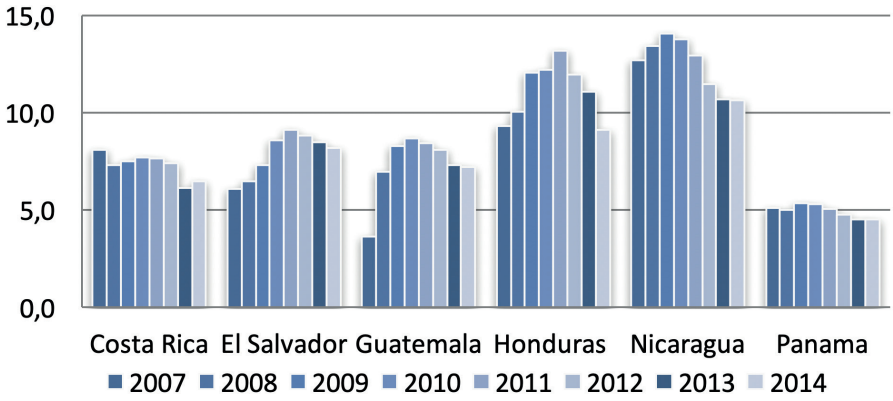
Administrative Expenditure / Total Financial Income



Source: Central American Monetary Council (2015)

Appendix E

Interest Margins

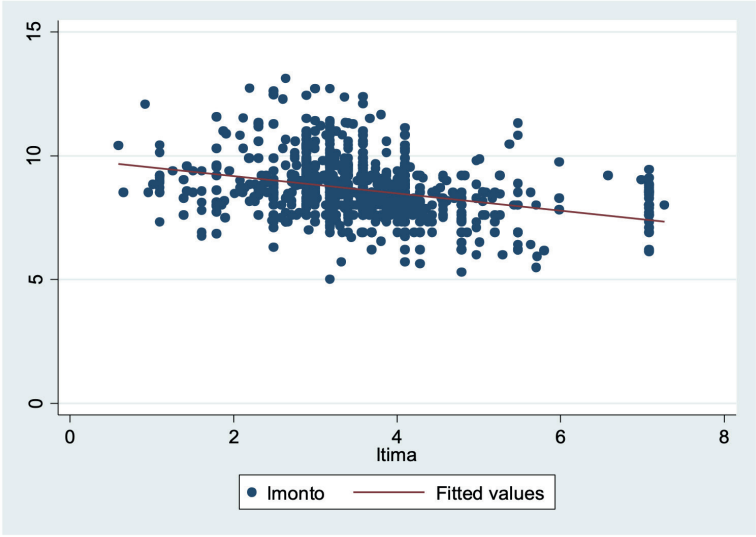


Source: Central American Monetary Council (2015)

Appendix F

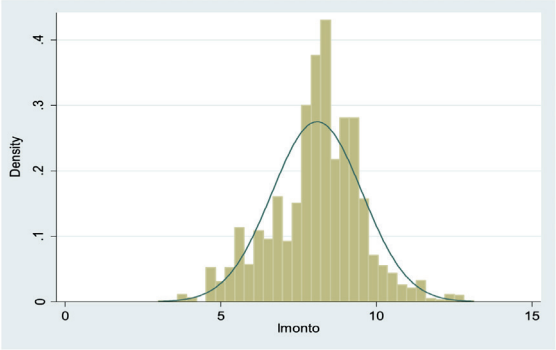
Sample Data Characteristics

Fitted values

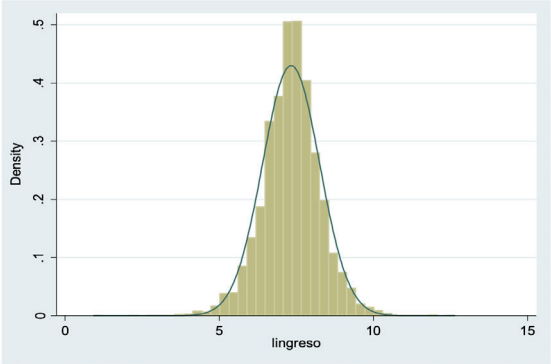


Densities

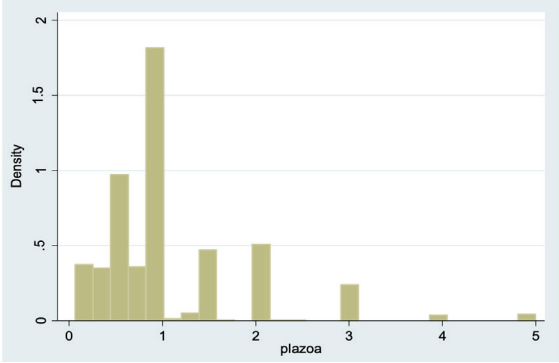
Credit Amount



Ln Income



Maturity



Appendix G

Definition and sources of variables

Variable	Definition	Source
Interest Rate	Are high interest rates an obstacle? (1) a minor obstacle, (2) a moderate obstacle, (3) a major obstacle Details of costs by Banks in Nicaragua	LSMS 2005
Sex	Is a dummy that takes the value of 0 when it is a male and 1 when it is female.	LSMS 2005
Education	The basic technical requirement for education is to have at least eight years of formal studies. For the average technical level, the figure is nine years of formal education, for senior technicians 12 years, for university level 16 years, and for masters and doctoral levels 17 to 22 years respectively (Number of years of education)	LSMS 2005
Location	Is a dummy of area that takes the value 0 when it is Urban and 1 when it is Rural.	LSMS 2005
Age	Age stratification (in years)	LSMS 2005
Bank Concentration	Banking spread or HH index. The HHI is calculated based on the market share of each firm in the industry, squaring it, and sum up the result.	BCN 2013 Database
Collateral	House Ownership Are the collateral requirements of banks/financial institutions (1) no obstacle, (2) a minor obstacle, (3) a moderate obstacle, (4) a major obstacle?	LSMS 2005
Distance	Accessibility to the nearest main road (in km)	LSMS 2005
Marriage	Marital status (also taking into consideration domestic partners). It takes the value of 1 when is married and 0 otherwise.	LSMS 2005
Household Size	Household size (number of people living in the same house)	LSMS 2005
Maturity	Banks' terms for loan portfolio, refers to the final payment date of the loan (loan period), expressed in number of years..	BCN 2013 Database
Income	Takes into considerations all form of payment given to a person that are product of the realization of an economic activity during a month period. (in Córdobas)	LSMS 2005
Household Income	Sum of individual incomes within a given family -max five people. (in Córdobas)	LSMS 2005
Formal Private Banks/ Institutions	commercial banks and micro-financial institutions	BCN 2013 Database
Cooperatives and credit associations	rural credit unions, producer associations and cooperatives	LSMS 2005
NGOs/projects	NGOs or social projects	LSMS 2005
Informal private lenders	informal credit lines, neighbours, friends, traders, etc.	LSMS 2005
Ln(it)*Private Banks	Interest rate for open market operations (percentage)	BCN 2013 Database
Ln(it)*Cooperatives	Interest rate for cooperatives (percentage)	LSMS 2005
Ln(it)*NGOs/Projects	Interest rate for NGOs or projects (percentage)	LSMS 2005

Appendices to Chapter 4

Appendix H

Regions: Rural Atlantic areas, Urban Atlantic areas, Rural Central areas, Urban Central areas, Rural Pacific area (excluding the Department of Managua, capital of Nicaragua), Urban Pacific areas (excluding the department of Managua) and Managua.

Sectors: correspond to where the occupation originated; primary, secondary and tertiary sectors.

Occupations: Two digits (2) were chosen because of a large number of specific activities. Hierarchical models can be sensitive to the number of groups generated at different levels so robustness tests were performed with three digits (3). A list of occupational categories (e.g., of digits used) and their income differences is presented in Annex I.

Appendix I

Occupational Categories

Occupational Categories	Percentage	Monthly average income	Males monthly average income	Females monthly average income	Difference M/F
Military	0.26	C$ 5,452.38	C$ 5,494.45	C$ 4,731.63	-14%
Member Of The Central Government, Parliament And Regional Government – Managerial Level	0.35	C$ 23,268.83	C$ 25,001.68	C$ 18,412.21	-26%
Enterprise Directors	0.87	C$ 11,856.73	C$ 11,978.40	C$ 1,751.94	-2%
Enterprise Managers	1.11	C$ 8,428.55	C$ 11,517.32	C$ 7,480.41	-35%
Professional/ Scientists On Physics, Chemistry, Mathematic And Engineering	0.65	C$ 10,435.81	C$ 10,492.58	C$ 10,268.45	-2%
Professional/ Scientists In Biology, Health And Medicine	0.8	C$ 8,559.22	C$ 9,337.04	C$ 7,935.72	-15%
Academics	1.41	C$ 5,099.74	C$ 5,477.83	C$ 4,797.51	-12%
Other Professional, Scientists And Intellectuals	1.99	C$ 8,516.60	C$ 8,973.33	C$ 7,901.42	-12%
Middle Level Technician And Professionals Of Physics And Chemical Sciences, Engineering And Related	0.69	C$ 5,396.87	C$ 5,819.38	C$ 4,040.76	-31%
Middle Level Technician And Professionals In Biology, Medicine And Health Related Issues	0.67	C$ 4,833.20	C$ 4,163.56	C$ 5,368.88	29%
Middle Level Teachers And Instructors	2.23	C$ 3,204.76	C$ 3,328.89	C$ 3,164.06	-5%
Others Middle Level Technicians And Professionals	3.13	C$ 7,074.87	C$ 7,948.81	C$ 5,943.32	-25%

Office Employee	1.85	C$ 5,108.13	C$ 4,949.56	C$ 5,231.27	6%
Employees With Direct Contact To The Public	1.57	C$ 4,609.60	C$ 5,558.34	C$ 4,060.63	-27%
Security And Surveillance Services Employees	5.59	C$ 3,276.05	C$ 4,839.90	C$ 2,842.40	-41%
Models And Salesmen	9.59	C$ 4,099.83	C$ 4,942.69	C$ 3,771.13	-24%
Farmers And Skilled Agricultural Forestry And Fishing Workers	15.89	C$ 3,071.07	C$ 3,170.65	C$ 1,690.34	-47%
Agricultural And Fishery Workers (Low Level)	0.31	C$ 932.37	C$ 976.25	C$ 866.14	-11%
Officers And Operators Of The Mining And Construction Industries	3.61	C$ 4,236.37	C$ 4,461.09	C$ 4,233.10	-5%
Officers And Operators Of The Metallurgic And Mechanics	2.96	C$ 4,322.93	C$ 5,895.21	C$ 4,309.91	-27%
Handcrafters, Artisans And Related Graphics	0.62	C$ 2,653.65	C$ 3,168.55	C$ 1,722.47	-46%
Other Officers, Workers, Mechanical Artisans And Other Arts Crafts Related Issues	3.97	C$ 2,867.72	C$ 3,413.12	C$ 2,251.44	-34%
Fixed Related Installations Operators	0.38	C$ 4,669.10	C$ 5,569.42	C$ 4,624.07	-17%
Machinery Operators	3.14	C$ 3,366.51	C$ 3,434.97	C$ 3,301.80	-4%
Drivers And Heavy Machinery Operators	3.87	C$ 5,800.03	C$ 6,788.89	C$ 5,778.35	-15%
Unskilled Workers On Sales And Services	17.44	C$ 2,747.60	C$ 3,292.27	C$ 2,399.03	-27%
Peasants And Fishermen	10.85	C$ 2,110.76	C$ 2,116.23	C$ 2,069.09	-2%
Worker In The Mining, Construction, Manufacturing And Transportation Industries	3.87	C$ 3,051.62	C$ 3,107.58	C$ 3,046.33	-2%
Assistant (In Any Industry Or Occupational Activity)	0.31	C$ 2,207.47	C$ 2,207.47	C$ 2,207.47	0%
Total/Average	**100**	**C$ 5,560.63**	**C$ 6,118.12**	**C$ 5,041.42**	**-18.7%**

Source: Authors calculations based on the LSMS (2009) in Nicaraguan Córdobas

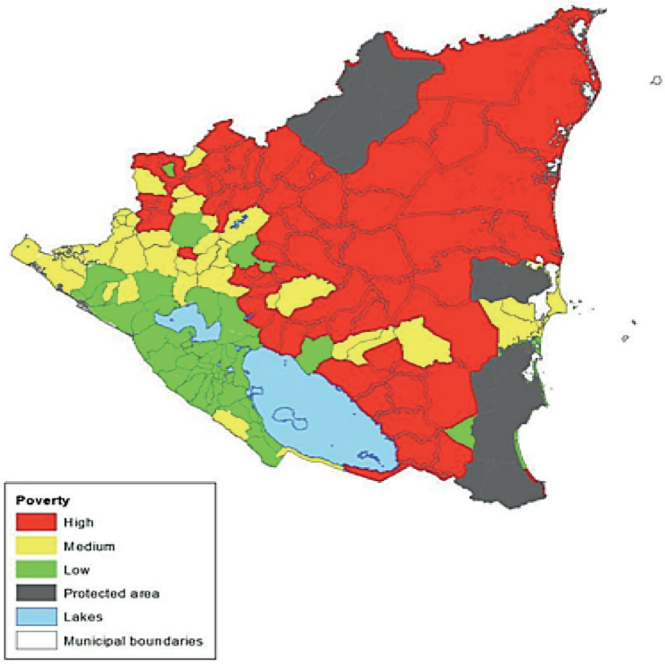
Appendices to Chapter 5

Appendix J

Poverty Map of Nicaragua

The Nicaragua poverty map shows that poverty is more severe in rural areas and in the Caribbean coast, notwithstanding the economic potential in those regions'. This contrasts with rural areas in Western Nicaragua, which experienced poverty reduction in the period 1993 to 2009.

Because of the strong heterogeneity between macro-regions and for the illustrative purposes of this study, we present a poverty map that shows the critical areas in terms of poverty: areas of extremely high incidence of poverty (red), medium incidence (yellow) and low incidence (green). The map also presents environmentally protected areas. Key policies in these high and medium poverty level areas focus on identifying and resolving major bottlenecks to facilitate a better use of land, as well as on optimizing natural resources potential through adequate use of technological advancement and water supply management.



Source: World Bank (2013c) based on the LSMS 2009.

Appendix K

Irrigation index by land exploitation size (2011)

	# of Farmers		Access to water	
	Numbers	**%**	**Has access**	**Uses water**
0-1 Ha	57,588	22%	1.80%	1.50%
1-2 Ha	31,694	12%	3.90%	3.40%
2-5 Ha	49,528	19%	5.10%	4.40%
5-20 Ha	60,020	23%	5.90%	5.20%
20-100 Ha	51,781	20%	4.60%	4.10%
› 100 Ha	11,932	5%	6.90%	6.00%
Total	262,543	100%	4.40%	3.84%

Source: Zegarra & Chirinos (2016), p. 19.

Appendix L

Model with Temperature Change

Explanatory variables	OLS Model		HIERARCHICAL MODEL	
	Model 1	Model 2	Model 3	Model 4
Fixed Part				
Household Characteristics				
Rural Area	0.012	-0.058***	-0.056***	-0.055***
	(0.01)	(0.01)	(0.02)	(0.02)
Years of Education Head of Household	0.021***	0.018***	0.018***	0.018***
	(0)	(0)	(0)	(0)
Household Unemployment Rate	-0.002***	-0.003***	-0.003***	-0.003***
	(0)	(0)	(0)	(0)
Household Dependency Rate	-0.099***	-0.096***	-0.094***	-0.093***
	(0.01)	(0.01)	(0.01)	(0.01)
Household Illiteracy Rate	-0.001**	-0.000*	0	0
	(0)	(0)	(0)	(0)
Lack of Access to Information	-0.135***	-0.088***	-0.087**	-0.088**
	(0.01)	(0.01)	(0.03)	(0.03)
Overcrowding	-0.112***	-0.060***	-0.061***	-0.061***
	(0.01)	(0.01)	(0.01)	(0.01)
Lack of Access to Basic Services	-0.118***	-0.058***	-0.056***	-0.057***
	(0.01)	(0.01)	(0.02)	(0.02)
Log (Capital Income)	0.287***	0.256***	0.257***	0.257***
	(0.01)	(0.01)	(0)	(0)
Log (Remittances per Capita)	0.015***	0.010***	0.011***	0.011***
	(0)	(0)	(0)	(0)
Log (Transfer per Capita)	0.001	0	0	0
	(0)	(0)	(0)	(0)
Main source of Income from a Tradeable Sector	-	-0.088***	-0.088***	-0.089***
		(0.01)	(0.01)	(0.01)
Housing Conditions	-	-0.029**	-0.028**	-0.028**
		(0.01)	(0.01)	(0.01)
Log (Capital Stock)	-	0.075***	0.076***	0.076***
		(0)	(0.02)	(0.02)
Departmental Characteristics				
Temperature Change (8 years)	-	-0.688**	-0.551*	-0.743*
		(0.31)	(0.34)	(0.41)
% Agricultural Occupancy	-	-	-	0.001
				(0)
% Education Program Covered	-	0.161*	0.138**	0.126
		(0.09)	(0.07)	(0.08)
% Health Program Covered	-	0.241***	0.276***	0.173
		(0.09)	(0.07)	(0.15)
Population Density	-	0.012	-0.035	-0.2
		(0.09)	(0.31)	(0.25)

Interactions				
% Health P. Covered* Change in temperature	-	0.770*	0.488	0.841
		(0.42)	(0.5)	(0.67)
cons	8.344***	7.747***	7.731***	7.836***
	(0.03)	(0.09)	(0.21	(0.14)
Random Part				
Cons (Random intercept var)	-	-	0	0
			(0)	.
% of explained variance			0.000	0
Temperature Change (Random slope var)	-	-	0.04	0.038
			(0.013)	(0.013)
% of explained variance			0.258	0.248
Goodness of fit				
-2*Log Likelihood	-	-	129924.72	129707.2
X2 - Change in comparison with previous models	-	-	-	-217.52
AIC	-	4189.77	129968.70	129753.70
BIC	-	4323.96	130116.30	129907.50
N (households)	6365	5839	5839	5839
N (departments)	17	17	17	17
r^2	0.649	0.698	-	-
Potential Poverty	40.59	42.8	42.93	42.58

*Figures in parentheses are standard errors; ***p<0.001, **p<0.01, * p<0.05*

Appendix M

Chronology of climate events in Nicaragua (1997-2014)

Year	Event
1997	El Niño
1998	Hurricane Mitch
2001	Drought
2002	El Niño
2004	El Niño
2006	El Niño
2006	Tropical storms
2007	Hurricane Felix
2009	Drought
2011	Tropical storms
2014	El Niño

Appendix N

Variance Inflation Factor (VIF)[63]

Variance Inflation Factor				
	Model 1		Model 2	
Variable	**VIF**	**1/VIF**	**VIF**	**1/VIF**
Lack of Access to Basic Services	1.87	0.5347	1.96	0.5099
Log (Capital Income)	1.68	0.5939	1.85	0.5408
Years of Education Head of Household	1.64	0.6111	1.65	0.6047
Rural Area	1.52	0.6558	1.77	0.5655
Household Illiteracy Rate	1.4	0.7123	1.41	0.7078
Lack of Access to Information	1.32	0.7566	1.33	0.7524
Overcrowding	1.31	0.7623	1.42	0.7043
Household Dependency Rate	1.13	0.8857	1.14	0.8757
Log (Remittances per Capita)	1.07	0.9316	1.06	0.9433
Log (Transfer per Capita)	1.05	0.9569	1.05	0.9511
Household Unemployment Rate	1.03	0.9665	1.04	0.9589
Main source of Income from a Tradable Sector	-	-	1.27	0.7875
Housing Conditions	-	-	1.50	0.6687
Log (Capital Stock)	-	-	1.33	0.7519
Population Density	-	-	2.12	0.4712
% Education Program Covered	-	-	3.46	0.2894
% Health Program Covered	-	-	2.76	0.3621
% Health P. Covered* Change in Precipitation	-	-	77.38	0.0129
Change in Precipitation (8 years)	-	-	72.13	0.0139
Mean VIF	1.37		9.35	

[63] *Used to quantify the severity of multicollinearity in the analysis. A general interpretation is that if VIF is greater than 10 then multicollinearity is high.*

Summary

This thesis consists of four independent chapters. The first chapter examines whether massive inflows of foreign aid to Nicaragua had a damaging impact on the appreciation of the Real Exchange Rate (RER) during the 1960-2009 period. Several co integration approaches are used to test the robustness of the conclusions. Moreover, short and long run analysis is performed.

The second chapter presents a conceptual background on credit segmentation in Nicaragua. It offers a critical revision of the main aspects that affect access to credit for the broad range of Nicaraguan households. Likewise, it shows new empirical indications for the monopolistic power held by financial institutions in this country.

The third chapter estimates multilevel models of the Nicaraguan labour market, offering an investigation of how gender income varies as a function of economic activity in a specific local labour market context in Nicaragua. The outcomes may contribute to improved understanding and better public policy on the issue, as it points to segregation as an essential cause of the perseverance of income gaps between males and females. Women's progress in breaching gender stereotypes manifested in economic favouritism is still limited.

The final chapter analyses the connections between poverty, vulnerability and climate variability by examining spatial heterogeneous effects. It highlights that attention must be paid not only to how wellbeing dimensions correlate for a given population, but also to how they relate to future scarcities. In Nicaragua, where poverty has decreased over the past years, the threat of income declines as a result of climate variability is growing and is a main concern.

Samenvatting in Nederlands

Dit proefschrift bestaat uit vier onafhankelijke hoofdstukken. Het eerste hoofdstuk onderzoekt of de massale instroom van buitenlandse hulp aan Nicaragua een schadelijke invloed had op de waarde van de reële wisselkoers in de periode 1960-2009. Verschillende co-integratie technieken worden gebruikt om de robuustheid van de conclusies te testen. Bovendien worden korte en lange termijn analyses verricht.

Het tweede hoofdstuk presenteert een conceptuele achtergrond voor de segmentatie van de kredietmarkt in Nicaragua. Het biedt een kritisch overzicht van de belangrijkste beperkingen voor de toegang tot krediet voor Nicaraguaanse huishoudens. Tevens biedt het nieuw empirisch bewijs voor de grote monopolistische macht van de financiële instellingen.

Het derde hoofdstuk schat verschillende multi-level modellen van de Nicaraguaanse arbeidsmarkt. Het biedt inzicht in de manier waarop het inkomen van mannen en vrouwen varieert naar beroep, economische activiteit, of regio in Nicaragua. De uitkomsten kunnen bijdragen aan meer inzicht in en beter overheidsbeleid over dit onderwerp, omdat het wijst op segregatie als essentiële oorzaak voor het continueren van inkomensverschillen tussen mannen en vrouwen. Genderstereotypen bepalen nog steeds waar mannen en vrouwen werken en dit heet gevolgen voor hun inkomens.

Het laatste hoofdstuk analyseert de relaties tussen armoede, kwetsbaarheid en variabiliteit van het klimaat door naar ruimtelijke heterogene effecten te kijken. In Nicaragua, waar de armoede in de afgelopen jaren is gedaald, is de dreiging van inkomensverlies door klimaatverandering een van de belangrijkste nieuwe zorgpunten.

About the author

Carlos Herrera holds a Masters in International Economics: Public Policy & Management (with Honours) from the University of Manchester, United Kingdom (2007) and a Bachelors of Science in Economics and Finance from the University of Mobile, Alabama, USA (2000), (USAID Scholarship).

Carlos Herrera has over 15 years of professional experience and an extensive background in the international and capital market development fields. In the multilateral sector, he has worked as Country Officer of the World Bank Group where he had exposure to strategic assistance fields including: Education, Health, Transport, Water and Sanitation, Agriculture, Public, Private and Financial Sectors Development, Gender, and Caribbean Coast Development.

He acquired public sector experience as Director of International Cooperation for the Nicaraguan Government at the Institute of Municipal Development. He acted as liaison between the central and local governments and several international organizations. He coordinated a portfolio of 15 national development projects related to decentralization and poverty reduction strategies. He also worked as an Investment Advisor for the Nicaraguan Institute of Social Security, focusing on the financial analysis of international investment strategies.

In bilateral assistance and diplomacy, he has worked as Economic Analyst and Project Supervisor at the Embassy of Japan. In this position he coordinated and supervised all activities related to the management, control and evaluation reports of the small grants assistance program acquiring exposure to more than 150 different development projects.

Carlos currently works as Senior Investment Banking Analyst at MDB Capital Group (a US investment bank). Earlier he acquired private sector experience as Economic and Financial Advisor of the President of the Nicaraguan Stock Exchange Market; and he was the financial architect of the first securitization fund in the Central American region. He worked as General Manager of ACRECER, a local financial institution. Carlos is co-founder and Executive Director of Global Development Gateway, an international business firm. He holds an International Stock Broker License and has had an overall product exposure throughout his career of over USD 1 billion.

Carlos began PhD research on “Understanding poverty heterogeneity in Nicaragua: Essays on aid dependency, financial segmentation, gender segregation and climate variability” in 2011. For the realization of this study, he was granted a scholarship from NUFFIC.