Inequality, Relative Deprivation and Human Development Outcomes in Mexico

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CHAPTER 0

Introduction

GEOGRAPHER and explorer Alexander Von Humboldt wrote in 1822 "Mégico es el país dela desigualdad. Acaso en ninguna parte la hay más espantosa en la distribución de fortunas, civilización, cultivo de la tierra y población" (p.196) (roughly, "Mexico is the country of inequality. Nowhere else it is more dreadful in the distribution of wealth, civilization, land and population"). More than 200 years later, things have not changed much; Mexico is still a country in which inequality plays an important role shaping the lives and decisions of its inhabitants. This thesis attempts to contribute to the understanding of whether and if so how/why inequality predicts important social outcomes - in particular school enrolment and levels of mental depressive symptoms- in the Mexican Population.

Income inequality in the country rose sharply between 1989 and 1994 and it is thought to have fallen between 1994 and 2010 (Campos et al. 2014). According to the Organisation for the Economic Co-operation and Development (OECD) however, Mexico is the most unequal country within the member of such organisation; the 10% richest of the population earns more than 30 times what the 10% poorest do (OECD 2015). Although the lack of income or wealth data prevents us from constructing measures of inequality at municipal or lower geographical levels, estimations using the methodology proposed by Elbers et al (2002) have positioned Mexican municipalities on a broad range of level of inequality, from levels as high as South Africa to levels low as Finland (Gini indices comparisons with data from the World Bank 2014 and CONEVAL 2013).

The current political division of the country started to be shaped by the Constitution of 1824, which divided the country into 31 states, a special territory known as Distrito Federal (Mexico City) and set up the further division of those states into municipalities. Nowadays, Mexico has 2,456 municipalities, a key feature in the Mexican socio-political panorama. Each municipality has an elected municipal president and a group of councillors. This level of government is mainly in charge of providing its population with basic infrastructure like electricity, water, roads, public security etc., but it also negotiates either with the state government, or directly with the federation, the amount of financial resources to achieve other development objectives.

It was not until the Constitution of 1917 in the midst of the Mexican Revolution that all inhabitants of Mexico were guaranteed the right to free education and health services. A decade later, the Public Education Secretary of State was founded and over three decades later, the nationwide Mexican Institute of Social Security started operating. Today, Mexico has a wide public education system in which attendance at school is mandatory for children from 6 to 15 years old. The country has also developed and financed several public institutions and social programs for people to access health services for free or at a minimum cost. Despite the efforts to ensure education and health services for everyone, there are still wide disparities both in access and in quality of these services across the Mexican Republic.

Regarding the education system, according to the latest educational census (SNIEE 2013), there were over 35 million students in the country being taught by almost 2 million teachers and lecturers. According to the estimations made based on such census almost 97% of the children who finish primary school continue to secondary school but only 80% finishes this level. Only about half of those who begin high school actually bring this to completion and only around 75% of these students continue to university. Most of the children in Mexico attend public schools which are mostly funded by the State they belong to (71% of the students) with only around 11% of the children attending schools funded and managed directly by the federation.

The health system in Mexico is more complex than the educational one. Despite the fact that the constitution states the right to free health services, there are some conditions that need to be met before accessing such services. The majority of the labour force in Mexico has access to the Instituto Mexicano del Seguro Social (IMSS). Workers have access to this service once their companies register them and agree to pay monthly contributions to the system. Civil servants have their own social security system called Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado (ISSSTE), except for the workers of the state-owned petrol company and the army which have their own hospitals and services (Romero Contreras and Garcia Cedillo 2013). For any individual who does not fit any of these criteria, in 2002 the Seguro Popular was created which offers a wide range of health services for a small monthly fee. Despite a wide coverage in terms of general health services in Mexico, mental health is still an ailment that does not receive a lot of attention. Only 2% of the total budget for health is spent on mental health and most of it goes to psychiatric hospitals (Berenzon Gorn et al. 2013; WHO 2011).

0.1 Inequality, Relative Deprivation and Relative Advantage

The study of inequality has concerned economists and other social scientists for a long time and from a wide variety of points of view. For many years, the main interest was the development of measurement tools able to quantify the degree of economic inequality (Dalton 1920; Gini 1921), explanation of the determinants of economic inequality (Kalecki 1938; Copeland 1947) and understanding the relationship between economic inequality and economic growth (Kuznets 1955). It was not until years later that the literature began to be interested in the link between economic inequality and other economic, social and demographic variables (See for example Sigelman and Simpson 1977 for the case of violence; Rodgers 2002 for mortality and; Flegg 1979 for fertilty, while for education and health,, the main social outcomes of interest in this thesis, see below).

Many authors have hypothesised that the mechanism behind the positive relationship between undesirable social outcomes and economic inequality (see Thorbecke and Charumilind 2002 for a discussion of several causal mechanisms regarding the impact of inequality on health and education) is that the latter reduces the levels of trust (Uslaner 2005) and social capital in society (see the works of Elgar and Aitken 2011; Elgar 2010; Kawachi et al. 1997 for homicides, health and mortality respectively). Kawachi et al (1997) in particular finds that lower levels of social trust are related to the majority of causes of death. In his influential work, Coleman (1988) argues that social capital is fundamental for the formation of human capital of children.

A related but different approach to investigating economic inequality concerns the study of interpersonal comparisons among individuals enjoying different levels of resources. The way this comparisons affect our lives has long interested a number of authors from a wide range of disciplines including Duesemberry (1949) and his relative income hypothesis in economics, Stouffer et al (1949) in sociology, Foster et al. (1972) in anthropology and Gurr (1970) in political science. Typically, the assumption is that upward comparisons incubate detrimental implications to the lives of individuals. The degree of these comparisons has been generically labelled relative deprivation and has been typically associated to lower levels of subjective well-being, life satisfaction and happiness (see D'Ambrosio and Clark (2015) for thorough examinations of the existing evidence). While the literature has somehow reached a consensus regarding the negative relationship between relative deprivation and happiness or life satisfaction, less work has been carried out to understand its role as predictor of other social outcomes. This is particularly true within the economics discipline, to the point that D'Ambrosio and Clark (2015) consider this an 'outstanding issue' for economics research.

In addition, the existence of a phenomenon such as relative deprivation suggests the investigation of the opposite side of the coin, namely relative advantage or elation, and how this may predict social outcomes. This idea is captured in Fehr and Schmidt's (1999) framework which conceptualises individual utility as a function of three arguments: absolute income, disadvantageous inequality (relative deprivation) and advantageous inequality (relative advantage). The question of whether downward comparisons also play a role in the determination of subjective wellbeing and other social outcomes has been studied to a much lesser extent compared to the case of upward comparisons. The hypotheses about the relationship between relative advantage and social outcomes is also less consensual -e.g. while one would expect relative advantage to increase happiness, Fehr and Schmidt's (1999) hypothesise that it might generate detrimental sense of guilt.

While inequality and relative deprivation (or satisfaction) are closely related, there is a profound difference between them. Whilst inequality is a concept which applies to a set of individuals and is measured at aggregate levels using indices such as the Gini or quintile ratios, relative deprivation and relative advantage can be referred to the individual and measured at the individual level (and then, depending on one's research objectives, individual figures can be combined at aggregate levels in the same fashion as customary measures of poverty). This means that, whilst everyone in society shares the same level of inequality and aggregate relative deprivation and aggregate relative advantage, each individual or household would experience idiosyncratic levels of relative deprivation and relative advantage. Econometrically, an important implication is that the use of aggregate measures (e.g. the Gini coefficient) to predict individual outcomes such as the individual probability of school enrolment may be argued to demand econometric techniques able to differentiate levels of variables (e.g. multilevel models such as those I discuss in chapter 2).

0.2 Inequality, Relative Deprivation and Relative Advantage and Human Development outcomes: Education and Health

There is a vast amount of multidisciplinary theoretical and empirical literature attempting to explain the relationship between inequality and human development outcomes. From a political economy view, people at the top of the income distribution may want to acquire services like education and health privately, and may be therefore reluctant to finance the public provision of these goods (Alesina and Rodrik 1994; Perotti 1996; Epple and Richard E Romano 1996; Epple and Richard E. Romano 1996). This in turn would reduce the resources available for the provision of public goods, therefore reducing levels of schooling and lowering the levels of health of the majority.

A large number of articles have been interested in exploring the impact that educational outcomes may have on economic inequality. The results usually show that the levels of education in a society (which often in this literature is the cornerstone of the notion of human capital) play a role in the distribution of economic resources (see Gregorio and Lee 2002; Becker and Chiswick 1966). Another body of literature, has addressed the opposite relationship, namely the potential role played by economic inequality on educational outcomes (for example Checchi (2003) or Odedokun and Round (2004)). For authors like García-Peñalosa (1995) or Checchi (2003) this relationship is explained due to the fact that credit markets are imperfect and only those above certain level of economic resources will be able to access education.

The inability to access education, which as we seen is generally believed to affect a larger number of individuals in an unequal society, is not the only way in which economic inequality may be thought to affect educational outcomes. It should be considered that education is not valued just as an investment to obtain material returns, but also for intrinsic reasons related to more spiritual goals such as inner development, personal awareness, ability to empathise with others, etc. (Esposito et al. 2011; Saito 2003).If inequality creates differences between social groups, making them more reluctant to cooperate or trust with each other (see for example Takata (2003), Uslaner and Brown (2005), Elgar and Aitken (2011), de Vries, Gosling and Potter (2011), Loughnan et al (2011), Neville (2012), Piff et al. (2012, 2012a), Trautmann, van de Kuilen and Zeckhauser (2013) and Piff (2014) for evidence of this) it is easy to see how these attitudes would reduce the value of education for intrinsic reasons and hence the educational outcomes. For example Dincer (2011) finds that lower levels of trust reduce the (aggregate) average years of schooling and argues that trust is the mediating mechanism in the relationship between inequality and years of schooling. At the individual level however, there have been fewer articles exploring how inequality affects individual propensity to be enrolled (exceptions are Vu, La and Muhajarine (2012) for Vietnam or Mckenzie (2005) for Mexico).

According to relative deprivation theory, relatively deprived individuals alienate from social norms and parents lower the expectations for their children, generating lower incentives to enrol in school (Mayer 2010). As pointed out by the influential work of Marmot (2004) and Wilkinson (1997), interpersonal comparisons increase stress and negative feelings that reduce the overall levels of health of the individual. Both children's and parental stress related to economic status have been found to be detrimental for children brain development (Hackman et al. 2010) which in turn reduces educational outcomes.

Besides happiness and life satisfaction most of the research linking relative deprivation and social outcomes has been made on health. The evidence for several health outcomes is reviewed in Adjaye-Gbewonyo and Kawachi (2012). The vast majority of this studies were performed in developed countries and in most cases RD is found to have a detrimental effect on health. Regarding RD and mental health, the results show RD as a robust predictor for emotional wellbeing (Elgar et al. 2013; Kearns et al. 2013), mood disorders (McLaughlin et al. 2012), mental health disorders (Eibner et al. 2004; Mendelson et al. 2008) and levels of grey matter in areas of the brain associated with how humans adapt to psychosocial stressors (Gianaros et al. 2007) and other areas in the brain (Gianaros et al. 2013; Hackman et al. 2014). The studies contrasting absolute, relative deprivation and relative advantage on health outcomes are much scarcer (Holland 2010).

0.3 Thesis structure

In this thesis I focus on the relationship between inequality, relative deprivation and two building blocks of human development: education and health. The first chapter, conceptualises the measure of economic status to be used throughout the thesis and explores its relationship with what it is thought to be a good proxy for permanent income in cross section data, namely consumption expenditure. The second and third chapter investigate inequality and relative deprivation as predictors of school enrolment respectively and the fourth chapter attempts to discern the role played by absolute and relative economic status in predicting depressive symptoms. An important methodological point to be made is that this thesis studies economic inequality, relative deprivation and relative advantage as predictions of social outcomes without pursuing formal strategies for the identification of causality mechanisms. The data used was not appropriate for the common strategies to address causation (for example, panel data) or included a limited set of information (which is the nature of a census) which restricted the set of potential instruments for the pursuit of an instrumental variable approach. This is however an important avenue for future research, as I argue in the conclusions of this thesis.

0.3.1 Chapter One

Asset index is a term used to describe a variable that is constructed using different household assets that can be durable goods, access to utilities such as water or electricity, construction materials of the dwelling like earth floors or cement walls and other indicators of economic status, usually driven by data availability. The basic idea behind such indices is that, in the absence of expenditure or income figures, the asset index will be a good proxy for economic status of a household. In the first chapter, I review the vast literature of articles proposing the use of such asset indices (see for example Townsend et al. 1985;

Bollen et al. 1995; Guilkey and Jayne 1997; Gorbach et al. 1998 etc) and literature that helps conceptualising the meaning of assets in developing countries (for example, Sherraden 1991). I review the different methodologies to construct such indices and focus specifically on the popular method proposed by Filmer and Pritchett (1999; 2001) of using principal components analysis (PCA) to calculate the asset index.

In the empirical part of the paper, I use the three waves (2008, 2010 and 2012) of the nationally representative Household Income and Expenditure Survey in Mexico. These surveys collect detailed information on consumption expenditure as well as the indicators typically used for the construction of asset indices. I build asset indices using different combinations of indicators and investigate their agreement with expenditure data in three different ways: linear and rank correlations, R2 coefficients, and the percentage of equally classified households by the two measures.

An important debate addressed in this chapter is the statistical procedure to develop asset indices. I focus in particular on the commonly and easy to interpret approach of using principal components analysis (PCA) to derive the weights for each indicator part of the index. The main criticism to this approach, is that PCA assumes multivariate normality in its covariates which is violated because the indicators typically used for the asset index are either binary or categorical. I use Kolenikov and Angeles (2004; 2009) research to generate polychoric correlation matrices to better approximate the normality assumption of PCA in the presence of non-continuous indicators.

The results show that if the objective is to generate an asset index to maximise its agreement with consumption expenditure, polychoric correlations should be used. The results also support the use of a wider set of indicators than the typically used (for example adding education or land tenure indicators). The agreement between the asset indices, however, was at most 'moderate' and suggests that in fact both variables are components of a broader concept such as standard of living. In the remaining chapters of the thesis, the use of the asset index is generically labelled as 'wealth' to express the extent of the stock of economic resources possessed by each household.

0.3.2 Chapter Two

The second chapter of the thesis has two main objectives. The first one is to investigate the role of municipal inequality as a predictor of school enrolment in individuals from 6 to18 years old in Mexico (i.e. pre professional levels). The second one is to incorporate municipal and household level interaction variables to examine the role that the educational environment plays in predicting the individual probability of being enrolled in school. As a conceptual framework, I review multidisciplinary evidence to understand the direction and mechanisms of the expected association between inequality, the educational milieu and schooling.

The economics literature generally foresees lower rates of enrolment in more unequal places. The direction of this effect is typically explained through demand or supply of education mechanisms. The former relates to the obstacles in access to education in an economy with imperfect credit markets in which just a proportion of the population above certain economic resources threshold will be able to afford education (examples of this are Galor and Zeira (1993), Perotti (1996), García-Peñalosa (1995), Chiu (1998) and Checchi (2003)). On the other side, inequality generates a lower supply of public education because individuals in the upper part of the income distribution might acquire education privately reducing their incentives to support public education with their taxes (see for example Tanaka's (2003) model and its extension developed by Gutierrez and Tanaka (2009)).

Regarding the educational milieu, there is a general consensus regarding the importance that the household plays in predicting children's educational outcomes (Dostie and Jayaraman 2006; Connelly and Zheng 2003; Bhalotra 2007). The level of education of the parents has been hypothesised to have a positive effect on children educational outcomes because more educated parents value education more, are more involved in their children school activities and they expose their children to intellectually stimulating material (Grolnick and Slowiaczek 1994; Davis-Kean 2005; Green et al. 2007; Hornby and Lafaele 2011). I use the average years of education in the household as an indicator of the household educational milieu. I use this variable and not parent's years of education to account for other possible positive influences or role models that children are exposed to (for example older siblings, grandparents or other relatives in the household).

The municipal educational milieu influence is also rooted in the idea that part of how individuals behave is influenced by those around them (for example Granovetter 1978; Crane 1991). Children living in more educated municipalities might benefit both in terms of being exposed to more educated role models (Jencks and Mayer 1990), incentives to fit better in society (Blossfeld 2009; Nielsen and Svarer 2009) and benefiting from lower levels of school dropouts (Crane 1991). The municipal educational milieu is operationalised using the ratio of adults with at least certain level of education (primary, secondary or high school) to those without that level of education.

Empirically, this chapter uses the sample from the extended questionnaire from the 2010 Mexican Census. The final sample size is around 2.9 million individuals in the 6-18 age range living in around 1.3 million households. Wealth and wealth inequality at municipal level are measured using a household asset index using polychoric correlations and PCA. The multilevel nature of the data and of the research question (the relationship between an aggregate and an individual level variable) demand an appropriate econometric model. I use a logistic multilevel model to control for the clustered structure of the data and also to model and explore the municipal variation left in the individual probability of school enrolment after controlling for other municipal level covariates.

The findings point to inequality being a negative predictor of school enrolment for the three age groups used according to the Mexican educational system (6-12 for primary school, 13-15 for secondary school and 15-18 for high school). The models that best fit the data as indicated by the lowest value of the Bayesian Information Criterion (BIC) are the ones that include interactions between household or municipal wealth and variables indicating the education milieu boys and girls are exposed to, namely household mean education and municipal educational ratios. At the household level, I find that mean education of the adults can compensate for the lack of wealth in early educational stages, but not for secondary and high school. At the municipal level the results show educational ratios to be a predictor of higher enrolment probability in municipalities with lower mean wealth whilst negative for high mean wealth.

0.3.3 Chapter Three

There was an interesting and surprising result from the models in the second chapter that needed to be explored in depth. Mean municipal wealth was found to be a negative predictor of the individual probability of enrolment. I make sense of this finding interpreting mean municipal wealth as relative deprivation in the light of Mayer's (2001) insight that "...feelings of relative deprivation can lead to isolation and alienation from the norms and values of the majority" (p. 4). This is investigated further in Chapter 3 in which we use explicit indices of individual relative deprivation to see how this concept helps predict the probability of school enrolment.

Whilst there is a well-established body of literature on the role that absolute standard of living plays on predicting school enrolment, performance and achievement (for example De Carvalho Filho 2012; Long and Toma 1998; Burney and Irfan 1995), there is no evidence regarding the relationship of the latter with respect to relative deprivation. Chapter 3 addresses this gap in the literature by investigating the role that relative standard of living plays in predicting school enrolment controlling for absolute standard of living and other important covariates as controls. Furthermore, I investigate this relationship using both linear and distribution-sensitive relative deprivation indices, an important step forward in the investigation of relative deprivation and social outcomes.

For the empirical model, relative deprivation is operationalised in two ways. The first one is the well-known Yitzhaki index (Yitzhaki 1979) defined as the summation of the distance between individual i's wealth and every individual j richer than her. The main assumption behind this index is that the function that defines the distances between individual's economic statuses is not sensitive to distributional changes, i.e. the weight for the different economic comparisons is constant in the formation of the total index. I contrast Yizhaki's index by making use of a concave relative deprivation index derived by Esposito (2010) which is consistent with Runciman's (1966) notion of 'fantasy wishes', i.e. the fact that comparisons with 'closer' better off individuals contribute more to relative deprivation than comparisons with 'far off' individuals.

As expected, the main results show that relative deprivation, however measured, is a negative predictor of school enrolment. Moreover, it is found that the model that best fits the data is the one where the Esposito index with the highest concatvity is used. The analysis is taken further by investigating the shape of the relative deprivation measures in relation with the degree of skewness in the distribution of wealth in a given municipality. The graphical analysis suggests that the underlying distribution of the variable used to measure relative deprivation determines the degree to which the Yitzhaki and the Esposito family of indices will be different from eachother.

0.3.4 Chapter Four

Finally, in chapter 4 I take a step forward in the study of the relationship between relative economic status and social outcomes. Using Fehr and Schmidt's (1999) framework of 'self-centred inequality', I study absolute economic achievement, relative deprivation and relative advantage as predictors of depressive symptoms (DS) in Mexico. To achieve this objective, I first review the ample social and medical sciences literature on the determinants of DS to understand the covariates to be used in the empirical section and to construct the relevant hypotheses. Absolute wealth is expected to be a negative predictor of DS while the opposite is expected for relative deprivation. There is no evidence on the relationship between relative advantage and DS although D'ambrosio and Frick (2012) argue that the wellbeing of an individual increases when she compares to poorer individuals.

In the empirical operationalisation, I use the 2012 wave of the Mexican National Health Survey which statistically represents the national and state level population. I construct the measure of DS utilising the 7 questions from the depression module consistent with the Centre for Epidemiologic Studies Depression Scale [CES-D]. Given the nature of the DS dependent variable a Negative Binomial Regression Model (NBRM) is used by employing a collection of control variables and interactions between gender, age and wealth as independent variables. Two kinds of robustness checks are conducted. The first one is to show that the results do not rely on a specific way in which the dependent variable (i.e. depressive symptions) is constructed. The second one attemps to reduce the level of collinearity between the three main variables of interest, absolute wealth, relative deprivation and relative advantage to get less noisy estimates. All of these robustness checks fully confirm the qualitative results of the base model.

In all of our model specifications relative deprivation predicts a higher number of depressive symptoms while absolute wealth and relative advantage predicts the opposite. Despite the extra number of parameters penalised by the BIC, the model that best fits the data is the one including interactions between gender-absolute wealth and age-absolute wealth. In addition, the model casts some results that are consistent with the literature on the determinants of DS. These results relate to the degrees of depressive symptoms shown by female, older individuals, the presence of illnesses and self-esteem.

The chapter further explores the role of education, age, gender and weatlh using graphical analysis and interaction effects. These analyses are motivated by the influential works of Gove and Tudor (1973), Gove (1984) Mirowsky and Ross (1992), Mirowsky (1996) among others from the psychology and medical sciences on the specific roles these variables play in predicting depressive symptoms.

0.3.5 Concluding Remarks

This thesis is a contribution to the debate around inequality and its relationship with human development outcomes. It shows that inequality whether is measured aggregately using an index of inequality or individually thanks to the use of relative deprivation indices, is linked to worse outcomes in two central elements of human development. Furthermore, it offers evidence that wealth interpersonal comparisons might be just as important (both upward and downward) as absolute wealth in predicting social outcomes.

The structure of each chapter is that of an self-standing academic article. It starts with an abstract followed by and introduction that sets up the problem to be investigated and a review of the relevant literature. Each chapter then describes its particular empirical methods and in particular for chapters two, three and four the econometric model to be used is described. The results are discussed next, along with some extensions to the basic econometric specifications and graphical analyses. For the chapters with econometric methods, several robustness checks are performed to test the stability of our results. Each chapter then concludes.

The last chapter of the thesis is a general summary and conclusion of the work presented and possible avenues for future research.

CHAPTER 1

Asset Index and Consumption Expenditure: an Empirical Analysis

Abstract

Asset indices have been extensively used to evaluate household economic status where data on income or consumption expenditure is non-existent or of questionable validity. The idea is that asset indices can be a useful proxy for income or consumption expenditure and capture household welfare (in particular long-run welfare). In this article the relationship between asset indices and consumption expenditure is investigated empirically using data from the 2008, 2010 and 2012 Mexican Household Survey on Income and Consumption Expenditure. Not only does the article examine this relationship using recent data, but for the first time the methodologies proposed by Filmer and Pritchett (1999; 2001) and Kolenikov and Angeles (2004; 2009) are scrutinised and directly compared. Our analysis suggests that the level of agreement between the asset index and consumption expenditure is rather modest, and points to the indices constructed using the Kolenikov and Angeles Approach as consistently more closely related to consumption expenditure.

1.1 Introduction

INCOME and consumption play an important role in our lives. Both have been shown to have positive impacts on health, education and general well-being outcomes in a variety of settings (Kenny 2005). However, data on income and consumption is time consuming and expensive to collect. In addition, in developing countries data on income is often either inexistent or unreliable given the size of the informal labour market, cyclical fluctuations and off market transactions (Deaton 2000; Sahn and Stifel

2000; Balen et al. 2010). These limitations pose severe challenges to the analysis of socio-economic dynamics or human development outcomes.

In the literature there have been several attempts to identify proxies for the welfare or socioeconomic position of individuals or households. For example, some researchers use education (Schellenberg et al. 2003; Mushi et al. 2003; Noor et al. 2007; Sahn and Stifel 2003) or the current occupation of the household head, while others try to account for a variety of income sources (Schellenberg et al. 2003; Friedman et al. 2005). An alternative approach is to derive asset indices on the basis of household durables and housing characteristics. These indices have been showed to be positively associated with various health (González et al. 2010; Houweling et al. 2003) and educational (McKenzie 2005) outcomes, in a similar way as income or consumption would be expected to. Yet it would be erroneous to consider asset indices as perfect substitutes for income or consumption, and the extent to which asset indices are able to proxy income or expenditures are able to proxy income or expenditures may well depend on the methodology used to derive such indices.

Different methodologies for the development of asset indices have been developed. In particular, Filmer and Pritchett (1999; 2001), proposed a methodology based on the use of dichotomous indicators on dwelling characteristics, durable goods owned and access to utilities. They suggest using the first component obtained from the implementation of Principal Components Analysis (PCA) on those indicators matrix as a proxy for wealth. Kolenikov and Angeles (2009; 2004), however, challenge this procedure by questioning the validity of using PCA with discrete variables. They revise the concept of polychoric correlations and propose to intervene on discrete variables using particular techniques before running PCA. Their simulations suggest that using polychoric correlations significantly increases the goodness of fit of the PCA model.

The objective of this paper is to investigate the empirical relationship between consumption expenditures and a series of asset indices constructed on the basis of durables and dwelling characteristics and following alternative methodologies. Data from Mexico is used, where an extensive socio-economic survey is collected every two years – in particular, the 2008, 2010 and 2012 surveys are analysed in the paper. The survey is statistically representative at national, urban and rural level, and is ideal for the purpose of this paper; not only does it cover an extensive list of income and consumption sources, but it also incorporates the typical indicators used to construct asset indices. The paper explores to what extent there is an agreement between asset indices and consumption expenditure, and whether this is greater using the the Filmer and Pritchett Producedure (FPP) or the Kolenikov and Angeles Approach (KAA). Robustness checks are carried out not only by using data from three waves of this nationally representative survey, but also by using different specifications of the asset index. In other words, for each of the 2008, 2010 and 2012 waves of the Mexican Household Survey on Income and Consumption Expenditure five alternative asset indices are built following two alternative methodologies –FPP and KAA. For each year and both sets of five indices, the ability to reflect consumption expenditures is investigated using three measures of agreement: correlation coefficients, R-squared and classification into quintiles. We find that KAA consistently yields a higher level of agreement, but that the correlation between asset indices and consumption expenditures is in general rather modest.

The remainder of the paper is organised as follows. Section 1.2 offers a brief review of the literature and is divided into three subsections; the rationale for the development of asset indices, the main methodologies proposed and the relationship between asset indices and human development outcomes. Section 1.3 describes the empirical strategy and the datasets used in the analysis. Results are presented in Section 1.4 and Section 1.5 concludes.

1.2 Literature Review

1.2.1 Conceptualisation of the asset index

Although the main justifications for the use of asset indices are often of a pragmatic nature (e.g. the lack of income data), there are also conceptual arguments that support their use. Opposite to income or wage which can be thought as a flow of economic resources, assets are the way in which households accumulate their streams of income into wealth (Sherraden 1991; González et al. 2010), and can be used to straighten consumption, earn an interest or as a reserve for emergencies (Friedman 1957; Moser 1998; Torche and Spilerman 2006). These stocks of resources are not just accumulated in terms of savings, shares, futures and other financial goods, but can include physical tangible assets like "personal possessions such as cars, houses, or consumer durables..." etc. (Atkinson 1983, p.159).

For the developed world, the term "assets" often makes reference to financial instruments or material goods with a clear market value. However, a number of authors have suggested that the concept of assets has to be seen in a broader way; for example, for Sherraden (1991), assets are every type of property or claim, whether it is tangible or abstract. This seems particularly true in Latin America, where households consider that their wealth is constituted by any asset that can generate either monetary or non-monetary returns (Torche and Spilerman 2006; Fay and Ruggeri Laderchi 2005). These assets can be accumulated either in the form of education, health, housing basic services (Szekely 2001), consumption goods, semi-durables, durables (Fay and Ruggeri Laderchi 2005) and even in social capital (Moser 1998; Sherraden 1991).

1.2.2 Asset indices methodologies

In developing countries, collecting data on income is usually problematic because a large number of transactions are carried outside the official market (Deaton 2000), and/or because income sources are multiple and vary seasonally (Sahn and Stifel 2003). Some authors prefer information on consumption expenditure as it is argued to fluctuate less than income (Deaton 2000). However, collecting data on consumption involves extensive questionnaires in which respondents have to recall the household consumption for a long period of time and for a large number of items introducing "recall bias" into the estimations (Deaton 2000; Balen et al. 2010). This paves the way to a number of measurement errors, requiring adjustments to be made to the data, especially if comparison among countries or across time are needed (Sahn and Stifel 2000; Booysen et al. 2008).

Due to these problems, some demographic and health surveys have followed a different, more pragmatic approach to data gathering. Asking questions about durable goods or access to utilities reduces the recall bias, and in addition the surveyor can readily evaluate dwelling characteristics. The assumption (or hope) behind this approach is that all these alternative indicators together '…will somehow serve as good proxies for living standards' (Montgomery et al. 2000, p.155)

The challenge becomes how to combine all the information on assets to reflect households' socioeconomic status and rank them according to their socioeconomic position. There have been several approaches seeking to accomplish this objective. Townsend et al. (1985) proposed a set of five indicators which include household rooms to people ratio, car ownership, number of economically active people in the household, children from 5 to 15 years old who receive free meals at school and the number of times the household was disconnected from the electricity network in the last year. Bollen, Guilkey, and Mroz (1995) simply used the sum of the household assets using the Tunisian 1988 Demographic and Health Survey (DHS). Montgomery et al. (2000) use data from the World's Bank Living Standard Measurement Study database to investigate the relationship between assets and consumption expenditure per adult. Their conclusions are that asset indices are weak predictors of consumption expenditure per adult, but that they might be used if the overall objective is to test the relevance of consumption to explain certain behaviour.

Whilst the simple sum of assets in a household has been adopted by some authors by virtue of its simplicity (e.g. Guilkey and Jayne, 1997 or Gorbach et al., 1998), other authors have preferred more elaborated indices which try to go beyond the simple 'count' approach. Essentially, the key issue distinguishing methodologies for the derivation of an asset index is how to assign weights to each item and aggregate them in order to assign a certain score to each household (this score can be used then in a cardinal way or simply to rank households). Morris et al.(2000) use several African household surveys and assign frequency weights to construct their asset index under the assumption that less frequent items were progressively more valuable. A different approach assigns market monetary values to each asset (Arlikatti et al. 2010); however, this is rather problematic given that most surveys that gather information on asset ownership do not include the monetary value or quality of those assets.

Filmer and Pritchett (1999) proposed a statistical based methodology employing PCA to assign weights to household assets; their goal was to assess educational attainment in 35 countries using the DHS Data. In a subsequent article they justify their approach in terms of index reliability by showing its internal validity as well as its performance in a children school enrolment regression (Filmer and Pritchett 2001). They argue that their index is internally coherent by constructing terciles and showing that total asset ownership is higher for higher terciles of the asset index. They check for robustness by constructing separate indices with different number of assets, finding high rank-correlations with the index constructed with the whole number of assets. A second robustness check is performed by deriving the weights using Factor Analysis (FA), finding almost perfect rank correlation between this index and the one derived from PCA. Finally, they use their asset index to make a comparison across Indian states using the national income based poverty rate. Although they find some differences in the two rankings, they conclude that the two rankings agree overall; in addition, the asset index shows a higher rank correlation with the poverty rate than the per capita state domestic product.

Besides PCA, other statistical procedures to reduce the dimensionality of a set of indicators have been used, including multiple correspondence analysis (Booysen et al. 2008), FA (Sahn and Stifel 2000) and Principal Axis Factoring (Balen et al. 2010). These analyses generally find high agreement between PCA and their chosen methods[1]. The criticism behind the use of PCA as the ‘golden method’ is the discrete nature of the data used to calculate this kind of indices. Kolenikov and Angeles (2009) propose to tackle this problem by using discrete data-specific techniques such as the polychoric correlation matrix before running PCA. Their simulations suggest that the results from the Filmer and Pritchett Procedure (FPP) can be improved by using such approach. Permanyer (2013) used this approach to check for robustness in his index, finding high correlation between the polychoric PCA, FA and the equal weighting scheme.

[1]As mentioned above, Filmer and Pritchett (2001) also make this robustness check for their original PCA index finding a 0.988 Spearman rank correlation with and index calculated using FA.

1.2.3 Asset indices and human development outcomes

Asset indices constructed using PCA or other methods have been used extensively, particularly in the health literature. The wide range of health outcomes include children health (Schellenberg et al. 2003), nutrition (Gwatkin et al. 2000; Friedman et al. 2005), the incidence of hypertension, rheumatism and arthritis (Vuković et al. 2008) across wealth groups in Serbia, contraceptive use in Colombia (González et al. 2010) and woman empowerment as well the intention to perpetuate female genital cutting and in Egypt (Afifi 2009). Houweling et al., (2003) constructed a series of indices for 10 developing countries using PCA to analyse measles immunisation coverage across groups and under 5 years old mortality rate.

The asset index has also been investigated with regard to other human development outcomes in the development economics literature. Sahn and Stifel (2000) and later Booysen, Van der Berg, Burger, Maltitz, and Rand, (2008) analysed trends in poverty across time in African countries using an asset index –the latter on the basis of FA and the former of multiple correspondence analysis. Both find high raking correlations between their indices and the ones constructed using PCA. In McKenzie's (2005) work on school enrolment in Mexico, an asset index is used to calculate an inequality measure which is found to predict school enrolment for boys in the 14 to 18 age range.

A number of studies have applied asset index methodologies to census data, which typically lack information on income or expenditure but contain information on durables and dwelling characteristics. Baschieri and Falkingham (2009) create poverty maps in Azerbaijan using the asset index at the district level using the 1999 census. In addition, they use the Elbers, Lanjouw, and Lan's (2002) methodology to impute consumption expenditures at such level to compare the results from both methodologies. Permanyer (2013) used an asset index as a component of a inequality-adjusted human development index at municipal level; in particular, using three Mexican censuses, he constructed an index using an equal weighting scheme for each indicator to proxy for the standard no living component of the HDI.

1.2.4 Asset indices and consumption expenditure

Despite the fact that asset indices have been proved useful analytical tools in a variety of settings, the issue of expounding the conceptual differences between asset indices and consumption is a thorny one. Filmer and Pritchett (1999; 2001) called their measure 'wealth index' and saw it as a proxy for long-run socioeconomic status. Filmer and Scott (2012) then decided to simply call it 'asset index' as they thought this name better reflects the way in which it is constructed. These indices have also been used to reflect the socioeconomic position of a household relative to others (González et al. 2010), socioeconomic status (Houweling et al. 2003) and long-term wealth (Sahn and Stifel 2003). Despite these differences, there is a general agreement that the asset index is a measure of long-term welfare since it uses household stocks rather than flows and therefore is less likely to be affected by short-term shocks.

This widespread idea and the need to clarify what the index is capturing have motivated a stream of literature looking into the empirical relationship between the index and more traditional measures of economic welfare (see Howe et al. 2009 for a systematic review). The preferred measure to proxy long-run economic status in cross sectional data and therefore to compare it against the asset index has consistently been data on consumption expenditure. The idea is that expenditure is a more stable indicator of economic status and that it will be more closely related to the asset index than income.

The choice of consumption over income is usually motivated by theoretical and empirical reasons. In developing countries the size of the informal market and the rate of self-employment might alter income estimates given the high seasonality of this kind of labour activities (Deaton 2000; Sahn and Stifel 2000) and possible false reporting (Balen et al. 2010). Consumption on the other hand is error prone given the recall periods and the deflators that have to be chosen in order to make comparisons across countries (Sahn and Stifel 2003). Theoretically, consumption has been preferred over income based on Friedman's (Friedman 1957) permanent income hypothesis. According with this hypothesis, both consumption and income are the sum of permanent and transitory uncorrelated parts. Permanent consumption is largely driven by the permanent part of the income rather than the transitory one (Friedman 1957). As households '... attempt to keep their marginal utility of consumption constant intertemporally' (Skoufias and Coady 2007, p.758), it is the permanent income of the household the one that will determine the level of consumption in a household (Deaton 1992). In cross section settings consumption is then seen as an imperfect proxy or as the realisation of a purely theoretical concept (Skoufias and Coady 2007).

There have been different approaches to find the relationship between assets and consumption expenditure data. These analyses are reviewed by Howe et al. (2009); they include R^2 from regressions of the Asset Index on consumption expenditures (see Jamal 2005 and Montgomery et al. 2000 for examples), sensitivity analysis (Skoufias and Coady 2007) and the percentage of households ranked equally by the two measures (Ward et al. 2011; Lindelow 2006). Howe et al. (2009) conclude that '... wealth indices are generally a poor proxy for consumption expenditure' (p. 875); they also find evidence that suggests that the asset indices are a better proxy of consumption in middle income countries.

Bollen et al. (2007) and Ferguson et al. (2003) follow a latent variable approach to estimate permanent income[2] using durable assets indicators. Bollen et al. (2007) find that the simple sum of assets and the principal components scores are the best proxies for permanent income; still they stress the worrying measurement error arising from this approach. However, for the purpose of employing the asset index as a control variable for SES in an econometric model, they conclude that the principal components analysis performs better than the monetary value of the durables and even consumption expenditures. Filmer and Scott (2012) conclude that the asset index and expenditure data might rank households differently and their agreement depends on the setting in which the former is being employed.

The relationship between the asset index and more traditional measures of household welfare, such as current consumption expenditure, has been investigated using Mexican data by McKenzie (2005) and Skoufias and Coady (2007). While McKenzie (2005) finds high agreement between the state-aggregate asset index and state mean consumption, Skoufias and Coady (2007) conclude the asset index is a poor welfare indicator to target social programs as compared to consumption. The choice of Mexico is therefore also interesting given the lack of recent evidence (the Mexican data they use are from 1996 and 1998), the availability of novel and rich datasets not yet exploited , the disagreement between McKenzie (2005) and Skoufias and Coady (2007) and the fact that neither of them adopts different specifications of the asset index.

1.3 Empirical Strategy

1.3.1 The datasets

The asset index will be constructed using the National Household Income and Expenditure Survey (ENIGH). This is an independent sample survey (i.e. not panel) carried out every two years; the three latest surveys available 2008, 2010 and 2012 will be used for this analysis –as mentioned at the end of the previous section, previous studies on Mexico focussed on older data and used only one wave. The survey sample is carried out following a stratified probabilistic sample that resulted in 9,711 households for 2008, 10,045 for 2010 and 9,002 for 2012. Given that the survey for years 2008 and 2010 had external sponsors (mainly State level governments) that wanted the survey to be representative at certain geographical levels, the final sample for those years was 29,468 and 27,655 respectively.

[2]According to Friedman (1957) both consumption and income are the sum of permanent and transitory uncorrelated parts. Permanent consumption is then largely driven by the permanent part of the income rather than the transitory one. As households '. . . attempt to keep their marginal utility of consumption constant intertemporally' (Skoufias and Coady 2007), it is the permanent income of the household the one that will determine the level of consumption in a household (Deaton 1992)

After pooling the three datasets and deleting observations that had missing values[3], the total observations available were 66,125. The survey is statistically representative at national, urban and rural level. The frequency expansion factor provided by the surveys was used throughout the different analysis.

1.3.2 The asset indices

The asset index is a multidimensional measure constructed using a group of indicators that are summarised into one number. This stresses the need of choosing weights for each indicator to finally sum them up across each household's characteristics. Given the fact that one of the main objectives of this paper is to compare between FPP and KAA, PCA will be used throughout the calculations.

Decancq and Lugo (2013) review ways of assigning weights in multidimensional indices. They identify three main approaches and eight different methodologies to overcome the problem of aggregating different dimensions. Filmer and Pritchett (2001; 1999) proposed to derive these weights using what Decancq and Lugo (2013) call the "Data-driven" approach, in particular the "statistical" methodology through the use of PCA. The intuition behind PCA analysis is to reduce the number of dimensions in a set of indicators that are correlated among them (Jolliffe 1986). If there are reasons to believe such number of indicators can be represented by a smaller uncorrelated number of variables, PCA can help to achieve this objective (among many others).

PCA is usually chosen because of its simplicity and intuitive understanding; however, it is often overlooked that it is a technique originally designed under the assumption of multivariate normality and it suits continuous data better. The discrete nature of the variables typically used to construct the asset index violates this assumption (Kolenikov and Angeles 2009; Kolenikov and Angeles 2004). Indeed, (Kolenikov and Angeles 2009) show that the use of dichotomised variables in PCA can lead to spurious correlations. When dichotomous variables are used in PCA, the proportion of explained variance is always underestimated and therefore "...does not show that [...] all of the variation could be explained with a single score" (2009, p.139). By running large simulations they conclude that when the researcher dichotomises a originally polytomous variable as proposed by the FPP, PCA will simply assign the largest weight to the dummy variable with the largest number of observations, which means that "...unless the two largest categories are the poorest and the richest members of the population [...] the first principal component would fail to give a meaningful direction of the welfare gradient" (2009, p.139).

[3]As part of the cleaning process of the dataset, all responses coded as "don't know" or "no answer" were recoded as missing values and therefore they were not taken into account for the construction of the indices. The observations deleted were less than 2% of the total initial observations

For Kolenikov and Angeles (2004; 2009), PCA can be used as long as it is performed using the correct correlation matrix for discrete variables for which they discuss the concepts of tetrachoric and polychoric correlations. These correlations are defined as "...maximum likelihood estimates of the correlation between the unobserved normally distributed continuous index variables underlying their discretized versions" (Kolenikov and Angeles 2009, p.135). Under the assumption that the observed categorical variables y_k with $1, ..., d_k$ categories are the discretised version of the underlying continuous variable y_k^*, the observed categorical variable is then obtained according to the thresholds $\alpha_{k1}, ..., \alpha_{k,d_k-1}$.

The maximum likelihood estimation in the case of two variables y_{i1}, y_{i2} is:

$$lnL = \sum_{i=1}^{N} ln\pi(y_{i1}, y_{i2}; \rho, \alpha) \tag{1.1}$$

where ρ is the $Cov(y_1^*, y_2^*)$. Maximising over ρ and the thresholds α the polychoric correlations are obtained. Tetrachoric stands for the correlation between two dummy variables and polychoric between at least one of the variables being categorical.

There are several advantages of using polychoric correlations to run PCA to assign weights. One of the results by Koleniko and Angeles (2009) suggests that PCA performs better if variables which are ordinal or can be ordered are kept as polytomous, rather than being dichotomised as proposed by Filmer and Pritchett (1999,2001) -i.e. category 3 is better than 2 and 1; category 2 is better than 1 and category 1 is the worst of all in terms of welfare). The first advantage of using polychoric correlations is that no extra assumption of the distance between categories of the same variable has to be made. The second advantage is that using PCA with categorical variables always underestimates the explained variance of the first component, whilst PCA with polychoric correlations returns the true amount of explained variation recovered by the first component (Kolenikov and Angeles 2009).

1.3.3 Estimation

The estimation was carried out using STATA 12. The main drawback of KAA is the intensive calculations required to obtain the polychoric correlations. For 66,125 observations and using The University of East Anglia's scientific cluster[4] it takes nearly 16 minutes for each index to be computed; this can increase significantly if a large data set is used or if the computations are done in a standard personal computer[5]. Whether the gains in the agreement showed below in this chapter overcome the computational resources needed is a decision to be made by the researcher with respect to the objectives of his/her research.

[4]UEA's High Performance Cluster is available to postgraduate and staff. It is specifically used for large memory or intensive computation analysis. More information about the characteristics of the cluster can be found here: http://rscs.uea.ac.uk/high-performance-computing/faqs/hpc-basics

[5]Kolenikov and Angeles (2009) report 25 minutes for 10,000 observations and 11 variables using a personal computer.

PCA works best in terms of factorability when the variables have enough variation and enough correlation with other variable assets to be used. The underlying assumption behind the construction of an asset index following this methodology is that such variation is explained by long term welfare, in line with Filmer and Pritchett's (Filmer and Pritchett 2001) claim. The choice of the assets that will be part of the index is the first important step. This choice is usually justified by data availability and the need to use as many assets possible in order for the index to better discriminate between households with respect to their standard of living. Following Balen et al. (Balen et al. 2010), the Bartlett's test for sphericity and the Kaiser-Meyer-Olkin (KMO) tests were employed to assess the factorability of different specifications to see if a reduced number of indicators (and categories) would be more efficiently agree with consumption. The one with the highest KMO and the one in which the Bartlett's test for sphericity rejects the null hypothesis of variables not intercorrelated was used.

One of the main differences between the FFP and the KAA is that, in the former, categorical variables need to be dichotomised to perform PCA on them. It follows that a variable made of m categories will lead to m dichotomous variables, and as a consequence FFP indices are developed on the basis of a larger set of indicators. By contrast, the matrix of polychoric correlations in the KAA is formed by the categorical variables as they are regardless of whether they can be ordered or not.

In this paper, the agreement with consumption expenditure data is explored for five different asset indices. The first one, labelled here as the typical asset index (TAI) consists of 39 indicators (38 dummies and 1 count) for the FPP and 33 (7 categorical, 1 count and 15 dummies) for the KAA. The surveys being employed have data not only the ownership of certain durable goods is gathered, but also on how many are possessed by a household. The second index (CAI) is calculated using the correlation matrix of the actual number of each durable good reported to run PCA. The third one (EAI) incorporates the education of the household head to comprise another possible dimension of the SES of a household. The fourth index (LAI) incorporates information on land size and the size of the dwelling; however, the LAI is calculated only for 2008 because the question was dropped for the 2010 and 2012 surveys. Finally, a fifth index (RAI) was constructed using only those indicators which can also be found in the Mexican census, in order to shed some light on what index could be constructed using this type of data (which covers the whole population but does not include consumption data). Each index was calculated following both the FFP and the KAA[6].

[6]The polychoric correlations were calculated in STATA using Stas Kolenikov user-written command "polychoricpca".

1.4 Results

1.4.1 The asset indices and their weights

I found a strong support from the specification test to reduce the number of categories used to construct the FPP. Table1.1 shows the number of indicators used for each of these indices, the variance explained by the first principal component (i.e. the goodness of fit of the index) and statistics for indicators selection criteria[7]. The null hypothesis in Bartlett's test for sphericity states that a correlation matrix is an identity matrix, which means that the indicators are not correlated. Finding statistical significance (generally accepted to be a p-value of less than 0.05) means that the indicators used for the index are correlated and that such non-zero correlations are not due to sampling error. The other statistic used to find with the best specifications for the indices is the Kaiser-Meyer-Olkin (K-M-O) measure of sampling adequacy. This statistic compares the magnitudes of the observed correlation coefficients against the magnitude of the partial correlation coefficients. It ranges from 0 to 1 where the value of 1 shows strongest support to perform factor analysis. It is generally accepted that this statistic cannot be less than 0.5 if any kind of factor analysis wants to be performed. As explained above, the number of indicators is always lower when using the KAA because variables are not dichotomised and therefore categorical indicators are used as a single variable. This number of indicators for each specification of the asset index comes from a stepwise selection of variables that derived the best selection criteria statistics (i.e. the lower Barttlet's p-value and the larger K-M-O). According to the K-M-O the best specification is the asset index that includes the education of the household head used as a categorical variable. As expected from Kolenikov and Angeles' (2009) results, the variance explained by the first principal component is always higher using the KAA, and almost twice the variance explained by FPP. Higher variance explained by the first component indicates a better fit of the model because it indicates that the first orthogonal component in KAA was able to capture more variation from the original correlation matrix than FPP, which is the objective of PCA.

The indices were calculated using the pooled sample for the three years with the number of indicators specified above[8]. The categorical variables were recoded to group categories with fewer observations and missing values were eliminated. Figure1.1 graphically shows the weights assigned for the first of the indices for both FPP and KAA. Both set of weights follow the same path along the graph, explaining the high agreement between the two (a

[7]The usual methodology is to use as many assets as possible and dichotomised categories as possible. Indices constructed under this approach showed to consistently derive lower linear and rank correlations with consumption expenditure than those specifications supported by the K-M-O and Bartlett's tests. Only the results of the latter are presented here, but the table of correlations comparing these two approaches for the pooled FPP sample is available upon request.

[8]A list of indicator used for each index can be found in Appendix A.1

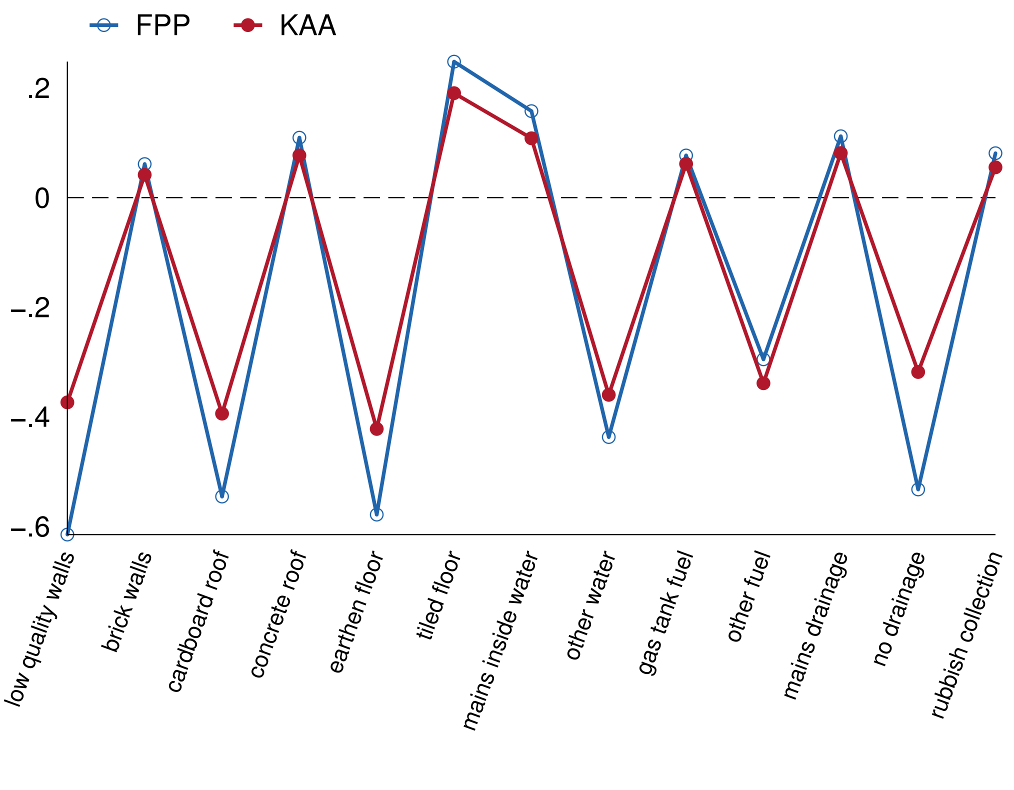
Table 1.1: Asset Indices Statistics

	Typical AI		Count AI		Education AI		Land AI		Reduced AI	
	FPP	KAA	FPP	KAA	FPP	KAA	FPP	KAA	FPP	KAA
Number of Indicators	39	33	39	30	40	34	43	35	29	24
% Variance Explained	23%	44%	24%	42%	23%	44%	23%	45%	28%	51%
Barttlet's p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
K-M-O	0.938	0.938	0.939	0.941	0.938	0.941	0.938	0.939	0.933	0.935

Source: Authors' elaboration with data from ENIGH 2008, 2010 and 2012.

correlation coefficient of 0.996). The FPP typically assigns higher and lower weights than the KAA, also explaining the higher standard deviation of the former (3.01 against 2.12). Exploring these weights allows us to decide whether the index "makes sense" in terms of reflecting SES.

Figure 1.1: Typical Index Dwelling Characteristics Weights

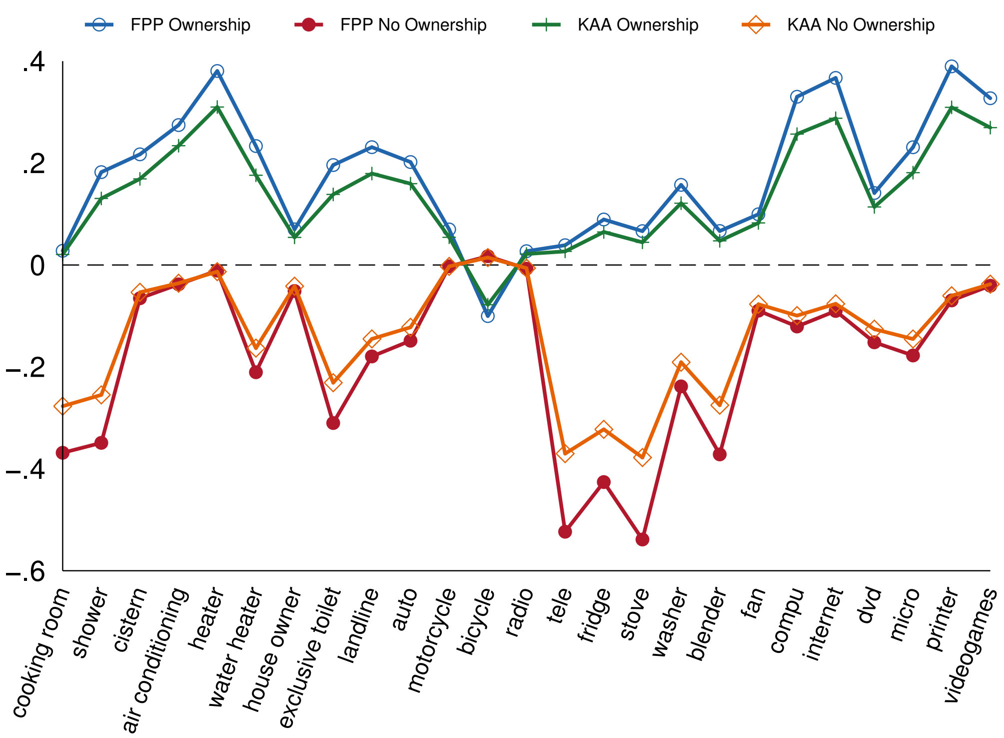


Source: Authors' elaboration with data from ENIGH 2008, 2010 and 2012. Original in colour.

The lower weights are assigned to what intuitively is regarded as low standard of living. Having low quality walls in the dwelling, cardboard roof, earthen floor, "other" source of water and no drainage, for example, substantially reduce the score of a household. The opposite categories to these ones in terms of quality or welfare always present positive weights. The two dwelling characteristics that substantially increase the value of the index, tiled floor and mains water inside the dwelling, are also two of the rarest characteristics in the sample. Only 40% of the households have tiled floors and just 69% of them are connected to the public mains of water inside their dwelling.

The fact that the first principal component is producing a welfare gradient is also confirmed by Figure 1.2, which shows the weights assigned by FPP and KAA to the ownership/not ownership of certain durable goods in the household. Those uncommon assets that are generally perceived as an indication of better off households present higher weights. Having central heating and air conditioning increase the index, but not having them does not reduce it much. On the other hand, not having fairly common assets (such as shower, fridge, etc.) does reduce the index in higher magnitude, but not having them does not increase it significantly.

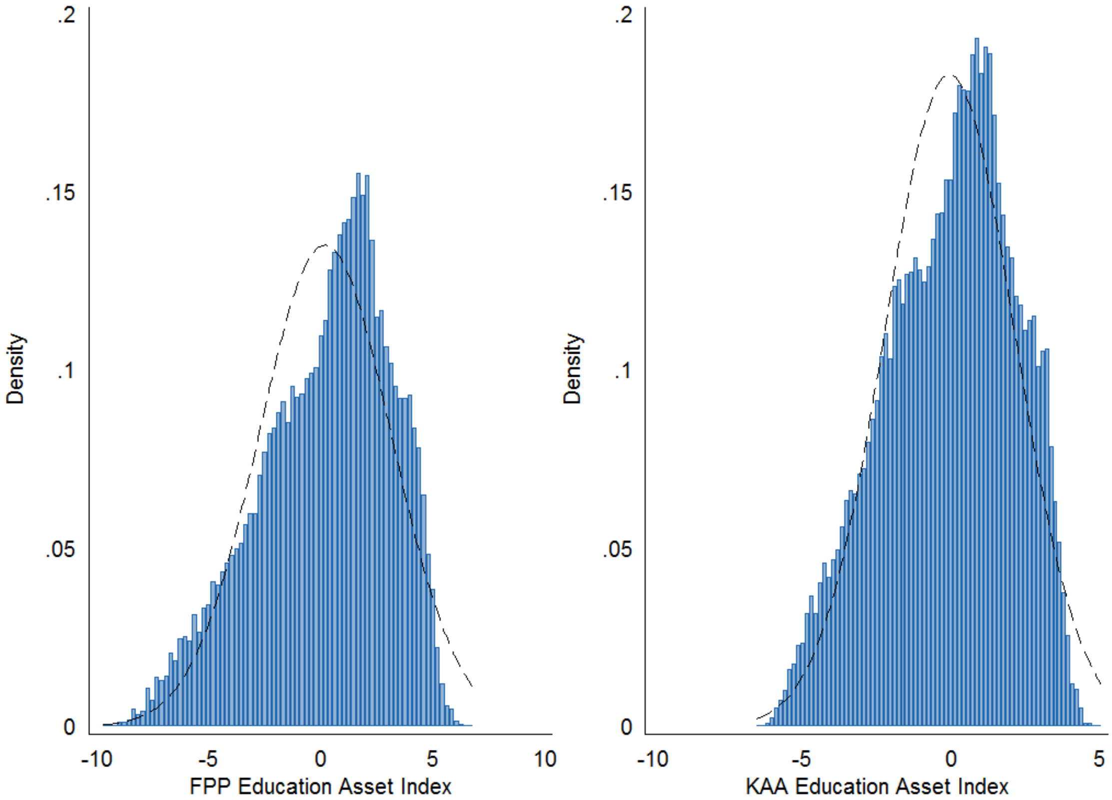
Figure 1.2: Typical Index Durables Weights



Source: Authors' elaboration with data from ENIGH 2008, 2010 and 2012. Original in colour.

Similar relations can be found in the weights of the alternative indices. FPP always assigns more extreme weights to either ownership or lack of ownership of certain asset than KAA. For example, it can be seen in Figure 1.3 how the KAA distribution in the Education Asset Index has a higher density of observations around its mean while the FPP shows a higher range of values. This relationship can be seen for all the indices: the FPP indices always have higher means and standard deviations than the KAA indices.

Figure 1.3: Education Asset Index Histogram



Source: Authors' elaboration with data from ENIGH 2008, 2010 and 2012. Original in colour.

The descriptive statistics of the pooled sample are presented in Table 1.2. The definition of consumption expenditure is defined by the survey. It is a variable that sums up expenditure in food, beverages and tobacco, expenditure in clothing and footwear, expenditure regarding dwelling expenditure in cleaning services and articles and furniture, expenditure in health, expenditure in transportation, expenditure in education and leisure, expenditure in personal care and expenditure in other transferences. As mentioned before, the FPP indices present higher standard deviations, but the KAA indices seem to better discriminate between households by consistently presenting a higher percentage of distinct values.

Current expenditure has 99% of distinct values being the best variable to differentiate households and just behind it is the LAI -in particular such index constructed using the KAA has 98% of distinct values. These results support the inclusion of questions on land size and dwelling in other surveys that do not cover expenditure. Information on the number of durables rather than simple ownership also contributes to the discriminatory power of the index as shown by the 92% of distinct values for the CAI. Unsurprisingly, RAI performs the worst with 52% and 58% of distinct values.

Another way in which we can glance at the distribution of a variable of welfare is the

Gini coefficient. This measure captures the area between the theoretical perfect equality and the observed distribution of certain variable. Values of 0 indicate a perfectly distributed welfare while the value of 1 indicates perfect inequality. The discriminatory power showed by the percentage of distinct values does not always translate into a higher Gini coefficient. While the pooled data on current expenditure show a Gini of 0.445, the second closest is far behind –0.209 for the Count Asset Index using KAA. FPP indices consistently derive lower levels of inequality than those developed using KAA, going as low as 0.160 for the RAI.

1.4.2 Agreement between consumption and the asset indices

Howe et al. (2009) review 17 articles that specifically look at the relationship between consumption expenditure and asset indices and list 5 different measures of agreement. Given the number of specifications considered for the asset index, in this paper I will focus on three highly intuitive and well known measures of agreement: classification into quintiles, R^2 values from regressions and correlation coefficients.

For each of the five specifications, pairwise comparisons of the FPP and KAA version are carried out. In addition, a second kind of comparison is performed, focussing on whether the relationship between such indices and consumption changes with different specifications. This assessment can also help decide which assets are to be used and how to select them if one's objective is to proxy consumption.

In their systematic review, Howe et al (2009) propose a series of cut-off points to decide the level of agreement for each measure found in the papers they review. They define these cut-offs as conservative because the objective is just to evaluate whether the asset index

Table 1.2: Asset Indices Summary Statistics

Overall		Std. Deviation	Distinct	Gini
Expenditure		26,343	99%	0.445
Typical AI	FPP	3.012	83%	0.167
	KAA	2.128	84%	0.190
Count AI	FPP	3.037	92%	0.183
	KAA	2.287	92%	0.209
Education AI	FPP	2.953	85%	0.169
	KAA	2.180	92%	0.192
Land AI	FPP	3.127	95%	0.177
	KAA	2.324	98%	0.203
Reduced AI	FPP	2.850	52%	0.160
	KAA	2.073	58%	0.179

Note:Consumption Expenditure is expressed in 2000 constant Mexican Pesos.
Source: Authors' elaboration with data from ENIGH 2008, 2010 and 2012.

is a good proxy for consumption expenditure or not, which also fits the objective of this paper. Although these cut-offs are arbitrarily defined by the authors and mainly driven by the articles reviewed, they do offer a baseline criteria of assessment. Table 1.3 reproduces the cut-offs proposed by Howe et al (2009) for the measures of agreement used in this paper.

Table 1.3: Cut-off Points to Assess the Strenght of Agreement

	Strength of Agreement		
Measure of Agreement	Strong	Moderate	Weak
Agreement of Classification into quintiles	>75% correctly classified	60-75% correctly classified	<60% correctly classified
R^2 values from regression	0.49-1.0	0.25-.049	<0.25
Correlation coefficients	>80%	65-80%	<65%

Source: Adapted from Howe et al (2009)

The first measures of agreement taken into examination are the well-known Pearson and Spearman correlations. The Pearson correlation coefficient accounts for the linear association between two variables and ranges from -1 to 1 – values close to zero suggest linear independence between the two variables, while values close to 1(-1) suggest perfect positive correlation (negative correlation). The Spearman rank correlation, on the other hand assesses whether one variable can be described as a monotonic function of the other or, seeing it differently, whether two variables can produce the same ranking. Its coefficient also ranges from -1 to 1 and the interpretation is as for the Pearson correlation coefficient.

Table 1.4: Pearson and Spearman Correlations with Expenditure

		Consumption							
		Pearson				Spearman			
		2008	2010	2012	Pooled	2008	2010	2012	Pooled
FPP	Typical	0.501	0.471	0.474	0.476	0.655	0.667	0.650	0.658
	Count	0.539	0.509	0.524	0.518	0.660	0.670	0.653	0.662
	Education	0.512	0.481	0.485	0.486	0.662	0.672	0.658	0.665
	Land	0.506	N/A	N/A	0.506	0.658	N/A	N/A	0.658
	Reduced	0.470	0.445	0.440	0.447	0.641	0.657	0.636	0.647
KAA	Typical	0.522	0.488	0.492	0.494	0.661	0.672	0.656	0.664
	Count	0.556	0.526	0.541	0.535	0.665	0.675	0.658	0.667
	Education	0.532	0.499	0.503	0.505	0.669	0.680	0.664	0.672
	Land	0.527	N/A	N/A	0.527	0.664	N/A	N/A	0.664
	Reduced	0.487	0.459	0.452	0.460	0.649	0.664	0.643	0.654

Source: Authors' elaboration with data from ENIGH 2008, 2010 and 2012.

Table 1.4 summarises the correlation coefficients (by year and for the pooled sample) between consumption and each of the specifications of the index. The first kind of comparison is between the indices constructed following FPP and KAA. The results strongly support the use of polychoric correlations to run PCA in the way suggested by Kolenikov and Angeles (2004; 2009). For each of our five indices, the correlation coefficient is higher when the index is calculated using KAA rather than FPP, pointing to the former as the methodology to be preferred to proxy consumption expenditure. The differences between FPP and KAA are, however, not impressive. For the Spearman rank correlations, KAA increases the coefficient on average by less than 1%. For the linear correlation differences are larger, reaching on average 3.58%. As to an evaluation of the strengths of the observed correlations, according to the cut offs borrowed from Howe et al. (2009) 10 of the correlation coefficients (7.2%) follow under the “weak” strength of agreement while the remaining 62 can be seen as “moderate” proxies for consumption.

Looking at the FPP and KAA separately, the first consistent result arises: the index most linearly associated to consumption is the CAI. This could be a reflection of the degree of “continuity” of the variables used for such that might be closer related to consumption (as also shown by the percentage of unique values from Table 1.2). This result also supports the collection of information on a wide number of durable goods owned by a household rather than just the dichotomous ownership commonly used. It’s up to the designers of instruments to assess how much more costly this is. In terms of rank correlation, however, it is the EAI the one that performs better (for every year and for both FPP and KAA), probably reflecting the strong empirical relationship between education of the household head and consumption.

Six papers in Howe et al. (2009) also used the value of the R^2 from regressions on either the indicators or the actual asset index on consumption data. The R-squared simply captures the proportion of the total variation explained by the variation of the right hand side variables. Values closer to one indicate a better fit of the model. In this case, consumption expenditure was regressed against each specification of the index, for each year as well as for the pooled sample. Table 1.5 summarises this information.

The results from this set of R-squared values support what the correlation coefficients suggested before. Although including education and land size to the indices does increase the value of the R^2 as compared to the TAI, for both FPP and KAA the Count Asset Index captures the largest amount of variation of the consumption data. This is a consistent result for each year of the sample and for the pooled observations as well. These indices also confirm the trends observed in the correlation coefficients across years. In fact, the KAA once again performs better for every index and every sample sometimes deriving an R-squared up to 8.5% higher than the FPP. Not surprisingly, the RAI is the one that performs the worst, only explaining between 21% and 22.5% of the consumption variation.

Finally, over 72% (13) of the indices calculated by the FPP scored an agreement of "weak" while only about 22% did so for the KA. The above evidence suggest that the R^2 measure of agreement fully supports the use of the Kolenikov and Angeles (2009) approach.

Table 1.5: R-Square Coefficients

		R-squared Coefficients			
		2008	2010	2012	Pooled
FPP	Typical	0.239	0.234	0.241	0.235
	Count	0.278	0.274	0.284	0.275
	Education	0.248	0.243	0.251	0.245
	Land	0.246	N/A	N/A	0.246
	Reduced	0.212	0.211	0.212	0.210
KAA	Typical	0.259	0.251	0.259	0.254
	Count	0.297	0.292	0.303	0.294
	Education	0.269	0.261	0.270	0.264
	Land	0.266	N/A	N/A	0.266
	Reduced	0.227	0.223	0.224	0.224

Source: Authors' elaboration with data from ENIGH 2008, 2010 and 2012.

Finally, one of the most common practises followed by the asset index literature is to divide the sample into groups and analyse the misclassification with another measure of welfare. Following this idea, each household was assigned to a quintile (households in quintile "1" being the "poorest" and those in quintile "5" the "richest") according to each index and consumption expenditure. The misclassification distance was calculated as the quintile each household was assign to by a given index minus the distance that same household was assign to using consumption expenditure. A household with a distance of zero therefore means that it was classified equally by a certain index as it was by consumption. This measure is particularly important in case the asset index wants to be used as targeting criteria for social programs.

Table 1.6 summarises the percentage of households that are classified in the same way using consumption and each of our five indices. It can be readily seen that figures are not very different across the FPP and KAA methodologies. For each year, they are all less than 1% apart, with a slightly larger difference in the case of the EAI. This is also the first agreement measure in which its results do not fully support KAA- for 3 of the 18 specifications the FPP derives a slight higher number of households classified equally with consumption expenditure.

The measure of agreement looking at household classification into the same quintile is the one which performs the worst in terms of the criteria developed by Howe et al. (2009). All indices score the "weak" strength of agreement and are somehow far from the "modest" threshold (at least 60% of households classified correctly). It is important to mention at this point that the choice of the number of groups to check for agreement is purely a researcher's decision. The quintile choice is a popular one (Lindelow 2006; Rutstein and Johnson 2004; Sahn and Stifel 2003)[9] but three groups are often considered- "poorest", "middle" and "top" (Sumarto et al. 2006; Filmer and Pritchett 2001) as well. Filmer and Scott (2012) just check the agreement in the 20% poorest classified by expenditure and the asset index.

In order to check the robustness the quintile classification of the indices and consumption expenditure presented in this chapter, different groups were constructed, but the 'weak' agreement of the asset indices with consumption expenditure did not change. As expected, the percentage of correctly classified households increased as the number of groups decreased, but it never reached over 60% to be classified as "moderate" agreement[10].

There are a couple of other results highlighted by Howe et al. (2009), which to some extent are confirmed by our analysis. One of them is the higher agreement with consumption expenditure showed by indices constructed using a higher number of indicators. While this does not hold for the FPP, the KAA indices always show a strong positive relation between the number of indicators and the strength of the agreement. The second one is that the incorporation of additional indicators to those in the "Typical Asset Index" (housing characteristics, consumer durables and access to services) increases the agreement with

[9]These articles do report a significantly lower agreement than the ones presented here. Lindelow (2006) reports 25.1%; Rutstein and Johnson (2004) report 36% and Sahn and Stifel (2003) between 30% and 37%.

[10]The results did almost reach this value. Some specifications derived over a little over 59% of households equally classified. These results are not reported here, but are available upon request.

Table 1.6: Equally Classified Households

		Equally Classified			
		2008	2010	2012	Pooled
FPP	Typical	39.4%	39.3%	40.1%	39.5%
	Count	39.6%	39.3%	40.3%	39.6%
	Education	39.7%	39.6%	40.6%	39.8%
	Land	39.5%	N/A	N/A	39.5%
	Reduced	38.0%	38.1%	40.1%	38.6%
KAA	Typical	39.6%	39.2%	40.7%	39.7%
	Count	39.9%	39.7%	39.9%	39.7%
	Education	40.0%	39.8%	41.1%	40.2%
	Land	39.4%	N/A	N/A	39.4%
	Reduced	38.4%	38.1%	39.9%	38.7%

Source: Authors' elaboration with data from ENIGH 2008, 2010 and 2012.

consumption. This result is confirmed by our indices that use the household head education and dwelling and land size.

1.5 Summary and Conclusion

The main objective of this paper was to explore to explore asset indices in terms of ability to reflect the dimension of consumption expenditure. For each of the 2008, 2010 and 2012 waves of the Mexican Household Survey on Income and Consumption Expenditure five alternative asset indices are built following two alternative methodologies –the Filmer and Pritchett Procedure and the Kolenikov and Angeles Approach. For each year and both sets of five indices, the ability to reflect consumption expenditures is investigated using three measures of agreement: correlation coefficients, R-squared and classification into quintiles.

Some general results can be drawn from such analysis. As suggested in the simulation carried out by Kolenikov and Angeles (2009), the use of polychoric correlations significantly increases the amount of variation explained by the first component. This leads to better criteria for the choice of the indicators for the development of the asset index. Our results also suggest that using all the categories available to construct the index using Filmer and Pritchett Procedure does not necessarily lead to a higher agreement with consumption expenditure; the sphericity and the K-M-O tests can help to develop and index which is not only more efficient but also closer to consumption expenditure.

In addition, our analysis strongly points to the Kolenikov and Angeles Approach as the methodology to be preferred in terms of agreement with consumption expenditure. Moreover, such agreement generally increased when the number of durables was used rather than simple ownership of that type of durable. This could be a significant improvement in the design of surveys that do not contain questions on income or consumption. How the benefit from collecting this data compares with the cost of more intense fieldwork is beyond the scope of this paper, but we feel that this is still likely to be more efficient than including an extensive income module in large-scale surveys.

Results vary also across our five specifications of the asset index. The indices incorporating education of the household head or land and dwelling size performed mildly better than the Typical Asset Index. However, if the asset index is to be used in an econometric model that also includes education, an asset index incorporating educational variables would create obvious estimation problems. As to land and dwelling size, these variables had a considerable amount of missing observations; this may suggest that it is hard for the respondents to answer such questions, and possibly improvements in the questionnaire design may be necessary.

In conclusion, our evidence shows that in order to proxy consumption expenditure an asset index should be built following the Kolenikov and Angeles Approach and accounting for the number of durable goods (rather than mere ownership). It is important, however, to keep in mind that the level of agreement is at best moderate. The scope for an asset index to be a good proxy for consumption may be limited; asset and consumption may rather be seen as components of a third variable which we could call standard of living. The analysis of the variance of consumption expenditure not explained by asset indices, and the search for proxies able to account for it, are interesting avenues for further research.

CHAPTER 2

Wealth Inequality, the Educational Milieu and School Enrolment

Abstract

Using data from the extended section of the 2010 Census (2.9 million households), we study how school enrolment in Mexico is associated with wealth inequality and the educational environment the child is exposed to within the household as well as in the wider social context. We provide robust evidence that wealth inequality is a negative predictor of school enrolment for the entire primary, secondary and high school age ranges, while the converse holds for the educational milieus. Importantly, our work shows the key role played by the introduction of explicit interaction terms for the interplay between economic and educational variables at both the household and the ecological levels. A graphical analysis of interacted variables illustrates similarities and idiosyncrasies of the underlying social dynamics explaining school enrolment for the different age ranges.

THE interest in economic inequality has grown a great deal in the past few years, an interest fostered by the publication of successful books addressing the general public –e.g. Wilkinson and Pickett (2009), Milanović (2010) and Stiglitz (2012). The appearance of Piketty's (2014) Capital in the 21st Century has recently put a spotlight on wealth inequality, on its upward trend in the last decades and on the implications this has for our societies. Among the social outcomes of major interest for academics and policymakers is education, which is a key component of human capital, an engine of growth, a universal human right, and a domain featuring in the most widespread multidimensional indices of societal progress as well as in the main global development initiatives (e.g. Human Development Index, Multidimensional Poverty Index, Millennium Development Goals, Post-2015 Sustainable Development Goals, etc.). Shedding light on the relationship between economic inequality and educational outcomes is important; in the case that a negative relationship exists between the two, greater inequality would be associated with lower educational outcomes and therefore with a significant cost for societies.

In this paper we investigate wealth inequality as a predictor of school enrolment, and we do this by fully taking into account the role of another variable which has been argued to be crucial for educational outcomes, namely the educational milieu surrounding the child. A body of literature which crosses the fields of economics, sociology and child development has studied how educational outcomes may be affected by economic variables (Galor and Zeira 1993; Alesina and Rodrik 1994; Basu and Van 1998; Mayer 2001; Gutiérrez and Tanaka 2009) and by the educational environment the child is immersed in (e.g. Crane 1991; Grolnick and Slowiaczek 1994; Cunha and Heckman 2007; Heckman 2007; Strulik 2013). To the best of our knowledge, no other paper exists which explores the interplay of economic and educational environment variables in the depth we pursue in this work. We contend, and our evidence confirms this hypothesis, that not only is the educational environment important, but it also interacts with economic variables and it does so at both the household and the wider levels (i.e. within and beyond the household). By unveiling such interconnections our paper also contributes to a fuller understanding of the demand side of education, which has a large potential for policy intervention (Handa 2002) and whose importance for developing countries is advocated by the recent work of Lincove (2015).

Our empirical analysis uses data from the extended-questionnaire section of the 2010 Mexican census, which covers around 2.9 million households and is statistically representative at municipal level (the lowest political and administrative level in Mexico). Given our interest in employing explanatory variables at household and municipal levels, we study the probability that a child is enrolled in school through multilevel logit models where the dependent variable is the dichotomous status of being enrolled/not being enrolled in school for children aged between 6 and 18. In order to allow for the possibility that enrolment dynamics may differ at different age levels, we investigate separately the three subsamples which correspond to primary, secondary and high school ages –i.e. the 6-12, 13-15 and 16-18 age ranges, respectively. For each of the three age ranges, we find strong evidence of inequality as a negative predictor of school enrolment and of a positive role played by the educational environment both within and beyond the household. The introduction of an interaction term between household wealth and mean education in the household improves the ability of our models to fit the data. Interacting economic and educational variables at municipal level proves not only to further improve the goodness of fit, but also to be crucial for determining the sign and significance of wealth inequality. The nuances of how the educational environment relates to school enrolment at the three different age levels are graphically described by plotting predictive margins. A final offer of our paper relates to municipal random effects. The use of multilevel models enables us to provide illustrations of how municipal effects on school enrolment can differ substantially, even in the case of contiguous municipalities.

The remainder of the paper unfolds as follows. In section 2.1 we lay out the conceptual framework for our analysis, with a focus on the ways in which economic inequality and the educational milieu surrounding the child at both household and wider levels may affect school enrolment. In section 2.2 we outline our empirical strategy by describing the models we employ, the data we use, the derivation of our wealth indicator and the explanatory variables included in our estimations. In section 2.3 we present our results by providing graphical representations of predicted probabilities alongside estimated coefficients, in particular for interaction effects as advocated by Greene (2010). In the final section we summarise and conclude by highlighting the main lessons and policy implications stemming from our study.

2.1 Enrolment: Inequality and the Educational Milieu

2.1.1 Economic inequality and education

The literature has discussed the potential impact of economic inequality on school enrolment looking at both the supply and at the demand of education. With regard to the former, the channel is a political economy mechanism whereby quality and quantity of the provision of a certain public good depend on citizens' willingness to contribute to it through taxation. The existence of inequality would lower the amount of resources available for the public provision of that good because the rich would purchase it on the private market (Alesina and Rodrik 1994; Perotti 1996; Epple and Richard E Romano 1996; Epple and Richard E. Romano 1996). In the case of education, the rich would send their children to private schools and would resist contributing to the funding of public education. This would result in a lower supply of education with negative effects on schooling –see Tanaka's (2003) model and its extension developed by Gutierrez and Tanaka (2009). The problem is analogous to the provision of other public goods; for example, the impact of inequality on health through the supply channel is discussed in similar terms by Kawachi (2000) and Leigh, Jencks and Smeeding (2009).

With regard to the demand side, the bulk of the literature addressing the effect of inequality on schooling has focused on access. Galor and Zeira (1993) show that the distribution of wealth is important because, given the imperfection of credit markets and therefore the existence of glitches in borrowing opportunities, in an economy where wealth is held by a few only these few are able to invest in education. Similar results are obtained by Perotti (1996), García-Peñalosa (1995), Chiu (1998) and Checchi (2003). The focus of these papers is affordability of education and the economic barrier to enrolment, an argument which is expressed clearly in Basu and Van's (1998) 'luxury axiom'; according to this view, education would be "a luxury good in the household's consumption in the sense that a poor household cannot afford to consume this good" (p. 415). It is important to note that there is a fundamental difference between the political economy and the access arguments. According to both arguments school enrolment will be, on average, lower in unequal societies compared to more equal ones. However, while the political economy argument deals with a mechanism whose implications reverberate through the whole population (lower education supply means fewer places in public schools for potentially everybody), the access argument has a micro focus and applies merely to those at the lower end of the economic spectrum –i.e. this barrier to enrolment does not affect the rich.

While the arguments outlined above have been discussed at length in the literature, there are a number of often neglected mechanisms through which a context of inequality can affect education. There is fast-growing multidisciplinary evidence of a series of phenomena, attitudes and behaviours which are corrosive to the social fabric and are shown to be more likely to occur in more unequal contexts. Among these there are lower levels of trust, social cohesion, civic engagement, agreeableness, as well as increased levels of individualism, self-enhancement and various sorts of antisocial or unethical behaviour –see, inter alia, Takata (2003), Uslaner and Brown (2005), Elgar and Aitken (2011), de Vries, Gosling and Potter (2011), Loughnan et al (2011), Neville (2012), Piff et al. (2012; 2012a), Trautmann, van de Kuilen and Zeckhauser (2013) and Piff (2014). It can be argued that economic inequality may have an impact on the demand of education through these channels. To see this, consider the twofold motivation for valuing education. As theorised by conceptual research in education (e.g. Saito 2003) and as emerges from empirical surveys (Esposito et al. 2011), education is valued for both intrinsic reasons (e.g. becoming a better person in society) and instrumental reasons (e.g. material benefits such as employment, a better wage, etc.). By fostering dynamics which are prejudicial to social coexistence, the potential effect of inequality on the demand of education for intrinsic reasons can be hypothesised to be a negative one –for a paper illustrating the relationship between schooling and trust see Dincer (2011). As for the instrumental motivation, the effect of inequality on school enrolment may be positive if staying in education is perceived as a tool for succeeding in a 'jungle-like' society; alternatively, it may be negative if such context fosters a myopic approach to lifetime consumption which prioritises immediate, over future, material gratification. Finally, inequality may have a negative impact on educational outcomes by triggering unhealthy attitudes such as smoking, which at a young age are proven to jeopardise the development of cognitive skills (Jacobsen et al. 2005) –for a recent paper relating inequality to increased unhealthy behaviour see Harling et al (2014).

2.1.2 The relevance of the educational milieu

The implicit stance behind the luxury axiom is that once the economic status box is ticked then the child will be automatically be enrolled in school. However, while undoubtedly important, the economic constraints limiting access to education account for only for part of the story (Ray 2000; Cameron and Heckman 2001; Bhalotra 2007). A crucial aspect which needs to be taken into account is the educational milieu the child is surrounded by. For example, Handa (2002) finds that increasing parents' education has a far greater potential for boosting enrolment in a developing setting than raising household income. We argue that the educational environment is important at both the household and the wider level, and that it can be hypothesised to interact with economic variables –in our case, household and mean municipal wealth.

Within the household

The importance of the educational environment surrounding the child in the household is well documented. Connelly and Zheng (2003), Dostie and Jayaraman (2006) and Bhalotra (2007), among others, find that parents' education is a strong a predictor of children's educational outcomes. A number of reasons have been given by educational specialists for the relevance of the educational environment within the household. The influential work of Grolnick and Slowiaczek (1994) argues that children's school achievement is affected by three components of parents' involvement –behavioural (attending school events), personal (caring about school) and cognitive (exposing the child to intellectual stimulating material)– and that all three are directly or indirectly positively related to parents' level of education. The beneficial effect of parents' education on pupils' academic achievements through education-oriented values, involvement and objective as well as perceived ability to help with homework is also illustrated by the work of Davis-Kean (2005), Green et al (2007) and Hornby and Lafaele (2011).

We hypothesise that the level of education of adults in the household interacts with economic status; in other words that its effect varies at different levels of household wealth. A reason for this is in order. Consider the following pairs of households: i) two equally affluent households A and B, where in A adults are well educated and gained their wealth through jobs such as a surgeon or a lawyer while in B they are uneducated and manage a restaurant; ii) two households C and D where all adults hold a university degree, but while C is wealthy D is not. It is clear that there will be no difference between A and B in terms of affordability of education, or between C and D in terms of the education-related environmental factors described above. However, the confluence of educational and economic accomplishments in the case of A and C is likely to enhance the awareness of material returns on schooling, and hence yield a motivational premium for children to demand education, as well as for parents to act in order to extend children's permanence in school.

Beyond the household

The conceptual underpinnings for the relevance of the wider educational environment lie in the notion that individuals' behaviour is influenced by those around them –see Granovetter's (1978) general threshold model of collective behaviour, and more specifically Crane's (1991) 'epidemic' approach to school dropout and Kling et al (2007) study of neighbourhood effects on educational outcomes. The motivational component has a key role in Jencks and Mayer's (1990) socialization theory wherein adults in the neighbourhood act as role models and in Strulik's (2013) framework where the aggregate behaviour of the community promotes the establishment of pro- or anti-schooling norms. In addition, a more educated context can also be an incentive to stay in education in order to culturally fit in society, meet higher educational requirements on the job market and for educational assortative mating purposes (Blossfeld 2009; Nielsen and Svarer 2009). Finally, as argued by Cunha and Heckman (2007), a more educated environment also fosters children's learning and academic achievements thanks to the intellectual stimuli the child is exposed to –this aspect is analogous to Grolnick and Slowiaczek's (1994) cognitive aspect of parents' involvement. Interestingly, Gumus (2014) finds that school enrolment in Turkey is positively affected by the proportion of adults in the area having completed primary school. Evidence from Mexico of the existence of neighbouring effects on schooling decisions is provided by Bobonis and Finan (2009) and Lalive and Cattaneo (2009).

As was the case for the household level, we hypothesise that educational and economic variables interact also at a wider level (municipal level). Our main focus is the interplay between educational aggregates and mean wealth; in our empirical section we show evidence of additional potentially interesting interactions between aggregate variables, but a conceptualisation of these alternative mechanisms is beyond the scope of this paper. To see the rationale for hypothesising an interaction between educational aggregates and mean wealth, the role of the latter as an explanatory variable for individual school enrolment should first be clarified. It is widely recognised that in models which explain individual-level social outcomes (e.g. individual educational attainments, health status, life satisfaction, etc.) by means of both individual and aggregate economic variables (e.g. household and municipal income or wealth), the latter plays the role of relative disadvantage or relative deprivation –see, inter alia, Luttmer (2005), Clark et al (2008), Gravelle and Sutton (2009) and Verme (2015). Following McLoyd (1990), Mayer (2001) and Hackman et al (2010), relative deprivation is expected to affect negatively educational outcomes by decreasing children's willingness to study or stay in school, lowering parents' expectations and increasing stress due to lower social rank. In addition, Mayer (2001) contends that relative deprivation can lead to isolation and alienation –other links between relative deprivation and social exclusion can be found in Adam Smith's (1776) often quoted linen-shirt argument (e.g. Sen 1983) and in the more technical work of Bossert et al (2007) and Esposito (2010). As argued by Mayer (2001), isolation may affect the adherence to the norms and the absorption of values which are prevailing in society; if this is the case, then the scope for the factors mentioned above in our discussion of the role of the wider educational environment to affect the demand of education can be expected to vary at different levels of relative deprivation. For example, the strength of role model (Jencks and Mayer 1990) or schooling norm (Strulik 2013) mechanisms as motivational drives for demanding education may differ at different levels of relative deprivation, being presumably weaker the greater the level of relative deprivation.

2.2 Empirical Operationalisation

2.2.1 Econometric strategy

The willingness to investigate school enrolment using explanatory variables at both household and aggregate levels motivates our choice of employing multilevel models. When the observations are not independent, one of the basic assumptions behind multivariate regression is violated given that the residuals are not uncorrelated. Overlooking this clustering leads to an underestimation of standard errors and a bias in the results, with a higher probability of a type I error. Standard errors should be estimated using a model able to account for this clustering and for the variation among groups. We use multilevel models to account for this clustering and therefore for the characteristics households living in the same municipality have in common; in addition, they enable the exploration of between-group variability and its effect on individual outcomes –for further details on multilevel models see Rabe-Hesketh and Skrondal (2008), Gelman and Hill (2009), Smith (2011) and Scott et al (2013).

In particular, we estimate multilevel logit models where the dependent variable is the individual-level dichotomous status of being enrolled/not being enrolled in school for children aged 6-18. In order to allow for the possibility that enrolment dynamics may differ at different age levels and detect this heterogeneity, we split our sample in three subsamples corresponding to primary, secondary and high school ages and investigate them separately. This means that for each specification we will estimate three models based on different samples: one using the subsample of children in the 6-12 age bracket, one with adolescents in the 13-15 age bracket and one with those in the 16-18 age bracket. In Mexico children are expected to start primary school at age 6 and carry on for 6 years before they attend secondary school and high school, both for three years[1]. Primary and secondary schools are mandatory but enforcement is weak.

Our level-1 explanatory variables of interest are household wealth and average years of formal schooling among adults in the household. The wealth variable is obtained by computing a household asset index in the fashion of Filmer and Pritchett (1999), already used as a determinant of school enrolment by Filmer and Pritchett (1999) and McKenzie (2005). In particular, given the discrete nature of the data used to construct this kind of indices, the Kolenikov and Angeles (2009) methodology is used[2]. Our level-2 (municipal level) explanatory variables of interest are the municipal Gini as a measure of wealth inequality, mean municipal asset index and a variable labelled as 'Ratio' accounting for the educational environment at municipal level. We create three of these variables tailored on the role model or schooling norm which is most directly relevant for each age-specific model; hence, for our models addressing age ranges 6-12, 13-15 and 16-18 we use, respectively, the ratio of adults in the municipality having completed primary school (Ratio1), secondary school (Ratio2) and high school (Ratio3).

In addition to these variables, we include the set of controls which are typically used in the literature on school enrolment in developing coutnries (Connelly and Zheng 2003; Dostie and Jayaraman 2006; Emerson and Souza 2008; De Carvalho Filho 2012; Gumus 2014) as well as specifically in Mexico (López Acevedo 2004; De la Cruz Tovar and Díaz González 2010). Our control variables include child's gender, age, whether she is indigenous, first born or whether she has a physical or mental disability, number of boys and girls in the household, whether the household is a beneficiary of a social program and characteristics of the household head such as gender, age and age squared. Controls at municipal level include municipality size, number of schools per children, average number of schools per children in neighbouring municipalities and outward migration intensity. The full list of dependent and independent variables together with their descriptive statistics is provided in Table 2.1 below.

[1]The described 6+3+3 scheme is the general rule applying to the very large majority of schooling patterns in Mexico; however, it is possible to find secondary schools or high schools which last 4 years.

[2]Standard Principal Components Analysis (PCA) assumes that the variables are multivariate normal. Following Kolenikov and Angeles (2009), we run PCA using polychoric correlations to better approximate the normality assumption and estimate the amount of variation explained by the first component. Finally, it should be noted that financial assets are not included in our measure of wealth.

Formally, the base model to be estimated is:

$$
\begin{aligned}
&Pr(Enrolment_{ihm}|I_i, H_i, M_m) = \\
&\qquad \alpha + \beta_1 Wealth_h + \beta_2 Schooling_h + \beta_3 Wealth_h * Schooling_h \\
&\qquad + \gamma_1 Inequality_m + \gamma_2 MWealth_m + \gamma_3 Ratio_m \\
&\qquad + \delta CI + \tau CH + \varphi CM + \zeta_m + \varepsilon_{ihm}
\end{aligned}
\tag{2.1}
$$

with

$$\zeta_m \sim N(0, \sigma^2_\zeta)$$

$$\varepsilon_{ihm} \sim N(0, \sigma^2_\varepsilon)$$

where the probability of enrolment of child i living in household h which is in municipality m will be modelled as a function of household and municipal variables of interest described before and a series of individual, household and municipal control variables (CI, CH and CM respectively) to get a more precise estimator of the parameters of our variables of interest and to reduce possible endogeneity problems (arising from correlations between the dependent variable and ε_{ihm}. The municipal random intercept is given by $\alpha + \zeta_m$ with $\zeta_m \sim (N, \psi)$. A number of interactions between $Inequality_m$, $MWealth_m$ and $Ratio_m$ will be added to subsequent models in 2.2 and 2.3.

2.2.2 Data, descriptive statistics and estimation details

We use data from the extended-questionnaire section of the 2010 Mexican census (Instituto National de Estadistica y Geografia, henceforth INEGI, 2010). This extended questionnaire is applied to a total of 10% of the population following a stratified clustered sampling design which is statistically representative at municipal level and covers around 2.9 million households. Looking at Table 2.1, one can see that 49.7% of children in our age range of interest are girls, a third is indigenous and 1.9% suffers from a disability. The household head is on average 44 years old and is a female in one sixth of total households. As expected, enrolment rates are notably different across the three age groups. Almost 97% of children in primary-school age attend school; this rate drops to 82% for children in secondary-school age and it dramatically decreases to less than 50% for adolescents in high-school age. The correlation between the municipality mean asset index we computed and the official municipality mean income estimated by the governmental agency called Consejo Nacional de Evaluación de la Política de Desarrollo Social (CONEVAL 2013) is high –0.81 for linear correlation and 0.91 for rank correlation.

Table 2.1: Descrpitive Statistics

	Observations	Mean/Proportion	SD	Minimum	Maximum
6-12 year old attendance	1,461,364	0.959	0.199	0	1
13-15 year old attendance	629,079	0.822	0.382	0	1
16-18 year old attendance	623,667	0.489	0.499	0	1
Gender (1 if female)	2,714,110	0.495	0.5	0	1
Oldest	2,714,110	0.302	0.459	0	1
Age	2,714,110	12.011	3.737	6	18
Disability	2,714,110	0.018	0.134	0	1
Indigenous	2,714,110	0.211	0.408	0	1
Household wealth	1,327,350	5.704	2.343	0	11.616
N of boys in HH	1,327,350	1.337	1.092	0	14
N of girls in HH	1,327,350	1.307	1.102	0	13
HH head female	1,327,350	0.167	0.373	0	1
HH head age	1,327,350	44.299	12.614	12	130
HH mean years of education	1,327,350	7.085	3.829	0	24
Social program	1,327,350	0.223	0.416	0	1
Municipal Gini	2,456	0.169	0.05	0.042	0.377
Mean municipal wealth	2,456	5.348	1.548	1.665	9.205
Ratio1[a]	2,456	1.025	0.779	0.085	11.936
Ratio2[a]	2,456	0.169	0.144	0.001	2.512
Ratio3[a]	2,456	0.087	0.101	0	1.765
#Primary per Child	2,456	0.012	0.009	0.001	0.1
#Secondary per Child	2,456	0.010	0.008	0	0.090
#HighS per Child	2,452	0.003	0.003	0	0.050
Neighbour Primary/Chld	2,456	0.002	0.001	0.0002	0.016
Neighbour Secondary/Chld	2,456	0.002	0.001	0.0002	0.020
Neighbour High/Chld	2,456	0.0005	0.0003	0	0.005
Schools per Children	2,452	0.009	0.006	0.001	0.059
Municipality Size	2,456	45,740	132,758	93	1,820,000
Municipal migration	2,456	2.691	2.311	0	14.356

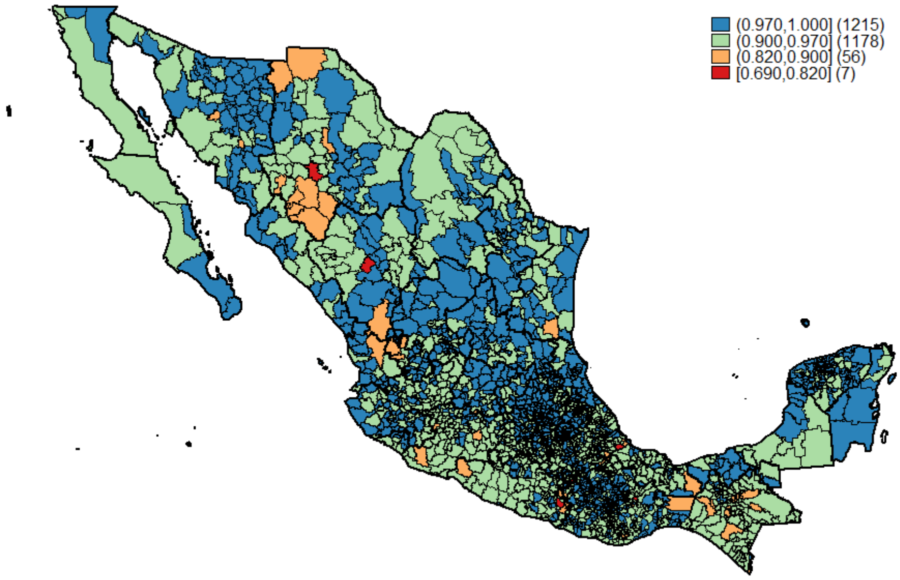
Source: Authors' elaboration with data from INEGI, Consejo Nacional de Población (CONAPO) and Sistema Municipal de Base de Datos (SIMBAD, which is part of INEGI). The migration variable is an index for outward migration to the United States.

[a]Proportion of the population having completed primary (Ratio1), secondary (Ratio2) and high school (Ratio3).

The spatial heterogeneity of enrolment rates can be appreciated by looking at Figures 2.1, 2.2 and 2.3. These maps show school enrolment rates across municipalities, with warmer (colder) colours representing lower (higher) enrolment rates. It is possible to notice that while clusters of neighbouring municipalities having similar enrolment rates certainly exist, there are also municipalities where enrolment rates dramatically differ from those of their neighbours.

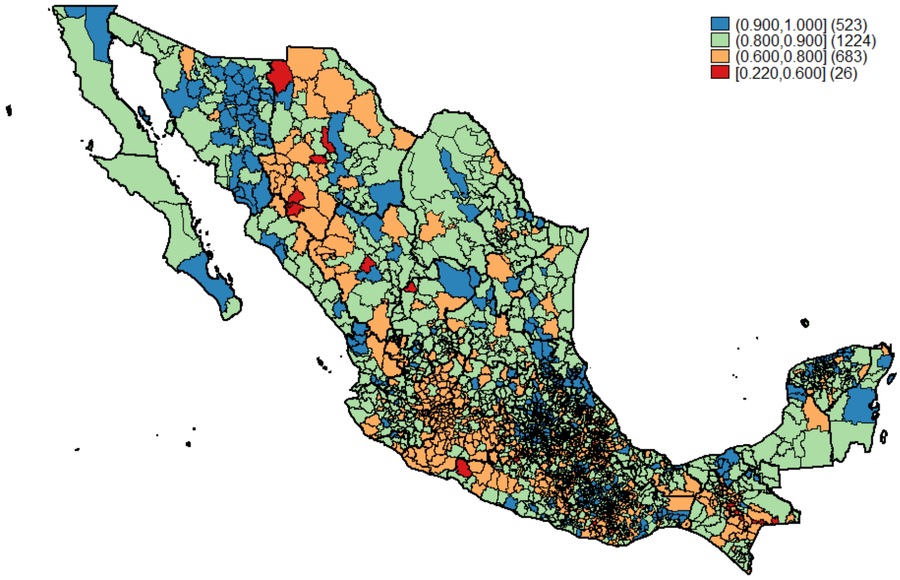
The analysis is carried out using STATA 13. This software offers two incorporated commands to estimate multilevel models, *xtlogit* and *xtmelogit*, both based on maximum likelihood estimations using adaptive quadrature approximation. Each of the commands offers pros and cons. The main advantage of the *xtlogit* command is that it is considerably

Figure 2.1: School Attendance Rates. 6-12 Age Category



Source: Authors' elaboration from census data (INEGI, 2010) using STATA 'spmap' command. Original in colour.

Figure 2.2: School Attendance Rates. 13-15 Age Category

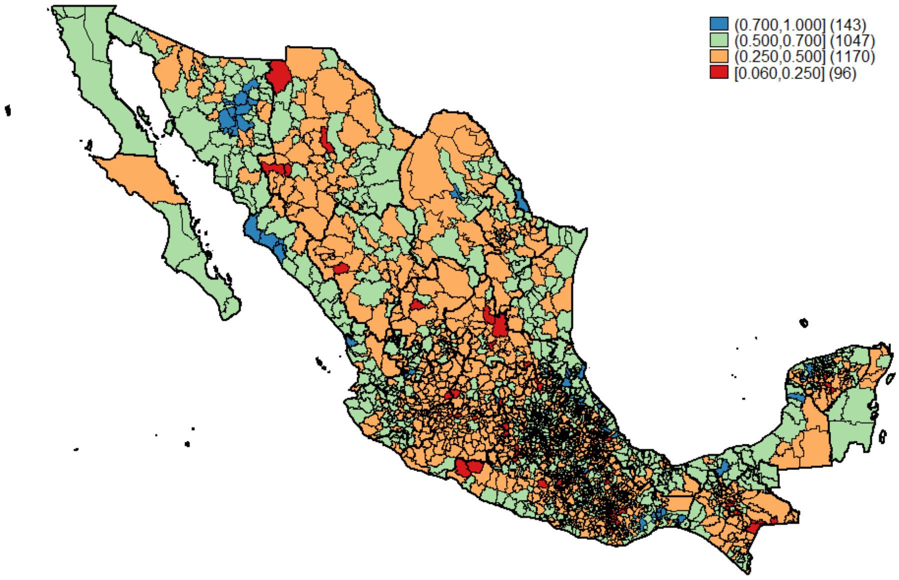


Source: Authors' elaboration from census data (INEGI, 2010) using STATA 'spmap' command. Original in colour.

faster, which for large datasets such as the one we use in this paper is a real plus[3]. The *xtmelogit* command is more flexible and offers more options; in particular, it allows the researcher to estimate not only the variation in municipal random effects but also each cluster's specific intercept. Given the nature of the estimation by approximation, both commands offer options to indicate the number of quadrature or integration points

[3]For example, using the University of East Anglia high-performance scientific cluster (more information can be found in http://rscs.uea.ac.uk/high-performance-computing) each of our specification for primary school age takes about 4 minutes if estimated using *xtlogit* and about 4 hours using *xtmelogit*.

Figure 2.3: School Attendance Rates. 16-18 Age Category



Source: Authors' elaboration from census data (INEGI, 2010) using STATA 'spmap' command. Original in colour.

–more of these ensure greater estimation accuracy but also require longer computational time. Rabe-Hesleth and Skrondal (2008) suggest checking the robustness of results to higher integration points. We report results from estimations using *xtlogit* with the default quadrature points (12); we check our results using 20 and 30 quadrature points as well as *xtmelogit* with 15, 22 and 30 integration points –results are robust to all these checks. Finally, the estimations for the illustration of municipal random effects in subsection 2.3.2 are obtained using the *xtmelogit* command.

2.3 Results

2.3.1 Main results

Results from our multilevel logit estimations can be seen in Table 2.2 and Table 2.3, with a total of seven specifications being estimated for each age bracket (full result tables are provided in appendices B.1 and B.2). Looking at Table 2.2, specifications (1)-(4) refer to the 6-12 age range and differ in the set of our variables of interest at municipal level featuring in the regression; only the Gini coefficient features in specification (1) and while further specifications progressively add municipal wealth, Ratio1 and the interaction between the latter two variables. The same logic applies to specifications (5)-(8) and (9)-(12) which refer to the 13-15 and the 16-18 age ranges, respectively. Household wealth and educational environment at both household and municipal levels are strong predictors of individual school enrolment; the wealthier the household and the greater the amount of education surrounding the child (at both household and municipal levels) the higher the probability that she is enrolled in school. The significance with negative sign of mean asset index points to the role of relative deprivation, which as we saw above is expected to be detrimental for school enrolment via its motivational and aspirational effects on both children and parents[4].

Significance and sign of the Gini coefficient may appear uncertain at first sight because in Table 2.2 they vary across our specifications. However, the Gini is constantly negative and highly significant across the three age ranges once the interaction between municipal wealth and Ratio1-3 is included as seen by Figure 2.4; this is the case for specifications (4), (8) and (12) as well as for all specifications in Table 2.3–i.e. specifications (13)-(21), which account for additional and more complex interactions involving municipal-level variables. A widely used way of discerning between competing models is to look at the extent to which they are able to capture the variability in the data. Looking at the bottom of Table 8 and Table 2.3, it is possible to see that each of specifications (4), (8), (12) and (13)-(21) outperform their competitors according to a number of goodness of fit statistics. Particularly meaningful in our case is Schwarz's (1978) approximation of the Bayes factor (known as Bayesian Information Criterion, BIC)[5], which, in the spirit of Occam's Razor principle of parsimony, penalises models more heavily for the use of additional regressors –compared to what other model selection criteria such as the Akaike's Information Criterion (AIC) do (Akaike 1973). In this way the BIC makes it more demanding for specifications employing more regressors to be preferred to those employing fewer ones; that is, it makes more difficult for specifications (4), (8), (12) and (13)-(21) to outperform their competitors. The degree to which each specification including the interaction between municipal wealth and Ratio1-3 is preferred to those not including it on the basis of the BIC is described in the literature as 'decisive'(Jeffreys 1961), 'very strong' (Raftery 1994; Kass and Raftery 1995) or 'extreme' (Vandekerckhove et al. 2015). It can be noticed that all the specifications reported in this paper include the interaction term between wealth and educational environment at household-level; the reason for this is that these specifications outperform those without this interaction term as to their ability to fit the data and including this interaction term does not influence sign or significance of the other regressors (the other results are available upon request). Before turning to the analysis of interacted variables, we refer to Table 2.4 which presents robustness checks for

[4]We remark that this interpretation of mean asset index relates to these specific models –as extensively explained by the body of literature quoted above. The adoption of mean asset index as explanatory variable in an OLS model for aggregate enrolment rates reveals (as expected) a positive and significant coefficient (results available upon request).

[5]The Bayes factor is a "summary of the evidence provided by the data in favour of a scientific theory, represented by a statistical model, as opposed to another" (Kass and Raftery, 1995, p. 777). Given two competing theories and data to test them, the Bayes factor is the posterior odds in favour of one of the theories, when the prior probabilities that they are true are equal.

specifications (4), (8), (12) using the Atkinson and Theil inequality indices and household random effects; as can be seen in the table, all results hold.

Table 2.2: Determinants of Individual School Enrolment by Age Range – Multilevel Logit Models

	6-12 Age range				12-15 Age range				16-18 Age range			
	(1) g1	(2) gm1	(3) gmr1	(4) gmm*r1	(5) g2	(6) gm2	(7) gmr2	(8) gmm*r2	(9) g3	(10) gm3	(11) gmr3	(12) gmm*r3
HHWealth	0.394***	0.403***	0.406***	0.405***	0.210***	0.216***	0.220***	0.220***	0.185***	0.191***	0.193***	0.193***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
HHAdEdu	0.304***	0.304***	0.304***	0.300***	0.162***	0.163***	0.164***	0.160***	0.139***	0.140***	0.141***	0.138***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
HHWealth*HHAdEdu	-0.029***	-0.029***	-0.030***	-0.029***	0.003***	0.003***	0.003***	0.003***	0.009***	0.009***	0.009***	0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
MunGini	5.041***	0.325	0.347	-1.287***	5.089***	1.260***	0.575*	-2.283***	6.027***	2.862***	2.204***	-1.156***
	(0.282)	(0.360)	(0.354)	(0.361)	(0.244)	(0.334)	(0.315)	(0.320)	(0.203)	(0.288)	(0.280)	(0.291)
MunWealth		-0.239***	-0.303***	-0.297***		-0.189***	-0.319***	-0.352***		-0.149***	-0.231***	-0.321***
		(0.013)	(0.014)	(0.014)		(0.012)	(0.013)	(0.012)		(0.010)	(0.011)	(0.011)
Ratio1			0.208***	1.629***								
			(0.023)	(0.106)								
MunWealth*Ratio 1				-0.177***								
				(0.013)								
Ratio 2							2.034***	11.577***				
							(0.115)	(0.460)				
MunWealth*Ratio 2								-1.213***				
								(0.056)				
Ratio3											1.779***	15.916***
											(0.121)	(0.619)
MunWealth*Ratio 3												-1.750***
												(0.075)
Constant	-0.246***	1.831***	1.897***	1.723***	6.663***	8.342***	8.725***	8.957***	2.876***	4.217***	4.584***	5.335***
	(0.080)	(0.134)	(0.132)	(0.128)	(0.096)	(0.142)	(0.138)	(0.132)	(0.086)	(0.124)	(0.123)	(0.121)
Obs.	1,464,132	1,464,132	1,464,132	1,464,132	630,208	630,208	630,208	630,208	623,667	623,667	623,667	623,667
Level 2 SD	0.5072	0.4632	0.4519	0.4269	0.4911	0.4649	0.4274	0.3831	0.4276	0.4077	0.3867	0.3395
Intra-Class Corr.	0.0725	0.0612	0.0584	0.0525	0.0683	0.0616	0.0526	0.0427	0.0527	0.0481	0.0435	0.0338
AIC	440,878	440,533	440,451	440,271	499,253	499,009	498,704	498,286	705,103	704,892	704,685	704,201
BIC	441,134	440,802	440,731	440,563	499,492	499,258	498,965	498,559	705,341	705,141	704,945	704,473
LL	-220,418	-220,245	-220,202	-220,111	-249,606	-249,482	-249,329	-249,119	-352,530	-352,424	-352,319	-352,076
Data fit compared to previous model		Strongly preferred	Strongly preferred	Strongly preferred		Strongly preferred	Strongly preferred	Strongly preferred		Strongly preferred	Strongly preferred	Strongly preferred

Note: Standard errors in parentheses. *, ** and *** denote statistical significance at $p < 0.1$, $p < 0.05$ and $p < 0.01$ levels, respectively. Additional controls are child's gender, age, whether she is indigenous, first born or whether she has a physical or mental disability, number of boys and girls in the household, whether the household is a beneficiary from a social program, and household head such as gender, age and age squared. Controls at municipal level include municipality size, number of schools per children and outward migration intensity.

In the name of the models "g" stands for "Municipal Gini", "m" for "Municial Mean Asset Index", "r" for the "Municipal Educational Ratios" and "1", "2" or "3" the educational level age estimated.

Table 2.3: Determinants of Individual School Enrolment by Age Range – More Complex Interactions

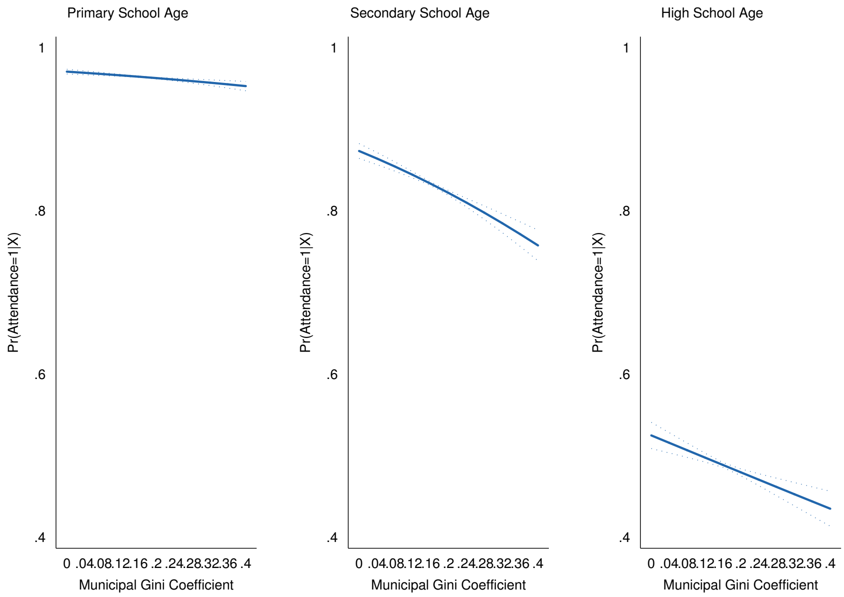
	6-12 Age range			12-15 Age range			16-18 Age range		
	(13) g*mm*r1	(14)g*rm*r1	(15)g*m*r1	(16) g*mm*r2	(17)g*rm*r2	(18)g*m*r2	(19) g*mm*r3	(20)g*rm*r3	(21)g*m*r3
HHWealth	0.405***	0.406***	0.405***	0.220***	0.219***	0.219***	0.193***	0.193***	0.193***
	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
HHAdEdu	0.300***	0.300***	0.300***	0.160***	0.160***	0.160***	0.139***	0.138***	0.138***
	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
HHWealth*HHAdEdu	-0.029***	-0.029***	-0.029***	0.003***	0.003***	0.003***	0.009***	0.009***	0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
MunGini	-1.931**	-1.894***	-5.913***	-2.308***	-1.652***	-2.573***	-0.275	-0.128	-1.182
	(0.933)	(0.567)	(1.162)	(0.783)	(0.451)	(0.950)	(0.673)	(0.333)	(0.732)
MunWealth	-0.321***	-0.315***	-0.365***	-0.353***	-0.335***	-0.360***	-0.292***	-0.299***	-0.315***
	(0.034)	(0.019)	(0.035)	(0.028)	(0.015)	(0.028)	(0.023)	(0.011)	(0.023)
MunGini*MunWealth	0.133		0.325*	0.005		0.161	-0.185		0.082
	(0.177)		(0.196)	(0.150)		(0.166)	(0.128)		(0.133)
Ratio 1	1.596***	1.322***	-0.015						
	(0.113)	(0.244)	(0.345)						
MunWealth*Ratio 1	-0.172***	-0.148***	0.011						
	(0.014)	(0.024)	(0.038)						
MunGini*Ratio1		0.868	9.404***						
		(0.626)	(1.685)						
MunGini*MunWealth*Ratio 1			-1.057***						
			(0.190)						
Ratio 2				11.569***	13.825***	13.108***			
				(0.500)	(1.227)	(1.778)			
MunWealth*Ratio 2				-1.212***	-1.420***	-1.323***			
				(0.063)	(0.119)	(0.190)			
MunGini*Ratio 2					-6.073**	-1.815			
					(3.074)	(8.011)			
MunGini*MunWealth*Ratio 2						-0.629			
						(0.868)			
Ratio 3							16.282***	25.755***	21.618***
							(0.668)	(1.716)	(2.295)
MunWealth*Ratio 3							-1.799***	-2.675***	-2.187***
							(0.082)	(0.168)	(0.244)
MunGini*Ratio 3								-24.343***	0.530
								(3.962)	(9.960)
MunGini*MunWealth*Ratio 3									-2.997***
									(1.073)
Constant	1.848***	1.921***	2.592***	8.962***	8.754***	8.910***	5.180***	5.010***	5.209***
	(0.210)	(0.192)	(0.254)	(0.187)	(0.167)	(0.219)	(0.161)	(0.131)	(0.172)
Obs.	1,464,132	1,464,132	1,464,132	630,208	630,208	630,208	623,667	623,667	623,667
Level 2 SD	0.4259	0.4256	0.4219	0.3829	0.3823	0.3822	0.3392	0.3357	0.3351
Intra-Class Corr.	0.0523	0.0522	0.0513	0.0427	0.0425	0.0425	0.0338	0.0331	0.0330
AIC	440,272	440,271	440,244	498,288	498,285	498,287	704,201	704,165	704,161
BIC	440,577	440,576	440,574	498,572	498,568	498,594	704,484	704,449	704,468
LL	-220,111	-220,110	-220,095	-249,119	-249,117	-249,117	-352,075	-352,058	-352,054
Data fit to compared to specifications without interaction	Strongly preferred	Strongly preferred	Strongly preferred	Strongly preferred	Strongly preferred	Strongly preferred	Strongly preferred	Strongly preferred	Strongly preferred

Note: Standard errors in parentheses. *, ** and *** denote statistical significance at $p < 0.1$, $p < 0.05$ and $p < 0.01$ levels, respectively. Additional controls are child's gender, age, whether she is indigenous, first born or whether she has a physical or mental disability, number of boys and girls in the household, whether the household is a beneficiary from a social program, and household head such as gender, age and age squared. Controls at municipal level include municipality size, number of schools per children and outward migration intensity.

In the name of the models "g" stands for "Municipal Gini", "m" for "Municial Mean Asset Index", "r" for the "Municipal Educational Ratios" and "1", "2" or "3" the educational level age estimated. Finally, an asterisk signifies an interaction between variables.

It can be seen that interaction terms are highly significant in all cases for specifications (4), (8), (12) and in most cases for specifications (13)-(21). While this is an indication of the relevance of the interaction terms on average, solely relying on summary statistics such as their coefficient and significance parameters can be misleading in nonlinear models. This is because the significance levels as well as sign of interaction terms can differ at different values of the covariates (see Ai and Norton 2003; Greene 2010; Hodge and Shankar 2014). As usefully illustrated by Karaca-Mandic et al (2012, Figures 2a-c), the

Figure 2.4: Average Predicted Probabilities at Values of Municipal Gini Coefficient



Source: Authors' elaboration from census data (INEGI, 2010).
Original in colour.
Average probabilities calculated "as observed" i.e. the value of the other covariates stayed as they are on the dataset.

introduction of an interaction term in a logit model allows for heterogeneity in the shape (rather than only in the position) of the curve representing the conditional probability that the dependent variable equals 1 as a function of the explanatory variable of interest; in other words, it allows this shape to differ at different levels of the interacted variable[6]. Following the suggestion of Greene (2010), we show graphically the interaction between explanatory variables X_1 and X_2 by plotting predicted probabilities that our dependent variable takes a value of 1 (the child is enrolled in school) along the domain of X_1 at different levels of X_2[7]. In particular, we are interested in exploring how the educational milieu (X_1), at both the household and aggregate levels, affects the probability of school enrolment and how its role interacts with economic variables (X_2). In conformity with the conceptual framework expounded in section 2.1, the graphical analysis we present below is based on specifications (4), (8) and (12) –it is also worth pointing out that specifications (4) and (8) are also the best performing overall for the 6-12 and 13-15 age ranges, respectively; graphs based on specifications (13)-(21) are highly similar to the ones below and are available

[6]This means that if a continuous variable is interacted with a dummy variable, we will have two possible shapes for this curve –one for each value of the dummy variable; if two continuous variables are interacted then we would have many (virtually infinite) shapes. We thank the authors for elucidating this point.

[7]In keeping with the type of interactions we have conceptualised in section 2.1 and following Occam's razor, we base our graphical analysis on specifications (4), (8) and (12) which present a single interaction term at municipal level. Graphs based on specifications (13)-(21) are in any case highly similar to those we present below.

upon request.

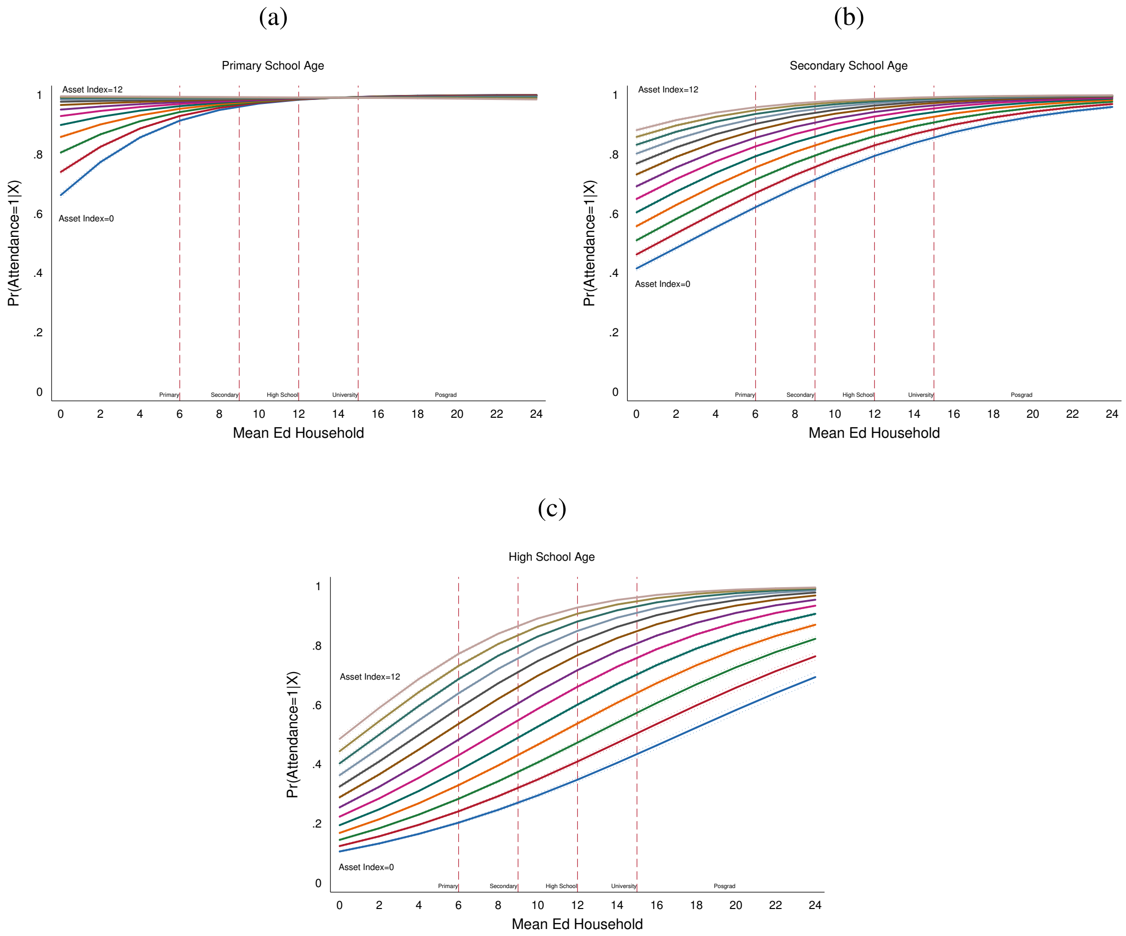
Table 2.4: Robustness Checks – Atkinson Index, Theil Index and Household Random Effects

	6-12 age range			13-15 age range			16-18 age range		
	Atkinson	Theil	Household FE	Atkinson	Theil	Household FE	Atkinson	Theil	Household FE
HHWealth	0.405***	0.405***	0.405***	0.219***	0.220***	0.220***	0.193***	0.193***	0.193***
	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
HHAdEdu	0.300***	0.300***	0.300***	0.160***	0.160***	0.160***	0.138***	0.138***	0.138***
	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
HHWealth*HHAdEdu	-0.029***	-0.029***	-0.029***	0.003***	0.003***	0.003***	0.009***	0.009***	0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
MunAtkinson $A = 1$	-2.213***			-3.421***			-1.546***		
	(0.538)			(0.472)			(0.427)		
MunTheil		-2.188***			-3.440***			-1.635***	
		(0.555)			(0.486)			(0.440)	
MunGini			-1.287***			-2.283***			-1.156***
			(0.361)			(0.320)			(0.291)
MunWealth	-0.293***	-0.296***	-0.297***	-0.338***	-0.342***	-0.352***	-0.311***	-0.313***	-0.321***
	(0.013)	(0.013)	(0.014)	(0.011)	(0.011)	(0.012)	(0.009)	(0.010)	(0.011)
Ratio 1	1.614***	1.599***	1.629***						
	(0.103)	(0.102)	(0.106)						
Ratio 2				11.329***	11.198***	11.577***			
				(0.444)	(0.439)	(0.460)			
Ratio 3							15.599***	15.566***	15.916***
							(0.592)	(0.585)	(0.619)
MunWealth*Ratio 1	-0.175***	-0.173***	-0.177***						
	(0.013)	(0.012)	(0.013)						
MunWealth*Ratio 2				-1.181***	-1.164***	-1.213***			
				(0.055)	(0.054)	(0.056)			
MunWealth*Ratio 3							-1.711***	-1.707***	-1.750***
							(0.072)	(0.071)	(0.075)
Obs.	1,464,132	1,464,132	1,464,132	630,208	630,208	630,208	623,667	623,667	623,667
Level 2 SD	0.4262	0.4263	0.4269	0.3826	0.3829	0.3831	0.3397	0.3396	0.3395
Intra-Class Corr	0.0523	0.0524	0.0525	0.0426	0.0427	0.0427	0.0339	0.0339	0.0338
AIC	440,266	440,268	440,271	498,285	498,287	498,286	704,203	704,203	704,201
BIC	440,559	440,560	440,563	498,557	498,560	498,559	704,476	704,475	704,473
LL	-220,109	-220,110	-220,111	-249,118	-249,120	-249,119	-352,078	-352,077	-352,076

Note: Standard errors in parentheses. *, ** and *** denote statistical significance at $p < 0.1$, $p < 0.05$ and $p < 0.01$ levels, respectively. Additional controls are child's gender, age, whether she is indigenous, first born or whether she has a physical or mental disability, number of boys and girls in the household, whether the household is a beneficiary from a social program, and household head such as gender, age and age squared. Controls at municipal level include municipality size, number of schools (primary, secondary or high school depending on the model) per children, the average schools per children in the neighbour municipalities and outward migration intensity.

Figure 2.5 show predicted probabilities of school enrolment for the three age ranges over the household educational domain at different levels of household wealth (each level of household wealth is represented by a separate curve). It can be seen that, for the three age ranges and for each level of household wealth, predicted probabilities increase with mean education in the household; in addition, as expected, these probabilities are higher for children in richer households. It is interesting to note that beyond this common pattern there are also notable differences. For example, while being enrolled at age 6-12 is almost a certainty for richest households (the relevant curves are basically flat and equal 1 over the whole educational domain), it is not so for less wealthy households. Interestingly, school enrolment becomes a certainty regardless of wealth when mean household education exceeds high school level; this shows how for early school enrolment lack of economic wealth can be at least to some extent compensated by the 'educational wealth' possessed by the household. Wealth-based differences in predicted probabilities tend to be mitigated

Figure 2.5: Predicted Probabilities – Education at Different levels of wealth (household level)



Source: Authors' elaboration from census data (INEGI, 2010).
Original in colour.
Average probabilities calculated "as observed" i.e. the value of the other covariates stayed as they are on the dataset

at higher levels of household education also with the case of the 13-15 age range, although they tend to converge only at the very end of the educational spectrum (where combinations such as 24 years of education and extremely low asset index are typically off sample). With regard to the 16-18 age range, wealth-based differences are more marked at the middle of the educational spectrum; this suggests that for this age group heterogeneity in school enrolment is greater among the middle class than among the very poor or the very rich. Finally, it can be noticed that while for wealthy households the curve is concave all the way, for most households it is initially convex before turning concave; this indicates that for non-compulsory school age the marginal effect of an additional unit of adult education in the household is initially increasing rather than decreasing.

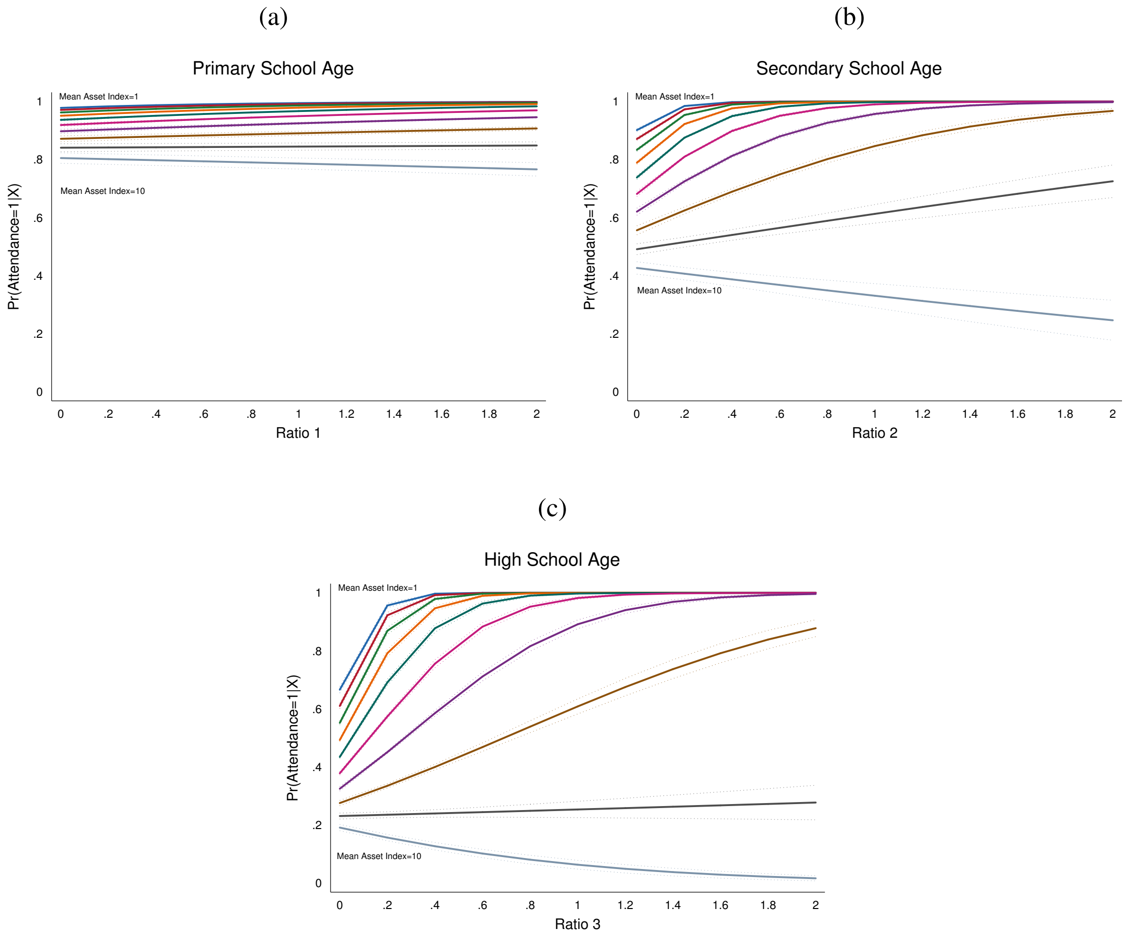
Turning to the municipal level, we explore how predicted probabilities of being enrolled in school vary with the 'fertility' of the wider educational environment. Figure 2.6 display predicted probabilities of school enrolment over the municipal educational domain at different levels of mean municipal wealth (each level of municipal wealth is represented by a separate curve). Four observations are worth pointing out. The first thing we notice is that, in accordance with the expected role played by relative deprivation, individual predicted probabilities are higher for lower levels of mean municipal wealth. Second, the vast majority of predicted probability curves have a positive slope, pointing to the educational environment as a positive predictor of enrolment –fostered by role models and the tendency to adhere to schooling norms in society. Third, predicted probabilities increase at decreasing rates with a degree of concavity more pronounced for the 13-15 and 16-18 age ranges. Lastly, it can be noticed that in the case of the two highest levels of mean municipal wealth (and therefore the highest degrees of relative disadvantage experienced by the household), predicted probabilities turn mostly flat or decreasing; this can be interpreted in the light of Mayer's (2001) insight that "feelings of relative deprivation can lead to isolation and alienation from the norms and values of the majority" (p. 4).

2.3.2 Additional insights and municipal random effects

Additional insights emerging from our regressions relate to rather intuitive school enrolment dynamics. Being indigenous or affected by a disability lowers the probability of being enrolled, while the opposite role is played by schools availability and being beneficiary of a social program. The negative coefficient for female household head is not surprising when one thinks that in most cases such characteristic in Mexico identifies single-mother households; in addition, the negative coefficient for number of girls and boys in the household probably captures the fact that the more siblings the tougher the competition for the resources devoted to investment in education. Being a girl rather than a boy seems to increase the probability of being enrolled in school, in particular for the 16-18 age range. Finally, we find the coefficients of outward municipal migration interesting. This is positive for primary-school age, probably reflecting a beneficial effect of remittances in alleviating economic hardship in poor households; yet, for older children it turns negative showing a lower investment in education for children who have presumably more connections abroad and may be possibly devoting time and resources to prepare for migrating.

We now turn to the analysis of municipal random effects. In Figures 2.1 to 2.3 above we illustrated how enrolment rates vary across municipalities; clearly, this simple illustration does not take any correlates into account –a municipality may have higher enrolment rates due to a richer educational environment, lower wealth inequality, greater school availability, etc. The analysis of municipal effects emerging from our estimations enables us to report on the differences in the probability of enrolment across municipalities which

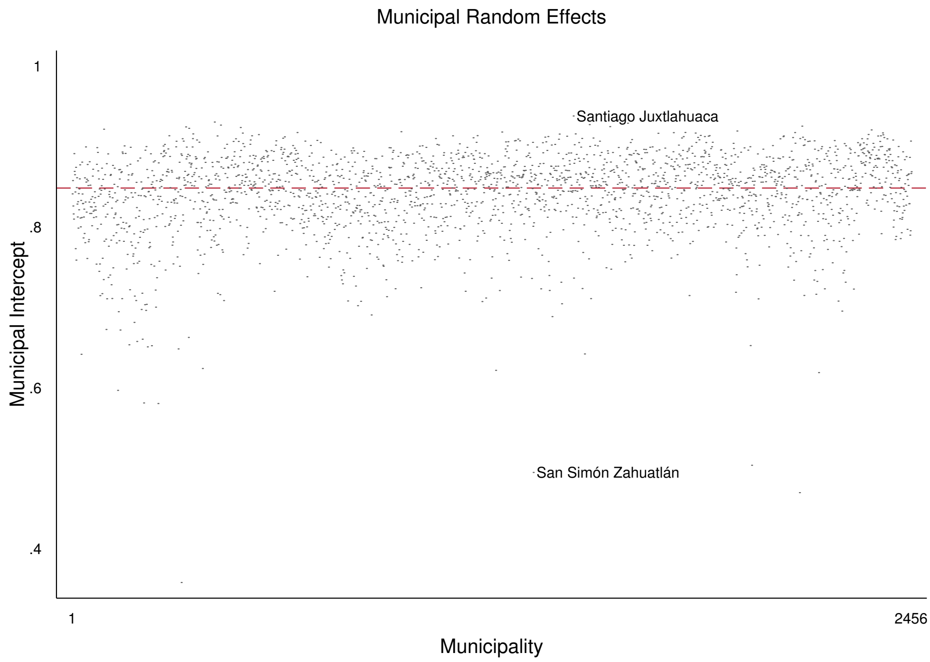
Figure 2.6: Predicted Probabilities–Educational Ratios at Different Levels of Wealth (Municipal Level)



Source: Authors' elaboration from census data (INEGI, 2010).
Original in colour.
Average probabilities calculated "as observed" i.e. the value of the other covariates stayed as they are on the dataset

remain after all our explanatory variables are controlled for. More precisely, consider that the right hand side of our econometric models can be simplified as $\beta_0 + \beta X + \beta_j$, where βX refers to the vector of explanatory variables and their estimated coefficients while β_0 and β_j are two constant terms. The former represents the country-level intercept and the latter is a parameter which is specific to municipality j; in other words, in the calculations of their predicted probabilities all individuals in the sample share parameter β_0 and all individuals living in municipality j share β_0. A positive (negative) value of β_j implies a positive (negative) contribution to the probability of enrolment due to living in municipality j. Figure 2.7 plots the β_0's for the 2,456 Mexican municipalities, arranged on the horizontal axis simply on the basis of their municipality code; as can be seen, there is a considerable spatial heterogeneity in the contribution to the probability of enrolment given by the municipal fixed effect. We report the names of two municipalities in the graph to give an example of how highly different intercepts can be found for municipalities within the same state (in this case, the southern state of Oaxaca).

Figure 2.7: Scatter Plot of Municipal Random Effects

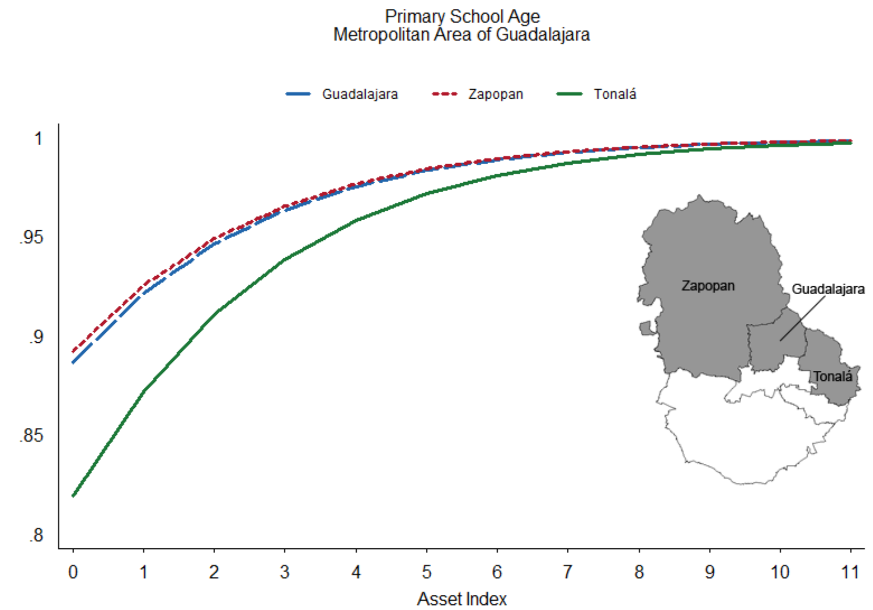


Source: Authors' elaboration from census data (INEGI, 2010).
Original in colour.
Average probabilities calculated "as observed" i.e. the value of the other covariates stayed as they are on the dataset.

In Figure 2.8 we illustrate the spatial heterogeneity in the probability of enrolment by focusing on a case study. In this figure we plot predicted probabilities for three children in primary school age who are identical in all respects other than the municipality they live in[8] –these are Guadalajara (the capital of the state of Jalisco) and two adjacent municipalities in the Guadalajara Metropolitan Area, namely Zapopan and Tonalá. In this way, any difference in their predicted probability curves is determined by unobserved municipal factors. We allow household wealth to vary along the horizontal axis, so that we can see what happens to differences between municipalities at different points of the distributional spectrum. As can be seen in 2.8, living in the capital or in Zapopan produces virtually no difference in the probability of being enrolled in school; conversely, living in Tonalá brings about a sensible reduction in predicted probabilities. This reduction is particularly noticeable for poorer households, while for wealthy ones we can see that differences across municipalities vanish. Additional illustrations regarding neighbouring municipalities in Mexico City and Monterrey are provided in Figure B.1.

[8]Continuous explanatory variables are set to mean values and dummies are set to zero (therefore this child is male, non-indigenous, does not have any disability, etc.).

Figure 2.8: Municipal Random Effects –a Comparison of Neighbouring Municipalities



Source: Authors' elaboration from census data (INEGI, 2010).
Original in colour.

2.4 Conclusion

Taking advantage of the large dataset provided by the extended section of the 2010 Mexican census, we have carried out an empirical analysis of the determinants of school enrolment. Our main explanatory variables of interest were wealth inequality and the educational environment surrounding the child within and beyond the household. Our results fit the conceptual framework we have drawn on the basis of a review of the related economic, sociological, educational and psychological literatures, which provide insights on how educational outcomes can be affected negatively by economic inequality and positively by the educational milieu via an array of social dynamics. We have also found that models which include interaction terms between the educational environment and economic variables fit the data better than those which do not, and our graphical analysis of interacted variables has provided a number of insights on their behaviours as predictors of school enrolment. Last but not least, our evidence in terms heterogeneity in the probability of being enrolled across municipalities sheds important light on the character of spatial inequalities in Mexico.

Our contribution raises important issues for researchers to take forward and offers valuable insights to policymakers. On the first count, natural extensions of our work would be to explore the relationships we found using datasets containing individual income, polytomous measures of educational outcomes (test scores, grades, etc.), or to focus on higher education. In addition, we have seen in Table 2.3 that there may exist potentially interesting additional and more complex interconnections among explanatory variables at municipal level, in particular for the 16-18 age range. Finally, we hope our work encourages future research on educational inequalities which embarks in the enterprise of disentangling contextual effects of economic inequality (impinging on everyone in an unequal society) from those related to relative deprivation (affecting those lagging behind more successful others); our interest in the interaction between municipal-level economic and educational variables motivated our use of mean wealth, but abstracting from this specific issue a valuable perspective can be gained by adopting idiosyncratic indices of relative deprivation.

On the second count, our work highlights at least three issues for policymakers. The first is that economic disparities are detrimental to school enrolment; this suggests an education-based motivation for supporting redistributive policies. At the same time, as sensibly recommended by Mayer (2010), these should be accompanied by specific measures targeting directly those socio-economic profiles for which access to schooling is found to be problematic and school dropout more likely; in this respect, our evidence points to households which are economically deprived, single-mother headed, with numerous children, etc. Secondly, our work also strengthens the idea that the benefits accruing from extending education are cumulative across generations; increasing the level of education of today's children will in turn boost that of their children tomorrow. Our research indicates that average adult education within the household reaching the high-school level would enable virtually 100% enrolment rate of children in primary school age; in addition, enhancing the attainment of high-school level education for adults would yield increasing returns for the enrolment of pupils in the 16-18 age range for a wide proportion of households. A target of universal high-school education for the new generations may currently seem utopian, but it is a goal which Mexico, as an upper-middle income country, OECD member and net contributor to a number of United Nations agencies cannot but take seriously. A final issue for policymakers to be aware of, and concerned with, is the disparity in the probability of being enrolled in school across municipalities. An effort should be made to tackle the sources of inequality in school enrolment illustrated in this paper. Education cannot be a prize for the children who are lucky enough to pick the right ticket in the lottery for the municipality to live in, or for the parents to be born to.

CHAPTER 3

Relative Deprivation and School Enrolment in Mexico

Abstract

Empirical evidence of the role played by relative deprivation as an explanatory variable for social outcomes other than subjective wellbeing is still rather scarce. Using data from the extended-questionnaire section of the 2010 Mexican census (2.9 million households), we provide solid evidence of relative deprivation as being a negative predictor of school enrolment, a finding which is in line with sociological and child development research. Marginal effects of relative deprivation are found to be stronger at higher standards of living and for older children. This is the first paper employing both linear and distribution-sensitive indices of relative deprivation as explanatory variables; an analysis of these indices in the cases of underlying distributions with different levels of skewness is provided.

3.1 Introduction

THE idea that in a context of economic inequality interpersonal comparisons may affect our lives has long been considered by a variety of disciplines, ranging from economics (Duesenberry 1949) to anthropology (Foster et al. 1972), political science (Gurr 1970), psychology (Bradburn 1969) and sociology (Stouffer et al. 1949). Relative deprivation refers to the detrimental implications arising from the inability to achieve as much as the people we compare with in society (the so-called reference group). The economics literature has engaged with both the theoretical and empirical analyses of relative deprivation. Theoretical models comprising a relativistic specification of utility have been developed for the study of consumption, risk, economic growth, taxation schemes, educational subsidies, labour supply, etc. –see Esposito (Esposito 2015) for a review. Empirical studies have focussed on the investigation of the (typically negative) relationship between relative deprivation and subjective wellbeing, life satisfaction or happiness –see Clark, Frijters and Shields (2008), Verme (2015) and D'Ambrosio and Clark (2015) for thorough examinations of the existing evidence.

Empirical research on the potential role of relative deprivation as an explanatory variable for other social outcomes is scarcer within the economics discipline. The expansion of the range of social outcomes of interest is listed by D'Ambrosio and Clark (2015) as one of the 'outstanding issues' for the understanding of how the 'haves' and the 'have-nots' affect our societies. In addition, while a certain amount of multi-disciplinary literature does exist across the social and medical sciences, results are less univocal compared to the case of the subjective wellbeing literature. This can be seen in Smith et al's (2012) meta-analytic review of studies on the relationship between relative deprivation and a wide array of social outcomes, where the authors conclude that "results are often weak and inconsistent" (p. 203).

In this paper we explore the role of relative deprivation as a predictor of school enrolment in Mexico. There is a large body of literature showing the relationship between socioeconomic gradients and academic achievement, dropout rates and cognitive development in both high- and low-income countries –inter alia, see Duncan, Brooks-Gunn and Klebanov (1994), McLoyd (1990), Bradley and Corwyn (2002), Engle et al (2011), Fernald et al (2011) and Walker et al (2011). Thanks to recent neuroscience work, also the physiology behind this pattern is becoming clearer with socioeconomic status being associated with heterogeneity in a range of domains including prefrontal cortex function (Kishiyama et al. 2009), structural and functional brain development (Hackman et al. 2010; Noble et al. 2012; Tomalski et al. 2013), epigenetic responses (Essex et al. 2013), systemic inflammation-related damage to brain networks (Gianaros et al. 2013) and working memory performance (Hackman et al. 2014). There are good reasons for associating disparities in educational outcomes to both the absolute standard of living and the relative deprivation experienced by the household. Absolute standard of living first of all relates to the ability of households to afford education –according to Basu and Van's (1998) 'luxury axiom', education is a good that poorer households are less likely to be able to afford. In addition, it allows households to endow the child with an array of inputs which enhance educational achievements –e.g. better nutrition, see Grantham-McGregor et al (1991), Glewwe, Jacoby and King (2001), Engle et al. (2007) and Jackson (2015). With regard to relative deprivation, according to the influential sociological work of Mayer (2001) "If children feel relatively deprived, they may be less inclined to study or stay in school. Relative deprivation can also make parents feel stressed and alienated, lowering their expectations for their children" (p. 4). Furthermore, among the cognitive, physiological and ecological mechanisms responsible for lower neurological development and academic achievements of children living in disadvantaged households illustrated by Hackman et al (2010), there is also the fact that these children and their parents "experience increased stress related to social rank" (p. 654)[1].

Using data from the extended-questionnaire section of the 2010 Mexican census, which is statistically representative at municipal level and covers around 2.9 million households, we provide robust evidence of relative deprivation as a negative predictor of school enrolment for children of 6-18 years of age. This is the first paper that alongside the widely used Yitzhaki (1979) index employs distribution-sensitive indices of relative deprivation as an explanatory variable for social outcomes –in particular, we adopt different members of the Esposito (2010) class. These are found to perform better in terms of ability of the model to fit the data. In addition, we show that marginal effects of relative deprivation are stronger at higher standards of living and for older children, and situate these findings within the relevant literatures. Finally, we show that the divergence between the Yitzhaki and the Esposito indices (hence the scope for their differing abilities to capture variability in the data) varies with the skewness of the underlying distribution.

The remainder of the paper develops as follows. In section 3.2 we outline the concept of relative deprivation and present the indices we use in our empirical analysis. In section 3.3 we present the data and outline our empirical strategy. Section 3.4 contains our results and is divided into two subsections. In subsection 3.4.1 we present our econometric results while in section 3.4.2 we take a closer look at the indices of relative deprivation we used including their comparison in the case of different underlying distribution. Section 5 concludes.

3.2 Relative deprivation: concept and measures

Relative deprivation and inequality and are strictly related concepts in that the latter is the condition sine qua non for the existence of the former. The idea is that within an unequal distribution, less successful individuals experience relative deprivation when they compare with more successful individuals. It is important to keep in mind that while inequality is a concept which inherently applies to a set of individuals, relative deprivation, similarly to utility, poverty or wellbeing, is a phenomenon which in the first instance refers to the individual –this atomistic perspective underpins Fehr and Schmidt's (1999) notion of 'self-centered inequity aversion' and D'Ambrosio and Clark's (2015) concept of 'comparative evaluation of inequality'. Relative deprivation indices intend to quantify

[1]Interestingly, stress features as a key element in the general framework elaborated by Williams Shanks and Robinson (2013) for the understanding of academic achievement and child development.

how the existence of more successful others impinges on the individual. They do this by modelling individual i's one-to-one comparisons with each member of the reference group; this is achieved through an individual deprivation function which provides the magnitude of individual i's relative deprivation when she compares herself with the jth member of the reference group –the value is positive if j is better off than i and zero otherwise. The normalised sum of these values represents individual i's total relative deprivation.

More formally, let $\mathbb{R}, \mathbb{R}_+$ and $\mathbb{R}_{++}$ denote the sets of positive integers, nonnegative and positive real numbers, respectively. For $n \in \mathbb{R}, \mathbb{R}^n_{++}$ is the positive orthant of the Euclidean *n-space* $\mathbb{R}^n$. Individual i's reference group consists of the fixed set of n individuals, where $y = (y_1, y_2, ...y_n) \in \mathbb{R}^n_{++}$ is the vector describing the distribution of the economic variable of interest (income, consumption, wealth, etc.), with elements of this vector being arranged in strictly increasing order –i.e. y_1 refers to the poorest individual. The relative deprivation felt by individual i when she compares with j is quantified by the individual deprivation function $IDF(y_i, yj) : \mathbb{R}_{++} \times \mathbb{R}_{++} \rightarrow \mathbb{R}_+$, which maps to zero for non-richer individuals while for richer individuals it becomes the function $IDF(y_i, yj) : \mathbb{R}_{++} \times \mathbb{R}_{++} \rightarrow \mathbb{R}_{++}$:

$$IDF(y_i, y_j) = \begin{cases} D(y_i, y_j), & \text{if } y_j > y_i \\ 0, & \text{if } y_j \leq y_i \end{cases} \tag{3.1}$$

The individual relative deprivation magnitudes deriving from one-to-one comparisons are then combined in the index $RD : (y_i, y_j)\mathbb{R}_{++}, \mathbb{R}^n_{++} \rightarrow \mathbb{R}_+$, which yields individual i's total relative deprivation and can be written as follows:

$$RD_i = \frac{1}{n} \sum_{j=1}^{n} IDF(y_i, y_j) \tag{3.2}$$

The main dividing line between existing indices of relative deprivation is whether the function $D(y_i, y_j)$ is sensitive to distributional changes[2] affecting better off individuals or not. Those which are not are based upon linear individual deprivation functions as originally proposed by Yitzhaki (Yitzhaki 1979) –see also Hey and Lambert (1980) and Yitzhaki (1980) and the two alternative characterizations of the Yitzhaki index proposed Ebert and Moyes (2000) and Bossert and D'Ambrosio (2006)[3]. The intuition behind linear indices is that the marginal increase in individual i's relative deprivation is constant over the $y_j > y_i$ domain. By contrast, measures that are sensitive to distributional changes among better-off individuals are concave in this domain; the motivation for this resides in the well-established belief in sociological theory that individuals are more sensitive to

[2]This clearly excludes the trivial cases where individuals just swap their incomes. Technically speaking, transfers bringing about distributional changes of interest are the so-called mean-preserving and non-re-ranking transfers.

[3]Other contributions based on the Yitzhaki index and its relationship with the Gini coefficient include Chakravarty and Chakraborty (1984), Berrebi and Silber (1985)and Chakravarty (1997).

advancements achieved by members of the reference group who are closer to their condition (Festinger 1954). Concave indices have been proposed by Paul (1991), Chakravarty and Chattopadhyay (1994), Podder (1996) and Esposito (2010) –the latter is the only index among these which is accompanied by an axiomatic characterisation. Recently, Bossert and D'Ambrosio (2014) characterised a generalisation of linear individual deprivation functions.

One of the main objectives of this chapter is to compare indices that are sensitive to distributional changes to those that are not. As a non sensitive index we employ the widely used Yitzhaki (1979) and as sensitive index we use Esposito (2010) because it is the only one of its kind with an axiomatic characterisation (Bossert and D'ambrosio, 2014). Other important contributions are the indices proposed by Bossert et al. (2007) which deals with inter-temporal deprivation or the ones proposed by Bossert and D'ambrosio (2006) and Bellani (2013) that allow for representation of the reference group within the index and domain multidimensionality respectively, that are beyond the scope and objective of this chapter.

The functional form of the Yitzhaki (1979) and Esposito (2010) over the $y_j > y_i$ domain, DY and DE, respectively, read as follows:

$$DY = \frac{1}{n}\sum_{j=1}^{n}(y_j - y_i) \tag{3.3}$$

$$DE = \frac{1}{n}\sum_{j=1}^{n}[1 - (\frac{y_i}{y_j})^{\beta}], \beta \in \mathbb{R}_{++} \tag{3.4}$$

For the Yitzhaki (1979) index, the magnitude of relative deprivation between individuals i and j is equal to the gap in their achievements. The Esposito (2010) index instead follows the tradition of normalised utility gaps which are typical of Dalton-type indices (Hagenaars 1987; Vaughan 1987). It can be easily seen that while for both indices $\frac{\partial D}{\partial y_j} > 0$, we have that $\frac{\partial^2 DY}{\partial y_j^2} = 0$ whilst $\frac{\partial^2 DE}{\partial y_j^2} < 0$

Further, it should be noted that in DE the degree of concavity changes with parameter β. As β increases, so does the importance of individuals who are closer to i's situation relative to further ones; in other words, the marginal increase in relative deprivation over the $y_j > y_i$ domain decreases more quickly.[4]

[4]For further justifications for this functional form, see Esposito (2010). These range from an understanding of relative deprivation as social exclusion to the ability to account for Runciman's (1966) notion of 'fantasy wishes' –with higher values of β increasing the importance of unfulfilled 'closer' aspirations and lowering the imaginary fantasy wishes threshold.

3.3 Data and Empirical Strategy

The role of relative deprivation as a determinant of school enrolment is explored through logit models where the dependent variable is the dichotomous status of being enrolled/not being enrolled in school for children aged 6-18. We include a set of regressors which are typically used in literature on school enrolment in developing counties –see the work by Connelly and Zheng (2003), Dostie and Jayaraman (2006), Bhalotra (2007), De Carvalho Filho (2012) and Gumus (2014), as well as work on school enrolment in Mexico by López Acevedo (2004) and De la Cruz Tovar and Díaz González (2010). As we discussed in the introduction, household wealth is well-known to be a strong determinant of school. The inclusion of absolute wealth as an explanatory variable enables us to disentangle the role of relative deprivation from that of absolute wealth; in other words, absolute wealth being controlled for, we analyse how school enrolment is associated with relative deprivation. Formally, the econometric model to be estimated is:

$$Pr(Enrolment_{iha}|RD_h, I_i, H_h, A_a) = \alpha + \beta_1 RD_h + \delta I + \tau H + \varphi A + \varepsilon_{iha} \quad (3.5)$$

where the probability of child i living in household h in community a[5] is a function of the relative deprivation of the household the child lives in RD, a set of individual level controls I, a set of household controls that include household absolute wealth H and some controls at the aggregate level A. ε_{iha} is the combined error term and β is the linear prediction associated to relative deprivation on the probability of enrolment. Although a causal identification is not the main objective of this paper, the rich set of regressors at different levels attempt to reduce endogeneity problems arising from independent variables being correlated with the error term.

Additional regressors are: child's gender, age, whether she is indigenous, whether she has a physical or mental disability, whether the household is a beneficiary from a social program, gender, age and age squared of the household head, and ecological variables such as municipality size, number of schools per child, educational expenditure per student and migration intensity.

We report results for the pooled sample but results are unchanged if we analyse compulsory and non-compulsory school age brackets separately. As to the choice of reference group, we first follow a basic geographical criterion based on municipality (the lowest political and administrative aggregate in Mexico) –results are unaffected whether we control for heterogeneity in municipality size through a continuous or categorical

[5]We labelled "community" as the municipality the child lives in, but we also include expenditure per student, which was only available at state level.

(ordinal) variable; we then refine the specification of the reference group along socio-demographic axes such as education and age. Other criteria used in the literature to define the reference group are gender, profession, education, etc. –for recent experimental evidence on reference group formation see McDonald et al. (2013) and for recent survey evidence see Clark and Senik (2010)and Mangyo and Park (2011) and Serajuddin and Verme (2015). Finally, given the presence of aggregate variables we estimate logit models with clustered standard errors (Moulton 1990). Following Cameron and Miller (2015), we present results with standard errors clustered at municipal level because the next clustering level (for us the household) not only confirms our results but also presents barely any variation in standard errors –in the bias-variance trade-off larger and fewer clusters have more variability but introduce less bias.

Table 3.1: Descriptive Statistics

	Mean	SD	MIN	MAX	N
Female[a]	0.495	0.5	0	1	2,714,110
Age	12.011	3.737	6	18	2,714,110
Disability[a]	0.018	0.134	0	1	2,714,110
Indigenous[a]	0.211	0.408	0	1	2,714,110
Household wealth	5.704	2.343	0	11.616	1,327,400
RDY	0.815	0.824	0	7.482	1,327,400
RDE $\beta = 1$	0.125	0.132	0	0.998	1,327,400
RDE $\beta = 2$	0.202	0.194	0	0.998	1,327,400
RDE $\beta = 5$	0.316	0.259	0	1	1,327,400
RDE $\beta = 10$	0.387	0.283	0	1	1,327,400
Adults Mean Years of Edu	7.086	3.829	0	24	1,327,400
Household Head Female[a]	0.167	0.373	0	1	1,327,400
Household Head Age	44.297	12.612	12	130	1,327,400
Social Program[a]	0.223	0.416	0	1	1,327,400
Schools per child	0.009	0.006	0.001	0.059	2,452
Municipality Size	45,740	133,000	93	1,820,000	2,456
Municipal Migration	2.691	2.311	0	14.356	2,456
Expenditure per Student	12.053	2.683	7.52	17.23	32

Source: Author's elaboration with data from the 2010 Mexican Census Sample, Instituto Nacional de Estadística, Geografía e Informática (INEGI), Consejo Nacional de Población (CONAPO) and Sistema Municipal de Base de Datos (SIMBAD, which is part of INEGI). The migration variable is an index describing outward migration to the United States.

[a] Dummy Variable

We use data from the extended-questionnaire section of the 2010 Mexican census as described in section 2.2.2, which is statistically representative at municipal level and covers around 2.9 million households. As can be seen in Table 3.1 this sample contains 2.7 million children aged 6-18, living in 1.3 million households; 49.6% of these children are females, a third is indigenous, 1.9% suffers from a disability and mean education in the household is just above seven years of schooling. Given the lack of income data at household level, our economic variable is household wealth. We compute a household asset index in the fashion of Filmer and Pritchett (1999) –this index was used by these authors as well as by McKenzie (2005) as a determinant of school enrolment. In particular, given the discrete nature of the data used to construct these indices, we follow the Kolenikov and Angeles (2009) methodology described in Chapter 1 [6]. The correlation between our municipality mean asset index and the official municipality mean income estimated by CONEVAL (2013) is high (0.81 for linear correlation and 0.91 for rank correlation).

3.4 Results

3.4.1 Relative deprivation as a predictor of school enrolment

Table 3.2 shows the results from six specifications of our logit models. In specification (1) we have all our regressors but relative deprivation is left out. This model serves as a baseline to see whether the introduction of relative deprivation yields improvements in the ability of the model to fit the data as hypothesised by the conceptual framework. In specification (2) we add the Yitzhaki index and in specifications (3)-(6) we add the Esposito index for different values of parameter β–respectively, 1, 2, 5 and 10. Results show a consistent pattern of household wealth being positively significant and relative deprivation being negatively significant (in both cases $p < 0.01$). Additional insights emerging from our regressions are highly intuitive and relate to both the demand and supply of education. Having a disability decreases the probability of being enrolled, as do being indigenous, having a female as household head (in Mexico this is generally equivalent to being a single-mother family) and living in areas with high outward migration (which is likely to decrease the investment in home education); positive predictors are instead being a girl, mean education in the household, household head age (presumably young parents are less aware of the value of education) and variables related to education supply (schools per child and expenditure per student).

All specifications are able to correctly predict a large percentage (around 86%) of zeros and ones in the dependent variable. Looking at the bottom of Table 3.2, it is possible to see that each specification outperforms the previous one according to Schwarz's (1978) approximation of the Bayes factor (known as Bayesian Information Criterion, BIC)[7]. In

[6]Standard Principal Components Analysis (PCA) assumes that the variables are multivariate normal. Following Kolenikov and Angeles (2009), we run PCA using polychoric correlations to better approximate the normality assumption and estimate the amount of variation explained by the first component. Finally, it should be noted that financial assets are not included in our measure of wealth.

[7]The Bayes factor is a "summary of the evidence provided by the data in favour of a scientific theory, represented by a statistical model, as opposed to another" (Kass and Raftery, 1995, p. 777). Given two

Table 3.2: Logit Models for School Enrolment

	(1) Asset Index	(2) RDY	(3) RDE $\beta = 1$	(4) RDE $\beta = 2$	(5) RDE $\beta = 5$	(6) RDE $\beta = 10$
Asset Index	0.148***	0.082***	0.062***	0.053***	0.046***	0.046***
	(0.005)	(0.008)	(0.009)	(0.009)	(0.009)	(0.009)
Yitzhaki		-0.195***				
		(0.015)				
Esposito $\beta = 1$			-1.381***			
			(0.110)			
Esposito $\beta = 2$				-1.031***		
				(0.081)		
Esposito $\beta = 5$					-0.856***	
					(0.065)	
Esposito $\beta = 10$						-0.821***
						(0.060)
Female	0.033**	0.032**	0.032**	0.032**	0.031**	0.031**
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Age	-0.464***	-0.465***	-0.466***	-0.466***	-0.466***	-0.465***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Mental or Physical Disability	-1.271***	-1.264***	-1.269***	-1.267***	-1.264***	-1.263***
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
Indigenous	0.137***	-0.041	-0.011	-0.031	-0.057	-0.067*
	(0.042)	(0.039)	(0.039)	(0.038)	(0.038)	(0.038)
Adults Mean Years of Education	0.173***	0.174***	0.175***	0.175***	0.174***	0.173***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
HH Female	-0.195***	-0.175***	-0.175***	-0.172***	-0.168***	-0.166***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Household Head Age	0.078***	0.076***	0.076***	0.075***	0.075***	0.074***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Household Head Age^2	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Social Program	0.228***	0.198***	0.192***	0.189***	0.187***	0.186***
	(0.014)	(0.014)	(0.013)	(0.013)	(0.013)	(0.013)
Schools Per Child	17.361***	9.561***	11.103***	9.840***	7.963***	6.998***
	(2.618)	(2.571)	(2.548)	(2.588)	(2.640)	(2.650)
Municipality Size	-0.000***	-0.000***	-0.000***	-0.000***	-0.000**	-0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Municipal Migration Rate	-0.059***	-0.048***	-0.049***	-0.048***	-0.046***	-0.046***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)
Expenditure per Student	0.035***	0.030***	0.031***	0.030***	0.030***	0.029***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Constant	3.589***	4.289***	4.396***	4.501***	4.646***	4.720***
	(0.097)	(0.130)	(0.132)	(0.138)	(0.146)	(0.148)
Obs.	2,714,110	2,714,110	2,714,110	2,714,110	2,714,110	2,714,110
R_{count}	0.8606	0.8610	0.8608	0.8608	0.8610	0.8612
AIC	0.6591	0.6575	0.6574	0.6573	0.6570	0.6568
BIC	-38,417,621	-38,421,895	-38,422,105	-38,422,552	-38,423,300	-38,423,877
LL	-894,420	-892,276	-892,171	-891,947	-891,573	-891,284

Note: Standard errors in parentheses. *, ** and *** denote statistical significance at $p < 0.1$, $p < 0.05$ and $p < 0.01$ levels

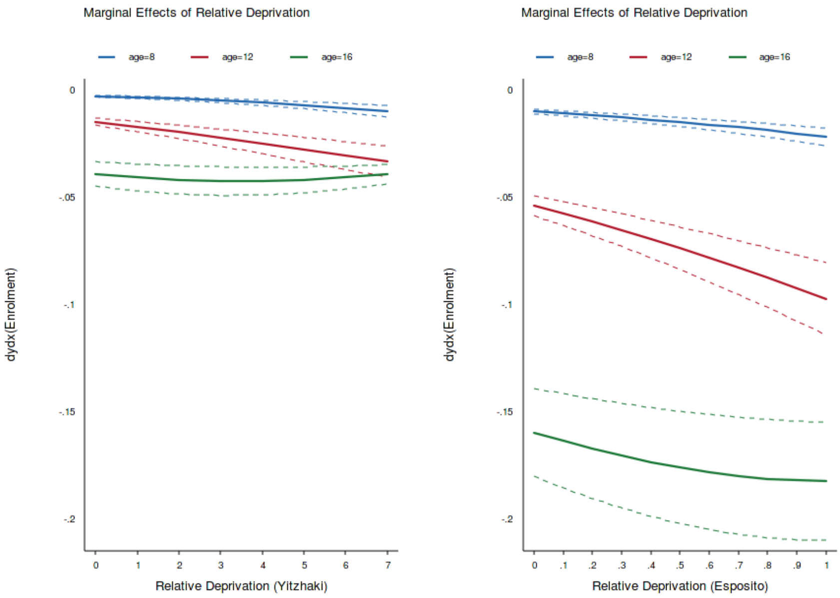
the spirit of Occam's Razor principle of parsimony, the BIC penalises models more heavily for the use of additional regressors compared to other model selection criteria such as the Akaike's Information Criterion (1973), hence making it more demanding for specifications (2)-(6) to be preferred to specification (1). The extent to which each specification in Table 3.2 is preferred to the previous one on the basis of the BIC is described in the literature as 'decisive' (Jeffreys 1961), 'very strong' (Kass and Raftery 1995; Raftery 1994) or 'extreme' (Vandekerckhove et al. 2015). The fact that all of specifications (2)-(6) outperform specification (1) indicates therefore that not only is relative deprivation highly

competing theories and data to test them, the Bayes factor is the posterior odds in favour of one of the theories, when the prior probabilities that they are true are equal significant and with the expected sign, but it also plays a meaningful role in the model in terms of increasing its ability to fit the data. It can be noticed that going from model (2) to model (6) the goodness of fit improves steadily for larger β's, that is, for a more pronounced concavity of the individual deprivation function; this is examined in greater detail in subsection 3.4.2.

Further inspection of the child development literature indicates the desirability of exploring the negative relationship between relative deprivation and school enrolment in terms of its possible variability with age. The extent to which relative deprivation impinges on children is believed to increase with age and with the approaching of adolescence. At older ages the awareness of relative status as well as the sensitivity to interpersonal comparisons are stronger and as a consequence lagging behind others becomes more painful –in the words of Levine (1983), "Social comparison information begins to influence 7 and 8 year old children and increases dramatically thereafter" (p. 29). Interestingly, Hustinx et al (2009) find that sensitivity to peers' judgements is stronger among older children compared to younger ones. This may also suggest an increasing effect of relative deprivation with age if one considers that relatively deprived children are likely to fare lower than their peers in a number of areas (e.g. clothing, leisure activities, etc.) and hence be exposed to mockery or negative comments. In addition, Butler (1990) and Butler and Ruzany (1993) show that children's tendency to judge own achievements in relative terms increases with age and that low relative performance reduces motivation. We investigate this issue by examining the marginal effects of relative deprivation at different ages. In Figure 3.1 we show the marginal changes in predicted probabilities at different values of relative deprivation (Yitzhaki on the left and Esposito on the right) at ages 8, 12 and 16. It can be noticed that marginal effects are always negative and statistically significant, and that in accordance with the child development literature mentioned above the older the child the greater the marginal effects of relative deprivation.

Given that the census questionnaire does not offer information on reference groups, we refined the definition to our original reference group (municipality) to include the average years of education of adults in the household and the age of the household head. For the education reference group, we use the cut offs of the Mexican education system: less or equal to 6 years, from 6 to 9 years, from 9 to 12 years and more than 12 years, which corresponds to primary, secondary, high school and university or higher. For the age of the household head, we use three groups: 30 years old or younger, between 30 and 50 years old and 50 years old or older. The results are presented in 3.4; models 1 and 4 are the baseline for comparison using just municipality as reference groups. Models 2 and 5 estimate the same model using Yithzaki and Esposito respectively using municipality plus education as reference group. Finally, models 3 and 6 estimate Yitzhaki and Esposito

Figure 3.1: Marginal Effects of Relative Deprivation at Ages 8,12 and 16



Source: Authors' elaboration from census data (INEGI, 2010).
Original in colour.

using municipality plus education plus age as reference groups.

Table 3.3: Logit Models for School Enrolment - Refined Reference Groups

	(1) Yithzaki Mun	(2) Yithzaki Mun+Ed	(3) Yithzaki Mun+Ed+Age	(4) Esposito Mun	(5) Esposito Mun+Ed	(6) Esposito Mun+Ed+Age
Asset Index	0.082***	0.063***	0.076***	0.046***	0.041***	0.046***
	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)
Yitzhaki	-0.195***					
	(0.015)					
Yitzhaki		-0.265***				
		(0.015)				
Yitzhaki			-0.225***			
			(0.015)			
Esposito				-0.821***		
				(0.060)		
Esposito					-1.140***	
					(0.071)	
Esposito						-0.714***
						(0.048)
N	2,714,110	2,714,110	2,714,110	2,714,110	2,714,110	2,714,110
R_{count}	0.8610	0.8609	0.8608	0.8612	0.8607	0.8609
AIC	0.6575	0.6572	0.6577	0.6568	0.6571	0.6573
BIC	-38,421,895	-38,422,753	-38,421,398	-38,423,877	-38,422,980	-38,422,399
LL	-892,276	-891,846	-892,524	-891,284	-891,733	-892,023

Note: Standard errors in parentheses. *, ** and *** denote statistical significance at $p < 0.1$, $p < 0.05$ and $p < 0.01$ levels
Full set of regressors included for all models.

The results are confirmed irrespective of the reference group used: relative deprivation negatively predicts school enrolment. In terms of goodness of fit, there seems to be some improvement from refining the reference group from municipality to municipality plus age; at the same time, there is some suggestion that over refining the reference group decreases the goodness of fit of the model -this can be seen in the case ofthe models including municipality plus education plus age as reference group.

Finally, in Table 3.4 we report the results from an additional robustness check, consisting of the estimations of specifications (2) and (6) of Table 3.2 separately for the poorest and richest 50% of our sample. As was the case the robustness checks mentioned in section 3, our results are fully confirmed. At the same time, this exercise goes beyond having a confirmatory purpose because it addresses the discussion in the literature around the importance of relativist concerns at different levels of standards of living. Echoing Maslow's (1943) idea of a hierarchy of needs, relativist concerns have been considered as a sort of luxury good demanded more strongly once a certain level of absolute standards of living is met. This view is supported by a number of empirical studies including Diener and Diener (1995), Ravallion and Lokshin (2010), Corazzini et al (2011) Corazzini et al (2012), Akay et al (2012) and Castilla (2012). However, notable exceptions to this evidence are the work of Fafchamps and Shilpi (2008) and Clark and Senik (2010). As can be seen in Table 3.4, relative deprivation coefficients suggest a stronger effect for richer households, regardless of whether the Yitzhaki or the Esposito indices. To test whether these effects are significantly different, we also estimate two additional pairs of models: i) with an interaction term between relative deprivation and household wealth (models 3 and 7) and ii) interaction between relative deprivation and a dichotomous variable that it is 1 if the household is above the 50th tile in terms of the asset index and 0 otherwise (models 4 and 8). The significance of these interaction and their signs further confirm the results from the split sample models.

3.4.2 Looking into relative deprivation measures

As can be seen in the last row of Table 3.2, the ability of our specifications to fit the data is greater for those employing the Esposito index with larger values of β. This leads to two considerations. The first one relates to the *interpretation* of our results in terms of the social dynamics behind them, which point to a premium in modelling relative deprivation in this context using the concave functional form of DE. In her sociological work, Mayer (2001) stresses the social exclusion route for understanding how relative deprivation may exert a negative impact on educational outcomes, and the ability to account for the relative deprivation component of social exclusion is indeed one of the motivations put forward to

Table 3.4: Logit Models for School Enrolment by Poorest and Richest Subsamples

	(1) Top 50%	(2) Bottom 50%	(3) Y Int	(4) Y Int 2	(5) Top 50%	(6) Bottom 50%	(7) E Int	(8) E Int 2
Household Wealth	0.110***	0.110***	0.092***		0.064***	0.077***	0.062***	
	(0.011)	(0.012)	(0.008)		(0.011)	(0.014)	(0.010)	
Bottom 50%				-0.215***				-0.146***
				(0.024)				(0.034)
Yitzhaki*HWealth			-0.024***					
			(0.004)					
Yitzhaki	-0.352***	-0.183***	-0.108***	-0.519***				
	(0.026)	(0.017)	(0.020)	(0.016)				
Yitzhaki*Bottom50%				0.278***				
				(0.016)				
Esposito 10					-1.108***	-0.698***	-0.617***	-1.318***
					(0.059)	(0.073)	(0.083)	(0.035)
Esposito*HWealth							-0.048***	
							(0.010)	
Esposito*Bottom50%								0.421***
								(0.049)
N	1,207,654	1,506,456	2,714,110	2,714,110	1,207,654	1,506,456	2,714,110	2,714,110
R_{count}	0.8892	0.8395	0.8613	0.8610	0.8895	0.8396	0.8614	0.8614
BIC	-16,268,194	-20,291,988	-38,422,265	-38,420,977	-16,269,215	-20,292,308	-38,424,085	-38,423,778
LL	-321,864	-568,729	-892,083	-892,712	-321,354	-568,569	-891,173	-891,312

Note: Standard errors in parentheses. *, ** and *** denote statistical significance at $p < 0.1$, $p < 0.05$ and $p < 0.01$ levels
All models include the full set of regressors.

justify the functional form of DE[8]. That being said, it is worthwhile to remark that our evidence should not be viewed as a ubiquitous relationship between relative deprivation and the social outcome of interest, but as the specific pattern found in the case of school enrolment in Mexico.

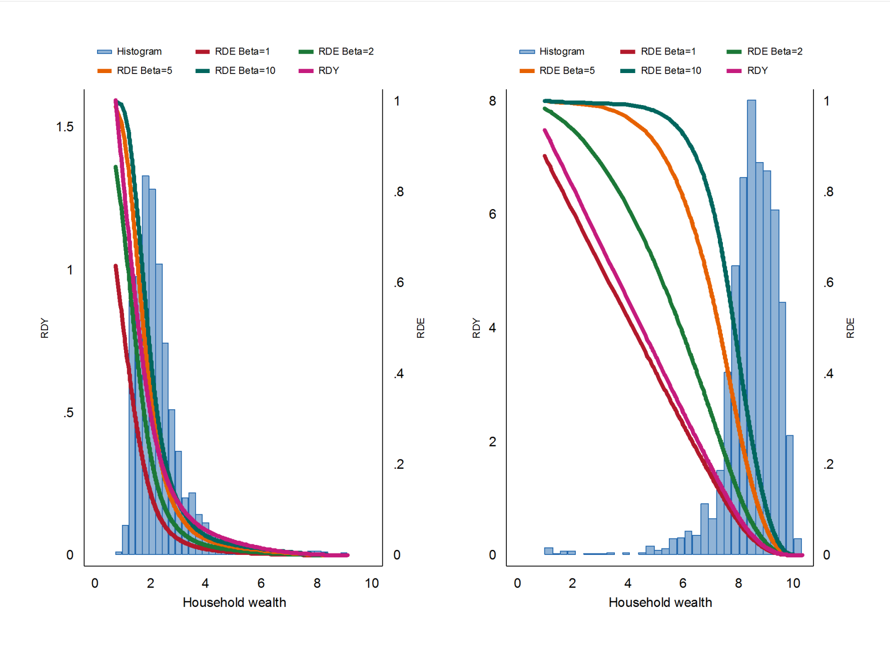
The second issue worth looking at concerns the statistical relationship between the measures of relative deprivation we use in this paper, and whether this relationship differs in the case of alternative underlying wealth distributions of the reference group. The evidence pointing to Esposito indices with larger β better reflecting the association between relative deprivation and school enrolment suggests that these indices are able to capture some variability in the data which indices with lower β or the Yitzhaki index cannot capture. It becomes interesting then to investigate the similarity or dissimilarity between the individual values assumed by the Yitzhaki and the Esposito indices. We do this in two ways. First, in Figure 3.2 we plot over the household wealth domain the individual total relative deprivation curves for the relative deprivation indices we used in our specifications (2)-(6); in other words, these lines show how relative deprivation varies at levels of own wealth according to those indices of relative deprivation. As can be noticed by the histograms in the background, the two panels of Figure 3.3 differ in the underlying wealth distribution –the left panel displays a municipality with a right-skewed distribution, the right panel one with a left-skewed one. It can be seen that the curves for different indices of relative deprivation resemble each other rather remarkably in the case of right-skewed distributions, but they are strikingly different for left-skewed distributions, and more so for larger values

[8]See Esposito (2010) for further details. Bossert, D'Ambrosio and Peragine (2007) fully expound the relationship between relative deprivation and the broader notion of social exclusion by including the temporal dimension.

of β's.

Next, in Figure 3.3 we plot the correlation between the Yitzhaki and the Esposito indices for the 2,456 Mexican municipalities, arranged on the horizontal axis according to the skewness of their distribution[9]. Two insights emerge from Figure 3.3. First, looking across the four panels, one can see that, while correlations are unsurprisingly high, they tend to be lower for larger values of parameter β (it can be noticed that they are lowest in the bottom-right panel). Second, different β's lead to specific correlation patterns between the Yitzhaki and the Esposito indices. For lower β's correlations are stronger in the case of left-skewed distributions while the opposite holds for larger β's; more specifically, correlation decreases with skewness for $\beta = 1$, decreases for $\beta = 5, 10$ and has an inverted-U shape for $\beta = 2$.

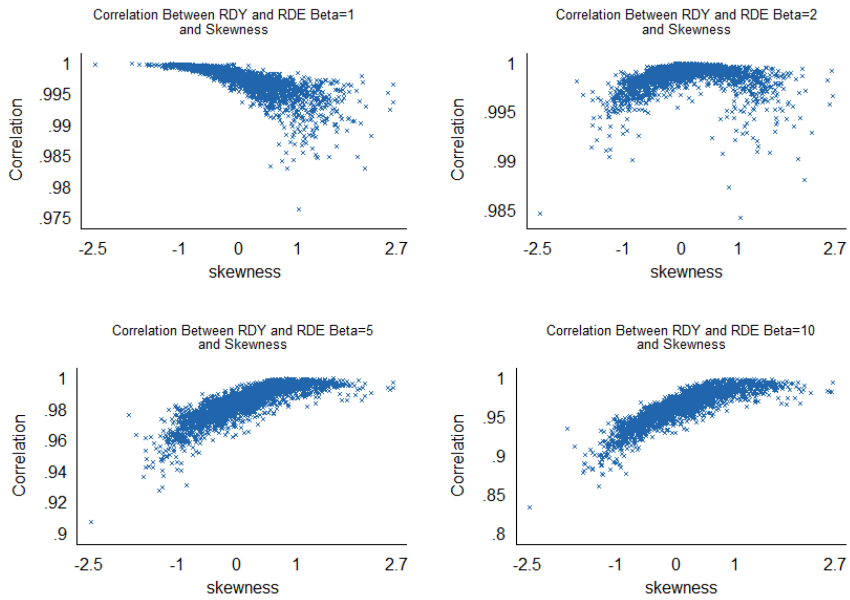
Figure 3.2: A Comparison of the Relative Deprivation Indices in the Case of a Left and Right Skewed Distribution



Source: Authors' elaboration from census data (INEGI, 2010).
Original in colour.

[9]Skewness is measured according to the customary Fisher-Pearson coefficient of skewness based on the second and third moments around the mean (Fisher 1929 and Pearson 1895) –see Groeneveld and Meeden (1984) for a review.

Figure 3.3: Correlation Yitzhaki-Esposito Indices and Skewness of the Underlying Distribution



Source: Authors' elaboration from census data (INEGI, 2010).

Original in colour.

3.5 Conclusion

The offer of this paper is threefold. First, we have contributed to the empirical analysis of relative deprivation as a predictor of social outcomes other than subjective wellbeing, happiness or life satisfaction. Using a very large dataset, we have presented solid evidence of relative deprivation as a negative predictor of school enrolment in Mexico –in this way also contributing to enriching the study of relative deprivation in developing countries. Second, we have provided insights on how the formation of human capital can be related to distributional issues. In particular, we have shown how disparities in the distribution of wealth can decrease school enrolment at both low and high levels of absolute wealth, and how these disparities may be particularly detrimental to older children and adolescents. Third, this is the first paper employing non-linear relative deprivation indices in the analysis of social outcomes. While the role of relative deprivation is confirmed regardless of the index used, we have shown that accounting for non-linearity in interpersonal comparisons does improve the ability of our econometric models to fit our data. We have also explored the behaviours of different indices of relative deprivation and illustrated how their correlation (and therefore the scope for heterogeneity in their ability to capture variability in the data) varies with the skewness of the underlying distribution.

Our findings bear important implications for researchers and policymakers. On top of showing that relative deprivation does matter, we have shown that we can be more precise in understanding how it matters. It is hoped that researchers will make use of these advancements for the investigation of the relationship between economic inequalities and a range of phenomena such as health outcomes, migration intentions, risk attitudes, etc. Our paper also sends clear messages to policymakers. Specific messages are that the negative effect of relative deprivation seems stronger at higher standards of living, and this may potentially offset some of the educational gains related to larger absolute wealth and economic growth; in addition, the toll on school enrolment because of the divide between the 'haves' and the 'have-nots' seems greater for teenagers and adolescents, a cohort needing particular attention and possibly tailored socio-educational programs addressing exclusion and isolation. The overall message is that an increase in economic disparities is likely to lead to an increase in school dropout rates. This means lower human capital in society, and a bleaker future for us all.

CHAPTER 4

Absolute Wealth, Relative Deprivation and Relative Advantage as Determinants of Depressive Symptoms: Evidence from Mexico

Abstract

Adopting Fehr and Schmidt's (1999) framework of 'self-centred inequality', we study absolute achievement, relative deprivation and relative advantage as predictors of depressive symptoms. Our empirical analysis is based on the 2012 Mexican Demographic and Health Survey, which is nationally representative and covers 43,912 individuals. We find that each of those variables is a significant predictor for the intensity of depressive symptoms, with a positive coefficient for relative deprivation and negative coefficients for absolute wealth and relative advantage. In addition, we show that the inclusion of interaction terms enables a better understanding of the role of demographic variables such as gender and age, which have received considerable attention in the medical literature.

4.1 Introduction

AN age long question is whether, or to what extent, we are affected not only by the absolute amount of our possessions or achievements but also by how much we have or achieve relative to others. Following from the analysis of relative deprivation in chapter 3, the idea is that being less successful than others leads an individual to 'look upward' and be affected negatively by the inability to have or achieve as much as them –*relative deprivation*. In addition, it has been hypothesised

that also a dual phenomenon takes place, whereby being more successful than others leads an individual to 'look downward' and derive a feeling of *relative advantage.*
The analysis of *relative deprivation* has received considerable attention by a number of disciplines. In particular, the economics literature has engaged with the measurement of relative deprivation as well as with theoretical and empirical analyses of the role it may play in society. Theoretical models comprising a relativistic specification of utility have been developed for the study of consumption, risk, economic growth, taxation schemes, educational subsidies, labour supply, etc. –see Esposito (2015) for a review. Whilst relative deprivation has been widely studied and documented, the phenomenon of *relative advantage* has received thus far considerably less attention. This is the case for both the axiomatic work on measurement as well as the theoretical and empirical analyses of the implications of the phenomenon on social outcomes. In particular, while there has been a cross-discipline solid confluence of views about the relevance of the phenomenon of relative deprivation –a confluence which was noted as early as Hirschman and Rothschild (1972), who spoke about 'an impressive body of converging writings, p. 547– scholars are more divided about relative advantage (referred to by some authors as relative elation, advantage, privilege or gratification). While psychologists and sociologists have produced a vast amount of evidence on this phenomenon [see Montada and Schneider (1989) Schmitt et al (2000), Guimond and Dambrun (2002) Leach et al (2002), Dambrun et al (2006), Leach et al (2007; 2006), Postmes and Smith (2009) and Dambrun and Taylor (2013)] economists seem more divided. For example, Stutzer (2004) and Frey and Stutzer (2008) argue for the inexistence of looking downward effects, while some evidence in favour of the looking downward thesis is found by Ferrer-i-Carbonell (2005) (although only for the Eastern Germans subset of their sample), by Vendrik and Woltjer (2007) adopting the framework of Kahneman and Tversky's (1979) Prospect Theory and by Corazzini, Esposito and Majorano (2012) on the basis of a cross-country questionnaire study. Blanchflower and Oswald (2004) find inconclusive evidence and conclude that indeed "much remains to be understood" (p.1378).

In this paper, we study the association between depressive symptoms and economic wellbeing or economic status. Our aim is to disentangle the roles of wealth-based measures of absolute achievement, relative deprivation and relative advantage as predictors of the presence of depressive symptoms. This can be seen within the framework proposed by Fehr and Schmidt's (1999), which is based on the idea that each one of these three components of economic status has an independent role with respect to a certain social outcome (in their case utility). In this way we bring the literature forward on two counts. First, we offer evidence of the association between relative deprivation and a social outcome different from happiness, subjective wellbeing or life satisfaction. This evidence is particularly important not only because of the paucity of studies by economists, as lamented by D'Ambrosio and Clark (2015), but also because while a certain amount of multi-disciplinary literature does exist across the social and medical sciences, results are less univocal compared to the case of the subjective wellbeing literature. Smith et al's (2012) meta-analytic review of studies on the relationship between relative deprivation and a wide array of social outcomes concludes that "results are often weak and inconsistent" (p. 203). Second, we carry out an analysis which, by employing Fehr and Schmidt's (1999) framework, sheds light on both the 'looking upward' and 'looking downward' mechanisms whilst controlling for absolute achievement.

In our empirical analysis, we use the 2012 wave of the Mexican National Health Survey (henceforth ENSANUT) which follows a stratified probabilistic sampling design and grants statistical representativeness at national and state level. The sample size for the health module for adults (individuals aged 20+) is around 44,000 observations. We find that absolute achievement and relative advantage decrease the incidence of depressive symptoms while the opposite holds for relative deprivation. In addition, we show how the relationships between depressive symptoms and two demographic axes such as gender and age, on which the medical literature has focussed for long time, are better understood if those variables are interacted with the absolute achievement variable.

The remainder of the paper develops as follows. Section 4.2 has two subsections. In subsection 4.2.1 we review the literature on the determinants of depressive symptoms; this is important to gain an understanding of the existing evidence of which economic and demographic variables have been identified as predictors of depressive symptoms by previous studies. In subsection 4.2.2 we formally introduce our three wealth-based economic wellbeing or economic status variables, namely absolute achievement, relative deprivation and relative advantage. In section 4.3 we describe the data and outline our empirical strategy, while in section 4.4 we present our results. We summarise our findings and conclude in section 4.5.

4.2 Literature Review

4.2.1 Predictors of depressive symptoms

The literature has highlighted a number of socio-demographic and economic axes along which systematic patterns for depressive symptoms are found. Among demographics, the strongest evidence concerns gender. Females are more likely to be affected by depression –this result is vastly reported in the literature, for recent studies see Chiavegatto et al (2013), Elgar et al (2013), Rai et al (2013). The result concerning this gender effect is often made sense of by making use of the work of Gove and Tudor (1973). This framework emphasises the different gender roles in society, with women being engaged in less rewarding and less self-esteem-boosting activities than men, in particular in terms of recognition outside the household; while this diversity in gender roles presumably becomes more tenuous at higher degrees of 'modernization' of society, it may certainly be very present in Mexico. The literature has discussed a number of additional explanations for the greater susceptibility of females to mental health problems, ranging from social dynamics to epigenetic mechanisms (Uddin et al. 2013) –a full review of these explanations is beyond the scope of this paper.

Education has been found to have a negative effect on depressive symptoms –according to the systematic review by Lund et al (2010), over two thirds of the papers including education as explanatory variable find significant coefficient pointing in this direction. Various reasons have been put forward to account for this, among which the positive impact of education on the ability to think logically, analyse problems and find effective solutions, and on the development of qualities such as self-confidence, perseverance, sense of control of one's life, etc. –for details, see Ross and Mirowsky (2006). In this paper, Ross and Mirowsky develop two alternative hypotheses on the issue of whether education might benefit the mental health of females or males unequally, which they label as Resource Substitution Theory and Resource Multiplication Theory. The starting point of these hypotheses is that education is one of the resources individuals have at their disposal to achieve mental health –others are authority, life opportunities, etc.

According to Resource Substitution Theory, there is a sort of diminishing marginal return mechanism applying to the set of resources available, as if they 'competed' against each other; in this way, education as an additional resource would provide a greater contribution to the gender group detaining fewer resources which is females –in particular, the channel emphasised by the authors is the stress-alleviating impact of education. By contrast, according to Resource Multiplication Theory the benefits of education would 'multiply' with those accruing from other resources and therefore would be more beneficial for the gender group with more resources (males).

With respect to other demographic characteristics, another rather stable result has to do with marital status, whereby being divorced or widowed (rather intuitively) increases the presence of depressive symptoms –see, inter alia, Rai et al. (2013). The relationship between age and depression seems instead more complex. A first reason for the difficulty in identifying a clear age-related pattern is that many of the existing papers focus on specific age groups –e.g. 'elderly' (60+), 'youngsters' (12-18), etc.– with the implication that they have a more limited scope for unveiling the overall potential role of age across the board. An additional reason which makes it difficult to identify an overall age-related pattern from the literature is that the evidence is rather mixed. For example, while Das et al (2007) find that mental health problems increase with age, Ross and Mirowsky (1992) find a U-shaped pattern (mental health disorders reaching a minimum in the middle age) and Fone et al (2013) find the opposite relationship –an inverted-U pattern, with mental health disorders peaking at middle age.

With regard to economic wellbeing or economic status variables, there seems to be a general agreement on the fact that that absolute income or wealth is negatively associated with depressive symptoms. The arguments used to explain this finding are varied and range from the sufferance caused by material hardship, to the ability to afford pleasant goods or experiences and having the means to access counselling services –see Bruce et al (1991), Conger et al (1994), Lorant et al (2003), McLeod and Owens (2004), Goodman et al (2005) and Rai et al (2013). Conversely, relative deprivation or lower socio-economic status are positively associated with depressive symptoms via psychological and physiological stress, and feelings of shame and inferiority arising from the comparison with more successful individuals –see McLaughlin et al. (2012), Elgar et al (2013), Scott et al (2014) and Wickham et al (2014). No work has been found on the relationship between presence of depressive symptoms and relative advantage.

Finally, the literature has attempted to explore the interplay between absolute economic achievement variables (whether income or wealth) and demographics such as gender and age. In the case of gender the underlying principle is the so-called 'double jeopardy' hypothesis, whereby the joint presence of disadvantageous attributes yields particularly harmful mental health outcomes. Following this hypothesis, low economic resources would be more harmful for females; yet, the empirical evidence supporting this idea is rather weak –for further details on this hypothesis as well as a review of the evidence, see Mendelson et al (2008). The idea of absolute economic achievement playing a different role at different ages has been put forward by Mirowsky and Ross (2001); however, it should be noted that they focus on a particular indicator which is economic hardship –they find that the ability to cope with economic hardship is greater at older ages, in support for an 'older age as maturity' hypothesis. A table with these and other determinants of depression is given in Appendix C.1.

4.2.2 Absolute Achievement, Relative Deprivation and Relative Advantage

The three components of economic wellbeing or status can be seen in the framework of 'self-centred inequality' proposed by Fehr and Schmidt (1999) –in their terminology, the looking upward element is referred to as 'disadvantageous inequality' while the looking downward component as 'advantageous inequality'[1]. In this framework, each of the three components has an individual role in the determination of a social outcome –in their case utility. Imagine the simple case of a society made of three individuals h, i and k whose absolute achievements are described by the vector $w = (w_h, w_i, w_k)$–assumed to be arranged in increasing order.

Following Fehr and Schmidt (1999, equation 1, p. 822),(the utility of individual i) is given by the following equation:

$$u_i(w) = \underbrace{\varphi_{abs}(w_i)}_{\text{absolute achievement}} + \underbrace{\alpha_{rd}\varphi_{rd}(w_i, w_k)}_{\text{relative deprivation}} + \underbrace{\alpha_{rs}\varphi_{rs}(w_i, w_h)}_{\text{relative advantage}} \tag{4.1}$$

where $\varphi(\bullet)$ is a function modelling the different components and α_{rd} and α_{rs} can be interpreted as weights attached to relative deprivation and relative advantage components, respectively. As it would be natural to expect, Fehr and Schmidt assume $\alpha_{rd} < 0$ –meaning that relative deprivation has a negative impact on individual utility. However, they are far less definite about the sign of α_{rs}. They note that whilst α_{rs} can be assumed to be positive in line with the looking downward argument according to which relative advantage has a positive impact on individual utility, a focus on fairness considerations may actually support a negative sign due to a feeling of 'guilt' for being richer than others. A generalisation of equation Equation 4.1 which accounts for the dynamic aspects of both relative deprivation and relative advantage has been proposed by D'Ambrosio and Frick (2012, equation 7, p. 289). Their empirical analysis using panel data from Germany over the period 1992-2007 suggests that "an individual's wellbeing is negatively affected by the comparison with permanently richer individuals… and is positively affected by the comparison with permanently poorer individuals" (p. 298).

Turning to how we operationalise such framework, given the lack of a module on income and the difficulty to create an overall expenditure variable from the data in the survey, we base our indicators on wealth. Hence our indicator of absolute achievement is household wealth measured through an asset index created on the basis of the large amount of data on dwelling characteristics, access to public services and ownership of durable goods. As is evident in Equation 4.1, and as is the case since Yitzhaki (1979; 1980) and Hey and Lambert (1980), relative deprivation and relative advantage measures are functions of individual's absolute achievements.

[1]In a similar fashion, D'Ambrosio and Clark's (2015) use the terminology 'comparative evaluation of inequality' to refer to Fehr and Schmidt's (1999) notion of 'self-centred inequality'.

In order to introduce the relative deprivation and relative advantage measures more formally, let $\mathbb{R}, \mathbb{R}_+$ and $\mathbb{R}_{++}$ denote the sets of positive integers, nonnegative and positive real numbers, respectively. For $n \in \mathbb{R}, \mathbb{R}^n_{++}$ is the positive orthant of the Euclidean *n-space* $\mathbb{R}^n$. The vector $w = (w_1, w_2, ...w_n) \in \mathbb{R}^n_{++}$ describes the wealth distribution for the individual i's reference group (the people individual i compares to), with elements of this vector being arranged in increasing order –i.e. w_1 refers to the poorest individual (or in general the poorest wealth receiving unit). The outcome of interpersonal comparisons when individual i compares with individual j are quantified through the individual comparison function $ICF(w_i, wj) : \mathbb{R}_{++} \times \mathbb{R}_{++} \to \mathbb{R}_+$. In the case of relative deprivation, ICF is an individual deprivation function which maps to zero for non-richer individuals while for richer individuals it becomes the function $IDF(w_i, wj) : \mathbb{R}_{++} \times \mathbb{R}_{++} \to \mathbb{R}_{++}$:

$$IDF(w_i, w_j) = \begin{cases} D(w_i, w_j), & \text{if } w_j > y_i \\ 0, & \text{if} w_j \leq w_i \end{cases} \tag{4.2}$$

The individual relative deprivation magnitudes deriving from one-to-one comparisons are then combined in the index $RD : (w_i, w_j)\mathbb{R}_{++}, \mathbb{R}^n_{++} \to \mathbb{R}_+$ which yields individual i's total relative deprivation and can be written as follows:

$$RD_i = \frac{1}{n} \sum_{j=1}^{n} IDF(w_i, w_j) \tag{4.3}$$

Conversely, for relative advantage an individual satisfaction function will be used which maps to zero for non-poorer individuals while for poorer individuals it becomes the function $ISF(w_i, wj) : \mathbb{R}_{++} \times \mathbb{R}_{++} \to \mathbb{R}_{++}$:

$$ISF(w_i, w_j) = \begin{cases} S(w_i, w_j), & \text{if } w_j < y_i \\ 0, & \text{if} w_j \geq w_i \end{cases} \tag{4.4}$$

The individual relative advantage magnitudes deriving from one-to-one comparisons are then combined in the index $RS : (w_i, w_j)\mathbb{R}_{++}, \mathbb{R}^n_{++} \to \mathbb{R}_+$ which yields individual i's total relative advantage and can be written as follows:

$$RS_i = \frac{1}{n} \sum_{j=1}^{n} IDF(w_i, w_j) \tag{4.5}$$

A number of functional forms have been proposed in the literature for D –see Bossert and D'Ambrosio (2014) and Esposito (2015)– but, as we mentioned above, the same does not hold for function S. Our empirical results are robust to a number of functional forms for relative deprivation and relative advantage. The specific functional forms of D and S which we employ for the derivation of functions are the following:

$$D_i(w_i, w_j) = w_j - w_i; w_j > w_i \quad (4.6)$$

$$S_i(w_i, w_j) = w_i - w_j; w_j < w_i \quad (4.7)$$

D is the building block of the well-known Yitzhaki (1979) measure of relative deprivation while S is the gap from poorer individuals. The main difference is that in D each individuals compares herself to those richer than her, whilst in S the inter personal comparisons are with those poorer than her. Both our S and D measures are linear in comparison incomes –i.e. they are insensitive to mean-preserving changes among richer (relative deprivation) or poorer (relative advantage) individuals. This choice is made in order not to introduce particular assumptions on the functional form of D and S in our main analysis. In addition, it should be noticed that while non-linear (concave) measures of relative deprivation have been developed and justified on the basis of sociological grounds – Paul (1991), Chakravarty and Chattopadhyay (1994), Podder (1996) and Esposito (2010) and Bossert and D'Ambrosio (2014). No formal measurement work on relative advantage has been carried out to explore non-linearities in interpersonal comparisons.

4.3 Data and Empirical Strategy

In our empirical analysis, we use the 2012 wave of the Mexican National Health Survey (henceforth ENSANUT). This follows a stratified probabilistic sampling design and grants statistical representativeness at national and state level. The sample size for the health module for adults (individuals aged 20+) is 43,912 observations. Females are 57% of the total sample, average age is just over 43 years and average household size is almost 4. More information on descriptive statistics can be found in Table 4.1.

One randomly selected respondent per household was presented with a reduced form of the widely used Centre for Epidemiologic Studies Depression Scale (CES-D) –originally developed by Radloff (1977) and then revised by Eaton et al (2004). This is a battery of questions where each of them refers to the weekly frequency of occurrence of a depressive symptom (e.g. feeling oppressed, sad, being unable to sleep, etc.) –the options are "less than a day", "1-2 days", "3-4 days" and "5-7 days", and these are coded 1 to 4 respectively. Our main measure for Depressive Symptoms (DS) used as a dependent variable ranges from 0 to 7 and was generated as the count of items in which the adult answered either of the top two frequency categories –in other words, for each item a value of one is associated with the "3-4 days" and "5-7 days" answers, zero otherwise, and these values are then summed up. While a variety of cut-off points are used in the literature, we chose this specific one on the basis of the meaning attributed in this way to our dependent variable; in

Table 4.1: Descriptive Statistics

	N	Mean	SD	MIN	MAX
Asset Index	43,912	6.919	2.152	0	13.987
Relative Deprivation	43,912	0.881	0.937	0	7.778
Relative Advantage	43,912	0.927	0.870	0	7.019
Female[a]	43,912	0.572	0.495	0	1
Age	43,912	43.315	15.741	20	101
Paid Work[a]	43,912	0.528	0.499	0	1
Limitation in Activities	43,912	0.163	0.49	0	7
Number of People in HH	43,912	3.872	1.848	1	19
Other Health Problems[a]	43,912	0.152	0.359	0	1
Number of Chronic Diseases	43,912	0.154	0.444	0	3
Victim of Violence[a]	43,912	0.021	0.143	0	1
Education	43,912	1.844	1.145	0	4
Civil Status	43,912	2.727	1.047	1	5

Source: Author's elaboration with data from the 2012 National Health Survey (ENSANUT), Instituto Nacional de Salud Publica,(INSP).
[a] Dummy Variable

particular, it seems reasonable to think that if 3 days or more a week a symptom is present then there is a certain likelihood of existence of a depressive issue of some relevance –by contrast, the inclusion of the previous category in those leading to a 'one' would deem as 'depressed' also respondents having experienced that symptom only once. It should be noted that, as we shall mention soon when describing our robustness checks, our results do not depend on the choice of this specific cut-off.

Depressive Symptoms as a function of absolute achievement, relative deprivation and relative advantage will be operationalised through a binomial regression model (NBRM). This differs from the Poisson regression model (PRM) in that NBRM estimates a parameter alpha which models and tests for the over dispersion of the data. In other words, PRM assumes that the dependent variable is equidistributed (it has equal expected value and variance) while the NBRM incorporates the over dispersion as a parameter in the model. Given that the mean and conditional means of our dependent variable are always lower than its variance, this suggests the use of NBRM. Additionally, all the NBRM models we run show that the over-dispersion parameter alpha is always different from zero, further confirming our choice of using NBRM as correct (UCL Statistical Consulting Group n.d.; Long and Freese 2014)). Despite the large number of zeros, we do not use zero-inflated models because we believe that it would be erroneous to consider zero values as qualitately (as opposed to quantitatively) different from non-zero values –the typical example is fertility decision, where having zero children may result from a qualitatively different situation such as infertility rather than the deliberate decision of not having children (see Long and Freese 2014).

The choice of NBRM relies on the interpretation of our dependent variable as a count variable; it might be objected that DS is not strictly speaking a count variable because it combines heterogeneous items –i.e. each ‘one’ derives from questions which are strongly related for the sake of studying depression but are nonetheless different questions. For this reason we check (and we are able to confirm) that our results are robust to the use of an ordered probit model. We also dichotomise our dependent variable and create a variable which takes the value of zero if all the six items are zeros and 1 otherwise; our results are again confirmed when this is used as a dependent variable in a probit model. Finally, we remove any cut-off and create a variable consisting of the sum of the six items as they appear on their 1-4 scale; in this way we obtain a variable ranging from 6 to 24 (which we rescale in the 0-18 range). Our results are confirmed when this is used as a dependent variable in customary ordinary least squares regressions. Formally, the equation to be estimated is:

$$DS_i = \alpha + \beta ABS_i + \gamma RD_i + \delta RA_i + \tau C + \varepsilon_i \tag{4.8}$$

where DS_i is the count variable described above,ABS_i is absolute achievement (absolute wealth), RD_i is the Yitzhaki index and RA_i is the ’mirror’ version of the Yiztaki index. C is a vector of control variables described below and in table 4.1. β, δ and τ are estimated coefficients and ε_i is the idiosyncratic error with the usual characteristics.

In our econometric analysis we control for customary demographic variables as well as for a set of health-related variables. For example, besides variables such as gender, education and marital status, we include a dummy variable indicating whether the respondent had any health problem (other than depression-related problems) in the past two weeks. We also included the number of chronic diseases that were diagnosed in the last year and the number of daily life activities the individual has difficulties in performing and in addition, we include a dummy variable capturing whether the respondent has been a victim of a violent episode in the last year.

Turning to how we operationalise the absolute-plus-relative achievements framework described in the above section, given the lack of a module on income and the difficulty to create an overall expenditure variable from the data in the survey, our indicator of absolute achievement is household wealth. This is measured in similar fashion as explained in previous chapters and explored in detail in chapter 1. The index was then rescaled for a value of 0 to represent the worse-off household and the maximum value (13.98) the best-off one. For what concerns the choice of reference group, as was the case for the main analysis in Chapter 3 we follow a basic geographical criterion based on municipality[2] (the lowest political and administrative aggregate in Mexico) –results are not qualitatively different in the cases that we control for heterogeneity in municipality size through a continuous variable or categorical (ordinal) variables.

4.4 Results

4.4.1 Main results

Table 4.2 shows results from 9 alternative specifications of our NBRM regressions. All of these specifications include the full set of control variables; they differ in the number of economic wellbeing or status variables included and in the presence of interacted variables. The first three specifications represent the typical analysis of absolute achievement and relative deprivation; in particular, specifications 1-3 include only absolute wealth, only relative deprivation and both variables, respectively. Specification 4 adds relative advantage to the picture and specifications 5-7 further include, respectively, the interaction between absolute wealth and gender, the interaction between absolute wealth and age and both interactions.

Moving to the role of individual variables, with regard to our economic wellbeing or status variables the general picture is that absolute achievement and relative advantage are negatively associated with DS[3] while the converse holds for relative deprivation. It is interesting to notice that absolute wealth is significant in specification 1 but it is not in specifications 4 and 5, where it is employed together with relative deprivation or relative advantage. Yet, the remaining of the specifications suggest that it would be erroneous to deem absolute wealth to have no predictive role, but rather that this is mediated by variables such as gender and age; in these specifications absolute wealth turns back to be significant and so are the interaction terms with gender and age (again, these will discussed in detail in sub-section 4.4.2.). In Figure 4.1 we plot predicted probabilities of occurrence of the lowest (left panel) and highest (right panel) categories of DS along the domain of relative deprivation (horizontal lower axis) and relative advantage (horizontal upper axis) –predicted probabilities are based on specification 7 (the same applies to the figures which shall follow). It can be seen that, as expected, the slope for the relative deprivation curve is negative slope while the slope of the relative advantage curve is positive.

[2]We refined the reference group to include, besides municipality, two groups of education: with and without university degree. Not only are the coefficients nearly identical in all of the independent variables, but there is a small worsening in the BIC of these new group.

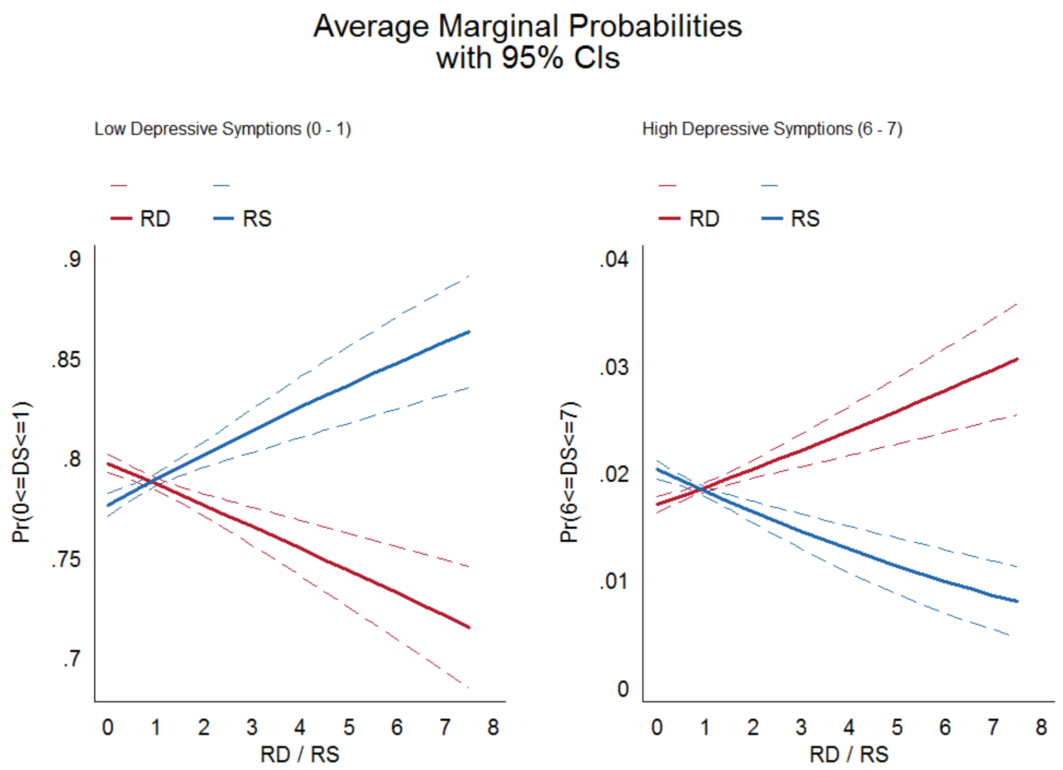
[3]The positive coefficient for absolute wealth in specifications 8 and 9 (those where wealth is interacted with age) needs to be interpreted in conjunction with the negative interaction term –this will be discussed in detail in sub-section 4.4.2.

Table 4.2: Predictors of Depressive Symptoms

	(1)AI	(2)RDY	(3)RS	(4)AI+RDY	(5)AI+RS	(6)AI+RDY+RS	(7)AI*GENDER	(8)AI*AGE	(9)BOTH
Asset Index	-0.021***			0.007	0.004	0.019***	-0.001	0.073***	0.052***
	(0.005)			(0.006)	(0.006)	(0.007)	(0.008)	(0.013)	(0.014)
RD		0.077***		0.086***		0.065***	0.062***	0.065***	0.062***
		(0.009)		(0.012)		(0.013)	(0.013)	(0.013)	(0.013)
RA			-0.090***		-0.097***	-0.073***	-0.076***	-0.072***	-0.075***
			(0.012)		(0.015)	(0.016)	(0.016)	(0.016)	(0.016)
Age	0.029***	0.030***	0.030***	0.030***	0.030***	0.031***	0.031***	0.040***	0.039***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
Female	0.480***	0.482***	0.480***	0.481***	0.479***	0.480***	0.253***	0.480***	0.275***
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.059)	(0.020)	(0.059)
(Gender)(Asset Index)							0.033***		0.030***
							(0.008)		(0.008)
(Age)(Asset Index)								-0.001***	-0.001***
								(0.000)	(0.000)
N people in HH	0.019***	0.022***	0.021***	0.022***	0.021***	0.023***	0.023***	0.023***	0.023***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Health Problems	0.344***	0.342***	0.343***	0.342***	0.343***	0.341***	0.342***	0.340***	0.341***
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
One Chronic Illness	0.268***	0.267***	0.264***	0.266***	0.263***	0.263***	0.262***	0.265***	0.264***
	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)
Two Chronic Illness	0.333***	0.332***	0.329***	0.331***	0.329***	0.328***	0.329***	0.330***	0.331***
	(0.049)	(0.049)	(0.049)	(0.049)	(0.049)	(0.050)	(0.050)	(0.050)	(0.050)
Three Chronic Illness	0.628***	0.634***	0.622***	0.632***	0.620***	0.625***	0.622***	0.631***	0.628***
	(0.075)	(0.075)	(0.075)	(0.076)	(0.075)	(0.075)	(0.076)	(0.075)	(0.075)
Victim of Violence	0.626***	0.619***	0.623***	0.618***	0.623***	0.617***	0.621***	0.620***	0.623***
	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)
Works	-0.055***	-0.059***	-0.058***	-0.060***	-0.058***	-0.062***	-0.069***	-0.066***	-0.073***
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
Age^2	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
N of Act Limitations	0.238***	0.234***	0.234***	0.234***	0.234***	0.232***	0.232***	0.229***	0.229***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Primary	-0.048	-0.049*	-0.052*	-0.055*	-0.057*	-0.060**	-0.063**	-0.033	-0.038
	(0.030)	(0.029)	(0.029)	(0.030)	(0.030)	(0.030)	(0.029)	(0.030)	(0.030)
Secondary	-0.156***	-0.158***	-0.159***	-0.169***	-0.167***	-0.174***	-0.177***	-0.149***	-0.153***
	(0.034)	(0.033)	(0.033)	(0.035)	(0.034)	(0.035)	(0.034)	(0.035)	(0.035)
Post-Secondary	-0.342***	-0.338***	-0.330***	-0.353***	-0.339***	-0.348***	-0.350***	-0.332***	-0.335***
	(0.041)	(0.039)	(0.040)	(0.041)	(0.041)	(0.041)	(0.041)	(0.042)	(0.041)
University +	-0.535***	-0.530***	-0.496***	-0.549***	-0.507***	-0.525***	-0.522***	-0.514***	-0.512***
	(0.046)	(0.043)	(0.045)	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)
Free Union	-0.040	-0.043	-0.043	-0.041	-0.042	-0.043	-0.041	-0.031	-0.030
	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)
Married	-0.133***	-0.122***	-0.126***	-0.122***	-0.126***	-0.120***	-0.117***	-0.112***	-0.110***
	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)
Divorced	0.180***	0.171***	0.172***	0.171***	0.172***	0.167***	0.169***	0.175***	0.176***
	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)
Widow	0.045	0.048	0.046	0.049	0.046	0.049	0.055	0.054	0.060
	(0.040)	(0.040)	(0.040)	(0.040)	(0.040)	(0.040)	(0.040)	(0.040)	(0.040)
Constant	-0.872***	-1.120***	-0.973***	-1.156***	-0.986***	-1.170***	-1.028***	-1.584***	-1.428***
	(0.081)	(0.084)	(0.081)	(0.090)	(0.083)	(0.091)	(0.098)	(0.125)	(0.131)
lnalpha									
Constant	0.839***	0.836***	0.836***	0.836***	0.836***	0.835***	0.834***	0.833***	0.833***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Obs.	44,618	44,618	44,618	44,618	44,618	44,618	44,618	44,618	44,618
Alpha	2.314	2.308	2.307	2.308	2.307	2.304	2.302	2.301	2.299
AIC	116,006	115,964	115,964	115,965	115,966	115,946	115,933	115,927	115,917
BIC	-2,426	-2,468	-2,468	-2,458	-2,458	-2,469	-2,473	-2,479	-2,480

Note: Standard errors in parentheses. *, ** and *** denote statistical significance at $p < 0.1$, $p < 0.05$ and $p < 0.01$ levels

Figure 4.1: Predicted Probabilities - Relative Deprivation and Relative Advantages



Source: Authors' elaboration with data from ENSANUT (INSP, 2012).
Original in colour.

4.4.2 Interactions

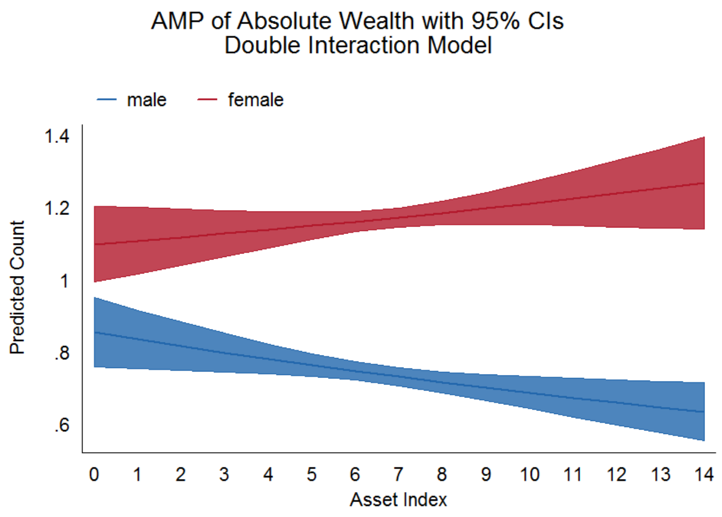
As we mentioned above, the coefficient for absolute achievement is significant in specification 1, it loses significance when relative deprivation and relative advantage are included and it becomes significant again when it is interacted with gender and/or age. Coupled with the better data fit achieved by specifications including one or both wealth interactions, this suggests some sort of heterogeneity in the role of wealth as a predictor of depressive symptoms along the gender and age axes. In order to fully understand this result, it is important to keep in mind that solely relying on summary statistics of interaction effects such as variables' coefficients and significance parameters can be misleading in nonlinear models –as, in our case would be the positive coefficient of wealth in specifications 6 and 7 where wealth is interacted with age. This is because the significance levels as well as sign of interaction terms can differ at different values of the covariates (see Ai and Norton 2003; Greene 2010; Hodge and Shankar 2014). As usefully illustrated by Karaca-Mandic et al. (2012, Figures 2a-c), the introduction of an interaction term in a nonlinear model allows for heterogeneity in the shape (rather than only in the position) of the curve representing the conditional probability that the dependent variable takes a certain value as a function of the explanatory variable of interest; in other words, it allows this shape to differ at different levels of the interacted variable[4].

Following the suggestion of Greene (2010), we show the behaviour of interacted variables graphically so that their role can be appreciated along their whole domain. In particular, in Figure 4.2 and Figure 4.3 show, respectively, predicted level of DS and predicted probabilities of being in the lowest levels (left panel) and highest levels (right panel) of DS –in both cases, by gender at different levels of wealth. In both figures, an opposite pattern can be seen for males and females. First of all, both graphs confirm that depressive symptoms are more common amongst females –the females curve is above the males curve in Figure 4.2 and the females curve is below the males curve in the left panel and vice versa in the right panel in Figure 4.3. In addition, it can be seen that a different wealth-related pattern can be observed for the two genders. In both graphs the females and males curves have opposite slopes. The predicted DS score shown in Figure 4.2 increases as wealth increases for females but it decreases for males.

In Figure 4.3, the probability of having low depressive symptoms increases with wealth for males but it decreases for females; the opposite holds for the probability of having severe depressive symptoms. According to this evidence, males in poorer households are more likely to be affected by DS compared to males in richer households, while the opposite holds for females. An explanation for this pattern can be that in a society like Mexico where there is a significant gender discrimination in the labour market (Meza González 2001; Domínguez-Villalobos and Brown-Grossman 2010), the richer the household the more significant the contribution of the male is likely to be; this may boost males' perception of themselves as being able to comply with the breadwinner role society expect of them, and possibly foster behaviours which may undermine the mental serenity of the female partner. It should certainly be acknowledged that while this is a potentially interesting explanation, our dataset contains only a unitary measure of household wealth and is therefore unable to properly address intra-household issues.

[4]This means that if a continuous variable is interacted with a dummy variable, we will have two possible shapes for this curve –one for each value of the dummy variable; if two continuous variables are interacted then we would have many (virtually infinite) shapes. We thank the authors for elucidating this point

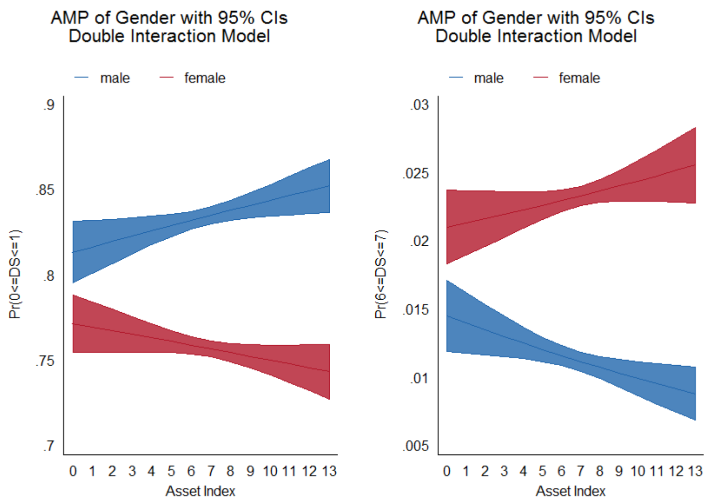
Figure 4.2: Predicted DS Count at Different Levels of Wealth



Source: Authors' elaboration from ENSANUT (INSP, 2012).

Original in colour.

Figure 4.3: Predicted probabilities by gender at different levels of wealth

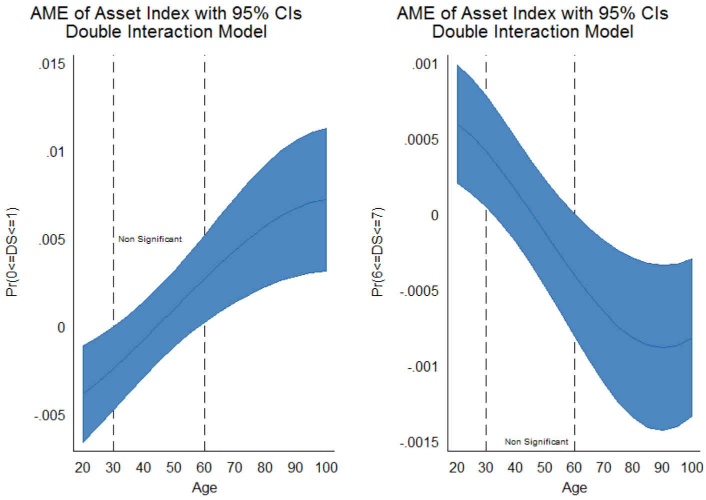


Source: Authors' elaboration from ENSANUT (INSP, 2012).

Original in colour.

In Figure 4.4 we shed some light on the interplay of wealth and age by means of a different graph. Here we plot the marginal effects of wealth on the probability of having the lowest (left panel) and the highest (right panel) DS category over the age domain. The range of values of age external to the two broken vertical lines in both panels indicate the domain where the marginal effect is statistically different from zero, while in the domain comprised between these two lines marginal effects are not significant. The range at which age does not seem to have any relationship with the levels of DS is the basically the same

Figure 4.4: Average Marginal Effects of Wealth over the Age Domain



Source: Authors' elaboration from ENSANUT (INSP, 2012).
Original in colour.

for both panels. In the left panel, marginal effects are negative and significant between 20 and 30 years of age, which indicates that an increase in wealth for someone within this age range is associated with a reduction in the probability of being in the lowest category of DS; marginal effects are positive and significant over 60 years of age, which by contrast denotes a 'depression alleviating' effect of an increase in wealth at older age. The right panel can be seen as the mirror image of this pattern. Our reading of this pattern is that while a marginal increase in wealth in older age is likely to provide a sense of security and alleviate psychological distress, for young people it possibly gives rise to consumption patterns or lifestyles leading to mental health problems.

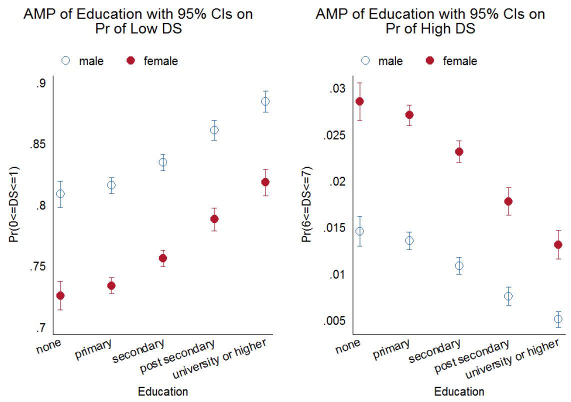
4.4.3 Further Analysis Education and Age

Looking at regressors other than our economic wellbeing variables, a number of interesting results emerge. In line with the evidence presented in our literature review, where education emerges as being able to boost one's self-confidence, make one feel in control of her life, etc., we find that every higher educational level (categorical dummies 'primary', 'secondary', 'post-secondary' and 'university degree or higher' compared to the 'no education' baseline) further reduces the presence of depressive symptoms. Another result of ours which is vastly corroborated by existing evidence is the greater susceptibility of females to be affected by DS. In order to shed light on the gender hypotheses presented in our literature review, in Figure 4.5 we plot predicted probabilities of occurrence of the lowest (left panel) and highest (right panel) categories of DS at different levels of education, separately for males and females –the pattern remains unvaried regardless of the exact procedure followed to calculate these predicted probabilities[5]. It can be seen that the difference in predicted probabilities across gender is larger at lower levels of education and it is minimum for the university degree of higher educational category. This suggests that the psychological benefits of education are larger for females, as hypothesised by Resource Substitution Theory. This result also lends support to Gove and Tudor's (1973) explanation of the difference in incidence of DS between males and females in terms of gender roles in society and the lower levels of accomplishments and gratification enjoyed by females outside the household, which are arguably larger for more educated women. In addition, this result can also be seen as lending support to Gove and Tudor's (1973) explanation of the difference in incidence of DS between males and females in terms of gender roles in society. According to this view, females' greater propensity to exhibit DS is (at least partly) triggered by the lower levels of accomplishments and gratification they enjoy outside the household; the gender difference in this dimension is arguably larger in less educated households, hence the pattern observed in Figure 4.5.

Finally, it is interesting to look at age, which has a positive and highly significant coefficient and a negative and highly significant squared term. This suggests that the incidence of DS increases with age, and that it does so at decreasing rates. By plotting the predicted count (Figure 4.6 and Figure 4.7) of DS at different ages, we note that the effect of the negative squared term goes as far as making the curve bend downward and produce an inverse-U pattern. We first observe that this result echoes the existing evidence of happiness/subjective wellbeing, which has been showed to follow a U-shaped pattern over the age domain –see Blanchflower and Oswald (2004) and Frijters and Beatton (Frijters and Beatton 2012). Next, more specifically, we believe that the inverse-U pattern we observe can be made sense of in two ways. First, adulthood is perhaps the time where one is most strongly subjected to psychologically burdening societal demands, such as having a productive role in society, parenting, taking care of the elderly, etc. Second, this pattern can be understood by coupling the evidence of DS increasing with age (illustrated in our literature review) with a selection mechanism brought about by survival: lower survival rates for the most depressed groups reduce the observed incidence of DS amongst older people (Mirowsky and Ross 1992), hence offsetting or possibly reversing the pure age effect.

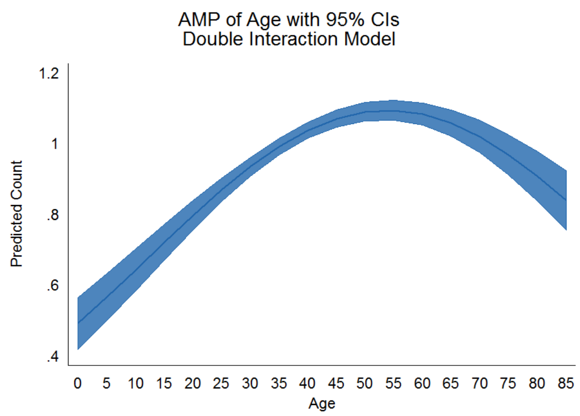
[5]Figure 4.5 is produced by treating all observations in turn as each one of the possible combinations of the gender and educational categories –hence treating the whole sample first as females with no education, then as females with primary school, etc., and the same for males. An alternative procedure is to calculate predicted probabilities of each combination simply as they feature in the sample. As mentioned in the text, the graphs resulting from these two procedures are very similar.

Figure 4.5: Predicted Probabilities for Different Gender/education combinations



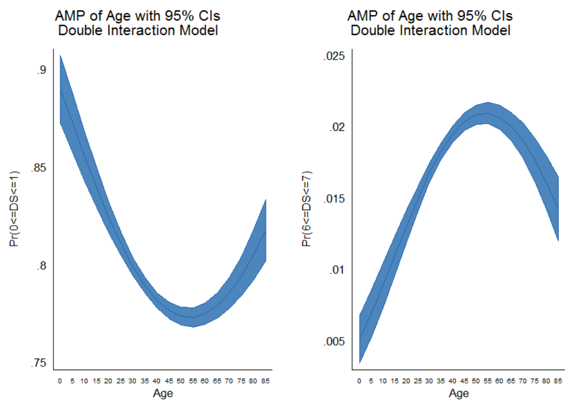
Source: Authors' elaboration from ENSANUT (INSP, 2012).
Original in colour.

Figure 4.6: Predicted DS count at different age values



Source: Authors' elaboration from ENSANUT (INSP, 2012).
Original in colour.

Figure 4.7: Predicted Probabilities of Low and High DS at Different Age Value



Source: Authors' elaboration from ENSANUT (INSP, 2012).
Original in colour.

4.5 Conclusion

In this paper we have studied absolute achievement, relative deprivation and relative advantage as predictors of depressive symptoms among adults (20+) in Mexico. We have followed Fehr and Schmidt's (1999) framework of 'self-centred inequality', where each of these components is expected to play a role in the determination of a certain social outcome. We find that relative deprivation is a positive predictor of depressive symptoms, in conformity with the idea of lower economic status leading to shame, feelings of inferiority and stress for not being able to 'keep up with the Joneses'. By contrast, and somehow as a mirror image to the relative deprivation result, absolute wealth and relative advantage are negative predictors of the presence of depressive symptoms. In addition, we have provided novel evidence on the interplay between wealth and demographic variables such as gender and age, on which the medical literature on the subject has focussed for long time. Wealth seems to play a different role for males and females, and it seems particularly important between age 20 and 30 as well as above 60, with an opposite role for individuals in these two age ranges.

Our results are are confirmed by a number of robustness checks in terms of dependent variable used, regressors employed and econometric models adopted. Our results are also highly intuitive, along the notion of relative deprivation undermining self-confidence whilst absolute achievement and relative advantage fostering the creation of a positive self-image and presumably boosting inner strength. However, while the story seems clear, the policy implications are less straightforward. The existence of economic inequality takes a toll on the losers in terms of likelihood of presence of depressive symptoms, whilst it 'rewards' the winners. This means that while the losers would have been better off had inequality not existed, the opposite possibly applies in the case of the winners. This posits the question of how to trade these gains and losses against one another. From a pure 'count' approach, where individuals anonymously count all as one, this is an algebraic sum and the policymaker may well be interested in comparing the amount of depressive symptoms in the existing scenario against the 'more equal' scenario. What the exact outcome of this comparison would be (i.e. whether the prevalence of depressive symptoms were higher in one or the other scenario) is a technical question; the answer to which would need to come, at least ideally, from a well-designed randomised trial or quasi experimental study. Whether we want a society which accepts the existence of 'economic losers', being knowledgeable that this already disadvantaged situation will also mean a systematic greater likelihood of mental health problems for them, belongs instead to the "class of human problems which can be called 'no technical solution problems'" (Hardin 1968, p.1243).

CHAPTER 5

Summary and Conclusions

THROUGH the use of some of the largest and most recent data collected in the country, this research has contributed to the understanding of the interplay between inequality and human development outcomes in the Mexican population. In particular, it offered novel and interesting results regarding the association between an unequal wealth distribution and social outcomes such as school enrolment and mental health issues.

The first chapter uses three waves of large and nationally representative income and expenditure surveys to shed some light on the use of asset indices in social research. The general aim of this paper was to test to what extent an asset index can be used as a proxy for measures of flow (as opposed to stock) such as income/consumption; it was found that an asset index does correlate with flow measures, but this is far from perfect. This does not mean that an asset index is a meaningless measure of economic wellbeing, but rather that it does reflect other aspects of it. The more specific aim of this paper was to compare the widely used method proposed by Filmer and Pritchett (2001; 1999) with the one developed more recently by Kolenikov and Angeles (2004; 2009). The latter was found to lead to an asset index which better proxies income/consumption. Beyond the interest of its own findings, this chapter was instrumental for conceptualising and developing the asset index that would be used in the remaining chapters, in order to overcome the lack of income or expenditure data in the datasets used for the rest of the thesis.

Chapters two and three use the large and publicly available dataset resulting from the extended questionnaire administered on the 10% sample of the 2010 Mexican Census. Both chapters looked at the individual probability of enrolment in pre professional levels in Mexico (children aged 6 to 18). For both analyses a household asset index constructed using over three million observations and twenty six indicators of household durable goods, access to utilities and quality of construction materials was calculated. In chapter two I calculated Gini coefficients at municipal level using the household asset index and in chapter three I calculated individual relative deprivation measures for the Yitzhaki (1979) index and different level of concavity of the Esposito (2010) index. While chapters two and three had as a main goal the study of the association between school enrolment and, respectively, inequality and relative deprivation, both chapters provide a series of additional findings. Chapter two provided evidence of the germane importance of the educational milieu (at both the household and the wider level) in predicting the likelihood of individual school enrolment, and illustrated how this factor may play a role for households enjoying different levels of wealth.

Chapter three described the heterogeneity in the association between relative deprivation and school enrolment for children of different ages and households belonging to the poorest vs richest 50% of the wealth distribution. An additional offer of this chapter was of a more purely statistical character –an analysis of the similarity/divergence between linear and concave relative deprivation indices in the cases of underlying distributions of wealth with different degrees of skewness.

Chapter four rounds up the understanding of economic disparity by discerning three components of economic wellbeing at the individual level: absolute economic achievement, relative deprivation and relative advantage. The objective of this chapter was to explore the individual contribution of these three variables in predicting depressive symptoms. The empirical analysis was carried out using a 2012 large and representative national health survey for Mexico. A household asset index and individual level relative deprivation and relative advantage measures were calculated on the basis of the asset index. Social, medical and psychological literature on the determinants of depressive symptoms was reviewed to construct the econometric model. Results pointed to absolute wealth and relative advantage as negative predictors of depressive symptoms, while the opposite holds for relative deprivation. In addition, this chapter shed light on the association between depressive symptoms and socio-demographic variables such as gender, age and education. Finally, this chapter explored methodological and statistical implications of using variables that are highly correlated among each other, as was the case for the three indicators of economic wellbeing used in this paper.

In summary, the results of this thesis point out to inequality, whether it is measured at the aggregate or at the individual level, as a negative predictor of human development outcomes such as education and health –and more specifically, school enrolment and mental health. The main difference between the analyses at the aggregate level (addressed in chapter two) and the individual level (addressed in chapters three and four) is the following. In the latter, the assumption is usually that those negatively affected by a context of inequality are the ones at the bottom of the distribution, the opposite of relative deprivation that can affect everyone irrespective of their position in the social ladder. The existence of a phenomenon such as relative deprivation suggests that its mirror concept -relative advantage- may also affect individuals and plays in determining social outcomes.

In the specific case of education, the conclusions are not just that both inequality and individual relative deprivation help predict lower levels of individual probability of enrolment, but also that educational outcomes are also closely related to the educational milieu both at the household and the broader municipal level. Moreover, through the use of interaction terms and graphical analysis, the nuances of these social dynamics were expounded. It was shown that mean education of the adults in the household can to some extent compensate for low levels of household wealth. The interaction between educational ratios and mean wealth at municipal level also revealed that the predicted positive influence from more educated people in the municipality disappears in municipalities with higher mean wealth, i.e. more relative deprivation.

Chapter three specifically investigated relative deprivation and its relationship with the individual probability of school enrolment. This paper offered several contributions to the existing body of literature. First, it expanded the range of outcome variables taken into examination in the relative deprivation literature –which typically focuses only on subjective wellbeing, happiness and life satisfaction. Relative deprivation proved to be a negative, significant and predictor predictor of the probability of enrolment; this and the other findings hinted at above have been situated in the sociological, economics and child development literature. Second, this is the first paper employing non-linear indices of relative deprivation for the study of social outcomes; it also compares the performance of such indices with the commonly used linear index, i.e. the Yitzhaki index. The fact that the models that best fitted the data were the ones in which the Esposito indices were employed and in particular those with highest concavity is an important results and contribution to the literature. Third, as we mentioned above, the paper offered a statistical contribution by analysing the correlation between relative deprivation indices in relation to the skewness of the underlying distribution of wealth. The graphical analysis provided for this issue showed that for right-skewed distributions the correlation between the Yitzhaki index and the Esposito indices is almost perfect and while for left-skewed distributions this is not the case and in fact the correlation between the two indices decreases as the concavity of the Esposito index increases.

Another important contribution of this thesis to the study of economic inequality is given by the last chapter, where depressive symptoms of the Mexican population are modelled as a function of economic variables such as absolute wealth, relative deprivation and relative advantage, as well as a series of other relevant socio-demographic variables. Besides confirming and qualifying some of the existing findings in the literature regarding the role of gender, age, education, absolute wealth and relative deprivation as predictors of depressive symptoms, the incorporation of relative advantage in the analysis is a noteworthy novelty. The results from chapter 4 showed that interpersonal comparisons, both with relatively better off and relatively worse off individuals are important for the mental health of the population and that absolute wealth, while important, does not account for the whole story. Interestingly, these results held also in 'frugal' models which were created to investigate the collinearity between absolute economic status, relative deprivation and relative advantage.

The future avenues for research in this area are ample and varied. For example, inequality and relative deprivation could be employed to predict educational outcomes other than school enrolment like performance, days of absence, test scores, etc. The fact that relative deprivation as predictor of a wider range of social outcomes remains unexplored opens a vast number of opportunities for research in this regard. There is still room to investigate both conceptually and empirically how relative deprivation relates to other important indicators of human development like health attitudes, migration, employment, risk behaviour etc.
Other fertile branch for research on relative deprivation is the exploration of the relevant reference groups and domains to measure relative deprivation. This thesis focused on the wealth domain and on the use of geographically determined reference groups, but interdisciplinary research can offer valuable insights on what different groups of individuals use as reference and whether they attach more importance to income, wealth, or other observable and measurable indicators. A particular interest of mine is to research how individuals compare to themselves in the past and how that might have an impact on their current human development.
Finally, as mentioned in the introduction, this thesis did not attempt to pursue formal causation identification strategies in order to make firm causal claims; the empirical strategy and the econometric models adopted simply aimed to explore the way in which inequality and interpersonal comparisons were associated to human development outcomes. The next logical step is to pursue the issue of causality using appropriate individual panel datasets and the relevant econometric techniques. This thesis has outlined a number of reasons supporting the hypothesis of a causal effect of relative deprivation on several social outcomes; formalising and testing those hypotheses would be an important step forward in the literature.

In particular, with regard to this my plan is to build a research project using the National Household Standards of Living Survey (ENNVIH for its acronym in Spanish) which is a unique opportunity to investigate several social and economic topics using individual and household level panel data for the Mexican population. Currently there are three waves of the ENNVIH (2002, 2006 and 2012) which cover around 10 thousand households and contain detailed information on income, migration, fertility, health, education, remittances etc. This dataset combined with the correct econometric methods and theoretical basis undoubtedly has the potential to offer substantial contributions to the literature in economics, international development and social sciences in general.

APPENDIX **A**

Appendix

Table A.1: List of Indicators Used for Each Asset Index

		FPP					KAA				
		TAI	CAI	EAI	LAI	RAI	TAI	CAI	EAI	LAI	RAI
Categorical	Walls						x	x	x	x	x
dummy	Low quality	x	x	x	x	x					
dummy	Wooden										
dummy	Adobe										
dummy	High Quality	x	x	x	x	x					
Categorical	Roof						x	x	x	x	x
dummy	Rubbish, cardboard	x	x	x	x	x					
dummy	Metallic sheet										
dummy	Asbestos, wood										
dummy	Vault, concrete, tiles	x	x	x	x	x					
Categorical	Floor						x	x	x	x	x
dummy	Earthen	x	x	x	x	x					
dummy	Cement										
dummy	Wooden, Tiled	x	x	x	x	x					
Categorical	Water						x	x	x	x	x
dummy	Mains inside dwelling	x	x	x	x	x					
dummy	Mains outside dwelling										
dummy	Public, other dwelling, tanker	x	x	x	x	x					
Categorical	Cooking fuel						x	x	x	x	x
dummy	Gas Tank	x	x	x	x	x					
dummy	Gas Mains										
dummy	Wood										
dummy	Other	x	x	x	x	x					
Categorical	Drainage						x	x	x	x	x
dummy	Public net	x	x	x	x	x					
dummy	Septic tank										
dummy	other/no drainage	x	x	x	x	x					
Categorical	Rubbish disposal						x	x	x	x	x
dummy	Collected	x	x	x	x	x					
dummy	Burnt										
dummy	Other										
Count	Number of rooms	**(1-25)**				x					x
dummy	Cooking Room	x	x			x		x			x
dummy	Shower	x	x			x		x			x
dummy	Cistern	x	x			x		x			x

Table A.1: List of Indicators Used for Each Asset Index

		FPP					KAA				
		TAI	CAI	EAI	LAI	RAI	TAI	CAI	EAI	LAI	RAI
dummy	Air conditioning	x	x					x			
dummy	Central heating	x	x					x			
dummy	Water heater	x	x			x		x			x
dummy	House ownership	x	x					x			
dummy	Exclusive toilet	x	x			x		x			x
dummy	Landline	x	x			x		x			x
dummy (count)	Automobile	x	**(0-13)**			x		**(0-13)**			x
dummy (count)	Motorcycle	x	**(0-10)**					**(0-10)**			
dummy (count)	Bicycle	x	**(0-20)**					**(0-20)**			
dummy (count)	Radio	x	**(0-10)**					**(0-10)**			
dummy (count)	Television	x	**(0-14)**			x		**(0-14)**			x
dummy (count)	Fridge	x	**(0-10)**			x		**(0-10)**			x
dummy (count)	Stove	x	**(0-10)**			x		**(0-10)**			x
dummy (count)	Washer	x	**(0-11)**			x		**(0-11)**			x
dummy (count)	Blender	x	**(0-10)**					**(0-10)**			
dummy (count)	Fan	x	**(0-22)**					**(0-22)**			
dummy (count)	Computer	x	**(0-10)**			x		**(0-10)**			x
dummy	Internet	x	x			x		x			x
dummy (count)	DVD player	x	**(0-14)**					**(0-14)**			
dummy (count)	Microwave	x	**(0-10)**					**(0-10)**			
dummy (count)	Printer	x	**(0-10)**					**(0-10)**			
dummy (count)	Videogame console	x	**(0-7)**					**(0-7)**			
dummy	Mobile					x					x
dummy	Water tank					x					x
Categorical	Household head education								x		
dummy	No education			x							
dummy	Elementary/some secondary										
dummy	Secondary/some high school										
dummy	High school/some university										
dummy	University										
dummy	Posgrad			x							
Categorical	Dwelling size (in m2)									x	
dummy	less than 30			x							
dummy	30 to 45										
dummy	46 to 55										
dummy	56 to 75										
dummy	76 to 100										
dummy	more than 100			x							
Categorical	Total land size (in m2)									x	
dummy	less than 70			x							
dummy	70 to 90										
dummy	91 to 120										
dummy	121 to 160			x							
dummy	more than 160										

APPENDIX B

Appendix

Table B.1: Full Table 2.1

	6-12 Age range				12-15 Age range				16-18 Age range			
	(1) g1	(2) gm1	(3) gmr1	(4) gmm*r1	(5) g2	(6) gm2	(7) gmr2	(8) gmm*r2	(9) g3	(10) gm3	(11) gmr3	(12) gmm*r3
HWealth	0.394***	0.403***	0.406***	0.405***	0.210***	0.216***	0.220***	0.220***	0.185***	0.191***	0.193***	0.193***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
HHAdEdu	0.304***	0.304***	0.304***	0.300***	0.162***	0.163***	0.164***	0.160***	0.139***	0.140***	0.141***	0.138***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
(HWealth)*(HHAdEdu)	-0.029***	-0.029***	-0.030***	-0.029***	0.003***	0.003***	0.003***	0.003***	0.009***	0.009***	0.009***	0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
MunGini	5.041***	0.325	0.347	-1.287***	5.089***	1.260***	0.575*	-2.283***	6.027***	2.862***	2.204***	-1.156***
	(0.282)	(0.360)	(0.354)	(0.361)	(0.244)	(0.334)	(0.315)	(0.320)	(0.203)	(0.288)	(0.280)	(0.291)
MunMean		-0.239***	-0.303***	-0.297***		-0.189***	-0.319***	-0.352***		-0.149***	-0.231***	-0.321***
		(0.013)	(0.014)	(0.014)		(0.012)	(0.013)	(0.012)		(0.010)	(0.011)	(0.011)
MunWealth*Ratio 1				-0.177***								
				(0.013)								

Continued on next page

Table B.1 – continued from previous page

	6-12 Age range				12-15 Age range				16-18 Age range			
	(1) g1	(2) gm1	(3) gmr1	(4) gmm*r1	(5) g2	(6) gm2	(7) gmr2	(8) gmm*r2	(9) g3	(10) gm3	(11) gmr3	(12) gmm*r3
MunWealth*Ratio 2								-1.213***				
								(0.056)				
MunWealth*Ratio 3												-1.750***
												(0.075)
Ratio 1			0.208***	1.629***								
			(0.023)	(0.106)								
Ratio 2							2.034***	11.577***				
							(0.115)	(0.460)				
Ratio 3											1.779***	15.916***
											(0.121)	(0.619)
Female	0.016	0.016	0.016	0.016	0.013	0.013	0.013	0.013	0.118***	0.118***	0.118***	0.118***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.008)	(0.008)	(0.008)	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)
Oldest Child	-0.026**	-0.025**	-0.025**	-0.024**	0.330***	0.330***	0.330***	0.329***	0.604***	0.604***	0.603***	0.603***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.009)	(0.009)	(0.009)	(0.009)	(0.006)	(0.006)	(0.006)	(0.006)
Age	0.060***	0.060***	0.060***	0.060***	-0.666***	-0.666***	-0.666***	-0.666***	-0.566***	-0.565***	-0.566***	-0.565***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)
Disability	-2.209***	-2.207***	-2.207***	-2.207***	-1.215***	-1.215***	-1.214***	-1.213***	-0.527***	-0.527***	-0.527***	-0.525***
	(0.017)	(0.017)	(0.017)	(0.017)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
Indigenous	-0.001	-0.065***	-0.068***	-0.044**	0.033**	-0.009	-0.012	0.012	-0.008	-0.039***	-0.046***	-0.037***
	(0.019)	(0.019)	(0.019)	(0.019)	(0.016)	(0.016)	(0.016)	(0.016)	(0.013)	(0.013)	(0.013)	(0.013)
N of boys	-0.086***	-0.086***	-0.086***	-0.085***	-0.055***	-0.055***	-0.054***	-0.053***	-0.072***	-0.072***	-0.072***	-0.071***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
N of girls	-0.078***	-0.078***	-0.078***	-0.077***	-0.048***	-0.048***	-0.047***	-0.046***	-0.075***	-0.075***	-0.075***	-0.075***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
HH head Female	-0.324***	-0.318***	-0.320***	-0.321***	-0.251***	-0.247***	-0.250***	-0.252***	-0.143***	-0.140***	-0.142***	-0.143***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.010)	(0.010)	(0.010)	(0.010)	(0.008)	(0.008)	(0.008)	(0.008)
HH head age	0.003	0.002	0.002	0.002	0.054***	0.054***	0.054***	0.054***	0.111***	0.111***	0.111***	0.111***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
HH head age2	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

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Table B.1 – continued from previous page

	6-12 Age range				12-15 Age range				16-18 Age range			
	(1) g1	(2) gm1	(3) gmr1	(4) gmm*r1	(5) g2	(6) gm2	(7) gmr2	(8) gmm*r2	(9) g3	(10) gm3	(11) gmr3	(12) gmm*r3
Social Program	0.396***	0.389***	0.390***	0.390***	0.281***	0.276***	0.277***	0.279***	0.178***	0.172***	0.173***	0.174***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.009)	(0.009)	(0.009)	(0.009)	(0.007)	(0.007)	(0.007)	(0.007)
N Primary Supply	20.232**	-13.174	-15.165	-16.984*								
	(9.931)	(9.428)	(9.264)	(8.916)								
Primary Supply	-0.956	-2.540	-0.893	2.161								
	(1.783)	(1.685)	(1.669)	(1.630)								
Mun. Size	-0.000***	-0.000**	-0.000***	-0.000**	-0.000***	0.000	-0.000***	-0.000	-0.000**	0.000	-0.000***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Mun. Migration	0.013**	0.027***	0.047***	0.064***	-0.071***	-0.058***	-0.024***	-0.002	-0.077***	-0.071***	-0.053***	-0.034***
	(0.006)	(0.005)	(0.006)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)
N Secondary Supply					77.448***	49.254***	35.838***	26.899***				
					(10.946)	(10.569)	(9.968)	(9.262)				
Secondary Supply					15.857***	12.007***	14.523***	17.374***				
					(1.730)	(1.681)	(1.600)	(1.509)				
N High School Supply									372.748***	312.028***	294.341***	261.046***
									(31.268)	(30.388)	(29.198)	(26.559)
High School Supply									59.798***	55.004***	54.670***	57.138***
									(3.718)	(3.605)	(3.474)	(3.190)
Constant	-0.246***	1.831***	1.897***	1.723***	6.663***	8.342***	8.725***	8.957***	2.876***	4.217***	4.584***	5.335***
	(0.080)	(0.134)	(0.132)	(0.128)	(0.096)	(0.142)	(0.138)	(0.132)	(0.086)	(0.124)	(0.123)	(0.121)
Obs.	1,464,132	1,464,132	1,464,132	1,464,132	630,208	630,208	630,208	630,208	623,667	623,667	623,667	623,667
Level 2 SD	0.5072	0.4632	0.4519	0.4269	0.4911	0.4649	0.4274	0.3831	0.4276	0.4077	0.3867	0.3395
Intra-Class Corr.	0.0725	0.0612	0.0584	0.0525	0.0683	0.0616	0.0526	0.0427	0.0527	0.0481	0.0435	0.0338
AIC	440,878	440,533	440,451	440,271	499,253	499,009	498,704	498,286	705,103	704,892	704,685	704,201
BIC	441,134	440,802	440,731	440,563	499,492	499,258	498,965	498,559	705,341	705,141	704,945	704,473
LL	-220,418	-220,245	-220,202	-220,111	-249,606	-249,482	-249,329	-249,119	-352,530	-352,424	-352,319	-352,076

Note: Standard errors in parentheses. *, ** and *** denote statistical significance at $p < 0.1$, $p < 0.05$ and $p < 0.01$ levels, respectively.

In the name of the models "g" stands for "Municipal Gini", "m" for "Municial Mean Asset Index", "r" for the "Municipal Educational Ratios" and "1", "2" or "3" the educational level age estimated.

Table B.2: Full Table 2.2

	6-12 Age range			12-15 Age range			16-18 Age range		
	(13) g*mm*r1	(14)g*rm*r1	(15)g*m*r1	(16) g*mm*r2	(17)g*rm*r2	(18)g*m*r2	(19) g*mm*r3	(20)g*rm*r3	(21)g*m*r3
HHWealth	0.405***	0.406***	0.405***	0.220***	0.219***	0.219***	0.193***	0.193***	0.193***
	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
HHAdEd	0.300***	0.300***	0.300***	0.160***	0.160***	0.160***	0.139***	0.138***	0.138***
	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
HHWealth*HHAdEdu	-0.029***	-0.029***	-0.029***	0.003***	0.003***	0.003***	0.009***	0.009***	0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
MunGini	-1.931**	-1.894***	-5.913***	-2.308***	-1.652***	-2.573***	-0.275	-0.128	-1.182
	(0.933)	(0.567)	(1.162)	(0.783)	(0.451)	(0.950)	(0.673)	(0.333)	(0.732)
MunWealth	-0.321***	-0.315***	-0.365***	-0.353***	-0.335***	-0.360***	-0.292***	-0.299***	-0.315***
	(0.034)	(0.019)	(0.035)	(0.028)	(0.015)	(0.028)	(0.023)	(0.011)	(0.023)
Ratio 1	1.596***	1.322***	-0.015						
	(0.113)	(0.244)	(0.345)						
Ratio 2				11.569***	13.825***	13.108***			
				(0.500)	(1.227)	(1.778)			
Ratio 3							16.282***	25.755***	21.618***
							(0.668)	(1.716)	(2.295)
MunGini*MunWealth	0.133		0.325*	0.005		0.161	-0.185		0.082
	(0.177)		(0.196)	(0.150)		(0.166)	(0.128)		(0.133)
MunGini*Ratio 1		0.868	9.404***						
		(0.626)	(1.685)						
MunGini*Ratio 2					-6.073**	-1.815			
					(3.074)	(8.011)			
MunGini*Ratio 3								-24.343***	0.530
								(3.962)	(9.960)
MunWealth*Ratio 1	-0.172***	-0.148***	0.011						
	(0.014)	(0.024)	(0.038)						
MunWealth*Ratio 2				-1.212***	-1.420***	-1.323***			
				(0.063)	(0.119)	(0.190)			
MunWealth*Ratio 3							-1.799***	-2.675***	-2.187***

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Table B.2 – continued from previous page

	6-12 Age range			12-15 Age range			16-18 Age range		
	(13) g*mm*r1	(14)g*rm*r1	(15)g*m*r1	(16) g*mm*r2	(17)g*rm*r2	(18)g*m*r2	(19) g*mm*r3	(20)g*rm*r3	(21)g*m*r3
							(0.082)	(0.168)	(0.244)
MunGini*MunWealth*Ratio 1			-1.057***						
			(0.190)						
MunGini*MunWealth*Ratio 2						-0.629			
						(0.868)			
MunGini*MunWealth*Ratio 3									-2.997***
									(1.073)
Female	0.016	0.016	0.016	0.013	0.013	0.013	0.118***	0.118***	0.118***
	(0.010)	(0.010)	(0.010)	(0.008)	(0.008)	(0.008)	(0.007)	(0.007)	(0.007)
Oldest Child	-0.024**	-0.024**	-0.025**	0.329***	0.329***	0.330***	0.603***	0.602***	0.602***
	(0.012)	(0.012)	(0.012)	(0.009)	(0.009)	(0.009)	(0.006)	(0.006)	(0.006)
Age	0.060***	0.060***	0.060***	-0.666***	-0.666***	-0.666***	-0.565***	-0.565***	-0.565***
	(0.002)	(0.002)	(0.002)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)
Disability	-2.206***	-2.206***	-2.206***	-1.213***	-1.213***	-1.213***	-0.525***	-0.525***	-0.525***
	(0.017)	(0.017)	(0.017)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
Indigenous	-0.043**	-0.045**	-0.044**	0.012	0.013	0.014	-0.039***	-0.033**	-0.034**
	(0.019)	(0.019)	(0.019)	(0.016)	(0.016)	(0.016)	(0.013)	(0.013)	(0.013)
N of boys	-0.085***	-0.085***	-0.085***	-0.053***	-0.053***	-0.053***	-0.071***	-0.071***	-0.071***
	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
N of girls	-0.077***	-0.077***	-0.077***	-0.046***	-0.046***	-0.046***	-0.075***	-0.075***	-0.075***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
HH head Female	-0.321***	-0.321***	-0.321***	-0.252***	-0.252***	-0.252***	-0.143***	-0.143***	-0.143***
	(0.013)	(0.013)	(0.013)	(0.010)	(0.010)	(0.010)	(0.008)	(0.008)	(0.008)
HH head age	0.002	0.002	0.002	0.054***	0.054***	0.054***	0.111***	0.111***	0.111***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
HH head age2	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Social Program	0.391***	0.391***	0.390***	0.279***	0.279***	0.280***	0.174***	0.175***	0.175***
	(0.011)	(0.011)	(0.011)	(0.009)	(0.009)	(0.009)	(0.007)	(0.007)	(0.007)
N Primary Supply	-17.022*	-17.766**	-18.502**						

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Table B.2 – continued from previous page

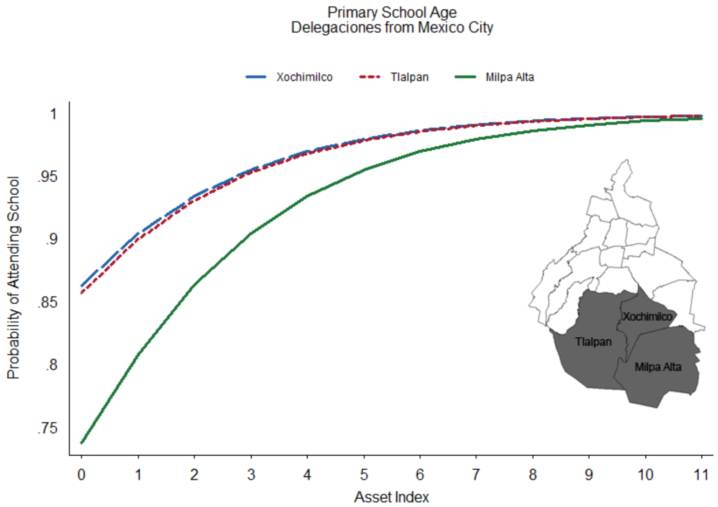
	6-12 Age range			12-15 Age range			16-18 Age range		
	(13) g*mm*r1	(14)g*rm*r1	(15)g*m*r1	(16) g*mm*r2	(17)g*rm*r2	(18)g*m*r2	(19) g*mm*r3	(20)g*rm*r3	(21)g*m*r3
	(8.834)	(8.845)	(8.797)						
Primary Supply	2.252	2.441	2.080						
	(1.623)	(1.630)	(1.624)						
Mun. Size	-0.000**	-0.000**	-0.000**	-0.000	-0.000	-0.000	-0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Mun. Migration	0.063***	0.064***	0.062***	-0.002	-0.001	-0.002	-0.033***	-0.032***	-0.033***
	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)
N Secondary Supply				26.896***	27.217***	27.511***			
				(9.235)	(9.234)	(9.235)			
Secondary Supply				17.371***	17.236***	17.144***			
				(1.505)	(1.505)	(1.508)			
N High School Supply							261.838***	259.212***	259.476***
							(26.545)	(26.350)	(26.322)
High School Supply							57.009***	57.420***	57.091***
							(3.189)	(3.168)	(3.168)
Constant	1.848***	1.921***	2.592***	8.962***	8.754***	8.910***	5.180***	5.010***	5.209***
	(0.210)	(0.192)	(0.254)	(0.187)	(0.167)	(0.219)	(0.161)	(0.131)	(0.172)
Obs.	1,464,132	1,464,132	1,464,132	630,208	630,208	630,208	623,667	623,667	623,667
Level 2 SD	0.4259	0.4256	0.4219	0.3829	0.3823	0.3822	0.3392	0.3357	0.3351
Intra-Class Corr.	0.0523	0.0522	0.0513	0.0427	0.0425	0.0425	0.0338	0.0331	0.0330
AIC	440,272	440,271	440,244	498,288	498,285	498,287	704,201	704,165	704,161
BIC	440,577	440,576	440,574	498,572	498,568	498,594	704,484	704,449	704,468
LL	-220,111	-220,110	-220,095	-249,119	-249,117	-249,117	-352,075	-352,058	-352,054

Note: Standard errors in parentheses. *, ** and *** denote statistical significance at $p < 0.1$, $p < 0.05$ and $p < 0.01$ levels, respectively.

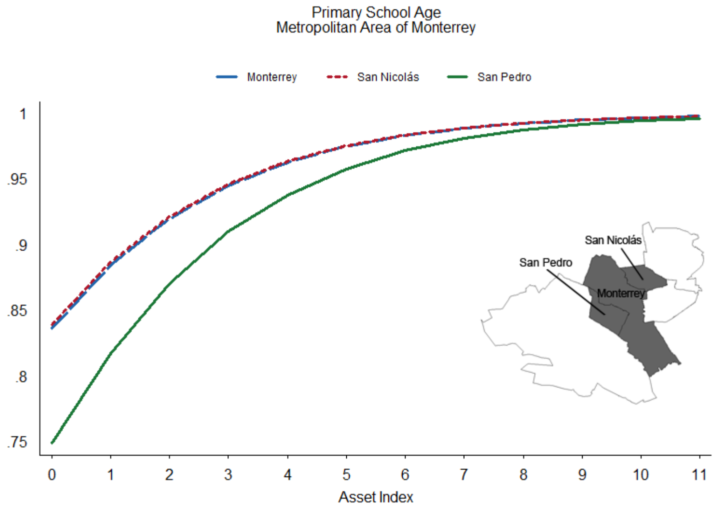
In the name of the models "g" stands for "Municipal Gini", "m" for "Municial Mean Asset Index", "r" for the "Municipal Educational Ratios" and "1", "2" or "3" the educational level age estimated. Finally, an asterisk signifies an interaction between variables.

Figure B.1: Municipal Random Effects

(a) Mexico City



(b) Metropolitan Area of Monterrey



Source: Authors' elaboration from census data (INEGI, 2010).
Original in colour.

APPENDIX C

Appendix

Table C.1: Determinants of Depressive Symptoms

Author(s)	Journal	Dependent Variable	Where	Main Results
(Das et al. 2007)	Social Science and Medicine	Average of Mental Disorder Scale	Bosnia, India, Indonesia,Mexico and Tonga	For Mexico:Female (+), Age (+), Poor with lower mental disorder index
Elgar et al. 2013)	International Journal of Clinical Psychiatry and Mental Health	Several Scores from different questions. Interested in the one they call "Internalising Problems"	Canada, about 6,000 youngsters.	Female (+), "Absolute Affluence" (A type of Asset index) (-), Relative Deprivation (Yitzhaki) (+) (and also found it reduces "Emotional Well being", and "Life Satisfaction")
(Chiavegatto Filho et al. 2013)	Journal of Epidemiology and Community Health	Depression/Anxiety	Sao Paulo, Brasil, around 3,500 adults	Odd Ratios of Having Depression or Anxiety,Female (+) (+),Age (-) (+ / -),Income (-) (+ / -),Gini (+) (+)

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Table C.1 – continued from previous page

Author(s)	Journal	Dependent Variable	Where	Main Results
(Fone et al. 2013)	The British Journal of Psychiatry	Mental Health Index (5 questions)	Wales, around 88,000 adults	Inequality (+, i.e. Improved Mental health)They define Neighbourhood Deprivation as the % of people with lower income than a certain cut off. The main result is: “Mental health was better for people living in neighbourhoods categorised as high inequality and low deprivation“.
(Gianaros et al. 2007)	Social Cognitive and Affective Neuroscience	Slightly different: increment in the Grey Matter of the “perigenual area of the anterior cingulate cortex (pACC)” which is involved in experiencing emotions and regulating behavioural and physiological reactivity to psychosocial stress.	100 individuals (USA)	Main result: “Individuals who reported holding a low social standing [. . .] showed a reduced grey matter volume in the pACC (a paralimbic region implicated in adaptive emotional, behavioural and physiological responding to environmental and psychosocial stressors). This held after controlling for several demographics. No differences in the hippocampus or the amygdala (memory and emotions-fear processing) Interestingly, SES was insignificant.

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Table C.1 – continued from previous page

Author(s)	Journal	Dependent Variable	Where	Main Results
(Hackman et al. 2010)	Nature Reviews. Neuroscience	This article is a great review of 1) the associations that have been found between "Socio Economic Status" (SES) and different mental disorders or neuroscience research and 2) the possible mechanisms of the impact of SES on the brain.		
(Hiilamo 2014)	PLOS One	Anti-depressant	Municipal Level Data (Finland)	Using Gini and % of people bellow a poverty line they test the "stress theory" against the "materialist Theory" Gini Coefficient only significant for Elderly Females and just barely for Elderly Males. But the signs are NEGATIVE (just like we had found at individual level). Meaning more inequality reduces % of people taking antidepressant at municipal level. % of people bellow a poverty line is always significant and positive.
(Jackson & Goodman 2011)	Race and Social Problems	Log of CES-D Scale	"Young, bi-racial", around 1,300 (USA)	Female (+) SES (+) The effect on Race disappears as soon as you included SES in the specification. The claim that their novelty is adding interaction with gender, race and SES, but apparently none of their interactions are significant and they do not report them!

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Table C.1 – continued from previous page

Author(s)	Journal	Dependent Variable	Where	Main Results
(Kearns et al. 2013)	Journal of Epidemiology and Community Health	Warwick-Edinburgh Mental Well-Being Scale (14 to 70 where + means + well-being)	Deprived Areas in Glasgow. Around 4,600 individuals.	Higher Mental Well Being was related to people who thought they lived in an area where some people had much higher income than others! (High perceived inequality?) "Positive OWN relative position" was associated with a higher mental well-being. They conclude that "upward social comparisons may be beneficial to those in deprived areas".
(Lund et al. 2010)	Social Science and Medicine	Systematic Review on Poverty and Common Mental Disorders (CMD).	313 papers in Low and Middle Income Countries (between 1990 and 2008)	79% of the community based papers presented a +poverty +CMD relationship. Especially when the poverty variable related to education, food insecurity, SES, social class, etc.
(McLaughlin et al. 2012)	American Journal of Public Health	Last 12 month Mood Disorders, Anxiety Disorders, Disruptive Behaviour Disorders and Substance Disorders in Adolescents (13-18).	USA with a sample size of around 6,500	Relative Deprivation (normalized distance to the mean) was associated only with an increase in "Mood Disorders". Neither family income nor Parent's education was significant. Inequality was never significant (Gini) and the Subjective Social Status (where you are in a society ladder) was always significant and negatively associated to the dependent variables.

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Table C.1 – continued from previous page

Author(s)	Journal	Dependent Variable	Where	Main Results
(Rai et al. 2013)	The British Journal of Psychiatry	WHO World Mental Health Survey version of the Composite International Diagnostic Interview labelled as Depression. They constructed a dummy variable.	53 countries, 187,496 individuals.	The variance in depression explained by the country level variables was higher for poorer countries. No significance with Income Inequality (Gini) or Country-Level Income Female (+) (stronger for richer countries) Divorced (+) Widowed (+) Asset Index (-) Spending (+) No evidence in their country-level*individual level interactions.
(Reiss 2013)	Social Science and Medicine	Systematic Review on the relationship between measures of SES and Mental Health outcomes for Children and Adolescents.	55 included studies between 1990 and 2011	52 studies presented an inverse relationship between SES and Mental Health Outcomes. No robust evidence in gender.
(Uddin et al. 2013)	Depression and Anxiety	Review		The main argument is that DNA methylation changes occur in response to environmental stress, with some of these occurring in a sex-specific manner.
(Halbreich & Lumley 1993)	Journal of Affective Disorders	Depression Symptoms	99 subjects	
(Garvey & Schaffer 1994)	Journal of Affective Disorders	Symptoms of Depression	177	Age was associated to 14 out of the 39 symptoms of depression (not incredibly useful).

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Table C.1 – continued from previous page

Author(s)	Journal	Dependent Variable	Where	Main Results
(Eibner et al. 2004)	The Journal of Mental Health Policy and Economics	Any probable mental health disorders.Probable major depressive disorders.Probable anxiety disorder.	Around 29,228 in Texas and New York	Yitzhaki is always positive when Yitzhaki is calculated using "Age", "Age+Gender", "Age+Gender+Marital Status" all of these + geographical variable as reference groups.
(Gove & Tudor 1973)	American Journal of Sociology	Functional Psychoses	Great bullet points of why we might expect higher rates of mental illness for women.	Women are restricted to a single societal role (marriage and child bearing). Their main instrumental activities are frustrating because they do not involve a "great deal of skill. Their role is relatively unstructured and invisible which does help when they need to switch off from their worries. If she works, she is in a typically less satisfactory position than the male. They see themselves as "complementing" the family income. They are discriminated in the job market. Plus, they still do the household chores. Expectations confronting women are "unclear and diffuse" if not contradictory. They had a more important role before the industrial society.
(Mendelson et al. 2008)	Social Science and Medicine	Internalising symptoms scale (depression, anxiety)	Around 6000 x 2 waves in Chicago.	No significance in any of their interactions with gender.

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Table C.1 – continued from previous page

Author(s)	Journal	Dependent Variable	Where	Main Results
(Mirowsky & Ross 1992)	Journal of Health and Social Behaviour	CES-D with seven items. Mean Response of the 7 items.	Two telephone surveys 2,031 respondents. USA (1990) 809 respondents. Illinois, USA (1985)	This is an article interested in the relationship between age and depression. They Explain this relationship in terms of 5 hypothesis: Maturity Decline Life Cycle Survival Historical Trend "Depression reaches its lowest levels at about 45" Basically they find a U shaped curve. Their measure of age are ln(Age-17) and (Age-18)3, it kind of seems to be they are imposing what they want to find? Not sure, could read more deeply if needed.
(Mirowsky & Ross 2001)	Journal of Health and Social Behaviour	CES-D with seven items. Mean Response of the 7 items	Around 2,600 households in USA	They interact a variable of "Economic Hardship with age". They find that being older in times of economic hardship is associated with LOWER DS. Interestingly, household income is not significant. According to the authors this support the "Experience Surviving Hypothesis" that states that older people can deal better with economic hardship.

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Table C.1 – continued from previous page

Author(s)	Journal	Dependent Variable	Where	Main Results
(Ross & Mirowsky 2006)	Social Science and Medicine	CES-D with seven items. Mean Response of the 7 items.	Telephone survey, three waves 2,592 respondents. USA (1995, 1998 and 2001)	This is an article interested in the relationship between gender and education on depression. They explain this relationship in terms of 2 hypothesis Resource Substitution Resource Multiplication Education: Constructed categories from total years of education. OLS MODELS: Female (+)Education (-) Female*Education (-) Married (-) Earnings (NS) Dummy Low Income (NS) Age (-) “Depression’s negative slope with respect to education is steeper for women than for men.” They believe the mediators behind this results are:Work Creativity (Dummy)Sense of Control (Dummy)

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Table C.1 – continued from previous page

Author(s)	Journal	Dependent Variable	Where	Main Results
(Layte & Bertrand 2009)	ECONSTOR Working Paper	WHO-5 Measure of mental Well-Being rescale to be 0-100		They are going to test whether the effect of 'Income Inequality' is mediated by 'Own individual's assessment of her position in society' by using the question "Some people look me down because of my job situation or income" Multi-Levels models. Results regarding social comparisons: "Greater disagreement that 'others look down on me because of my job or income' leads to a very significant increase in mental well-being compared to agreement with this statement."

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