THE MIDDLE SEGMENT OF THE SOCIETY AND SOCIOECONOMIC POLARIZATION: A MULTIDIMENSIONAL APPROACH APPLIED TO COLOMBIA

by

Mauricio Quiñones Domínguez

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Approved by:

_____
Dr. Roslyn Arlin Mickelson

_____
Dr. Jennifer Troyer

_____
Dr. Stephanie Moller

_____
Dr. Rob McGregor

_____
Dr. José Antonio Ocampo

ABSTRACT

MAURICIO QUIÑONES DOMÍNGUEZ. The Middle Segment of the Society and Socioeconomic Polarization: A Multidimensional Approach Applied to Colombia. (Under the direction of DR. ROSLYN ARLIN MICKELSON)

The purpose of this dissertation is to demonstrate the relevance for Colombia of analyzing the middle segment of the society – as the core concept – and socioeconomic polarization due to its linkage with the middle segment of the society, with a multidimensional framework for public policy purposes. Theoretically, I use Sen's multidimensional approach on capabilities and functionings, which has been applied for studying poor populations but not the middle segment of the society. I propose the multidimensional middle class (MMC) to empirically address the middle segment of the society with the relevant dimensions, rather than the middle income population (MIP) or the middle class (MC) as is currently done. Similarly, I propose an index of multidimensional polarization (IMP), rather than income polarization currently in use. The research questions that lead the dissertation are: i. What is the size – in percentage – of the Colombian MMC? Thus, is the MMC expanding or shrinking during the analysis period? ii. What is the trend of the Colombian IMP? iii. How does the size of the MMC fluctuate, compared to the IMP trend during the analysis period? Do trends suggest a linkage between both concepts after their multidimensional framed operationalization?. I implemented two methodologies to calculate the MMC and the IMP. To calculate the MMC, I implemented the Alkire-Foster (AF) methodology, and to calculate the IMP, I implemented the Gigliariano-Mosler (GM) methodology. I propose a novel application of these multidimensional methodologies with data available for years 2003, 2008, 2010,

2011, 2013, 2014 and 2015, based on the Colombian Living Standards Measurement Surveys (C-LSMS). The main findings are: i) the size of the MMC has a minimum value of 24.3% in 2003 and a maximum value of 36.5% in 2003. Therefore, excluding the year 2008, the MMC has an upward trend. ii) The IMP does not show a linear trend with income groups or with socio-occupational groups. The IMP with income groups increases from 2003 to 2008, then shows a decreasing trend. The IMP with socio-occupational groups increases from 2003 to 2008 as well; however, its trend from 2008 to 2015 is slightly upward but relatively stable. iii) The MMC and the IMP do not have a perfect inverse relationship; however, an increase in the MMC results in a reduction in the IMP, thus, the MMC and the IMP show time trends with similar patterns of unidimensional analysis. Therefore, I present the inverse relationship between the MMC and the IMP as an empirical regularity that supports the conclusion that societies with large middle segments have lower levels of polarization.

DEDICATION

To my daughter Salomé and my son Arturo, for their smiles, many laughs, and all the new experiences they have brought to our lives.

To my wife Sonia, for her love and strength.

To my mother Dora Alicia, my father Arnulfo, and my sisters Carolina and Catalina, for their unconditional support always.

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1. CHAPTER 1: INTRODUCTION

The purpose of this dissertation is to demonstrate the relevance for Colombia of analyzing the middle segment of the society – as the core concept – and socioeconomic polarization due to its linkage with the middle segment of the society, with a multidimensional framework for public policy purposes. Theoretically, I use Sen's multidimensional approach on capabilities and functionings, which has been applied for studying poor populations but not the middle segment of the society. I propose the multidimensional middle class (MMC) to empirically address the middle segment of the society with the relevant dimensions, rather than the middle income population (MIP) or the middle class (MC) as is currently done. Similarly, I propose an index of multidimensional polarization (IMP), rather than income polarization currently in use. I propose using multidimensional indices in order to perform more comprehensive estimations of both concepts.

Conceptually and empirically, the middle segment of the society often is referred just as the middle class, and the MIP and the MC are used interchangeably. Thus, the literature on the middle class, regardless of its measure, describes positive features of societies with a large middle class not only in the economic sphere but also in social and political spheres (Easterly (2001), Solimano (2008), Acemoglu, Naidu, Restrepo, and Robinson (2015), Birdsall (2012), Pressman (2016), Bergh (2004)). Even the classical political philosophy of ancient Greece describes societies desirable attributes of the middle class, as the following quotation represents.

> It is possible for those states to be well governed that are of the kind in which the middle-class is numerous, and preferably stronger than both the other two classes, or at all events than one of them, for by throwing in its weight it sways the balance and prevents the opposite extremes from coming into existence . . . Surely the ideal of the state is to consist as much as possible of persons that are equal and alike, and this similarity is most found in the middle-classes. Aristotle [c 350 BC], 1997.

Recently, Colombian economic development and public policies are linked to the claim that "… seven out of ten Colombians are now in that population [the middle class] segment,[1]…" (Press Office of The Presidency of Colombia (PRC, 2016)). In addition, the Colombian government reports that the middle class is composed of "…39% of Colombians [who] are in the *emerging* or *vulnerable* middle class, and 30.5% [who] are in the *consolidated* middle class" (DNP, 2016a).

Despite the undeniable reduction in both poverty headcount and income inequality in Colombia for the last decade (DNP, 2015; ECLAC, 2016), I hypothesize that the Colombian government's public statement on the substantial increase of the size in the middle class might not be compatible, in economic terms, with Colombia's level of inequality measured by Gini coefficient, which is still high in international context[2] (Montenegro & Meléndez Arjona, 2014).

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[1] This conclusion was widely disseminated through the main newspapers in Colombia such as El Tiempo (2016), El Espectador (2016) and Semana (2016).

[2] Colombia ranks 11th among 154 countries in 2013 (World Bank, 2016). In addition, "Colombia … is one of the most inegalitarian societies in the WTID [the World Wealth and Income Database]". (Piketty and Goldhammer (2014), p. 327.) There is also a criticism to the Colombian government methodology to calculate Gini coefficient. Colombian government indicated that the Gini coefficient was 0.522 in 2015 – it was 0.538 in 2014 – (DANE, 2016). Nonetheless, the Economic Commission for Latin America and the

In order to be accurate when I refer to the middle class size in Colombia because the relevance of the topic from the public policy standpoint, I requested from the Colombian National Planning Department[3] (NPD) the study that supports the government's conclusion. The official answer provided states:

> … estimations to [calculate] the consolidate middle-class are based on the World Bank technical document `A vulnerability approach to the definition of the middle-class' from López-Calva and Ortiz-Juarez (2013)…
>
> …Estimations for Colombia are preliminary…, [currently] a validation exercise performed jointly by [the Colombian National Planning Department] DNP and [the Colombian National Statistics Department] DANE[4] will ratify or adjust the thresholds [to calculate classes] calculated by the authors for Colombia. DNP , 2016b. See original response in Spanish in Appendix 1. Author's underlining, not in the original letter. Author's free translation.

My interpretation of this answer in light of the dissertation's general objective leads me to several interpretations. First, methodologies to calculate the middle class are still part of the academic debate and have recently influenced the Colombian government to take the firsts steps to include them as official monitoring indices. This situation leaves

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Caribbean (ECLAC) reports that for 2015 the Gini coefficient was actually 0.55 because ECLAC includes tax information for high income population and Colombian government does not (ECLAC, 2016).

[3] The Colombian National Planning Department (NPD) is a technical entity that promotes the implementation of the strategic vision of the country in the social, economic and environmental sectors through the design; the orientation and evaluation of public policies in Colombia; the management and allocation of public investments; and the realization of plans, programs and government projects. Departamento Nacional de Planeación – DNP in Spanish.

[4] The Colombian National Statistics Department (NSD) is the governmental bureau responsible for the planning, collection, processing, analysis, and dissemination of Colombia's official statistics. Departamento Administrativo Nacional de Estadística – DANE in Spanish.

room for exploring and proposing methodologies to calculate the size of the middle class that are both relevant for policy purposes and feasible for empirical measurement.

Secondly, calculation of the middle-class size, unlike estimating poverty, is not a policy objective for current or previous governments. Therefore, an official or standardized methodology does not exist for calculating it, as it does for calculating poverty. In fact, in Latin America governments do not include measuring the middle class as an explicit goal in policy plans (Ferreira et al., 2012). I hypothesize that this happens because reducing or expanding the middle class is interpreted as the logical consequence of the explicit policy goal of focusing just on overcoming poverty. I argue that the fundamental reason to follow this argument relies on the unidimensional analysis and the nature of its measurement variable, which is income. The Colombian government has explicitly set the reduction of poverty as a policy goal. Because income is treated as a continuum, the most likely logical consequence – and government expected outcome – of income poverty reduction is greater upward mobility, therefore, an expansion of the middle-class.

In addition, although polarization is still only part of the academic research, reducing polarization is a desirable, yet unintended, consequence of expanding the middle class if both concepts are measured by income. Hence, a more general logical argument is that a country with low (income) poverty rate and relative high upward mobility will experience both an expansion of the middle class and a reduction of (income) polarization. In this way, the middle class and income polarization are inversely related because moving the middle class in one direction results in moving income polarization in the opposite direction.

Thirdly, it seems too early to conclude a remarkable growth in the size of the middle class without having an official measure because a) several definitions exist to calculate the middle class (discussed in literature on middle income population, section 2.3.1) that might lead to a less encouraging conclusion, and b) deriving implications from *preliminary* results might weaken credibility and reliability of policies, as well as implications of the middle class expansion, such as reducing polarization.

Assuming it is accurate to estimate that "seven out of ten Colombians" are part of the middle class, I can argue this proportion would be comparable, for instance, with Atkinson's and Brandolini's[5] (2013) calculations for "…Nordic countries (around 70 percent) [and above] Germany (64 percent), Italy (58 percent), and the United States (54 percent)" (Atkinson and Brandolini (2013), p. 10). This size of the Colombian middle class would have represented a remarkable improvement in a relatively short time, compared to the middle class in industrialized countries.

A middle-class size of 30.5% – I take this value from the aforementioned *consolidated* middle class – seems to reflect a more realistic assessment of the country's current economic and social conditions. This size of the middle class is closer, for instance, to Birdsall's (2012) calculation that 25.76% of the Colombian population in 2006 middle class, or Stampini's et al. (2015) calculation that 27.2% of Colombians in 2013 were in the middle class and 36.7% were in the *vulnerable* middle class.

All of these are unidimensional income-based estimations. Nonetheless, a stream of literature concludes a class comprehensive conceptualization demands utilizing a multidimensional framework. For this dissertation, I adopt the multidimensional

[5] Atkinson and Brandolini (2013) use as income cutoffs 75 and 200 percent of the median value of the income distribution.

framework to calculate the size of the middle class and polarization. Therefore, I will explore the implications of this change for both concepts and their linkage. I will propose a novel application of multidimensional methodologies to calculate the size of the middle class and level of polarization in Colombia with data available for years 2003, 2008, 2010, 2011, 2013, 2014 and 2015, based on the Colombian Living Standards Measurement Surveys (C-LSMS).

The research questions that lead the dissertation are: i. What is the size – in percentage – of the Colombian middle class if the concept of the middle class is operationalized by a multidimensional perspective? Thus, is the middle class expanding or shrinking in the analysis period? ii. What is the trend of the Colombian index of polarization, if the polarization concept is operationalized by a multidimensional perspective? iii. How does the size of the middle class fluctuate, compared to the polarization trend in the analysis period? Do trends suggest a linkage between both concepts after their multidimensional framed operationalization?

Consequently, taking into account Colombia's societal and economic context, I propose to investigate the following hypotheses that are derived from the research questions:

1. Hypothesis 1: The size of the multidimensional middle class (MMC) in Colombia has decreased during the period of analysis.
2. Hypothesis 2: The index of multidimensional polarization (IMP) in Colombia has increased during the period of analysis.
3. Hypothesis 3: If hypotheses 1 and 2 are corroborated and ratified, trends of the MMC and IMP will suggest that the inverse relationship between

> the size of the middle class and polarization is still an empirical regularity, even under a multidimensional framework.

Some studies acknowledge that reaching a large middle-class in Latin American countries means facing simultaneous challenges, such as structural inequality and weak political systems (Ferreira et al., 2012; Gasparini & Lustig, 2011; Rodrik, 2001). Other challenges are Colombia's historical internal conflict and its link with rural land distribution (Ocampo, 2005), which display the difficulties of governmental institutions to implement re-distributive policies country wide.

In line with the argument of structural challenges, signals of deceleration of inequality reduction, in some cases stagnation, have been observed in Latin American countries in the 2010s (Gasparini, Cruces, & Tornarolli, 2016), after a noticeable decline of inequality in Latin America starting the 2000s, measured by a decreasing trend of Gini coefficient (Gasparini & Lustig, 2011). Gasparini et al. (2016) discuss if the decline in inequality was a consequence of temporally factors and these more recent signals can be interpreted as the persistent structural weaknesses of countries in the region to implement policies to reduce inequality in the long run.

Globalization and the role of multilateral institutions add more challenges to developing countries to equilibrate their internal dynamics and external conditions. For instance, Stiglitz (2002) describes the relevant role of the middle class in economic activity and also in political participation, and how the latter has been undermined in developing countries because the compliance of foreign policies that do not take into account countries' context. The following quotation exemplifies this point.

> The [International Monetary Fund] IMF underestimates the risks to the poor of its development strategies, it also underestimates the long-term social and political costs of policies that devastated the middle-class, enriching a few at the top, and overestimated the benefits of its market fundamentalist policies. The middle-classes have traditionally been the group that has pushed for the rule of law, that has pushed for universal public education, that has pushed for the creation of social safety net. These are essential elements of a healthy economy and the erosion of the middle-class has led to a concomitant erosion of support for these important reforms. Stiglitz, 2002, (p. 84).

In chapter two, I profile Colombia, describing its characteristics in historical context and internationally. Chapter two includes the literature review of the middle segment of society and its theoretical linkage with Sen's framework, the middle income population (MIP), the middle-class (MC), the selected relevant dimensions of this population, and polarization. In chapter three, I present in detail the two methodologies implemented to calculate the multidimensional middle class (MMC) and the index of multidimensional polarization (IMP), as well as the dimensions and indicators used to operationalize them. To calculate the MMC, I implemented the Alkire-Foster (AF) methodology, and to calculate the IMP, I implemented the Gigliariano-Mosler (GM) methodology. In this chapter, I also present main features of the data I used to empirically test my hypotheses.

In chapter four, I analyze both the MMC and the IMP. For the MMC, I present related indices to enhance the analysis, as well as decompositions by urban and rural

areas and household heads' life cycle. I also analyze the contribution of each dimension to the formation of the MMC. As a reference point, I present calculations of several definitions of the MIP and the MC and I contrast their trends. For the IMP, I present calculations for income groups and socio-occupational groups. In addition, I present the IMP decomposition by between- and within- component for both types of groups. All these calculations are for a specific set of parameters implemented with the generalized entropy measures (GEM). As a reference point, I present calculations of several income polarization indices and I describe their trends. In the final chapter, I discuss empirical results synthetizing the main findings and conclusions, as well as their policy application.

2. CHAPTER 2: COLOMBIA'S PROFILE AND LITERATURE REVIEW

2.1. Country Profile

2.1.1. Brief Economic History of Colombia

The following presentation of different stages of the economic history of Colombia aims to contextualize recent indices on the topics of inequality and polarization. I summarize Colombia's historical development since the European colonization by Spain in the 15th century until the major changes in the 20th century and early 21st century. To achieve this goal, I follow Ocampo, Avella, Bejarano, et al. (2007) classification of economic history periods as follows: colonial economy (1500-1740); economy of the *Virreinato* (1740-1810); disruption with the colonial past (1810-1850); the difficulties of a new model (1850-1899); the big push of the coffee sector (1900-1928); the world crisis and structural change (1929-1945); transition to modern capitalism (1945-1986); and substantial economic transformations (1986 to 2005). Next, I briefly describe characteristics until 1900 and analyze more details for the subsequent periods.

Colonial economy (1500-1740). The economic characteristics of this period do not allow classifying the recently discovered territory as feudal, neither pro-slavery nor even pre-capitalist (Colmenares, 2007). Instead, a combination of different institutional forms existed then. *La encomienda* was the first type of institution that involves a political-economic relationship between spanish conquerors and the indigenous population, which according to Kalmanovitz and Lopez's (2010a) estimations numbered an indigenous population of 6,000,000 of people in 1500 and 4,000,000 in 1550. Indigenous population was associated with several ethnic groups including *muiscas*,

taironas and *chibchas*.. In *La encomienda,* Spain conquerors exploited the indigenous population. The relationship also implied evangelization of indigenous people as a requirement. Spain's attempt to replicate the urban structure in the new territory created the first political conflict between *encomenderos – encomienda's* administrator – and the political representatives of the king of Spain. This conflict reflected the tension between *encomenderos,* who had political power through economic activity and the Spain king's representative, who exercised political power over new territories and hoped to keep economic privileges in the long run. In addition to this tension the substantial reduction of indigenous population due to economic exploitation, resulting in another conflict. This new conflict reflected the tension among *encomenderos* because the need to re-distribute indigenous population and to re-populate territories. The conflict also exacerbated tension within Spain because regardless of the reduction of indigenous population – its main productive resource – Spain demanded the same payment because it did not recognize the loss of economic activity.

Because this economic model started to show failures to satisfy conquers's demands, mining of gold and silver became the leading activity in the next centuries. This increased activity also was impacted by European demand for these metals. In turn, this new activity caused the need for a labor force with other physical features. The new labor force was brought from the close coasts of Africa through Portuguese traders and the people became slaves in the new territory. Then, *La Hacienda* became the relevant economic unit for the period. *La Hacienda* was an extensive land area, coercion occurred over slaves and very low capital existed, all of which made productivity dependent on labor. *La Hacienda*'s relevance as economic unit weakened because competition for the

reduced labor force and the low-level mining technology reduced productivity. In addition, these factors created tension between land renters within *La Hacienda* and the new owners of small lands. Both renters and new owners had enough autonomy to negotiate new economic agreements more beneficial for them.

Economy of the Virreinato (1740-1810). Between 1740-1810 the new territory economic activity was based on mining (Jaramillo, 2007). Until 1780, exports were 100% gold, then was 90% gold and 10% agricultural products. Internally, mining regions (known as mining districts) developed other sectors linked to the provision of goods for people who worked in mines (e.g. agricultural products and cattle, where agricultural development was linked to each region's natural advantages). Thus, economic cycle components, such as growth and recessions, were linked to the gold economic cycle (i.e. between 1620 and 1640, the lowest point of gold production). Historians presented the country's social stratification strongly influenced by ethnicity. According to 1778 Census, the population was: white people 203,510 (25.6%), indigenous people 157,944 (19.9%), free people 368,589 (46.3) and slaves 65,229 (8.2%) (Kalmanovitz & López, 2010a). Free people were ethnic mixture of white and indigenous, and indigenous and slaves (Colombia abolished slavery in 1821). Free people would become the majority of the population in the following periods.

Disruption with the colonial past (1810-1850). After the independence of Colombia (1810), the country started the *Republic* stage of its history and a presidential political structure was established (Tovar Pinzón, 2007). The period between 1810 and 1850 is characterized by the struggle between the political sector wanting to keep features of the colonial period (the war of re-conquer from 1815 to 1820 by Spain General Pablo

Morillo was not successful but affected economic structure) and the political sector wanting a full disruption from the colonial past and an insertion in the new international dynamic. The political sector that supported disruption with the colonial past imposed and implemented elements of the current economic ideology, such as free international commerce, intervention of the government in economic structure, protection of individual/private entrepreneurship, industrialization and protection of country's goods, and focus on exports of agriculture goods and extracted minerals. In this period, the two political parties *el Partido Liberal* with liberal philosophy and *el Partido Conservador* with conservative philosophy were consolidated.

The difficulties of a new model (1850-1899). In the period between 1850 and 1899, the government established moderate free-trade and expanded agriculture to uncultivated lands (Melo, 2007). Europe and the United States were the main export destinations. The Colombian government issued laws to decentralize the tax structure and to provide more autonomy to other parts of the country. The absence of an appropriate internal system of transportation stimulated investment in railroads in different regions of the country. In this period, the first version of a central bank was created to control issuance of banknotes and coins based on the gold pattern. Nonetheless, by the end of the period, economic conditions created an imbalance in government's budget because of the struggle to maintain taxes from exports and increase the expenditure to pay international debts. The country's social stratification in 1870 was influenced by occupational activities as follows: a) peasants, cattle takers and fisherman (53.9%); b) miners (2.6%); c) artisans and manufacturers (22.7%); d) traders/businessman (2.7%); and e) servants (14.7%), as the economically active population. Total population was distributed as,

economically active population 52.9%, children and students 29.1% and housekeepers 18.1% (Melo, 2007).

The big push of the coffee sector (1900-1928). At the beginning of the 20th century, a civil war that lasted between 1899 and 1902 – *La Guerra de los Mil Dias* – severely affected the economy, government finances, and social and political relationships among social groups. In an environment of challenges in different aspects, the government issued laws for stabilizing the circulation of bills and coins, subsidizing product for exports and internal consumption (e.g. tobacco, coffee, rubber and cotton), increasing tariffs on imports, increasing tax exemptions on imports of capital used as input (e.g. machinery), protecting the returns on investments and stimulating the first steps forward industrialization. The government also invested in roads and railroads infrastructure, and strengthened river transportation. The government alleviated part of its substantial debt with international markets, thanks to resources for selling Panama in 1903. This period between 1900 and 1920 also is known as the coffee expansion period (Bejarano Avila, 2007). The period was characterized as such because the economic unit was the smallholding economy – *economía parcelaria*. The smallholding economy had smaller land size, compared to *La Hacienda*, and was located mainly the in country's western section.

The smallholding economy linked to the coffee business substantially modified the country's economic structure. For instance, a product process specialized its different phases for the first time, and the coffee business was divided into commercialization and production. This specialization of phases allowed for a better classification of coffee for internal consumption and exports. The benefits of coffee expansion extended not only to

increasing coffee sales, but also to stimulating other steps of the process, such as internal transportation, urban traders and diversification of consumption products. These other steps mainly allowed individuals to accumulate capital and expand the size of the internal market. Coffee business also contributed to political stability because both political parties were interested in developing this product. However, the crisis after 1930 exacerbated conflicts between a growing urban proletariat, artisans and small peasants, and the government incapable of developing policies to absorb a growing labor force.

The world crisis and structural change (1929-1945). The world crisis triggered the structural change in Colombia's economy between 1929 and 1945 (Ocampo, 2007). The reduction of the international demand meant less demand for Colombia's exports, and the closed markets of semi-industrialized goods due to the World War II, created new challenges for the country. The population was increasing and the need for public services and utilities was a growing item in economic structure. Production of goods from sectors of chemistry, metallurgical and paper gained relevance, while traditional products, such as food and tobacco, experienced a reduction in country's total production.

Transition to modern capitalism (1945-1986). In the period between 1945 and 1986, the country is not characterized as rural and agricultural any more but as urban and semi-industrialized (Ocampo, Avella, Bernal, & Errázuri, 2007). The monetary policy[6] and the fiscal policy played an important role in reducing the effects on the economic structure that of coffee's lower production and exports. Simultaneously, Latin American countries experienced an historical period characterized by an industrialization process through substituting imports. The substitution of imports is a well-known period in the

[6] This is also a feature of modernization because the Colombian Central Bank (El Banco de La República in Spanish) was established in its modern version since 1923.

history of Latin America (Bértola & Ocampo, 2013). This historical period is described as the region's reaction to restrictions for purchasing industrial goods in international markets after the WWII. Thus, Latin American countries adapted their economic structures to produce these goods themselves. In this sense, this historical period is interpreted more as a necessity than the deliberate implementation of an economic growth or developmental model. Colombia, of course, took advantage of this process (Fajnzylber, 1983; Ocampo, 2004, 2010). After the 60s, the substitution of imports model also included exports diversification and regional integration, now as explicit as relevant goals (Ocampo & Ros, 2011).

In this time, the two political parties implemented a model that combined industrial production with heavy dependence on agricultural production. The implicit political agreement between these two parties to protect their group interest is argued by some authors as a model that did not focus enough on industrialization and ultimately prevented the country from giving "the jump" to consolidate the path of industrialization (Ortiz, 2009; Ortiz, Uribe, & Vivas, 2009).

In the middle 80s, it was more evident that the policies on industrialization and active participation of government gradually dissolved and were replaced by market-led policies and minimal participation of the government (Ocampo, Romero, & Parra, 2007). The debt crisis that affected Latin America in the 80s contributed to the hostile environment toward government intervention, although Colombia and Costa Rica were two countries where the negative effects were lower compared to their neighbors (Morley, 1995).

In 1991, Colombia's new Political Constitution was issued and changed substantially all aspects of the country. Regarding country's economic policies, the new laws were characterized by the implementation of commercial and trade policies that incentive imports because the substantial reduction in goods tariffs levels. New features in the Constitution also are, the total independence of the Central Bank from the government's goals and decisions and its main goal of controlling inflation through the monetary policy. In term of social policy, the Constitution expanded coverage for fundamental rights that should be guaranteed by the government such as health, education, public services and utilities and retirement fund. However, at the same time, their coverage and provision were open to the private initiative in free markets. This mixed model of public and private participation has not been identified as totally successful (Ocampo, Romero, et al., 2007). In term of the political policy and citizenship participation, the Constitution stated voting is the election mechanism for cities' mayors and departments' governors. These provisions were added to voting for country president, already in past constitutions. Voting also was the political mechanism for election of senators and other political representatives. In addition, a variety of mechanisms of political participation allowed the citizenship to be more involved and vigilant of policies in general.

2.1.1.1. Two Topics on the History of Colombia

Among the many Colombian historical events, currently two have relevance because of their influence on the country's social and economic policies. The two historical events are the formation of guerrilla groups and illegal drugs trafficking. In the

following sections, I briefly present their historical context to communicate why these are considered two of the structural obstacles more difficult to overcome as Colombia consolidates its reduction in poverty and inequality.

2.1.1.1.1. The Formation of Guerrilla Groups

The origin of the guerrilla movement in its modern version is complex and involves a sequence of specific events. On April 9, 1948, the most popular candidate for the presidency from liberal ideology was assassinated. This event is known as *El Bogotazo,* and is the beginning of a period name *La Violencia* (the violence). The social tensions from previous decades to the 40s, and the assassination of a charismatic political leader triggered one of the most violent periods among political groups (*La Violencia)* (Pecaut, 2010). In 1953, a *coup d'etat* took place in Colombia and the military government returned a relative stability to the country, which reduced political violence levels.

In 1957, the two traditional political parties returned to power in a period named *El Frente Nacional*. *El Frente Nacional* lasted 16 years and was defined by an explicit agreement to alternate the country's presidency with each political party every four years. This political context and the anti-communist environment translated into governmental repression. The response of rural guerrillas was the consolidation and creation of groups influenced by the Cuban revolution from 1959. The guerrilla groups formed were: FARC-guerilla (*Fuerzas Armadas Revolucionarias de Colombia* in Spanish) with Soviet philosophical influence, then, ELN-guerilla (*Ejercito de Liberacion Nacional* in Spanish) with Cuban philosophical influence, and EPL-guerilla (*Ejerecito Popualar de Liberacion*

in Spanish) with Maoist philosophical influence. All were created between 1964 and 1966. The M-19, another group of left nationalist ideology, arose in the 70s and was the second largest group after FARC.

In the decades following the end of the 70s, government and guerrilla groups attempted several times to reach a peace agreement. However, it was the M-19 the first agreed to become a legal political party in 1989 and participated in the discussion to issue the Political Constitution of 1991. Nowadays, the M-19 still has active representatives in Colombia's political venue. The EPL, the smallest group of all, disappeared as a relevant group in the political tension of the 90s.

The public came to doubt the political goals and ideological legitimacy of the remaining guerilla groups after the government confirmed they were funding their activities with the production and commercialization of illegal drugs. The 90s was the decade with the highest level of illegal drugs produced, commercialized and trafficked. This was the moment in the history of Colombia when both events, the guerrilla groups and the trafficking of illegal drugs, were more related and their activities overlap. Nevertheless, in 2016, government and FARC signed a peace agreement that is now being implemented. Meanwhile, since January of 2017 the government and ELN have been discussing terms of the agreement.

2.1.1.1.2. The Traffic of Illegal Drugs

The business of trafficking illegal drugs started in the beginning of the 80s. Scholars who studied this phenomenon explained the reason Colombia developed this particular type of business. First, the country's geographical localization in the route from

the Sud-American producer countries (Bolivia and Peru) to the main consumer country (the United States). Second, Colombia became a producer because of the limited government control on the vast rural areas. Third, the existent of a smuggling network of other products made the transition to this new product easier (Ocampo, Romero, et al., 2007). In addition, Thoumi (2005) argues that not only Colombia's natural advantages compared to other countries allow the development of this business, but also the institutional weakness of the state facilitated the expansion of corruption among civil servants, political parties and some citizens.

According to Kalmanovitz and López (2010b), the highest profit for the business of trafficking illegal drugs could represent 6% of Colombia's GDP. The business evolved and after big drug lords were captured or killed, then the business is defined as micro-traffic with no identifiable unique owners. In this context, Kalmanovitz and López (2010b) conclude that the United States cooperation has been useless in fighting against drugs and reducing its production and commercialization because the repression of the business has not reduced the global supply of drugs. Instead, the price has increased, making the business more profitable. As a consequence, illegal groups in Colombia have fought for land to grow coca crops, which has reduced the land available to grow legal products. In addition, the farmers have faced a "dead-life" dilemma because they usually are forced to grow coca crops due to threats on their lives. In other cases, they decide to grow coca crops because they can maximize their income because legal products' profits do not match coca crops profits. Currently, political and economic relationships between Colombia and the United States still involve discussions on the growth of coca crops and illegal traffic.

2.1.2. Government and Politics

This section covers basic characteristics of Colombia's governmental and political structure. Colombia's Political Constitution issued in 1991 states that Colombia is a unitary democratic state. The country's political-administrative division includes 32 *departamentos* (similar to US states) and 1,122 *municipios* (similar to cities). Santa Fe de Bogota D.C. is the capital.

Colombia's political structure is divided into three political branches: executive, legislative and judicial, based on the principle of checks and balances. In the legislative branch, Congress is composed of the Senate and House of Representatives. The executive branch is composed of the president, followed by ministers, councils and administrative agencies. The election of Congressional members and president happens every four years. At the local level, governors of *departamentos* and mayors of *municipios* are also part of the executive branch. The election of governors and mayors happens every four years, with two years difference between the elections for Congress and president.

In the judicial branch, there are four courts: i) the Constitutional Court, responsible for assuring the integrity of the Colombian Constitution; ii) the Supreme Court that deals with criminal and civil matters; iii) the Council of State, which has special responsibility for administrative law and also provides legal advice to the president, and the Superior Council of Judicature, which is responsible for auditing the judicial branch (Constitución Política de Colombia 1991 (1998), author's translation).

2.1.3. Geography

Colombia is located in the northwestern corner of South-America. It shares borders with Panama, Ecuador, Peru, Brazil and Venezuela. It shares a portion of the Amazon forest with Peru and Brazil and a portion of Orinoquia plain lands with Venezuela (Figure 1).

Figure 1 Map of Colombia and Latin America Region
Source: Author's processing based on Porto's (2015) data.

The Andes Mountains Chain ends in the country, which helps to delimit and identify five geographical regions, Andean region (center), Pacific region (west), Atlantic Region (north), Amazon region (south) and Orinoquia region (east). The 32 *departamentos* of Colombia's political administration are presented in Figure 2. Bogota D.C. the capital is in the Andean region and is followed in importance by the subsequent

capitals of *departamentos*: Medellin (Antioquia - northwest), Cali (Valle del Cauca - southwest) and Barranquilla (Atlántico - north).

Figure 2 Map of Colombia's Political Division by Departamentos
Source: Author's processing based on IGAC's (2016) data.

2.1.4. Demographics

Figure 3 presents information about total population and its classification by gender. In 2015, the population was 2.9 times the population in 1960, growing from 16.4 million to 48.2 million. However, the population growth rate has consistently decreased going from 3% to 0.8% in the same period. Although the country's population has been mostly female, in the same period, an increasing trend of this gender occurred since 1980.

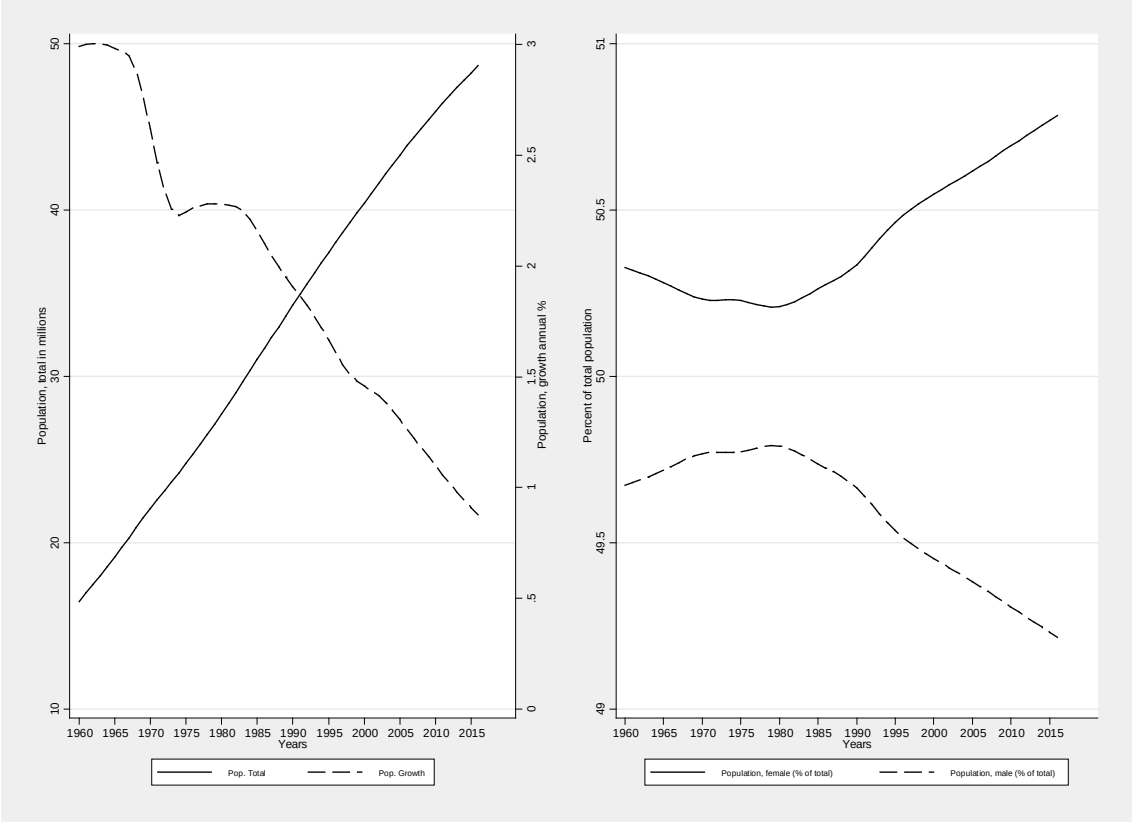

Figure 3 Total population and population growth (left) and Percent of Population by Female and Male (right), 1960-2015
Source: Author's processing based on Azevedo's (2016) data.

Although Colombia's urban population growth rate has decreased substantially in the period between 1960 and 2015, the overall country shows a strong pattern of population growth in urban areas (Figure 4). As far as rural population, rural population the growth rate shows a decreasing trend with some fluctuations in the 60s, 80s and 90s that does not change the overall trend.

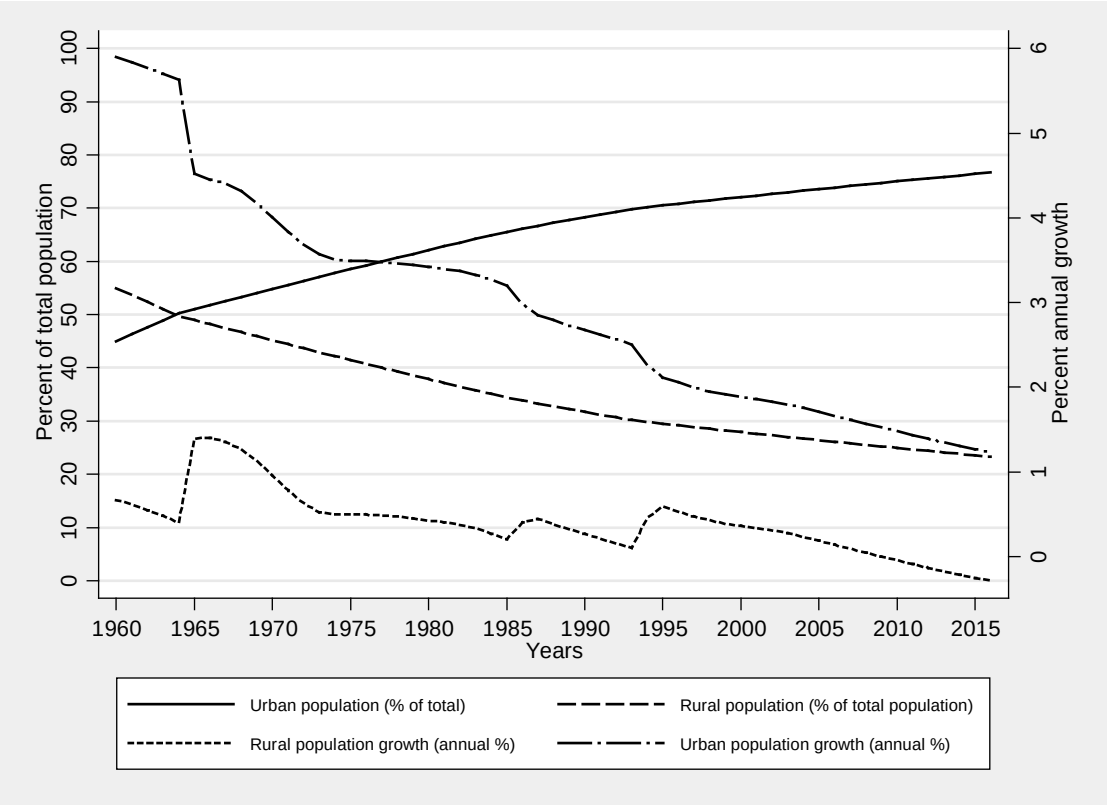

Figure 4 Population by Urban and Rural classification, and growth rates of Urban and Rural Population, 1960-2015
Source: Author's processing based on Azevedo's (2016) data.

Figure 5 presents information by age group and life expectancy in the country. Between 1960 and 2015 life expectancy at birth grew from 56.7 years to 74.1 years. As far as age groups population trends after the 70s, the 0-14 age group decreases and the 15-64 age group increases. The age population group of 65+ increases, but its pace is slow.

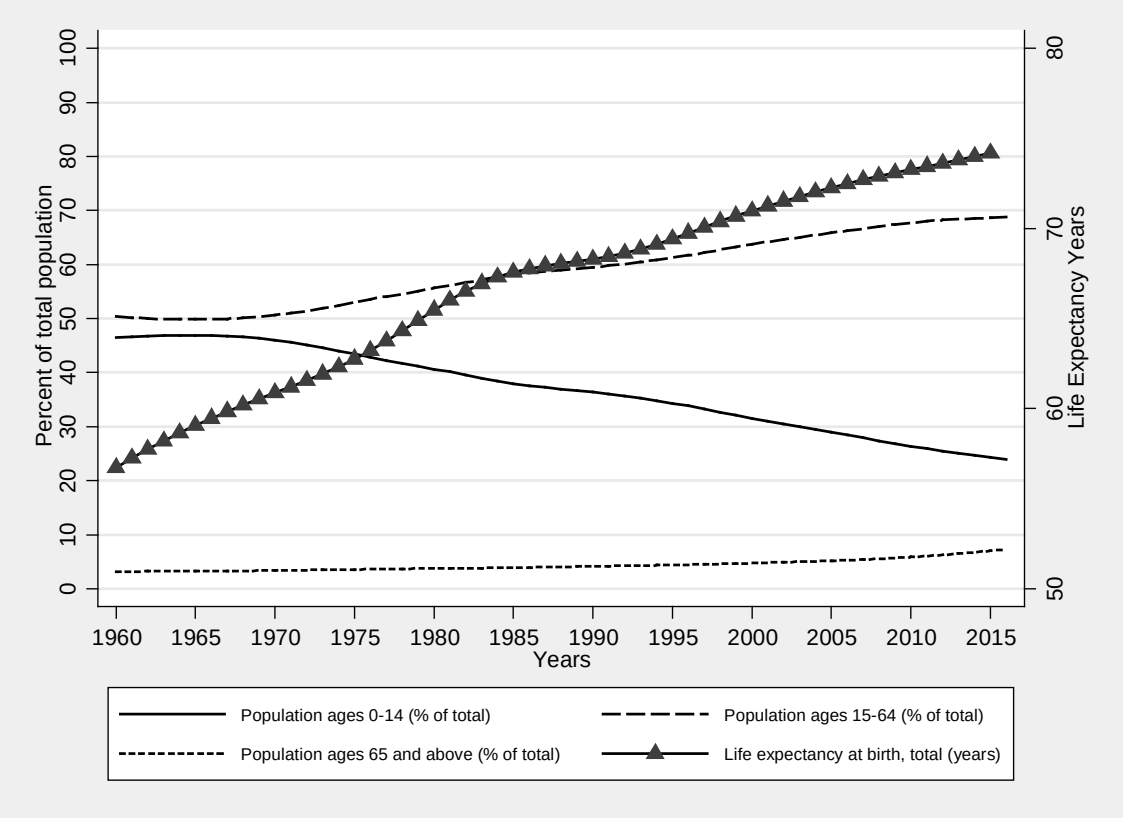

Figure 5 Percent of Population by Age Groups 0-14 years old, 15-64 years old and 65 years old and more, and Life Expectancy at Birth, 1960-2015
Source: Author's processing based on Azevedo's (2016) data.

Summary. Colombia's population is mostly urban, predominantly female and between 15 and 64 years old, and life expectancy is increasing. These demographic trends are intimately involved in the research of the middle segment of society in Colombia.

2.1.5. Economic and Social Indicators

More so than these demographic indicators, trends in social and economic indicators provide a detailed picture of the foundational changes in Colombia's society structure that shape the size of society's middle segment, irrespective of how it is calculated.

Colombia is classified in the high category according to the 2015 Human Development Index (HDI) (UNDP, 2016). High human development category is reserved for countries with a HDI range of 0.700–0.799 (UNDP, 2016). The components of HDI are life expectancy, education and income per capita. Information about these variables will be presented in this section. Time series data about the three traditional macroeconomic variables, Gross Domestic Product (GDP) and inflation (Figure 6), and unemployment (Figure 7) for Colombia appear in the next pages.

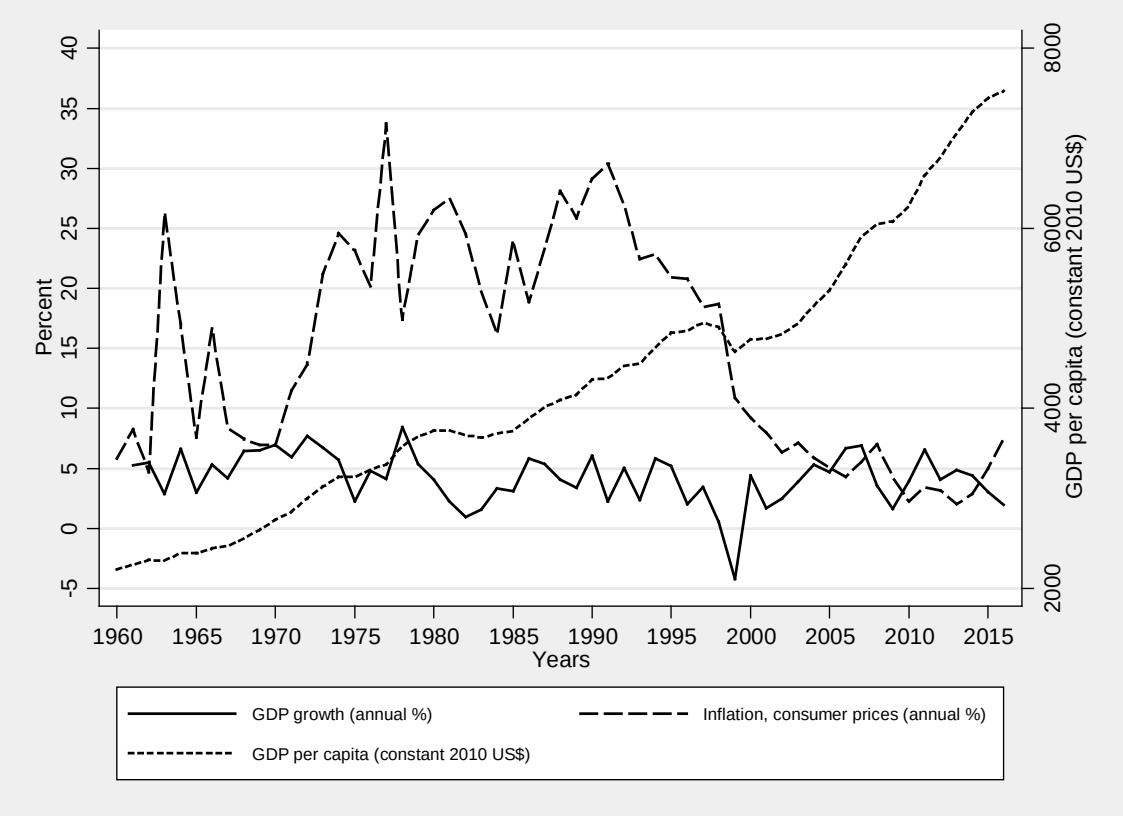

Figure 6 Gross Domestic Product (GDP) Annual Growth, GDP Per Capita and Annual Variation of Consumer Price Index (Inflation), 1960-2015
Source: Author's processing based on Azevedo's (2016) data.

The average economic growth from 1960 to 2015 is 4.2%, with the worst datum in 1999. Excluding the negative growth in 1999, GDP[7] per capita shows a positive trend since 1960. The country's economy was characterized by an inflation rate above 10% between the 70s and the 90s. However, the Banco de la Republica's (Colombia's Central Bank) monetary policy focused on keeping inflation low. This reduced inflation values since 1991, with values below 10% after 2000, creating an overall decreasing trend. As for unemployment, after having the highest value in 2000 (20.5%), the unemployment rate fell to 8.3% in 2015. However, the female unemployment rate has always been greater than the male unemployed rate.

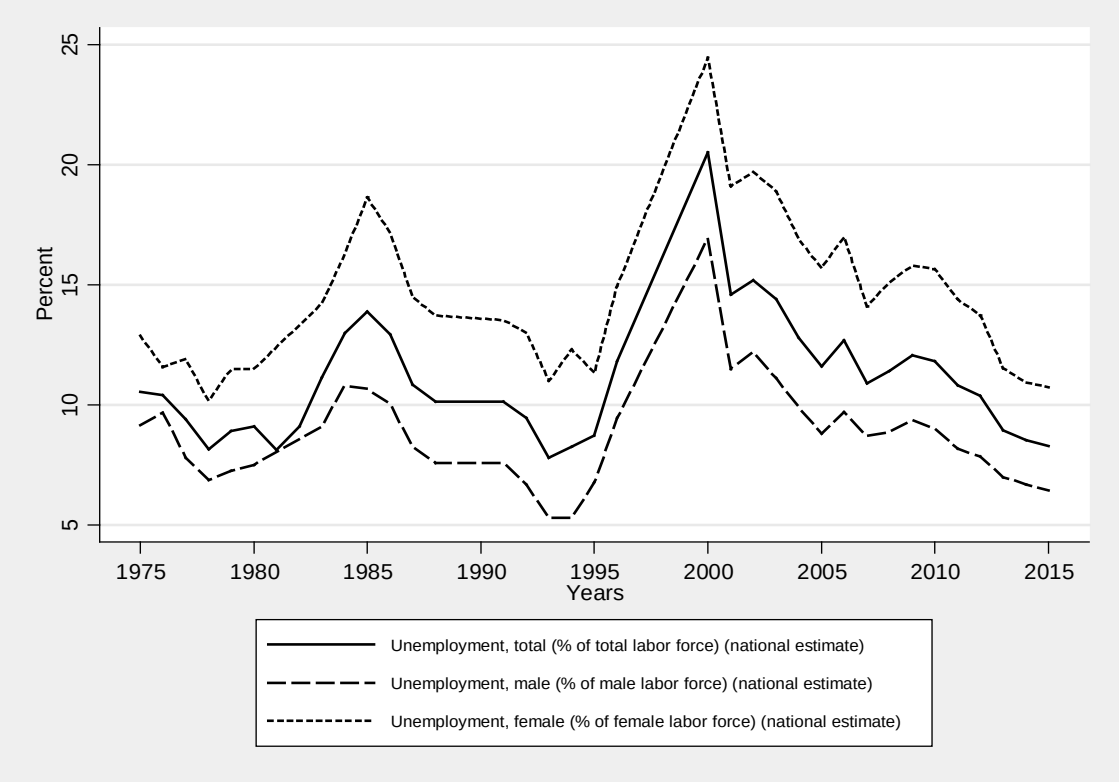

Figure 7 Unemployment Rate Total and by Female and Male, 1975-2015
Source: Author's processing based on Azevedo's (2016) data.

[7] Colombia is classified as an upper middle income country since 2008 according to World Bank (2017). Upper middle-income economies are those with a Gross National Income (GNI) per capita between U$3,956 and U$12,235 in 2016 (World Bank, 2017). Unlike the analysis in the dissertation which is from a microeconomic level, this classification is from a macroeconomic level because it uses macroeconomic aggregates.

Time series data since 1965 shows that both the agricultural and manufacturing sectors have contributed less to GDP, while contributions of industrial and services sectors have grown (Figure 8). However, in recent decades the decline of the agricultural sector is faster than manufacturing sector's decline. In contrast, the industrial and services sectors have led contribution to GDP, with services sector as the main contributor with a maximum of participation of 61.6% in 2000 and 2001. On the other hand, the contribution to the GDP by natural resources (Figure 9) reveals that oil is the natural resource that contributes most to Colombia's economy.

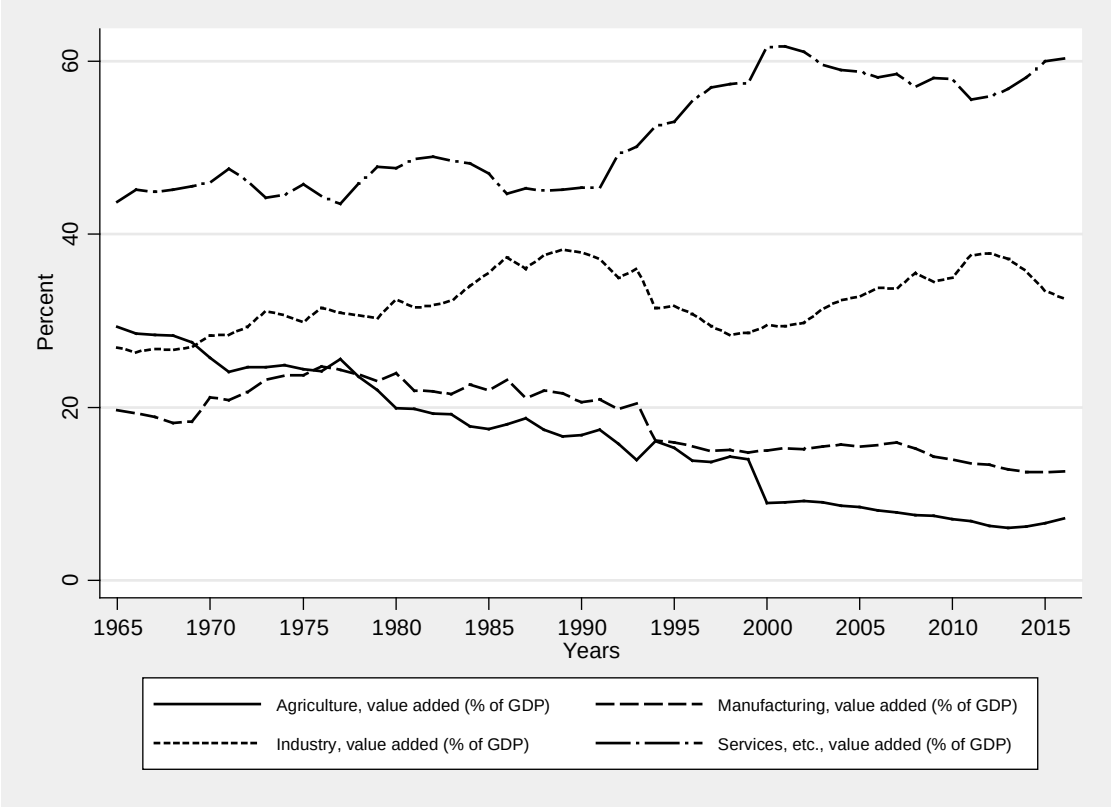

Figure 8 Participation by Economic Sectors in GDP, 1965-2015
Source: Author's processing based on Azevedo's (2016) data.

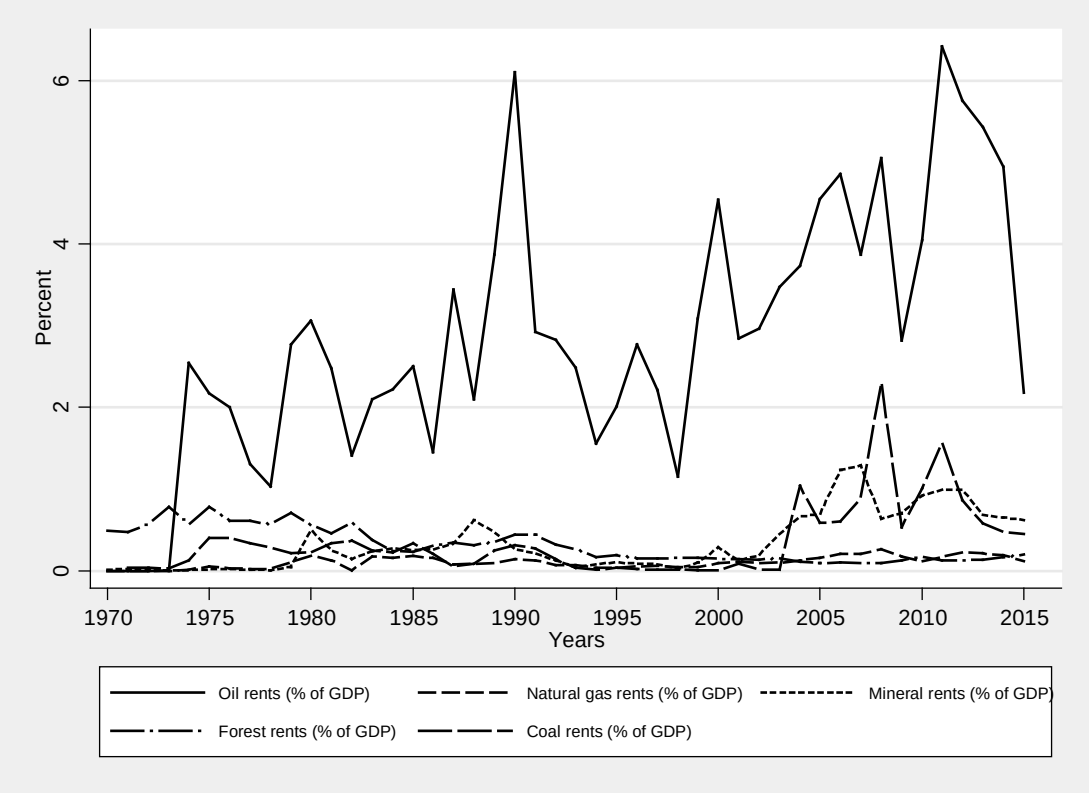

Figure 9 Rents by Natural Resources, 1960-2015
Source: Author's processing based on Azevedo's (2016) data.

The time series data of exports and imports as a proportion of GDP between 1960 and 2015 are in Figure 10. The trends of exports and imports have fluctuated and each one leads during different periods until 1994. After 1994, imports are consistently a greater proportion of GDP than exports. Only in 1999 were exports greater than imports, although by small percentage. Then after 1999, the gap between imports and exports remained despite several fluctuations.

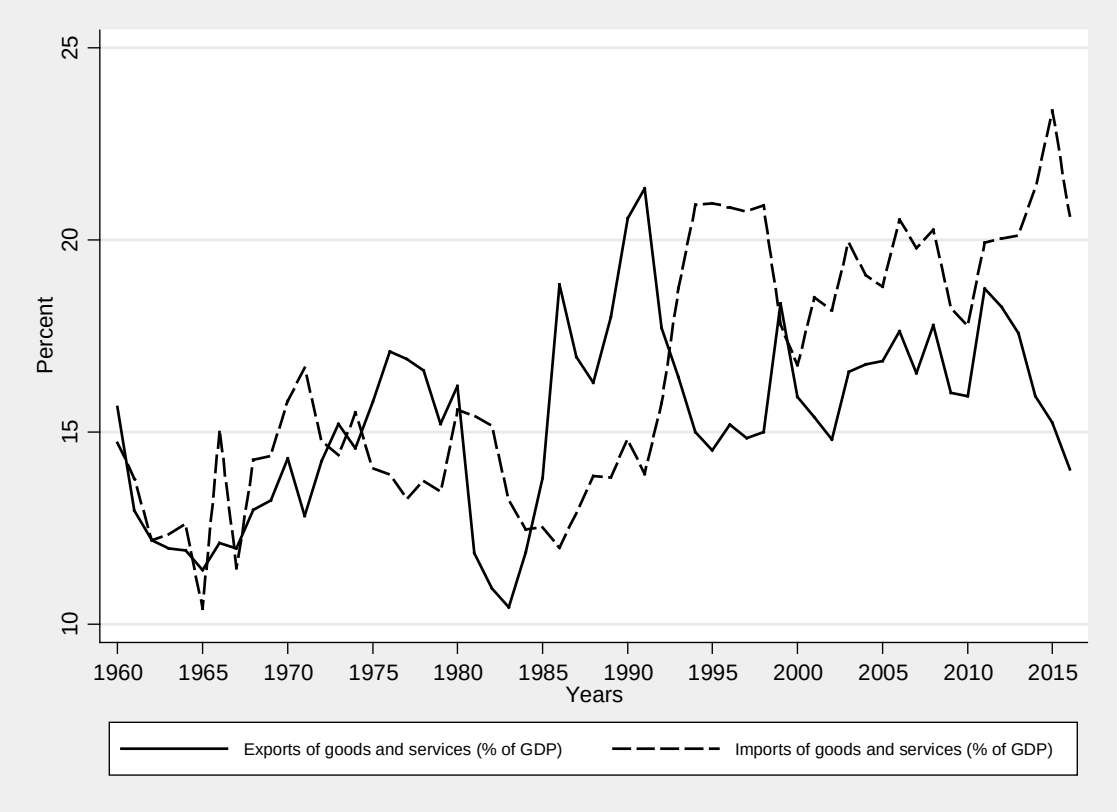

Figure 10 Export vs Imports, 1960-2015
Source: Author's processing based on Azevedo's (2016) data.

Information for the education sector is presented in Figure 11 and Figure 12. Specifically, some statistical information of government expenditure in education is in Figure 11. The expenditure for education as a percentage of GDP grew from 1.7% in 1979 to 4.5% in 2015. By levels of education, the expenditure per student in primary and secondary levels fluctuated between 10% and 18% during 1998 to 2015. Both educational levels have similar series fluctuation and their trend is slightly positive. The expenditure per student in tertiary level represents the biggest proportion among the three levels. However, its overall trend decreased from 34.3% to 20.2% during period 1998 to 2015.

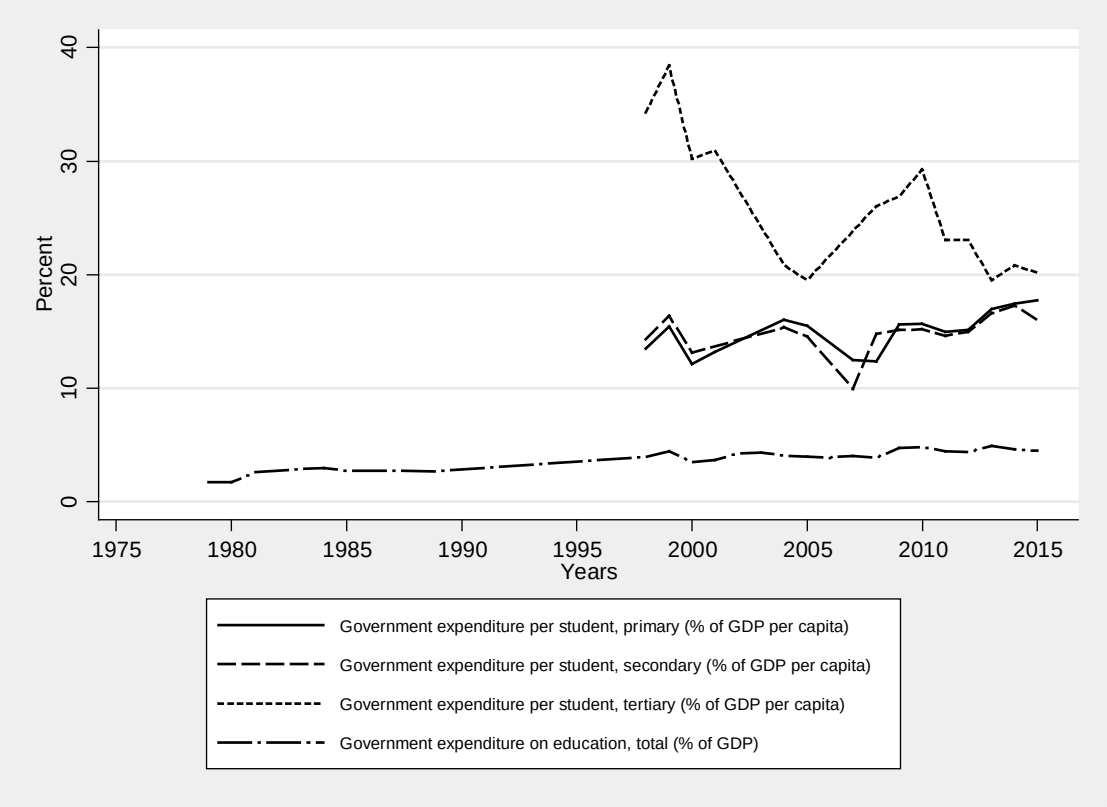

Figure 11 Government Expenditure by Education Level, 1978-2015
Source: Author's processing based on Azevedo's (2016) data.
*Only data available are depicted.

School enrollment by educational level and literacy rate are presented in Figure 12. The percentage of adults knowing how to read and write grew from 91% to 94.5% between 1993 and 2015. Regarding gross school enrollment, secondary and tertiary levels experienced a steep increase, while the primary level trend showed that policies to provide this level of education have been implemented more consistently than for the other two levels.

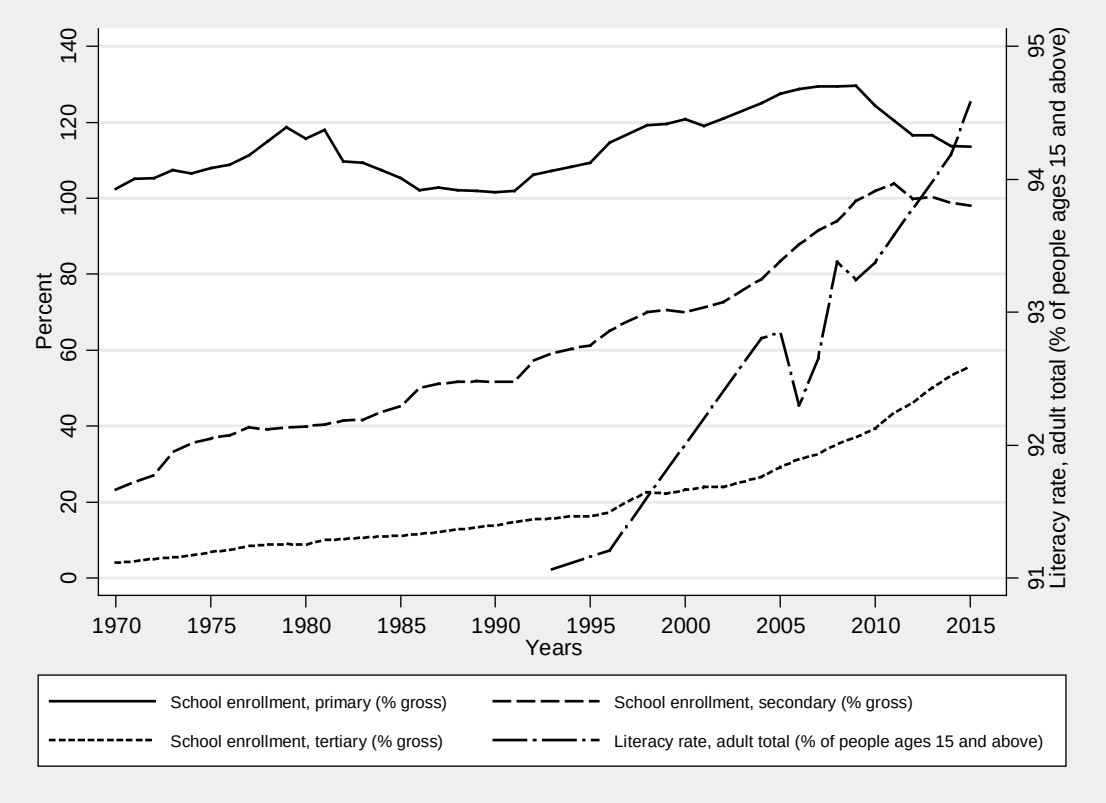

Figure 12 Percent of Gross School Enrollment by Education Level and Literacy Rate, 1970 - 2015
Source: Author's processing based on Azevedo's (2016) data.

Information for the health sector on expenditures and sanitation is presented in Figure 13 and Figure 14, respectively. The most significant percent of health expenditures comes from the public sector, which is on average 4.9% of GDP between 1995 and 2014. On the other hand, private health expenditure decreased between 1997 and 2000 and did not recover to the 1995 level. On average, private health expenditure was 1.8% of GDP between 1995 and 2014.

Four indicators complement the profile of the health sector (Figure 14): neonatal mortality rate, mortality rate under five years old, number of hospital beds per 1,000 people, and number of physicians per 1,000 people. Both indicators of mortality show a decreasing trend, with the mortality rate for children under five years old decreasing the

most. Mortality rate for those under five years old started at 127.3 in 1960 and was 15.9 in 2015. This and other demographic changes has been attributed to increase in expenditure in education and health, increase female participation in labor market, expansion of urbanized cities, and increase in population education (Acosta, Forero , & Pardo, 2015). The number of hospital beds per 1,000 people decreased until 1990. After this year, this indicator has shown several fluctuations with a decreasing trend but a slower rate than the period until 1990. On the other hand, the number of physicians per 1,000 people on the other hand has consistently increased after 1977.

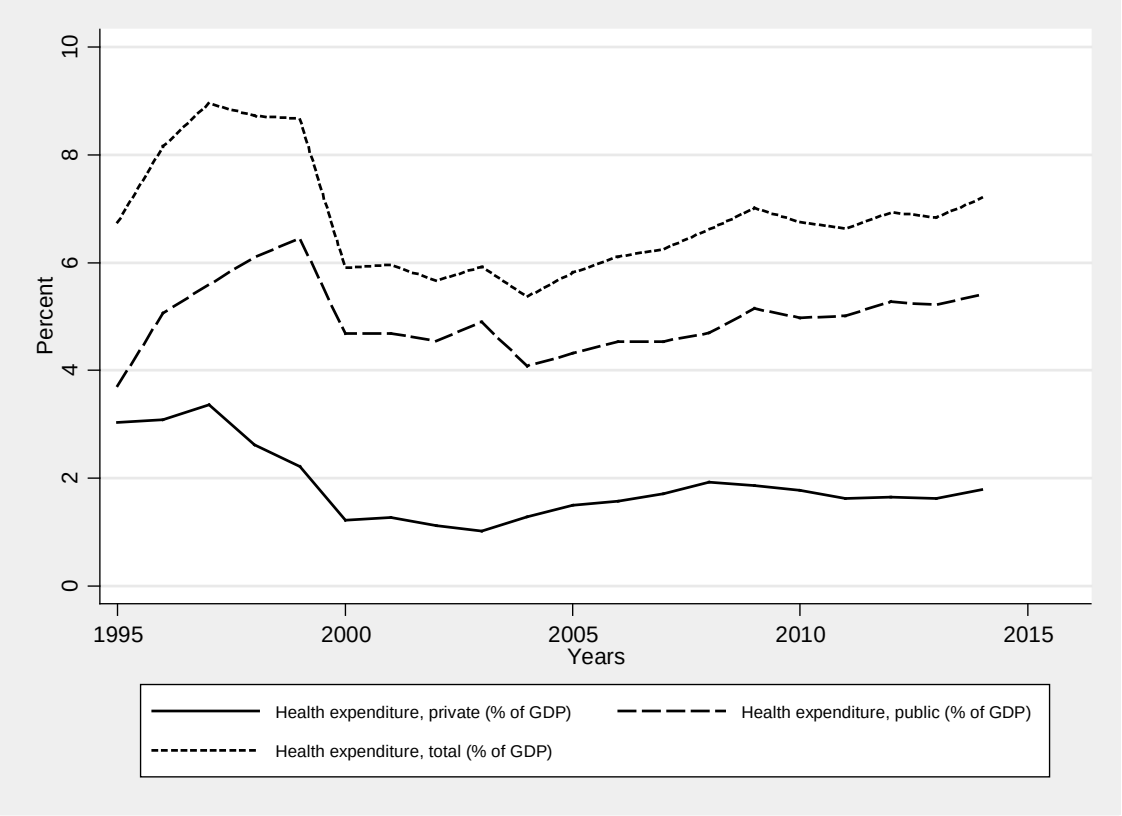

Figure 13 Health Expenditure by Private and Public Sector, 1995-2015
Source: Author's processing based on Azevedo's (2016) data.
*Private health expenditure includes direct household (out-of-pocket) spending, private insurance, charitable donations, and direct service payments by private corporations. Public health expenditure consists of recurrent and capital spending from government (central and local) budgets, external borrowings and grants (including donations from international agencies and nongovernmental organizations), and social (or compulsory) health insurance funds.

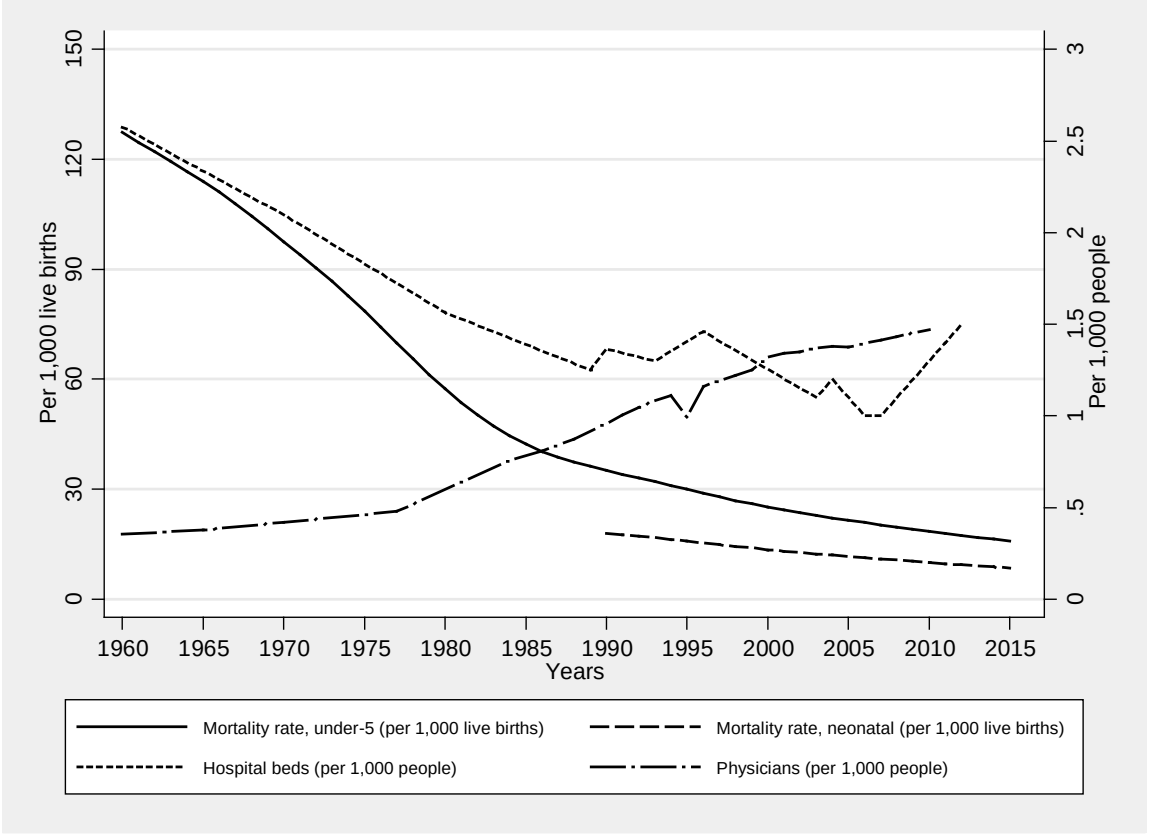

Figure 14 Evolution of some Health Indicators, 1960-2015
Source: Author's processing based on Azevedo's (2016) data.

Some indicators of Colombia income inequality are depicted in Figure 15. These are Gini coefficient, income shared by the highest 10% and income shared by the lowest 10%. Gini coefficient had a minimum value of 51.3 in 1991 and a maximum of 58.7 in 1999. Regardless of some fluctuations, the coefficient has been trending downward from 1999 until 2014. In Colombia, the highest 10% of the population accumulates not less than 40% of country's income, while the lowest 10% of the population accumulates between 1.3% in 1991 and 0.13% in 2000. Both proportions are consistent with the Gini trend after 1999, which indicates the highest 10% shows a slight decrease while the lowest 10% shows a slight increase. These trends corroborate a reduction in poverty and

inequality most of all in the recent years, which can be interpreted as an improvement in the size of the MIP.

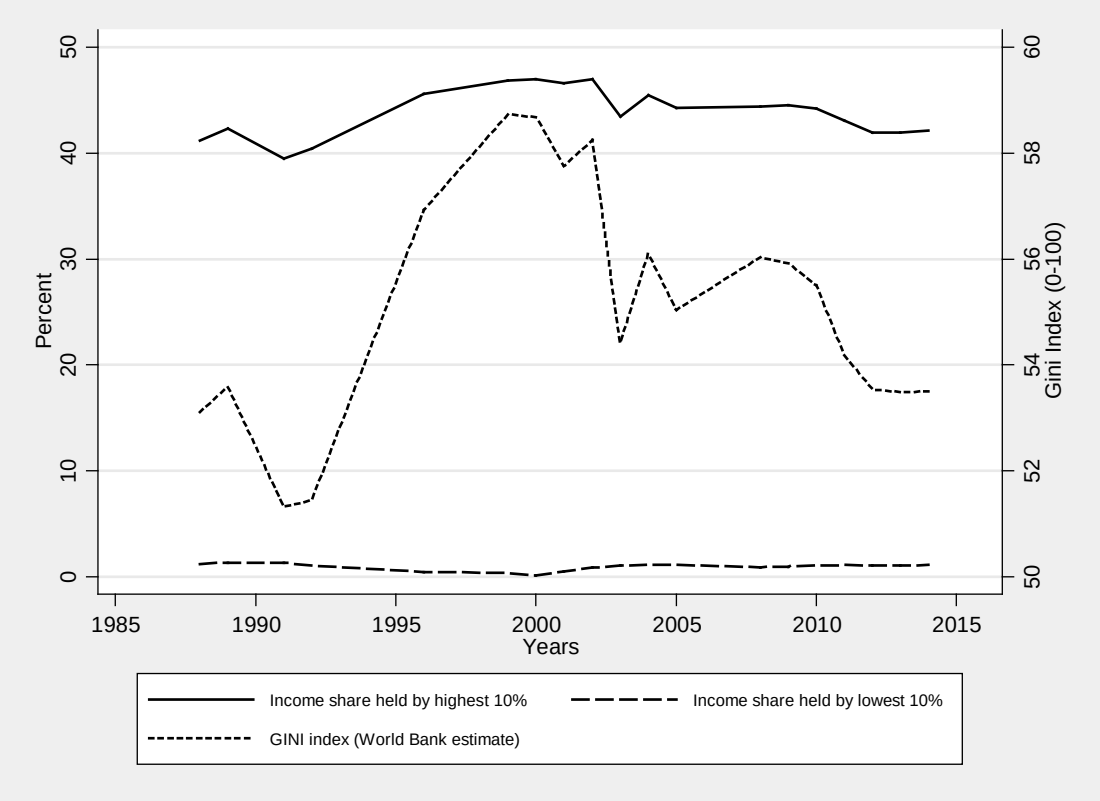

Figure 15 Income Inequality Indices, 1988-2014
Source: Author's processing based on Azevedo's (2016) data.

Summary. Economic and social indicators show substantial improvement. However, some aspects are not exempt from challenges. The last decade has shown low GDP growth but improvement in inflation and unemployment. Agricultural and manufacturing sectors have loss participation, while services sector widen its participation with respect other sectors. The extractive activities are led by the oil industry, with a recent reduction in its contribution to GDP. There is commercial deficit because the imports are greater than the exports.

The most relevant achievements in education are in elementary and secondary level, while public health expenditure is higher than private health expenses. Income

inequality declined during the last decade, but there is room for reducing economic disparities even more.

These economic and social features can be interpreted as the scenario where the population in the middle segment might increase, therefore, a potential decline in country's polarization. The next section focuses on indices of poverty and inequality between 2002 and 2015 in greater depth.

2.1.6. Poverty, Inequality and Income Distribution between 2002 and 2015

Two concepts frame this dissertation – middle segment of society and polarization. However, Colombia's government does not calculate indicators related to them. These concepts are still part of the academic analysis and are not included among official monitoring indicators. Therefore, I present Colombia's poverty and inequality statistics during the period 2002 – 2015 in order to contextualize the analysis of the middle segment of the society and polarization. I present the following indicators to describe the context:

1. Poverty and extreme-poverty incidence indicator
2. Gini coefficient
3. The Colombian Multidimensional Poverty Index (C-MPI).[8] The C-MPI is the Colombian adaptation of the Alkire-Foster (AF) methodology, which I apply to measure the size of the multidimensional middle class (MMC).
4. GDP growth.

[8] Colombian Multidimensional Poverty Index or C-MPI. See C-MPI dimensions, indicators and weights in Appendix 2.

I also present Colombia's position in the international context based on the most common inequality and poverty indicators and income polarization indicators. The methodology used by the Colombian government to calculate poverty incidence is based on the definition of *the basic food basket* that should cover the caloric daily requirements necessary for individuals to perform their activities. The *basic food basket* translates into monetary units which are adjusted by the Orshansky's coefficient (Orshansky, 1963, 1965) calculated for Colombia. The calculation of Orshansky's coefficient is used to define the cut-offs for poverty line and extreme-poverty line, in other words, to calculate poverty incidence and extreme-poverty incidence which are the income poverty indicators (DNP-DANE, 2012).

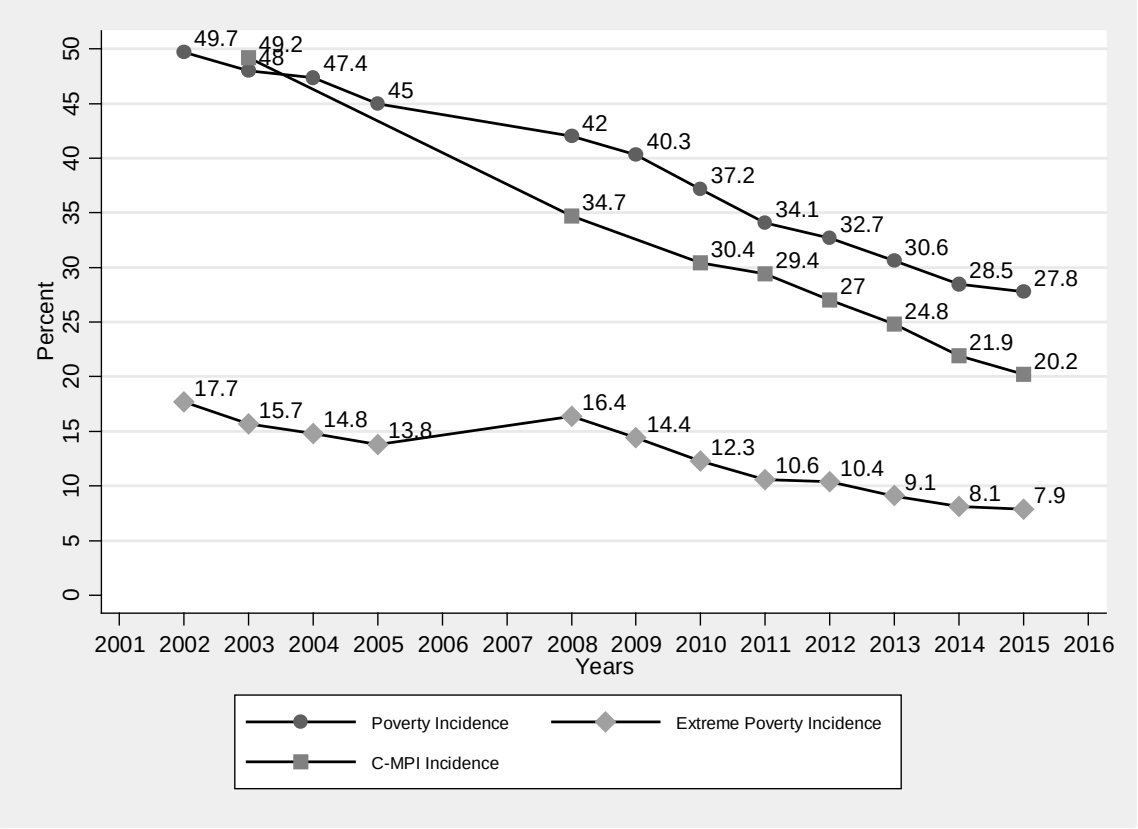

Figure 16 Colombia's Poverty Incidence, Extreme-Poverty Incidence and C-MPI, 2002 – 2015*

Source: Author's processing based on DANE (2017c) data.

*C-MPI data year 2003 and 2008 from Angulo, Diaz, and Pardo (2013).

Figure 16 presents the trend of income poverty indicators and C-MPI. The main conclusion from this figure is that both income poverty and multidimensional poverty have decreased during the analysis period. Figure 17 compares the trends of the Gini coefficient and GDP growth. The Gini coefficient shows a decreasing trend in the period of analysis, while the GDP growth fluctuates with a substantial reduction after the 2008 global crisis but shows no clear pattern. The next section focuses on the international comparison of these indices.

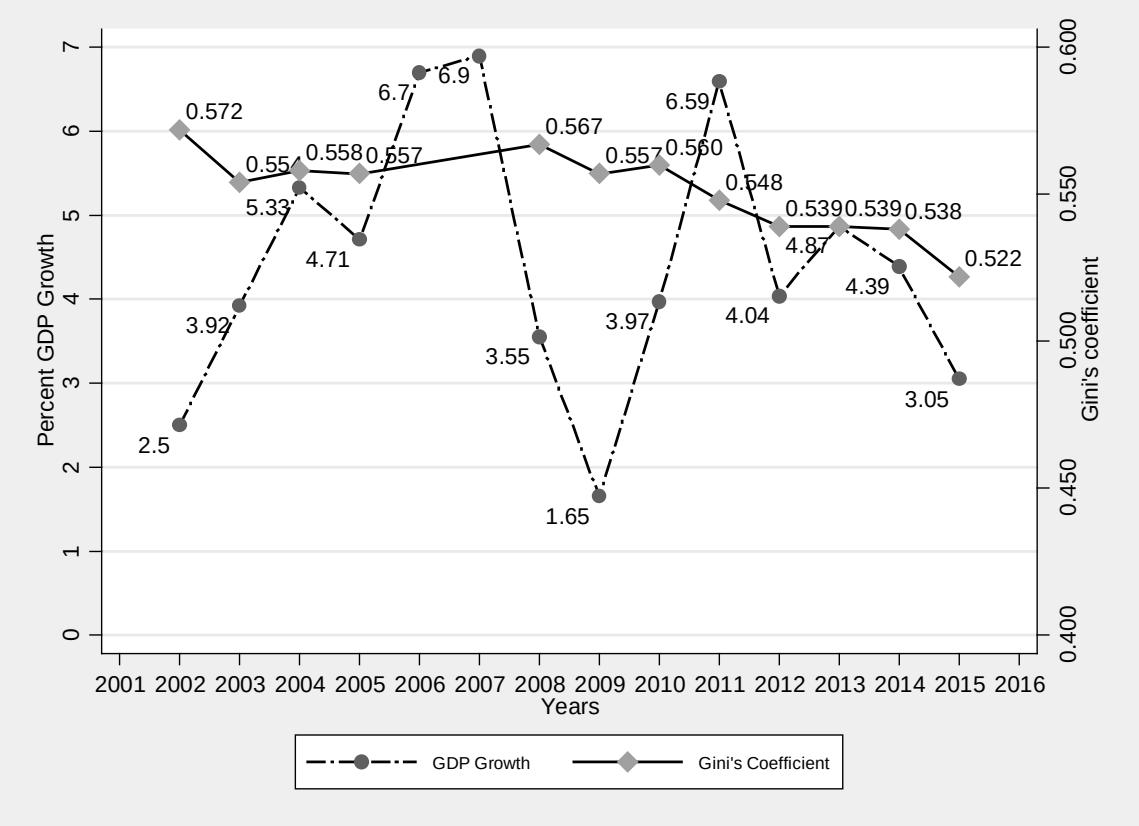

Figure 17 Colombia's Gross Domestic Product and Gini Coefficient, 2002 – 2015
Source: Author's processing based on DANE (2017b); (DANE, 2017c) data.

2.1.7. Colombia in International Context between 2002 and 2015

Figure 18 presents Gini coefficients for Colombia and selected Latin American and OECD countries. Colombia begins the period of analysis in the first place among the selected group of countries, meaning its income level made the country the most unequal among the depicted countries. The downward indicator trend shows Colombia ranks second by the end of the period behind Brazil. The figure reinforces conclusions that Latin America is as a very unequal region. Hence, the level of income inequality in Colombia is among the highest worldwide and is decreasing a very slow pace.

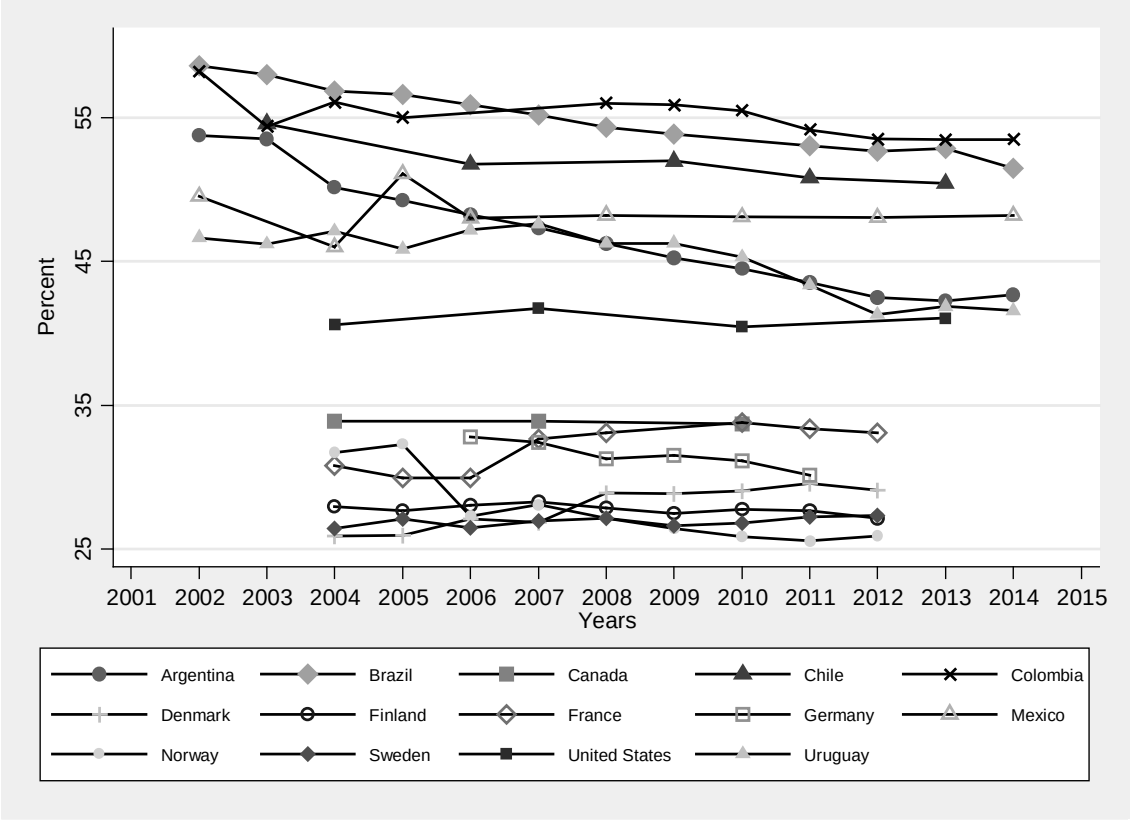

Figure 18 Gini Coefficient International Comparison of Selected Latin American and OECD countries, 2002 – 2014
Source: Author's processing based on Azevedo's (2016) data.
*Mexico and Chile are the only two Latin American countries in the OECD.

The global multidimensional poverty index (MPI)[9] is presented in Figure 19. The figure also shows the two components for its calculation of the multidimensional poverty headcount ratio (*H*), and the intensity of deprivation (*A*). While *H* and *A* are in percentages, *MPI* ranges between zero and one. Thus, the country closer to zero is in better condition.

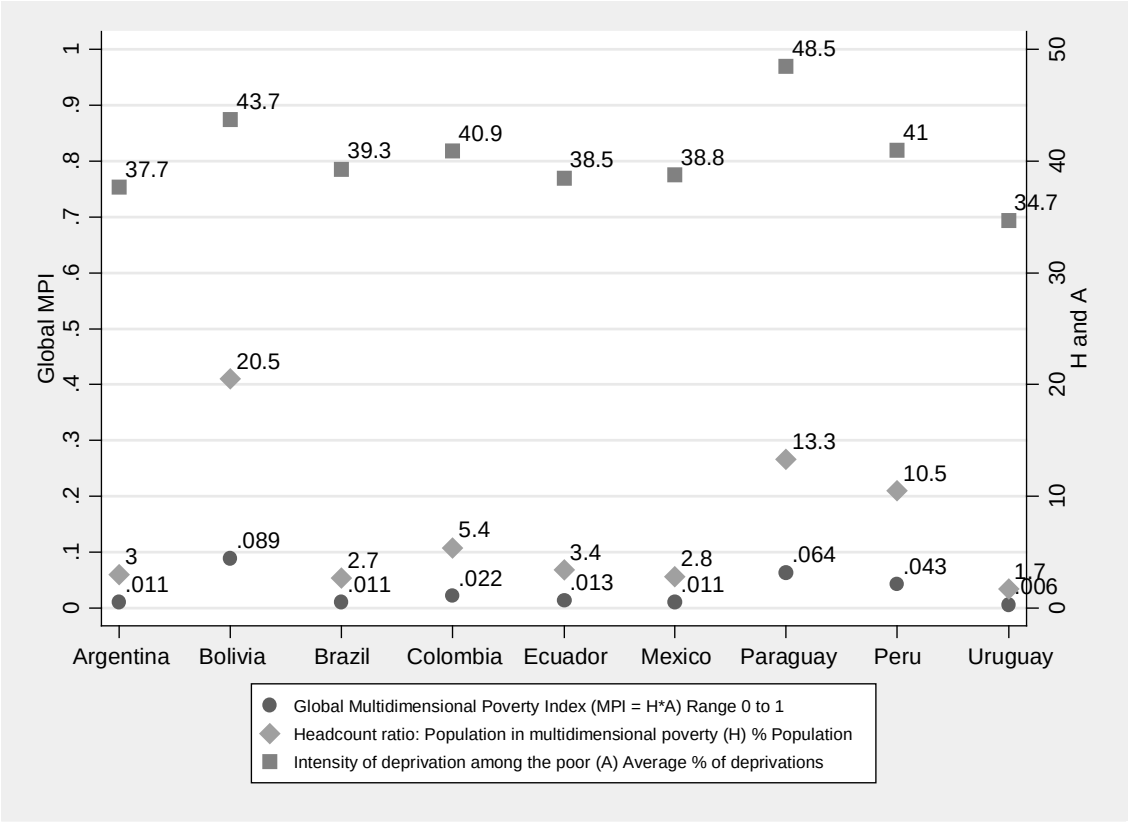

Figure 19 Global Multidimensional Poverty Index (MPI), Multidimensional Poverty (H) and Intensity of Deprivation Among Multidimensional Poor (A), Selected Latin American Countries*

Source: Author's processing based on OPHI (2017) data.

*Global MPI is calculated only for developing countries. Datum Year of Argentina 2005, Bolivia 2008, Brazil 2006, Colombia 2010, Ecuador 2013/14, Mexico 2012, Peru 2012, Paraguay 2002/03, and Uruguay 2002/03.

[9] The global Multidimensional Poverty Index (MPI) is an application of the AF methodology policy oriented at an international level. It has been reported annually since 2010 in the Human Development Report of United Nations Development Program (UNDP). MPI dimensions are: education, health, and standard of living (Alkire et al. (2015) pp. 169), see its detailed structure in Appendix 3.

Bolivia, Paraguay and Peru are the countries with higher percentages of people classified as multidimensional poor, as well as with higher intensities of deprivation. Colombia ranks in fourth place based on these two indicators. However, overall, Colombia's MPI ranking is sixth, after Uruguay, Argentina, Brazil, Mexico and Ecuador. This international comparison aims to communicate the magnitude of Colombia's improvements in economic and social indicators discussed in the previous section, and presenting what could be the levels of inequality and poverty compatible with a large size of the middle segment of the society.

Several authors have proposed different indicators to analyze income polarization. In Figure 20, I present a selected number of these indicators.[10] Because polarization is a characteristic of income distribution, which means the income distribution can have two or more poles that group a large enough size population, polarization is related to income inequality analyses.

Figure 20 shows downward trends in polarization for all countries and all indicators. However, Colombia, Mexico and Paraguay have a slower pace than countries such as Argentina, Brazil, Bolivia and Peru. In terms of the magnitude of income polarization, Colombia and Brazil rank first and second in 2015 in all indicators, while Uruguay and Peru are the least polarized countries in 2015 as well.

[10] Technical details of income polarization indices are discussed in Appendix 4.

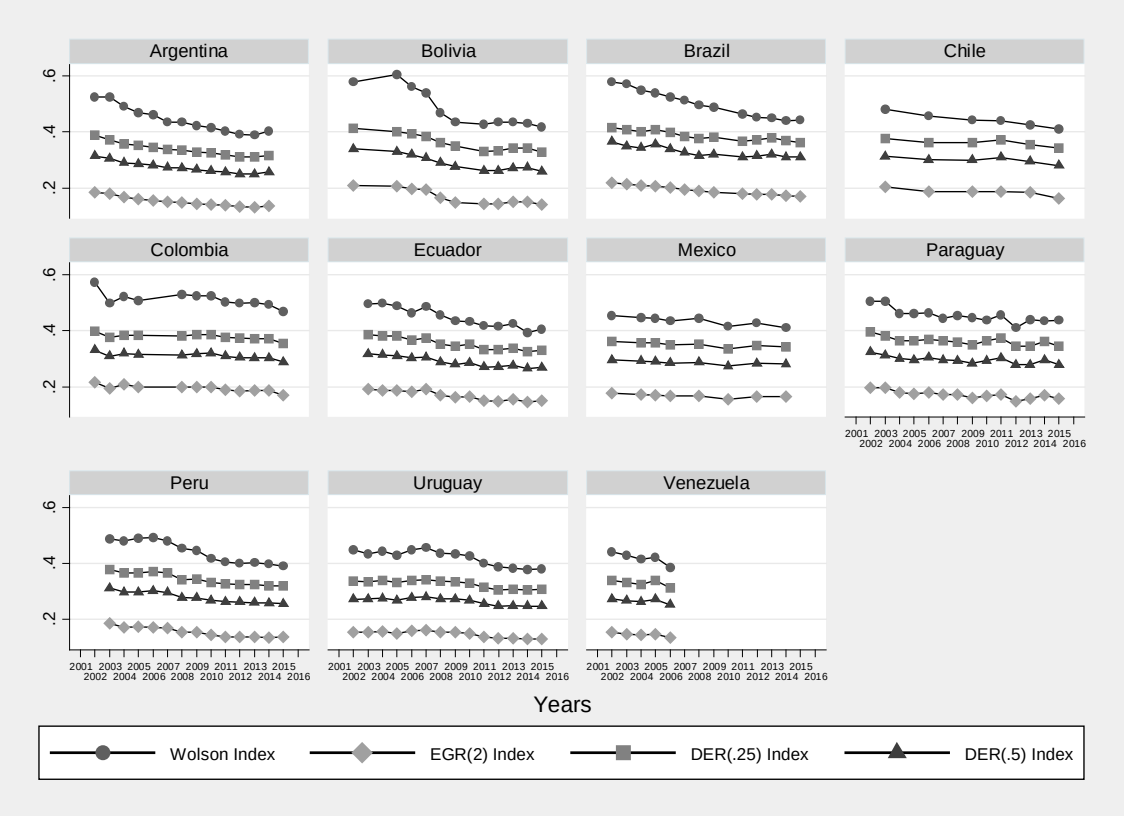

Figure 20 Selected Income Polarization Indices for selected Latin American Countries, 2002 - 2015
Source: Author's processing based on SEDLAC (2016) data.

Based on the reviewing of indices of income inequality, poverty and polarization for Colombia I can conclude: first, evidence exists of an undisputable reduction in both topics between 2002 and 2015; and second, convincing evidence exists that in the international context Colombia manifests important differences compared with similar (Latin American) or developed (OECD) countries. I use this context to better understand how these positive outcomes frame the multidimensional middle class and multidimensional polarization I propose in this dissertation.

2.2. Sen's Framework and Multiple Dimensions to Address the Middle Segment of the Society

Empirical multidimensional approaches are not new in poverty research. In Europe, since Rowntree's (1902) seminal study of poverty in York, the approaches have evolved. They indicate a complementarity between income and other dimensions, including subjective dimensions. Studies with multidimensional approaches influenced policies on poverty in different historical contexts in England (Glennerster, Hills, Piachaud, & Webb, 2004). Townsend (1979) conducted another influential study in the United Kingdom, in which he posited assessing poverty through 12 dimensions: diet, clothing, fuel and light, home amenities, housing conditions and facilities, immediate environment of the home, conditions at work, family support, recreation, education, health and social relations. Table 1 summarizes other studies with multidimensional approach some European countries.

Table 1 Summary of some Studies using Measures of Deprivation for Poverty in Europe

Author(s), Year	Country	Data	Methodology/Empirical Approach	Definition of Poor
Mack and Lansley (1985)	United Kingdom	Public's Perceptions of Minimum Needs (PSE 1983) known as Breadline Britain Survey	Definition of 35 items. Retained 26 items classified as necessities by at least 50% of the population	If an individual cannot afford three or more of the equally weighted items
Gordon (2000)	United Kingdom	Breadline Britain Survey of 1983, 1990 and 1999	Definition of 35 updated items.	If household cannot afford two or more of the equally weighted items and simultaneously has relative low income

(continued)

Table 1 (continued) Summary of some Studies using Measures of Deprivation for Poverty in Europe

Author(s), Year	Country	Data	Methodology/Empirical Approach	Definition of Poor
Callan, Nolan, and Whelan (1993)	Ireland	Data from Economic and Social Research Institute in 1987	Study defines three dimensions: basic lifestyle (8 items), housing and durable goods (7 items), and other lifestyle aspects (9 items)	If an individual does not own one or more items of basic lifestyle and is below relative income poverty line
Layte, Maître, Nolan, and Whelan (2001)	Ireland	European Community Household Panel Survey (ECHP)	Material Deprivation Index using 30 items	Endogenous definition of relative income poverty line based on 40%, 50%, and 60% of the median income
Muffels and Vriens (1991)	Netherlands	Dutch Socioeconomic Panel Survey	Index of relative and subjective deprivation	Subjective deprivation poverty line based on econometric model
(Halleröd, 1994, 1995)	Sweden	Swedish Standard of Living Survey in 1992	Proportional Deprivation Index based on 35 items from Mack and Lansley (1985) but weighed by the proportion of population	Poverty cut-off Mack and Lansley (1985)
Eurostat (2002)	Europe	European Community Household Panel Survey (ECHP)	Index of non-monetary poverty based on Factor Analysis on 24 dichotomous items (having/not having)	People with a deprivation score of 60% or more

Source: Author's adaptation based on Alkire et al. (2015), section 4.1, p. 128-133.

In a more recent policy application, the European Commission's (2010) strategy for monitoring people "at risk of poverty and social exclusion" defined three indicators to assess multidimensional poverty: relative income poverty, severe material deprivation, and quasi-joblessness. All these methodologies and approaches are different from the AF methodology. However, Whelan, Nolan, and Maitre (2014), who explore the use of the AF methodology for the case of the European Union using EU-SILC data, suggest substituting the current approach with the AF approach, as it is more structured, less ad

hoc, and more transparent than others. In addition, it is flexible in terms of the poverty cut-off and the axiomatic properties of its measures (Alkire et al. (2015)).

In Latin America, several countries have applied the multidimensional Unsatisfied Basic Needs (UBN) method since the 80s (Feres & Mancero, 2001). The UBN includes indicators that can be classified in four dimensions: i) Access to housing that meets minimum housing standards; ii) Access to basic services that guarantee minimum sanitary conditions; iii) Access to basic education, and iv) Economic capacity to achieve minimum consumption levels (Feres & Mancero, 2001). Individuals in the household are classified as poor if at least one of them has one unsatisfied basic needs. The UBN is understood in the literature as the governments' effort to assess and implement policies on poverty not exclusively focusing on income.

In the same vein of multidimensional analysis, Sen (1984, 1992, 2000) posits that individuals' achievement of a fulfilled life includes something more than income. Thus, he claims that the poverty income paradigm should be replaced by a poverty paradigm in the space of *capabilities* that allows some relevant *functionings* for individuals who live fulfilled lives. He has argued that the capability approach has advantages over approaches based on resources (e.g. income) or utility. For instance, income is part of the means to achieve an objective, thus, "…the value of the living standard lies in the living, and not in the possessing commodities…." (Sen, Muellbauer, and Hawthorn (1987), p. 25). Sen criticizes the utilitarian welfare theory because in the redistributive analysis it ignores the relevance of goods differentiation and individuals' heterogeneity. Sen's research has posited the multidimensionality approach on capabilities and functionings to address poverty, which is the theoretical foundation of the AF methodology (Alkire & Foster,

2009, 2011; Alkire et al., 2015) that I will use in the dissertation. Although Sen's multidimensionality approach has been applied to poverty analysis, I believe the approach's philosophical tenets can be extended to the calculation of the middle segment of the society.

As for poverty analysis, Sen posited two stages to calculate the number of poor people: identification and aggregation stages (Sen, 1976). In the identification stage, some criteria are applied to select who is poor. Then, in the aggregation stage, using a specific functional relationship, all individuals are added up and counted to give the final number of poor people. The AF methodology applies these stages and suggests the following steps for implementing its procedure:

> 1. Defining a set of relevant indicators;
>
> 2. Defining a threshold (deprivation cut-off in the case of poverty) for each indicator such that if the person does not reach it, she is considered deprived;
>
> 3. Creating binary deprivation status for each person in each indicator, where 1 is deprived and 0 non-deprived;
>
> 4. Assigning a weight or deprivation value to each considered indicator;
>
> 5. Producing a deprivation score by taking the weighted sum of deprivations (or counting the number of deprivations, if they are equally weighted);
>
> 6. Setting a threshold score of poverty (or poverty cut-off) such that if the person has a deprivation score at or above the threshold, she is considered poor. Alkire et al., 2015, p. 123.

The selection of dimensions and cut-offs falls into the category of *normative economics* that refers to "what should do" in opposition to *positive economics* "what reality is". Based on the normative perspective, the selection of dimensions will draw upon different types of assessments such as expert assessments, empirical assessment, deliberative insights, theoretical assessments, practical constraints, and policy relevance (Alkire et al., 2015). In the dissertation, I extend the AF methodological flexibility and refinement to address the empirical calculation of the middle segment of the society.

Empirical methodologies by Sen's approach face several challenges including: i) defining the dimensions for the analysis, ii) explicitly stating the ethical values that affect the definitions of dimensions' thresholds and weights, and iii) the effective reflection of *freedom* as part of *capabilities*. In the next paragraphs, I discuss these three challenges.

The first challenge implies a wide range of possible dimensions. For instance, the Scandinavian approach to welfare integrates the following domains [dimensions] of human life: health and access to health care, employment and working conditions, economic resources, education and skills, family and social integration, housing, security of life and property, recreation and culture, and political resources (Aaberge & Brandolini, 2015). Another scholar using the capability approach is Nussbaum (2003), who proposes the following "central human capabilities": life, bodily health, bodily integrity, senses, imagination and thought, emotions, practical reason, affiliation, care about other species, play and leisure, and control over one's environment. Also, Stiglitz, Sen, and Fitoussi (2009) include as relevant dimensions: material living standards, health, education, personal activities including work, political voice and governance, social connections and relationships, environment (present and future conditions), and

economic and physical insecurity. These three examples illustrate the variety of dimensions and their interpretations depending on the theoretical perspective.

The second challenge poses a choice of indicators once a set of dimensions is selected. Each dimension can be measured using several indicators, and each indicator can have a different level of measurement, making their definitions difficult. For instance, cardinal continuous variables (e.g. income), dichotomous variables (e.g. well-nourished or not), and categorical variables (e.g. education attainment) can be combined into an index using statistical procedures. However, doing this does not necessarily keep the desirable properties that other multidimensional measures demand (e.g. indices based on factor analysis). However, the AF approach has demonstrated the ability to perform the calculations, maintaining the desirable properties of economic poverty analysis (Alkire et al., 2015).

As the third challenge, data availability is an unavoidable constraint in all empirical studies. In the case of multidimensional measures, some theoretically desirable dimensions cannot be operationalized through indicators. For instance, poverty research has identified additional or missing dimensions. According to Alkire (2007) they are: i) quality of work, ii) empowerment, iii) physical safety, iv) social connectedness, and v) psychological well-being. For the dissertation, I consider missing dimensions that likely are relevant in the Colombian context: i) access to financial services (e.g. debit and credit card), ii) leisure, iii) “consumption” of cultural good/services, and iv) social network (e.g. channels for finding job). Although they are relevant dimensions, they are not operationalized in this dissertation due to data limitations.

2.2.1. Dimensions Selection for the Middle Segment of Society and Polarization

Drawing upon the previous discussion on several useful dimensions, in the following sections I provide the rationale for selecting dimensions to operationalize both the middle segment of society and polarization from a multidimensional perspective. I ground my selection on three sources. First, I use information of the C-MPI as the main empirical reference. The C-MPI is the relevant empirical reference because it is an application of the AF in the Colombian context and has been part of the government dashboard of official policy monitoring indices since 2012 (Angulo et al., 2013; CONPES, 2012) (see Appendix 3).

Second, I compared the dimensions definitions of the C-MPI with the dimensions definitions proposed in the literature on human development previously discussed, and I included dimensions based on the similarities I found among several definitions.[11] Third, I also compared multidimensional poverty indices among Latin American countries (Atkinson, 2016). The comparison results suggest the dimensions relevant both for policy purposes and feasible for empirical measurement (see Table 2). Thus, literature on multidimensional poverty suggests that an analysis of classes/income populations always share a limited group of dimensions that are relevant to classify people.[12] Therefore, I believe this justification can be extended to the operationalization of the middle segment of society and polarization. I selected some dimensions from the multidimensional poverty empirical approach (such as education, health and employment). Unlike the

[11] Gasparini, Sosa, Marchionni, and Olivieri (2013) assess multiple dimension of poverty for Latin America and include in dimension services: water and electricity; and in dimension durable goods: fixed phone, cell phone, computer and internet.

[12] "Myth: possible and relevant dimensions are endless. Fact: poverty measures regularly use very similar dimensions" (Alkire et al., 2015)

process of selecting dimensions, selecting and conceptualizing indicators is a more challenging task. The rationale for creating each indicator is described in detail in section 3.4.

Table 2 Dimensions in Official Multidimensional Poverty Indices in Latin America

Country	Dimensions	Reference
Chile	1) **Education**, 2) **Health**, 3) **Work** and **Social Security**, 4) Basic Standard of Living	Government of Chile 2015
Costa Rica	1) **Education**, 2) **Health**, 3) **Work** and **Social Security**, 4) Basic Standard of Living	Government of Costa Rica 2015
Colombia	1) **Education**, 2) Childhood and Youth, 3) **Work**, 4) **Health** Care, 5) **Housing** and Public Services	CONPES 2012
Ecuador	1) **Education**, 2) **Health**, Water and Nutrition, 3) **Work** and **Social Security**, 4) **Housing** and Public Services	Castillo Añazco and Jácome Pérez 2016
El Salvador	1) **Education** and Childhood, 2) **Health** and Food Security, 3) **Work**, 4) **Housing**, 5) Security and Environment	Government of El Salvador 2015
Mexico	1) **Education**, 2) Access to **Health** Care, 3) Access to Food, 4) Access to **Social Security**, 5) **Housing**, 6) Basic Home Services, 7) Income	CONEVAL 2010

Source: Atkinson (2016) Table 2.2, p.158.

Therefore, I propose to address the empirical operationalization of the Colombian middle segment of society through the multidimensional middle-class (MMC), and I also propose to address the empirical operationalization of the polarization through the index of multidimensional polarization (IMP). Both the MMC and the IMP will include the following dimensions: i) Income, ii) Employment, iii) Education, iv) Health, v) Assets and vi) Housing.

2.3. The Middle Segment of the Society and the Dimensions that Define It

The middle income population (MIP) and the middle class (MC) are two analytical categories used by scholars, government and policy analysts to address the study of the middle segment of the society. The middle segment of the society often is referred just as the middle-class, and the MIP and the MC are used interchangeably,

although, both analytical categories entail different theoretical backgrounds. Operationalization of the MIP comes from economics based on a country's income distribution. Alternatively, operationalization of the MC comes from sociology based on occupational categories built upon work related activities.

The theoretical frameworks for both operationalizations have substantial differences. For instance, the MIP grounds on the economic agent which is a theoretical concept that describes a person's behavior and represents any individual in a society. The economic agent has these three fundamental features: i) the agent's decisions on goods and services consumption are based on a preferences structure; ii) the agent's goal is to maximize her utility – or satisfaction –, however, her utility depends on her level of consumption, and her level of consumption is constrained by her income budget; and iii) the agent aims to reach higher levels of utility with higher levels of income (Mas-Colell, Whinston, & Green, 1995; Varian, 2003). Thus, for the purpose of analyzing the middle segment of the society, individuals in a society can be ordered from the lowest income level to the highest income level. Therefore, the MIP includes the population identified in the middle segment of the income ordering – income distribution – between a lower and an upper bound (Ferreira et al., 2012; Gasparini, Cicowiez, & Sosa, 2012).

On the other hand, identifying the MC involves analyzing social groups and their location in a society, based on the social relationships of production. The MC has features such as individuals' property over the means of production, individuals' type of relationships – either of exploitation or domination, and their intensity – and the previously listed characteristics in light of the historical context (Wright, 1997). The literature about class location also indicates that the occupational categories – to approach

classes' characteristics – were defined based on country-specific contexts. Thus, there are several proposed class schemes used to calculate the size of the MC (Goldthorpe & McKnight, 2006; Wright, 1983).

Although economists and sociologists study the middle segment of society with fundamentally different theoretical frameworks, both groups of social scientists agree about this segment's relevance for socioeconomic analysis and they associate countries with a large middle segment with more economic development, implementation of progressive policies, and political stability (Acemoglu et al., 2015; Bergh, 2004; Birdsall, 2012; Brown & Hunter, 1999; Dallinger, 2013; Easterly, 2001; Landes & Rogers, 1998; Pressman, 2016; Solimano, 2008).

In addition, enlarging the size of the middle segment of society will potentially, "…[reduce] the polarization between the rich and the poor, thus potentially enhancing social cohesion and reducing sources of conflict. The middle-classes can also ease the formation of alliances that can give rise to greater redistribution and thus help to reduce [income] poverty through the political process" (Cruces, López-Calva, and Battistón (2011), p. 3).

The previous discussion states that each operationalization focuses on just one dimension, either income (the MIP) or occupational categories from employment (the MC). The literature that calculates the size of the MIP or the MC presents a pattern: after its calculation, the population in the MIP or the MC is then characterized with additional indicators in relevant dimensions such as education, health, household composition, and employment status, among others. Because Sen's approach states that a multidimensional perspective demands including the relevant dimensions to accurately measure a segment

of the society, in this dissertation I will ground on empirical literature my selection of the additional four dimensions to operationalize the middle segment of the society. The additional four dimensions are: education, health, housing and assets. Therefore, in the next sections, I present literature on the relevance of the MIP and the MC as leading operationalized concepts, and their potential contributions to the empirical definition of each indicator for the MMC and the IMP.

2.3.1. Literature on Operationalization of the Middle-Income Population (MIP)

The literature on operationalization of the MIP lacks unified criteria. However, two types of measures are identified from empirical studies on this topic: relative and absolute measures.

Relative Measures. Relative measures use statistical characteristics of the income distribution as a reference. Based on the income distribution, researchers analyze the MIP by first setting the lower and upper income percentiles, then calculating the size of the MIP, or first setting the size of the MIP, then identifying the lower and upper income percentiles. The former analysis is more common than the latter. Similarly, researchers who set the lower and upper percentiles first, often use the fiftieth percentile (the median value of income distribution) as the reference to define the MIP interval (Gasparini et al., 2012). In some cases, the interval is symmetrical – the median is multiplied by the same proportion to set both lower and upper income percentiles. In other cases, the researcher justifies her upper and lower bounds' selection.

Among researchers who set first the lower and upper income percentiles as a percentage of the median income value are Thurow (1984), who defined the MIP as the

population with income between 75% and 125% (as did Birdsall, Graham, and Pettinato (2000)); Blackburn and Bloom (1985), who changed the cut-off points to 60% and 225%; Leckie (1988), who used cut-off points of 85% and 115%; Davis and Huston (1992), who applied 50% and 150% as cut-offs; and Atkinson and Brandolini (2013), who made their estimations with 75% and 200%.

Researcher who first set the size of the MIP before determining the cut-off points on the population percentiles include Levy (1987), who sets the MIP as the population between the 20th and 80th percentiles;[13] Alesina and Perotti (1996), whose application describes the income share of the third and fourth quintiles of the distribution; Partridge (1997), who uses the middle quintile; Easterly (2001) and R. J. Barro (2000), who use the middle three quintiles; and Solimano (2008), who focuses on the third through the ninth deciles.

Absolute Measures. Absolute measures define income levels for their upper and lower bounds. Milanovic and Yitzhaki's (2002) research is among examples of those using the MIP intervals in this type of measure. Their research used global wide estimations and defined the MIP as the average per capita incomes between 12U$PPP[14]/day and 50U$PPP/day. Banerjee and Duflo (2008) use expenditure for their calculations, setting the interval between 2U$PPP/day and 10U$PPP/day. Ravallion (2010) sets the interval between 2U$PPP/day and 13U$PPP/day; Kharas (2010) defines "the global middle-class" between 10U$PPP/day and 100U$PPP/day. With a different approach, Birdsall (2007) uses absolute and relative bounds because her definition of the

[13] An index developed by Levy to capture the interaction between polarization and the MIP was criticized by Foster and Wolfson (2010) because his empirical strategy was inaccurate and misguided.
[14] Purchasing Power Parity (PPP), 2005 US$ PPP per day.

MIP includes people at or above the equivalent of 10U$PPP/day, and at or below the 90th percentile of the income distribution in each country analyzed in her study.

Less common but empirically appealing are the studies on endogenous definitions of the thresholds. For instance, D'Ambrosio, Muliere, and Secchi (2003) find cut-off points in the income distribution for each income class based on different assumptions on the data generator process. This methodology was implemented by Olivieri (2007) with data from Argentina. The use of non-parametric statistical techniques was performed by Zhu (2005), who applies adaptive kernel density estimations, and Massari, Pittau, and Zelli (2009), who applies the relative distribution approach to overcome arbitrariness in the definition of the thresholds. Gigliarano and Mosler (2009b) addressed the size of the MIP in terms of inner cohesion and dispersion applying models from physics. Table 3 summarizes the different types of measures of the MIP with exogenous defined cut-off points.

Table 3 Comparison of the MIP Measures*

Comparison of Relative and Absolute Measures		
Relative Definitions of the MIP Percentiles of Income Distribution		
Thurow (1984) & Birdsall et al. (2000)		$.75y(p_{50})\leq y_i\leq 1.25y(p_{50})$
Blackburn and Bloom (1985)		$.60y(p_{50})\leq y_i\leq 2.25y(p_{50})$
Leckie (1988)		$.85y(p_{50})\leq y_i\leq 1.15y(p_{50})$
Davis and Huston (1992)	$i \in$ *middle-class*	$.50y(p_{50})\leq y_i\leq 1.50y(p_{50})$
Atkinson and Brandolini (2013)		$.75y(p_{50})\leq y_i\leq 2.0y(p_{50})$
Alesina and Perotti (1996)		$p_{40}\leq p(y_i)\leq (p_{80})$
Partridge (1997)		$p_{40}\leq p(y_i)\leq (p_{60})$
R. J. Barro (2000) & Easterly (2001)		$P_{20}\leq p(y_i)\leq (p_{80})$
Solimano (2008)		$P_{20}\leq p(y_i)\leq (p_{90})$

(continued)

Table 3 (continued) Comparison of the MIP Measures*

Comparison of relative and absolute measures		
Relative Definitions of the MIP Percentiles of Income Distribution		
Thurow (1984) & Birdsall et al. (2000)	$i \in$ *middle-class*	$.75y(p_{50}) \leq y_i \leq 1.25y(p_{50})$
Blackburn and Bloom (1985)		$.60y(p_{50}) \leq y_i \leq 2.25y(p_{50})$
Leckie (1988)		$.85y(p_{50}) \leq y_i \leq 1.15y(p_{50})$
Davis and Huston (1992)		$.50y(p_{50}) \leq y_i \leq 1.50y(p_{50})$
Atkinson and Brandolini (2013)		$.75y(p_{50}) \leq y_i \leq 2.0y(p_{50})$
Alesina and Perotti (1996)		$p_{40} \leq p(y_i) \leq (p_{80})$
Partridge (1997)		$p_{40} \leq p(y_i) \leq (p_{60})$
R. J. Barro (2000) & Easterly (2001)		$P_{20} \leq p(y_i) \leq (p_{80})$
Solimano (2008)		$P_{20} \leq p(y_i) \leq (p_{90})$
Absolute Definitions of the MIP		
Milanovic and Yitzhaki (2002)	$i \in$ *middle-class*	U\$12≤y_i≤U\$50 a day
Banerjee and Duflo (2008)		U\$2≤y_i≤U\$10 a day
Kharas (2010)		U\$10≤y_i≤U\$100 a day
Ravallion (2010)		U\$2≤y_i≤U\$13 a day
López-Calva and Ortiz-Juarez (2013) & Ferreira et al. (2012)		U\$10≤y_i≤U\$50 a day
Absolute and Relative Measures Combined	$i \in$ *middle-class*	
Birdsall (2007)	*for each country*	U\$10 a day≤$y_i \leq (p_{90})$

Source: Author's adaptation based on Ferreira et al. (2012), p. 32.
*Notation: p = F(y) representation of income distribution.

Conceptually, the vulnerability-to-poverty approach also has shaped the operationalization of the MIP. Cruces, Gasparini, Bérgolo, and Ham (2010) apply this approach with data of 18 Latin American countries. They estimate the lower and upper bound for the vulnerable population – a new population classification different than the three traditional ones – by predicting the risk of falling into poverty in the future. They created a synthetic panel data[15] based on cross sectional data for the 18 Latin American countries. Because the vulnerable population is located between low-income and middle-

[15] Dang, Lanjouw, Luoto, and McKenzie's (2014) technique to asses poverty changes with repeated cross-sectional surveys.

income populations, the vulnerable population upper bound is the same as the middle-income population lower bound. The authors also validated their methodological strategy using real panel data available for Argentina and Chile. The heterogeneity among countries is statistically well predicted by the methodology after the robustness checks with the panel data.

A similar exercise was performed by Dang and Lanjouw (2016) with information from the United States and Vietnam. Their exercise also is based on synthetic panel data to measure changes in poverty applying the vulnerability-to-poverty approach. The World Bank (Ferreira et al., 2012) and the Inter-American Development Bank (Stampini et al., 2015) follow the vulnerability-to-poverty approach for measuring the MIP.

An often referenced application of the vulnerability-to-poverty approach is the Lopez-Calva and Ortiz-Juarez's (2013) paper. In the paper the authors link vulnerability and economic security (Goldthorpe & McKnight, 2006) focusing on "an income value that corresponds to a minimum requirement for the *functionings* – in Sen's sense – that define the middle-class". The authors posit that this approach "…[the approach] moves [researchers] a little closer, … to the concept of a common `lifestyle,' – including certain consumption patterns and cultural habits – that sociologists in the Weberian tradition associate with class." The authors "choose one particular `functioning' namely economic security, as the defining characteristic of the middle-class. And economic security is measured, in turn, as the converse of vulnerability to falling into poverty." (Ferreira et al. (2012), p. 32). Therefore, they claim this as the empirical link between economics and sociology also framed by Sen's perspective. Their empirical calculations define as a lower bound 10U$PPP/day and an upper bound 50U$PPP/day. In the same vein, Ferreira

et al. (2012) complement the class analysis including the vulnerable class for the Latin America region as those between 4U$PPP/day and 10U$PPP/day.

2.3.1.1. The Middle-Income Population in Latin America and the World

2.3.1.1.1. Latin American Countries

In Latin America, most analyses have measured the middle segment of the society through the MIP. Dayton-Johnson (2015) presents different empirical applications for selected Latin American countries in Table 4. Dayton-Johnson's summary information emphasizes the lack of unified criteria, which results in highly heterogeneous estimations of the size of the MIP. For instance, the size of the Colombia's MIP in 2010 ranges from 36% to 51%. While estimations based on Ravallion's measure show the highest value for Colombia of 49% and the lowest for Argentina of 10%, estimations based on the World Bank's measure show the highest value for Argentina and Chile of 66% and the lowest for Colombia of 51%.

Table 4 Different Estimates of the Size of the Latin American Middle-Class (Percent of Population)

Definition	**4 times Urban Poverty Line – 90th percentile (ECLAC-CEPAL)**	**$10-100/day (Kharas)**	**`50-150' (OECD)**	**$2-10/day (Banerjee and Dufflo)**	**$2-13/day (Ravallion)**	**$10-50/day (World Bank)**
Year	**2006**	**2005**	**2010**	**2010**	**2010**	**2010**
Argentina	74	53	55	6	10	66
Brazil	53	34	43	28	38	56
Chile	70	46	52	18	30	66
Colombia	39	25	47	36	49	51
Mexico	48	60	53	27	41	64
Peru	32	31	51	21	39	65

Note: Definitions of these measures are provided in the text. Years are not consistent for all countries.

Source: Dayton-Johnson (2015) Table 1.1, p. 17.

More evidence of different sizes of the MIP are presented by Castellani and Parent (2011), who apply relative and absolute definitions to estimate the size of the MIP in 10 Latin American countries and analyze mobility just for Peru and Chile. Authors' calculations of the size of the Colombia's MIP in 2008 are: 62.9% with 2-20U$PPP/day interval, 60% with 2 to 4 quintiles interval, 49.4% between 0.5 and 1.5 of the median income value, and 33% using poverty lines definition. The authors link their results on the MIP with social mobility. To link them, they calculate additional indices that suggest the gaps among income populations and the amount of income needed to move *from* lower income populations *to* upper income populations. They calculate that overall, "the region [Latin America] shows smaller middle-classes than more advanced countries, pointing its [the region] higher levels of inequality" (Castellani and Parent (2011) p. 34).

Castellani, Parent, and Zentero (2014, 2015), who analyze the MIP in selected Latin American countries, use Colombia as an emblematic example of fragility. The authors define the MIP's bounds as 50% and 150% of the median value of the income distribution (Davis and Hudson's (1992) cut-offs). They found that for the selected Latin American countries the MIP ranges between 40% and 60%, but Colombia and Bolivia have the smallest sizes of the MIP, 46% and 44%, respectively. The authors use Colombia as a case study to analyze population conditions if they are simultaneously in the MIP and multidimensional poverty based on the C-MPI. Their findings show that people classified in the MIP still face deprivation as multidimensional poor due to lack of formal employment, education, and access to health services. However, the percent of population in this double condition (belonging to MIP but facing multidimensional deprivations as poor) has reduced from 57.9% in 1997 to 26.7% in 2010.

Angulo, Gaviria, and Morales (2014) present optimistic outcomes from policies enacted between 2002 and 2011 in Colombia, although, the size of the MIP in the Latin American context is small. They calculate that the size of the MIP in Colombia (population between 4U$PPP/day and 10U$PPP/day) went up from 16% to 27%, and the poverty rate went down from 50% to 34%. The authors claim this positive outcome links significantly to 36% increase in the household income in real terms.

Stampini et al. (2015) construct a synthetic panel data for Latin America to estimate the MIP for each country. Based on their results, Stampini et al. highlight the reduction of poverty from 46.3% in 2000 to 29.7% in 2013 for the region, although, 14% of the MIP experienced poverty at least once in the period. Stampini et al. sub-classify the MIP in two groups, the vulnerable MIP (population between 4U$PPP/day and 10U$PPP/day) and the consolidate MIP (population between 10U$PPP/day and 50U$PPP/day). The sizes of both categories for Latin America are 30.5% and 37.6%, respectively. For Colombia, the estimated sizes are 27.2% and 36.7%, respectively.

Solimano's (2005) addresses the linkage of social and economic policies with the MIP in Latin America. He underlines the undesirable and unanticipated results of market-driven policies in the region. Solimano's research identifies an adverse scenario for the MIP because no reciprocity exists between the amount of this population's tax contribution and the amount of public services this population obtained and enjoyed in exchange. Solimano's policy recommendation focuses on including the MIP in the beneficiary group of social policies in Latin America, which will make the MIP less reluctant to make tax contributions.

Solimano (2006) also links governance with distributives policies in unequal societies. Assets, such as land ownership, house ownership and financial assets, have a concentration in high-income populations, which deepens inequality in the region. In particular, limited access to credit and financial services by the low-income population differentiate them from the remaining proportions of the population. His policy recommendation aims at democratizing access to those assets as building blocks of a transition from a developing toward a developed economy. In other words, "more widespread and less unequal ownership of assets in society can have a growth dividend by unleashing creativity, entrepreneurship and innovation latent in groups that traditionally have little access to formal capital markets and the legal system" (Solimano (2006) p. 21).

Lustig (2015) analyzes the re-distributional effects of fiscal policies on inequality in selected middle-income countries, including Brazil, Chile, Colombia, Indonesia, Mexico, Peru and South Africa. Lustig's research finds counter-intuitive results for Colombia and Brazil because a headcount poverty ratio increases post-tax policies implementation, fundamentally for the high consumption taxes on basic goods. Total spending on education is pro-poor (progressive) in all analyzed countries but Indonesia. Total health spending is pro-poor in Brazil, Chile, Colombia and South Africa, almost neutral in Mexico, and pro-rich (regressive) in Indonesia and Peru.

The literature referenced thus far presents analyses that use objective measures or income-based measures. However, analyses exist that use subjective measures that estimate the size of the middle segment of society based on self-perception of a specific group. Although subjective analyses have focused mostly on poverty (Castilla, 2010;

Gasparini et al., 2013; Gluzmann & Gasparini, 2017); Lora and Fajardo (2013, 2015) focus their analysis on all societal segments using data from the 2007 World Gallup Poll, which includes among its questions some related to the subjective topics. The authors analyze the (mis)match between objective and subjective measurements, where the latter ones are based on individuals' social self-perception. Answers about individuals' social self-perception on their relative wealth position (on a scale from 0 to 10), allow calculating a proxy for the size of the MIP. The matching percentages between self-perception and objective measure of the MIP ranges from 24% to 69%, depending on which factor of the subjective measure is compared with the objective measure of the MIP. Their findings show a significant mismatch between both types of measurements. This conclusion also is shared by Penfold and Rodríguez-Guzmán (2014).

2.3.1.1.2. The MIP in other Countries of the World

Expanding the discussion beyond Latin America, Chun (2010) and Amoranto, Chun, and Deolalikar (2010) present analyses of the size of the middle class for the Asia region from a historical perspective, and from individuals' self-perception, respectively. On one hand, Chun sets the MIP between 2U$PPP/day and 20U$PPP/day, and the vulnerable population between 2U$PPP/day and 4U$PPP/day. The time span of Chun's study covers 1990 to 2008 and concludes that the size of the MIP has increased, where China's contribution has been the most significant. On the other hand, Amoranto et al. use the World Values Survey[16] to create six indices of values: market competition, upward mobility, trust, gender inequality, value of science and technology, and political

[16] www.worldvaluessurvey.org

activism. The MIP ranks first for the average value of the index science and technology, and ranks in second place for the average value of the remaining indices. In addition, those who classified themselves as being in the MIP have higher levels of education and more skilled jobs, compared with those who classified themselves in the lower-income population. The class self-perception and self-income classifications do not show a clear pattern across countries.

Lin and Treichel (2012) present an interesting link between the regions of Asia and Latin America. Their research offers lessons from China's experience that are useful for Latin American countries. The authors suggest policies in technological innovation, industrial upgrading, economic diversification, focusing on comparative advantages, and educational policies toward more skilled and capital-intensive jobs as key elements that will contribute to accelerate income growth and overcome the middle-income trap.

Bourguignon, Ferreira, and Lustig (2004) also study the historical development of some Latin American[17] and Asian countries. They find that there is high heterogeneity across countries in this region. But, evidence also exists of increasing inequality for both regions, although it is less in Asia compared to Latin America.

For non-Latin American western countries, Dallinger (2013) contributes to the debate on the reduction of the size of the MIP in developed post-industrial countries. The distance between the middle third quintile and the fifth quintile has increased in the period of 1985 to 2005. Part of the explanation for this trend is supported by the fact re-distribution policies mainly target the low-income population, leaving the MIP less protected against eventual negative shocks and expose to economic crisis such as 1998's.

[17] Alvaredo and Gasparini (2015) present an updated and detailed description of inequality for developing countries that includes Asia and Africa.

The author highlights the importance of individuals in the MIP benefiting from broaden social policies reducing the adverse consequences of unexpected economic shocks.

2.3.1.2. Empirical Limitations of the Income Related Variables

As the previous sections indicate, income is the most used variable for empirical estimations of poverty, inequality, class classification, mobility and polarization (Gasparini et al., 2012). Income is classified as a component of individual achievement because individuals make decision on education, employment, investments, and family conformation which affect their income level. However, income can also be understood as an outcome of opportunities[18] because parents' income is given as an endowment to their children. Scholars generally agree that individuals' outcomes should not be – totally – determined by their initial conditions. Yet, the concept of opportunity is empirically challenging to operationalize, it has an ambiguous correlation with other variables, and by definition, it is multidimensional. Hence, aside from theoretical support for income as the welfare variable of measurement (Mas-Colell et al., 1995; Varian, 2003), income is most often used because "[it] provides a natural metric on a single dimension, facilitating the location of a 'middle group' " (Ferreira et al. (2012), p. 31).

Consumption is the alternative variable that has been used to obtain more accurate estimates of poverty and inequality. Both income and consumption are flux variables, meaning that they must be defined in term of specific time unit (e.g. day, month, or year). Thus, the definition of time unit is relevant since a very short period might not be

[18] Opportunity as a topic is as relevant as fruitful, however is not part of the dissertation theoretical framework. For a complete and updated discussion on Equality of Opportunity see Roemer and Trannoy (2015). For Colombia, a good application is presented by Velez, Azevedo, and Posso (2010).

representative of individuals' welfare along their lives, or very long periods can distort the conclusions. Hence, annual income is the most common and widely accepted time span applied by scholars.

The selection of income or consumption also has practical challenges. For instance, the retired population can maintain their consumption level based on savings or returns of shares and investments, if income is the measured selected this might lead to classify retired population in the low-income category, which might overestimate the poverty rate. Another challenge is that information related to consumption from households is obtained by different time spans (e.g. week, month, quarter and yearly) in the national surveys, thus, choosing one-time span measurement includes some purchases and services, and excludes others. Regardless the time span, income fluctuates more than consumption, which makes the relationship between income and other welfare measurements weak. Therefore, consumption is theoretical preferable to income, but income is more practical to use than consumption.

Nonetheless, practical advantages support using consumption as an alternative to income. One of the advantages is that people answer more accurately and honestly questions regarding consumption than income; in fact, income is under-declared very often. Another advantage is that consumption by definition is what remains after direct taxes, thus, its information is reliable, while accuracy between gross income or net income is not clear because income after-tax information is not reliable – most of all in Latin American countries (Gasparini et al., 2012).

After comparing developed countries with developing and poor countries, Deaton (2003) states that is easier to measure income than consumption in developed countries

because a significant proportion of the people has formal jobs, while consumption demands very extensive surveys. Developing countries experience the opposite situation, where measuring income is more difficult since the proportion of people with informal jobs is high and the agricultural activities still are important portion of economic activity. In Colombia surveys include questions on income and consumption. However, income is the most used variable to perform analyses for public policy and academic research.

In addition to the income/consumption dichotomy, the decision about the unit of analysis or measure, either household or individual, is a key methodological element. The natural candidate for the analysis is the individual. However, individuals are clustered in dwellings. The clustering introduces new features that demand additional steps to address the analysis of income distribution. For instance, in the same dwelling two or more families might live (this happens most of all in the low-income population); hence, surveys should capture information taking into account this specific feature. The objective is creating the variable *family income* as accurate as is possible imputing the appropriate income sources per each family within a dwelling.

After identifying *family income*, the objective is calculating *per capita family income* (*pcfi*). The *pcfi* is a simple average income per each family member regardless if each one of them has some type of employment or income source. The assumption for this calculation is that all family members enjoy the same level of welfare, therefore the indicator – income level – should be the same for all of them. This is the official indicator for Colombian poverty income measurements (DANE, 2014), which means is not adjusted for *adult equivalent scales*.

The *adult equivalent scales* concept relates to another relevant characteristic, the adjustment of income due to families' demographic composition or number of household members. The rigid assumption of equal distribution among family members is difficult to support. Changes to this assumption include taking into account realistic family features such as age, gender or physical activities. As consequence, several scales for equivalences (*adult equivalence scales*) were posited to overcome the unrealistic measurement (Deaton, 1997). The scales are tables based on nutritional studies, subjective needs, individuals' behavior and *ad hoc* specifications. These perspectives do not eliminate arbitrariness in the calculation and have practical difficulties for their application as well (Gasparini et al., 2012). However, there are several mathematical specifications that can fit the criteria of the researchers (Cowell, 2011; Lambert, 2001).

$$pcfi\_s_{ih} = \frac{family\ income_h}{\sum_{j \in h} a_{jh}} \ \forall i \in h$$

Equation 1

Equation 1 serves as an example of an equivalent scale application. The denominator changes for the equivalent value *a* (e.g. *a*=0.5 if a child is "equivalent" to half adult), thus the new indicator is *family income adjusted per equivalent scales.*

Economies of scale can also be included in the calculations. The assumption in this case is that some resources such as utilities or goods are shared based on common preferences of family members. Calculations taking into account economies of scale can be made with Equation 2, where $\theta \in [0,1]$ and N is the number of family members.

$$pcfi\_e_{ih} = \frac{family\ income_h}{N_h^{\theta}} \ \forall i \in h$$

Equation 2

Both adult equivalent and economies of scale can be combined in one expression as follows in Equation 3,

$$pcfi\_se_{ih} = \frac{family\ income_h}{\left(\sum_{j \in h} a_{jh}\right)^{\theta}} \ \forall i \in h$$

Equation 3

Equation 4 and Equation 5 are specifications classified into the *ad hoc* category, where M_h is number of adults in the family and C_h is the number of children in the family, $\alpha \in [0,1]$, and $\alpha < \beta$.

$$pcfi\_ah1_{ih} = \frac{family\ income_h}{(M_h + \alpha C_h)^{\theta}} \ \forall i \in h$$

Equation 4

$$pcfi\_ah2_{ih} = \frac{family\ income_h}{1+\beta(M_h - 1)+ \alpha C_h} \ \forall i \in h$$

Equation 5

The previous equations summarize the theoretical and practical challenges regarding the measurement of income for empirical applications. In this dissertation, I overcome several of these challenges using the AF methodology, which I detailed in section 3.1.

2.3.1.2.1. Dalton-Pigou's Transfers Principle and Its Relevance in The Distributive Analysis

This dissertation relies heavily on analytical tools of the distributive analysis. The distributive analysis developed a theoretical framework to assess policies that affect income distribution. Thus, to measure the middle segment of the society, I will apply a methodology that is consistent with the most relevant properties and principles of

distributive analysis. The welfare theory in economics uses a perfect egalitarian distribution as a theoretical construct to compare and measure the distance between the reality and the theoretical egalitarian scenario. Thus, literature in welfare economics has compared characteristics of income distributions among countries, periods, or other analytical categories having as a reference the egalitarian scenario. This is the essence of Lorenz's curve and Gini coefficient, two widely used indicators of inequality. The distributive analysis (a sub-topic of welfare economics) has studied the theoretical properties of the egalitarian scenario to assess when an income transfer between individuals approaches a society to a more egalitarian outcome. The Dalton-Pigou's (DP) transfers principle is the most used property to perform this type of assessment.

The DP transfers principle (Dalton, 1920) states that every income equalizing transfer leads to a less unequal income distribution. Equalizing income transfer means transfers from high-income population toward low-income population that does not worsen the original relative ranking of individuals in the distribution (Cowell, 2011). In other words, as the poor improve their situation, the rich do not worsen theirs, and the entire society is better off overall.

Although theoretically relevant, the principle has empirical challenges. First, in real life there is no perfect information to make a transfer that accomplish this property; such as the limitations described in section 2.3.1.2. Second, the principle only affects the ordering of the distribution but does not quantify how much inequality exists among distributions. And third, it is empirical impossible to compare vectors of distributions of thousands, or millions of observations without using some type of summarizing index. These reasons lead to the creation of inequality indices that contains relevant information

for making comparisons. It is expected that an inequality index accomplishes the following standard properties.

i) Dalton-Pigou (DP) property. Every equalizing income transfer should show a reduction in inequality through the index.

ii) Invariance to scale. If the income of every individual in a specific population are multiplied by the same positive constant, the inequality index does not change. This property is related to relative measurements. It supports inter-temporal comparisons or geographical categories comparisons (e.g. expressing all countries' income in terms of US Dollars of Purchasing Power Parity). When the objective is to focus on absolute differences, the property is Invariance to Translations.

iii) Invariance to replications. This property states that if the index is calculated for several samples extracted from the same original population, for each one of the samples extracted the index should be the same.

In this dissertation, I will apply the Alkire-Foster (AF) methodology to calculate the MMC and indices based on the AF[19] methodology accomplish the DP transfers principle. Thus, applying the AF methodology guarantee capturing relevant positional changes in individual distribution ranking.

2.3.2. Literature on Operationalization of the Middle class (MC)

The question of the size of the middle segment of the Colombian society can also be addressed from a different discipline, that not necessarily focuses on income as empirical tool. In the following sections, I review the sociological literature to present

[19] As for multidimensional indices, their properties have been discussed by Kolm (1976), Maasoumi (1986) and Atkinson and Bourguignon (1982).

different empirical testing of the MC that is associated with distinctive theoretical developments. This will contribute to expand and complement my proposal to measure the middle segment of the society. Although the theoretical frameworks have some elements in common, they have conceptual differences that also are influenced by historical and geographical contexts. In the next sections, I will present the classical perspectives of class analysis, their historical evolution, and how they contribute to the definition of the MC in the Latin American context.

2.3.2.1. The Classical Theoretical Frameworks of Class Analysis

The classical theoretical frameworks of class analysis are Marxist, Weberian, and Structuralist theories. None of them address straightforwardly the concept of the MC. Instead, each theory's features and frameworks allow researchers to infer the likely characteristics of the MC. Likewise, the three theoretical frameworks provide the foundations of contemporaneous analyses of the MC.

From the Marxist theoretical framework, social groups or classes are differentiated by the social division of labor in a specific historical context. Hence, material transformation happens in society based on how it organizes the productive labor and the means of production. Therefore, ownership over the means of production allows a clear identification of two classes: the bourgeoisie (owners of capital) and the proletariat (the labor force) (Wright, 2005).

The relationship between the bourgeoisie and the proletariat is characterized by exploitation that reflects the opposition between the interests of each class and creates the constant conflict and tension between them. In this vein, the Marxist theory does not

identify the MC explicitly because it interprets the MC just as a transitional group in the historical process. In addition, classes different from the bourgeoisie or the proletariat are considered subdivisions, such as petty bourgeoisie, of the main two classes.

From the Weberian theoretical framework, the definition of class is more complex because it includes not only relationships to the means of production but also conceptualizes a class based on the degree of power and domination as well as the status of social groups. Therefore, economic power, prestige, and political power interact to define the location of the groups in society. Consequently, classes are not fully homogeneous groups and depend on the degree of membership of each characteristic. Hence, the Weberian theoretical framework defines a social class as the environment where individuals are alike based on economic, status, and political features. In addition, they typically interact and transfer these relationships among generations (Wright, 2005). The Weberian theoretical framework identifies public and private employees, independent workers, and skilled workers as part of the MC from the economic feature. People in the MC are also those who share similar credentials and convictions associated with specific lifestyles, with a specific symbolic recognition among individuals in that specific class.

From the structuralist theoretical framework posited by Giddens, social differentiation is associated with an ordering/ranking based on the moral judgment about which are the most significant and valuable aspects identified within the society. Hence, individuals' ordering/ranking represents the desirable structure of the society. The structure of the society also implicitly communicates incentives to individuals to guarantee the stability and integration of stratified classes. The individuals' acceptance of

this ordering/ranking and class formation reinforces individuals' values identification in each class and the compliance with the institutions that protect them (Wright, 2005).

In the historical context of the industrial evolution of modern western societies, the labor occupational categories reflect those values. Thus, a more complex and expanded division of labor entails different levels of importance of the labor categories. The different levels of importance of the labor categories have impact on how classes preserve and reproduce societies' functioning. Additionally, the Structuralist theory associates status to the labor occupational categories, which contain the signals/information about status based on stratification. The power units also are important for identifying the MC because their interaction with the status structure extends the individuals' self-identification to cultural features like ideology. Therefore, based on this theory the clear identification of the MC is complex because of the high number of features involved.

2.3.2.2. New Developments About the Concept of the Middle Class

The historical changes of the 20th century created new social relationships, hence new groups in society. Specifically, the post-war period in the United States shows the rise of a group of people who share common relationships to means of production, mainly associated with non-manual jobs and similar levels of subordination and autonomy, clearly different from the classic working class under capitalism. Thus, the MC now includes the social location of a specific type of workers that has distinctive attributes as a group unlike those of classical bourgeoisie or working class.

In a classical analysis, Lipset and Zetterberg (1959) posit the argument that western industrial countries converge into a stratification that gives more value to non-manual jobs. In this vein, economic modernization, upward mobility and social equity are consequences of the industrial evolution. These changes weaken the Marxist prediction about worsening labor conditions for the working class and the transitional MC. In opposition to this argument, Braverman (1975) states that technological advances used to perform labor activities transform the work into repetitive and routine tasks leading to the degradation of work. In addition, Braverman claims white-collar workers in the MC can be seen more as a deteriorated working class due to technological advances than a class with a significant improvement in quality of life.

Carchedi (1977) is known as the first author to state the idea of the MC in terms of contradictory locations. His analysis classifies social groups in terms of social relationships of production but classified between capital function and collective working class. The former classification represents individuals who control and supervise the productive process, the latter classification represents workers who create surplus value. Therefore, people in the MC can be characterized by both classifications, so the MC is defined by contradictory class locations.

Braverman's and Carchedi's developments suggest a binary description of the MC. However, Ehrenreich and Ehrenreich (1978) break the dichotomous characterization. Ehrenreich and Ehrenreich posit that the sustainable increase in the white-collar workers is evidence of a class that differentiates between working class and capitalist class because white-collar occupations, such as professionals and managers, do not have ownership of the means of production (different to capitalists) but they do have

control over some portion of the production process (different to working class). Therefore, an accurate description of the classes in a society includes three classes instead of just two in the classical Marxist theory.

According to Poulantzas (1975) occupational categories such as professional, managerial and administrative managerial, are included as white-collar workers. Poulantzas characterizes white-collar workers as those with unproductive work activities, while they can supervise and control productive work. In addition, white-collar workers differentiate politically and ideologically from the working class because the degree of power over labor activities and the performance of these activities as intellectual job. In fact, there exists some degree of working class individuals' membership in the MC because they can share political or ideological linkages, despite the fact that economic differences remain regarding occupational activities.

In the tradition of the Weberian theoretical framework, Lockwood (1989) characterizes classes based on three criteria: i) market situation based on income level, labor social security and occupational mobility; ii) work situation based on the relationship of authority; and iii) status situation based on prestige. Hence, the MC is represented by managerial work, non-physical, performance in offices, with closeness and cooperation attitudes toward the upper occupational positions and property owners.

2.3.2.2.1. Contemporary Theoretical Approaches to Class Analysis

Wright and Goldthorpe are representative scholars of the neo-Marxist and the neo-Weberian theories, respectively (Wright, 2005). Wright (1983) analyzes class structure with a relational approach, which emphasizes that each occupational position

entails a set of relationships among individuals who belong to each class. Wright stresses that locations capture a set of practices, behaviors and activities that are inherent to them. For instance, the relationship between capital and work is characterized by the relationship between the bourgeoisie and the proletariat.

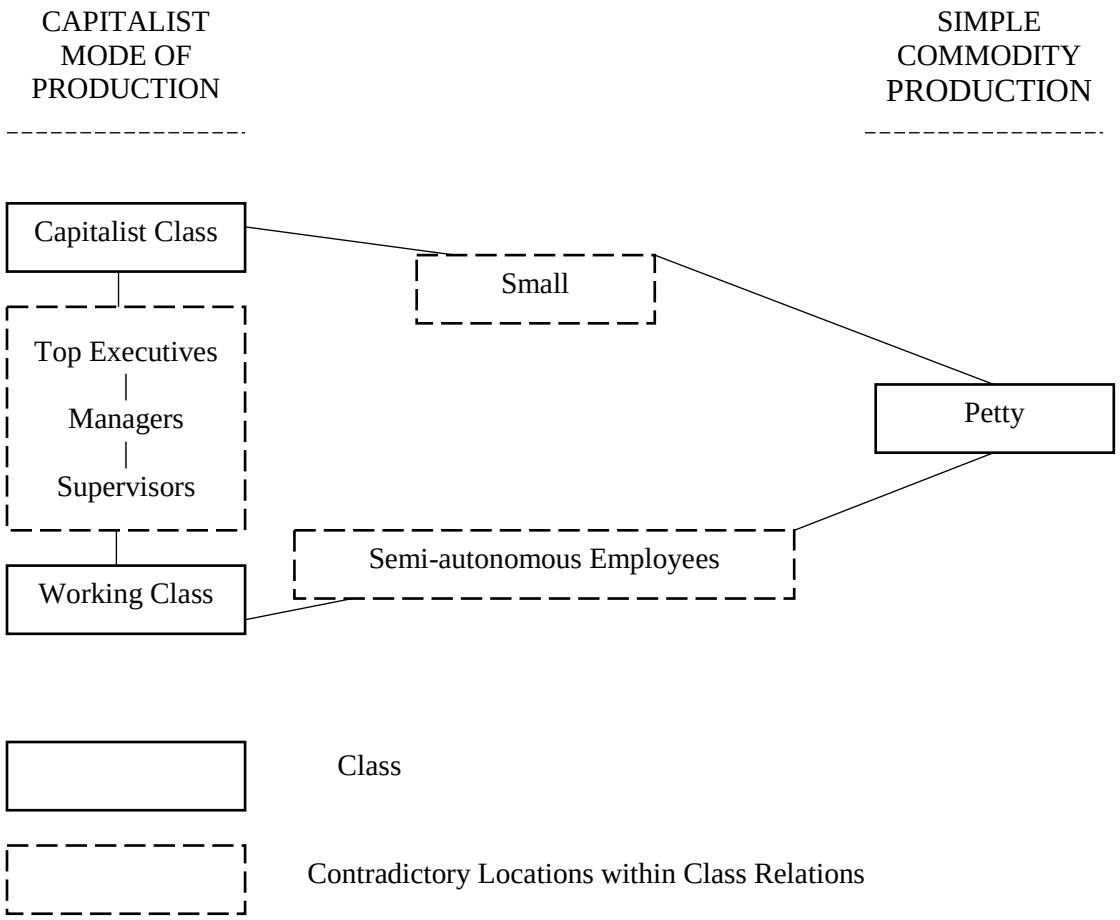

Figure 21 Basic Class Map of Capitalist Society
Source: Wright (1985), p. 48

Consequently, Wright presents two empirical representations based on the concepts of exploitation and domination. In the first empirical representation, the classes are i) clearly identifiable in the classical Marxist sense, the bourgeoisie, petty bourgeoisie and the proletariat, and ii) the contradictory locations materialize in small employers,

semi-autonomous employees, top executives, managers, and supervisors. Figure 21 summarizes locations and their relationships.

Table 5 Typology of Class Locations in the Capitalist Society

Assets in the means of production	Owners of means of production	Non-owners [wage laborers]			Organization Assets
Owns sufficient capital to hire workers and not work	1 Bourgeoisie	4 Expert Managers	7 Semi Credentialed Managers	10 Uncredentialed Managers	+
Owns sufficient capital to hire workers but must work	2 Small Employers	5 Expert Supervisors	8 Semi Credentialed Supervisors	11 Uncredentialed Supervisors	>0
Owns sufficient capital to work for self but not to hire workers	3 Petty Bourgeoisie	6 Expert non-managers	9 Semi Credentialed Workers	12 Proletarians	-
		+	>0	-	

Skill/credentials Assets

Source: Wright (1985) p. 88

Wright argues that the first approach gives excessive relevance to domination over exploitation. Doing so limits an accurate operationalization of different class categories. In the second empirical representation, he introduces the concept of multiple exploitations. In addition to the two traditional forms of exploitation – the labor force and the capital – he adds state exploitation through organization assets and social exploitation through skill/credential assets. Table 5 summarizes a more complete combination of the relationship types and occupation representing each of them.

Goldthorpe, drawing on neo-Weberian theoretical frameworks, links his class analysis to changes in intergenerational social mobility in industrial societies. Goldthorpe

shares with Wright the interpretation of classes in term of relationships among individuals. However, his empirical classification follows more a hierarchical structure. Goldthorpe proposes at least two schemes of classification in different stages of his work based on data of the United Kingdom. The first one, summarized in Table 6, has four classes, elite, service, intermediate, and the working classes. The intermediate class includes white-collar workers, petty bourgeoisie, and the higher working class.

Table 6 Scheme Version I

Elite Class		
I.	High Service Class	Service Class
II.	Lower Service Class	
III.	White-collar Class	Intermediate Class
IV.	Petty Bourgeoisie	
V.	High Working Class	
VI.	Skilled Working Class	Working Class
VII.	Non-skilled Working Class	

Source: Goldthorpe and McKnight (2006) p. 110

Goldthorpe's second scheme deepens and clarifies his proposed classification based on the following criteria: i) ownership over means of production; ii) distinguishing employer and self-employed; iii) distinguishing manual and non-manual jobs related to the agricultural activities, and iv) employment type of relationship. Then, Goldthorpe proposes the scheme summarized in Table 7.

Table 7 Scheme Version II

I. Professional, administrative and managerial employees of higher grade. *Includes 'large' employers, and independent professionals (Goldthorpe, 1997) II. Professional, administrative and managerial employees of lower grade **Includes independent professionals (Goldthorpe, 1997); technicians of higher grade	Service Class
IIIa Routine non-manual employees of higher grade IIIb Routine non-manual workers of lower grade IVa Small employers and self-employed. Workers with employees IVb Small employers and self-employed. Workers without employees V. Supervisors of manual workers; technicians of lower grade	Intermediate Class
VI. Skilled industrial manual workers VIIa Unskilled industrial manual workers VIIb Agricultural manual workers	Working Class

Source: Goldthorpe and McKnight (2006), p. 110.

In this scheme, individuals in the service class are characterized by having jobs with long-term contracts activities of supervision, job security, high wages and some degree of status. Therefore, the service class includes white-collar workers, managers, professionals and those categories of employees with skills and control over productive work. The fact that Goldthorpe's analyses focuses more on social mobility weakens the classification usefulness for intergenerational analysis.

Wolff and Zacharias' (2013) paper on class analysis critics the empirical operationalization of the capitalist class of previous researches. The authors claim that their operationalization of the capitalist class is more accurate because they include rentiers and wealthy business owners as members of the capitalist class. Thus, households classified in capitalist class are those with "… non-home wealth of at least $4 million or business equity worth of at least $2 million (in 2000 dollars)." (Wolff and Zacharias (2013), p. 1384).

Table 8 Alternative Class Scheme Excluding Capitalists

Wolff and Zacharias
Managers
Supervisors
Professionals
White-collar skilled workers
Blue-collar skilled workers
Non-skilled workers
Self-employed

Source: Wolff and Zacharias (2013) p. 1386.

For non-capitalist households, Wolff and Zacharias classify wage-earning individuals based on Wright's proposed classification. However, Wolff and Zacharias modify managerial and supervisory group definitions based on their skills. In addition, they include in the non-capitalist self-employed class owners of small enterprises as well

as professionals, such as doctors, lawyers, and skilled craftspeople, such as plumbers or electricians. Table 8 shows the authors' proposed empirical classification.

Both Wright and Goldthorpe analyze class formation based on relationships among individuals. But Wright adds exploitation and domination concepts, creating a more complex scheme, while Goldthorpe focuses on features related with social mobility. In this sense, Goldthorpe's scheme presents advantages for empirical research. The next section shows how the classical and contemporary theoretical frameworks influenced research in Latin America.

2.3.2.3. The Middle-class in Latin America: Studies from Selected Latin American Countries

The studies about the MC in Latin American countries show a significant transformation of the class structure after the middle of the 20th century[20]. After the implementation of the market driven policies in the middle '80s and'90s, fewer studies are interested in assessing the effects of structural changes on the MC (Sémbler, 2006).

Among those who discuss class structure in Latin America are Portes and Hoffman (2003), who study class and occupational categories after the '90s. According to Portes and Hoffman, Latin American economies lack features of the typical labor market of an industrialized country. Specifically, the weakness of the legal structure to effectively integrate the population to the economy has created high labor informality and low access to the market for consumption. Because consumption is the signal to classify

[20] Latin American countries experienced a historical period characterized by an industrialization process through the substitution of imports (described in section 2.1.1 about Colombia's historical context).

individuals in social groups in industrialized countries, this type of classification likely yields an inaccurate adaptation to Latin American countries.

Portes' and Hoffman's proposed classification uses the following criteria: i) power over capital and means of production; ii) control over labor force organized bureaucratically; iii) control over skilled workers; iv) control over unskilled workers; and v) job legally and explicitly regulated. In this typology, the MC is composed of petty bourgeoisie and non-manual formal proletariat. Table 9 summarizes the occupational classifications.

Table 9 The Latin America Class Structure

Class	***Sub-types***
I. Capitalists	Owners and managerial partners of large/medium firms
II. Executives	Managers and administrators of large/medium firms and public institutions
III. Elite workers	University-trained wage-paid professionals in public service and large/medium private firms
IV. Petty bourgeoisie	Own-account professionals and technicians, and micro-entrepreneurs with personally-supervised staff
Va Non-manual formal proletariat	Vocationally-trained salaried technicians and white-collar employees
Vb Manual formal proletariat	Skilled and unskilled waged workers with labor contracts
VI. Informal proletariat	Non-contractual waged workers, casual vendors and unpaid family workers

Source: Portes and Hoffman (2003), p. 46.

Mora-Araujo (2002) presents another operationalization of the MC applied to Argentina, with influence from the Weberian theoretical framework and gradational in opposition to relational (Lucas, Beresford, Chapa, & Yun, 2010). Weberian influence is evident in the use of three dimensions – education, labor and household goods ownership – to operationalize the concept, and gradational influence is apparent when the author interprets social stratification based on the construction of an index. The index of Socio-Economic Level[21] (ISEL) is the normalized aggregation of educational dimension

[21] Índice de nivel económico social (NES in Spanish)

(status), labor dimension (occupation), and household goods ownership dimension (economic power). Thus, the ISEL ranges between zero and 100 (the higher, the more affluent). Mora-Araujo defines six ranges based on index scores that correspond to the same number of index levels used to determine classes in Argentina. Table 10 summarizes class classification based on the ISEL.

Table 10 ISEL Components. Dimensions, Indicators, and Class Classification for Argentina

Dimensions	***Indicators***	***Levels/Scores (0-100)***	***Classes***
Educational	Maximum level of educational attainment from household head	High-High (93-100) High (63-92)	Affluent
		Medium-High (48-62) Medium-Low (35-47)	Middle
		Low (27-34) Low-Low (1-26)	Poor
Labor	Occupational category from household head		
Household goods ownership	Eleven items: TV, refrigerator, washing machine, drying machine, video recorder, air conditioner, telephone, PC, household's head with credit card, and car		

Source: Author's adaptation based on Mora-Araujo (2002).

Although mobility is the leading concept and not stratification in Leon and Martinez's (2001) analysis, their proposed scheme of occupational categories based on the labor market of Chile is useful for class analysis purposes. Leon and Martinez analyze social mobility and inequality in the last quarter of the 20th century. Their analysis focuses on the degree of rigidity/inflexibility of the transition from one class to another throughout generations. The MC is divided into occupational categories of wage-pay workers and independent workers. Table 11 summarizes authors' proposed occupational categories.

Table 11 Scheme of Occupational Categories for the MC in Chile

Occupational categories in the Middle-class
Wage-pay workers
Commerce employees
High Traditional State Bureaucracy
Medium Traditional State Bureaucracy
Low Traditional State Bureaucracy
High Modern State Bureaucracy
Medium Modern State Bureaucracy
Low Modern State Bureaucracy
High Private Services Modern Bureaucracy
Medium Private Services Modern Bureaucracy
Low Private Services Modern Bureaucracy
Independent Workers
Retail Businessmen or Dealer
Professionals high profile or skilled
Other professionals and technicians
"Modern" craftsman
Transportation Petty Bourgeoisie

Source: Author's adaptation based on León and Martínez (2001).

Valle-Silva (2006) studied the evolution of social stratification in Brazil between 1949 and 1999. Valle-Silva's classification is constructed based on two criteria, labor features and market features. He includes occupational categories in labor features, and income and educational attainment in market features. In addition, his classification considers the individual's position in agricultural, industry, and services sectors; manual or non-manual type of work; and supervision or lack of supervision over the specific activity. Under Valle-Silva's classification, the MC includes: other professionals, supervisors, technicians, independent businessmen and non-manual routine occupations. Table 12 describes Valle-Silva's proposed class structure.

Table 12 Class Structure for Brazil

Occupational Category
Independent professionals
Managers
Owners
Other professionals
Supervisors manual jobs
Technicians and artistic occupations
Independent businessmen
Non-manual routine occupations
Modern industry workers
General services workers
Informal services workers
Traditional industry workers
Personal services workers
Housekeeping workers
Rural Owners-Employer
Rural Workers

Source: Author's adaptation based on Valle-Silva (2006).

Pérez, Andrade-Eekhoff, Bastos, and Herradora (2004) analyze class structure of three Central American countries, Costa Rica, Guatemala, and El Salvador in the '90s. Perez et al. focus on the economic context of free trade and open markets policies. The authors apply the same proposed occupational scheme based on income and educational attainment to all countries. Perez et al.'s criteria to identify the categories are: i) ownership over means of production; ii) activities developed in the job place; iii) size of the business/factory; iv) job conditions; v) economy activity sector; and vi) urban/rural location. The authors include in the MC professional employees, non-contingent employees and small-size business owners. Table 13 describes the socio-occupational structure proposed by the authors.

Table 13 Socio-Occupational Structure of Costa Rica, Guatemala and El Salvador

Social Categories	***Socio-Occupational Groups***
Large-size business owners	Large-size business owners Large-size business managers
Professional employees	Professionals Public Sector Professionals Private Sector Independent Professionals
Non-precarious employees	Non-contingent Wage-pay public sector employees Non-contingent Wage-pay private sector employees
Small-size business owners	Small-size business owners Self-employed agricultural workers Self-employed rural workers Self-employed urban workers
Vulnerable workers	Contingent Wage-pay non-agricultural workers Contingent Wage-pay agricultural workers Housekeeping employees Non-earners workers (family and non-family)

Source: Author's translation from Pérez et al. (2004), p. 57.

In 2000 the Economic Commission for Latin America and the Caribbean[22] (ECLAC) published a study with regional scope. The study uses household surveys from Brazil, Colombia, Costa Rica, El Salvador, México, Panamá and Venezuela. The study applies the concept of occupational stratification, which allows authors to identify three levels: upper, intermediate and lower. The MC is located in the intermediate level of occupational stratification. The MC is subdivided into lower-level professionals, technicians and administrative employees. The MC or intermediate level represents 13.9% of the Latin American labor force. Table 14 presents the complete occupational stratification from the ECLAC study.

[22] Comisión Económica para América Latina y el Caribe (CEPAL in Spanish)

Table 14 ECLAC - CEPAL's Occupational Stratification

Occupations
Employers
Directors, manager and CEO's
Professionals
Technicians
Administrative employees
Retail workers
Workers, craftsmen, drivers of heavy machinery and transportation means
Workers of personal services
Agricultural workers

Source: ECLAC - CEPAL (2000)

Sembler (2006) performed a meta-analysis of the research on the MC in Latin American countries. Sembler's conclusions are: i) Hiring personnel in the '90s increased mainly through outsourcing that affected negatively employees' conditions compared to the hiring strategies in previous decades. ii) Expansion of education levels increased individuals' income and social mobility. However, cultural capital arose as a relevant attribute to differentiate social segments within the MC. iii) Female participation in the labor market increased, hence, its participation in the MC. However, it still needed to improve income level and social mobility to reduce the labor segmentation. iv) Policies for social security and retirement plans changed and adapted to the new economic dynamics, which was reflected in the transference of labor costs toward the employee and affected the size of the MC. v) In the period of the '50s to the '80s – the substitution of imports – the MC was associated with governmental employment and public services. Currently, the MC is associated with private sector employment, independent employment, and self-employed. vi) The transformation of occupational categories throughout the time was used to assess the intergenerational mobility as a component of the MC analysis.

All the occupational schemes previously discussed operationalize the MC utilizing different occupational classification framed by a specific theory. The relevance of this review for this dissertation mainly focuses on, first, how occupational categories entail other types of relationships that income cannot capture despite both concepts positive correlation, and second, how history and geographical context in Latin America affect approaching a functional measure of the middle segment of the society for policy purposes.

2.3.2.4. Limitations of Occupational Categories as Variable for Measurement

Although labor occupational categories are empirically useful to approach class classifications, the literature presents two main limitations: i) identification of individuals who are out of the active labor force, and ii) comparability of static occupational categories over a long-time span and different geographical context. In the first limitation, individuals who are classified as retirees, pensioners, students, children, housewives, and never employed are excluded by definition. Although there are empirical strategies to refine the inclusion of retirees, pensioners, and unemployed (e.g. using the last main job as reference), empirical testing of these strategies have not shown an improvement on the overall analysis (Domanski, Sawinski, & Slomczynski, 2009). There is also debate about whether the unemployed are the reserve army of labor or an underclass with independent identity (Wolff & Zacharias, 2013) and if so, this category's proper treatment on any analysis.

The second limitation refers to time and geographical contexts. The static nature of occupational classifications can reduce the reliability of the class analysis if the time span includes substantial societal changes which usually happens in long time spans, thus, undermining the stability of occupational categories' definitions (as well as the theoretical and empirical relevance). In addition, very heterogeneous countries can weaken the comparability of the occupational categories. In fact, different countries' paces of transition toward industrialized capitalism (e.g. Latin America (Portes & Hoffman, 2003) or former communist countries (Domanski et al., 2009)) suggest that an application of the unified/standardized occupational classification developed in industrialized countries such as the UK and the USA, should be contextualized and adapted to other countries specificities.

2.3.3. Literature on Operationalization of Education

There are several potential definitions for indicators in the education dimension. For instance, Goldin and Katz (2009) present individuals' high school completion educational level and individuals' college completion educational level as relevant features to explain U.S. economic growth since the 20th century. The massive expansion of both types of education levels, jointly with technological advances, increased the wage premium of college degrees more than the wage premium of high school. That fact widened the wage gap among both types of individuals, most of all during the last decades of the 20th century.

For Latin America, Torche and Lopez-Calva (2013) analyze intergenerational mobility and find that an increase in the educational level reduces the probability of

belonging to the lower-income class and increases the likelihood to belonging to and upper-income class. In addition, completing primary education is the minimum condition for starting upward mobility, while completing the entire level of secondary education matters, not just individual years. They conclude that post-secondary education is a distinct feature of being part of the MIP in the same line that Castellani et al. (2014). Also based on a framework of social mobility, Andersen's (2001) study highlights the relevance of indicators that extend their estimation on education to intra-household characteristics, such as parents' educational background, specifically mother's educational background (García, Rodríguez, Sánchez, & Bedoya, 2015).

According to Tornarolli (2014), who analyzes data for all countries in continental Latin America plus the Dominican Republic, the literacy is close to 100% for the population group of 15 to 24 year-olds, as it was expected. On average among the countries, enrollment rate in primary education is not less than 90% and enrollment rate in secondary education is not less than 80%. The enrollment rate in tertiary is around 38%. Regarding years of education, on average an individual classified in the MIP "… has completed 2.5 years of education more than an individual from the lower class, and 3.7 years of education less than an individual from the upper class." (Tornarolli (2014), p. 18).

Enrollment in private schools for population groups with ages 6 to 12, 13 to 17, and 18 to 23 is a distinct feature of the MIP in several countries of Latin America (Birdsall, 2012; Daude, 2012; Larrañaga & Rodríguez, 2016; Penfold & Rodríguez-Guzmán, 2014), mostly associated with quality attributes, such as location, quality of teachers and resources (Stromquist, 2004). However, according to Castellani et al. (2014,

2015) the majority of household heads in Latin America are men and household heads' partners (Deaton, 1997) complement a more accurate description of household as a unit of analysis (Angulo et al., 2013; Wolff & Zacharias, 2013).

Although full treatment of education and development is beyond the scope of this dissertation, it worth to mention that indicators of education dimension are associated with higher faster economic growth rates (R. Barro & Sala-I-Martin, 1990). Even though, economic growth and development are not equivalent concepts, economic growth is understood as necessary condition, not sufficient, for a country to achieve development. In this point human capital indicators (Schultz, 1981) have become important indicators of development. However, these approach from the macroeconomic perspective, while I applied a microeconomic perspective in this dissertation.

2.3.4. Literature on Operationalization of Health

Literature on the MIP does not very often reference explicitly the dimension of health. This dimension is more often referenced in inequality and poverty literature (Fajardo-Gonzalez, 2016) and complements the MIP's characterization (Castellani et al., 2014). Homedes and Ugalde (2005) and Cotlear et al. (2015) emphasize the structural effect on insurance coverage in Latin America because it is linked to formal jobs and the region has a high rate of job informality. Fajardo-Gonzalez (2016) analyzes health inequality for Colombia and highlights as important factors: type of funding of health insurance – either private or provided by the Colombian government – and health preventative practices. Her study suggests the MIP and affluent populations are more likely to have private insurance, and that health preventative practices are associated with better education levels, job security and time availability. In contrast, Peichl and Pestel

(2013b) use the AF methodology to assess well-being in the affluent population in Germany. They selected three dimensions, including health. In this case, health was operationalized with different indicators that include self-perception as a Likert scale with 10 items.

Health self-perception also was used in Lora and Fajardo's (2013) study, in which they set better health as a distinct feature of the low-income population but not useful to differentiate a middle from the high-income population. Borrell, Muntaner, Benach, and Artazcoz (2004) present health self-perception as a moderator of class identification and gender differentiation with data from Barcelona. Based on Wright's (1985) class scheme, they find that "… among men in particular, managers and supervisors with high credentials show a better self-reported health than other class positions, most notably semi-skilled and unskilled workers, semi-skilled and unskilled supervisors, petit bourgeois, and small employers. … Among women, the association between social class and reported health status is less evident than among men … and only unskilled workers had significantly worse health. … These results are not consistent with a previous survey of the same population using measures of social stratification, where the association between self-reported health and occupational social stratification was similar in men and women". (Borrell et al. (2004), p. 1883). Thus, based on the literature, the health dimension may include the type of health insurance, population health preventative practices and health self-perception.

2.3.5. Literature on Operationalization of Assets

The assets dimension or material possessions is a dimension widely referenced in the empirical literature on poverty and welfare as proxy of living standards (Aaberge &

Brandolini, 2015; Angulo et al., 2014; Angulo, Gaviria, Páez, & Azevedo, 2012; Deaton, 1997, 2003; Decancq, Fleurbaey, & Schokkaert, 2015; Lora & Fajardo, 2013; Roemer & Trannoy, 2015; Sen, 2000). Regarding the MIP, it is accepted among scholars that this segment of population can acquire durable goods as a long-term investment (Solimano, 2005, 2006) and own goods "to buffer unexpected shocks such as macroeconomic downturns or family restructuring" (Torche and Lopez-Calva (2013), p. 2). Therefore, assets that are distinctive for the MIP in the Latin American context are: material assets (land, capital, and housing), capital assets such as business assets, rental property, stocks and bonds concentrated in the highest income percentiles (Solimano, 2006).

Lora and Fajardo (2013) include among the physical assets variables of ownership of non-financial assets, such as house, television, computer, automobile, washing machine and freezer. Córdova (2009) computes an index of relative wealth for Latin America using dichotomous variables (yes/no) on ownership of television, refrigerator, conventional telephone, cellular telephone, vehicle, washing machine, microwave oven, indoor plumbing, indoor bathroom and computer.

Gaviria (2002) assesses socioeconomic status using access to drinkable water and sewage systems, and possessions of telephone, color television, washing machine, refrigerator, personal computer, car, and a second house or apartment. Although the theoretical framework is social mobility, Angulo et al. (2012) created an index of wealth based on the following variables: primary education, children with education, car, vacation house, stove, television, stereo, electricity, toilet, floor of material other than dirt and number of bedrooms.

Filmer and Pritchett (2001) test their methodology on data for India, with 21 asset indicators grouped into three types: household ownership of consumer durables, with eight questions (clock/watch, bicycle, radio, television, bicycle, sewing machine, refrigerator, car); characteristics of the household's dwelling, with 12 indicators (three about toilet facilities, three about drinking water source, two about rooms in the dwelling, two about building materials used, and one each about the main source of lighting and cooking); and household land ownership.

2.3.6. Literature on Operationalization of Housing

Although some literature includes housing ownership and housing features as part of material assets – like some studies in previous section shows – another stream of literature argues that characteristics related to the house should be treated as an independent dimension because owning a house in Latin America foster other features, such as access to financial credit and increase of labor supply from the low-income population (Balchin & Stewart, 2001; Ferguson & Navarrete, 2003; Field, 2007, 2008). Also as part of the debate, housing is linked to the property rights and land ownership that highlight the structural deficiencies of the housing market and the weakness in the policy of legal titles on informal houses (Gilbert, 2002). In addition, house ownership was issued as a proxy of wealth for Wolff and Zacharias (2013) and a feature of financial access in Colombian context (Chiappe de Villa, 1999; Pecha, 2011).

For the MIP, a house is the emblematic asset that owners see as an investment in a long-term durable goods, which allows them to face unexpected economic shocks, as conceptualized by Torche and Lopez-Calva (2013). According to De Ferranti, Perry, Ferreira, and Walton (2004) house ownership is above 60% even among the low-income

population in Latin America. Solimano's (2006) calculations show 69% are house owners, while Tornarolli's (2014) calculations show 67.6% in the MIP owns their house, higher than the low-income population (63.7%) but lower than the high-income population (73.2%). However, the authors do not specify if this includes houses fully paid or being paid (mortgage). Thus, house ownership alone does not differentiate the MIP. Attributes of the house, such as number of bedrooms or types of sanitation (toilet) become relevant for distinction. Tornarolli's (2014) research conclude that, on average, houses in the MIP have more rooms than those owned by the low-income population but fewer than houses owned by the high-income population. He finds statistics in the same sense regarding drinking water and toilets.

Related with the number of bedrooms, the overcrowding indicator calculated for Unsatisfied Basic Needs (UBN) method (Feres & Mancero, 2001) is useful as proxy of income classes. To identify poor, UBN in Colombia defines critical overcrowding as three people or more per bedroom (DANE, 2014). This is interpreted as the lower bound to identify the MIP. There is not empirical evidence to set the upper threshold, however, the value of 1.5 people per bedroom helps to identify a tipping point when household health conditions can start to deteriorate for countries, such as the U.S and the UK (HUD, 2007). Nonetheless, housing policies in Latin America show the high income-population below 1.5 people per bedroom (Bouillon, 2012).

2.4. Polarization and Its Linkage to the Middle Segment of the Society

In a broad sense, the concept of polarization communicates characteristics, such as the opposition of clustered groups (poles or classes), and distance and tension among

the groups. While polarization and size of the MIP have been linked through studies on income polarization (Wolfson, 1994), analyses of class formation that measure the size of the MC present polarization as a consequence of the antagonism among societal groups rather than a central topic (Wright, 1995, 2005). In this section, I rely mostly on literature about operationalization of income polarization because it describes the methodological construction of polarization synthetic indices.

Esteban and Ray's (1994) article is the main referenced publication that conceptualizes income polarization. The authors posit a polarization index (ER) which depends on two characteristics, i) the number of people identified themselves in each group and its homogeneity, or identification; and ii) the distance based on individual's income with respect others or alienation. Esteban and Ray also state the axiomatic structure[23] that these types of indices should follow to narrow down the mathematical expression suitable for the ER. From an empirical view, polarization finds a clustering around a local mean, thus, bipolarization does it for two local means.

Bipolarization has had theoretical appeal because it is usually linked to the so called middle-class and inequality debate. In fact, the economics literature presents research that investigates the shrinkage[24] of the MIP and economic polarization into two groups in the United States in the 80s (Foster & Wolfson, 2010; Wolfson, 1994). The two groups or poles are defined in terms of income.

[23] For all equations of polarization indices, axiomatic structure and properties see Appendix 4 Fundamental Properties of Income Polarization Indices.

[24] The DP transfers principle is also discussed here because overall inequality and polarization will reduce if the income transfer between individuals happens at the same side of the median value of the distribution, and will not if happens across the median value of the distribution.

Following Esteban and Ray's article, other authors have used the general identification/alienation theoretical framework with some variations for empirical estimations. In addition to income polarization and bipolarization, Duclos and Taptue (2015) have identified three additional types of polarization: social polarization, socioeconomic polarization, and multidimensional polarization.

Social polarization[25] focuses on qualitative variables and the size of the homogeneous groups. Thus, it is the groups' size which determines the tension because "the larger the size of another group, the greater the threat felt by a given group (proportional to the size of the other group)." (Duclos and Taptue (2015) p. 305). Socioeconomic polarization uses one variable for identification and a different one for alienation, therefore, properties and framework of bipolarization does not apply to it. Similar features are for multidimensional polarization, however, for this index the membership to a specific pole or group can be based on all economic and social characteristics, thus, all of them are included in the measure of alienation as well.

Another empirical approach for polarization is presented by Zhang and Kanbur (2001), who created an index (ZK) that decomposes into the between- and within-components. The between-clusters component captures inequality from external heterogeneity, while the within-clusters component captures inequality based on internal heterogeneity. Thus, the ZK is the ratio of the between- component and the within-component as in Equation 6. The ZK is not compatible with the identification/alienation

[25] Reynal-Querol (2002) studies civil war as societal phenomenon using religiosity as key feature for polarization. Her argument for using religiosity states that societies are more likely to experience division based on individuals' theological identification since this type of identification is fixed a long time and nonnegotiable.

framework, therefore, its result is not necessarily in the same direction of previous indices. Table 15 summarizes polarization indices of this section.

$$ZK = \frac{between-group\ inequality}{within-group\ inequality}$$

Equation 6

Table 15 Types of Polarization Indices

Types of Polarization	Identification	Distance	Indices
Income (clustering of cardinal variable around local means)	Discrete/continuous	Discrete/continuous	Duclos, Esteban, and Ray (2004); Esteban, Gradín, and Ray (2007); Esteban and Ray (1994)
Bipolarization (clustering of cardinal variable across two groups)	Discrete/continuous	Discrete/continuous	Foster and Wolfson (2010); Levy (1987); Wolfson (1994)
Social (polarization over non-cardinal variables)	Qualitative	0/1	Duclos et al. (2004); Reynal-Querol (2002)
Socioeconomic (social variables define groups; economic variables define distances)	Qualitative	Discrete/continuous	Zhang and Kanbur (2001)
Multidimensional (generalization of income and socioeconomic polarization)	Discrete/continuous	Discrete/continuous	Gigliarano and Mosler (2009a)

Source: Author's adaptation based on Duclos and Taptue (2015), p. 303.

I selected the multidimensional type of polarization indices for the dissertation because of a) it allows me to include income as well as other socioeconomic variables for its estimation and analysis and b) it is coherent with the multidimensional analysis of the middle segment of the society in Colombia. Therefore, I will calculate the index of multidimensional polarization (IMP) for Colombia based on the Gigliarano and Mosler (GM) (2009a) methodology.

2.4.1. Income Polarization Studies in Latin America

Income polarization in Colombia has been examined by a few Colombian authors. Cárdenas (2011) presents the theoretical framework of income polarization based on Esteban and Ray (1994) with no empirical estimations. In addition, the author discusses the relevance of social networks to model conflicts among groups from a microeconomic perspective. From his microeconomic model, he concludes that social networks allow individuals' multiple social memberships, thus, analyzing and solving social conflicts requires analyzing several individual's dimensions of. In a section of Bernat's (2009) doctoral dissertation, she calculates polarization index using wages in Colombian labor market which allows her to conclude the high level of polarization in the labor market.

Gasparini, Horenstein, and Olivieri (2006) analyze Latin American countries based on the household surveys for 21 countries between 1989 and 2004. They found that income polarization is high for the region but South-American countries are more polarized than Central-American countries. They highlight educational polarization with a decreasing trend. The authors also include in their study social mobility indices and examples of the size of the MIP. The following quote exemplifies Latin American countries in the international context, "the most polarized country in Europe, Russia, is comparable to the least polarized country in LAC [Latin America], Uruguay, which is considered the prototype of social cohesion in Latin America." (Gasparini et al. (2006), p. 38).

Gasparini, Horenstein, Molina, and Olivieri (2008) move in the same direction of previous analysis; however, they emphasize the potential linkage between countries' polarization and institutional weakness. Most of their estimations corroborate findings in

Gasparini et al. (2006), nevertheless, they give additional support to the interaction between economic variables and governmental/institutional variables. They used indices from political science publications to capture governmental/institutional environment – indices of democracy, government effectiveness, security of property rights, political constraints, rule of law, and voice and accountability –. Then, they estimated correlations between these indices, and polarization and inequality indices. All the correlations between polarization and inequality indices with governmental/institutional indices are negative, this means that when inequality and polarization are high, governmental/institutional environment is weak. The empirical regularity happens despite the heterogeneous political context of each country.

Deutsch, Silber, and Yalonetzky (2014) focus on polarization analysis for Latin American countries between 2000 and 2009. However, they mention the importance of the middle-class as core concept since their estimations are mainly based on bipolarization. In addition, they use data from Latinobarometro[26], which does not include information on income but durable goods; therefore, they create a measure of standard of living applying multiple correspondence's methodology. Their outcome supports the claim of an increase in bipolarization in Latin America, although the estimated values among countries are highly heterogeneous. The use of non-income variables in their polarization analysis was presented as an advantage for policy analysis and implementation.

[26] "Latinobarómetro Corporation researches the development of democracy and economies as well as societies, using indicators of opinion, attitudes, behavior and values. Its results are used by social and political actors, international organizations, governments and the media." http://www.latinobarometro.org/lat.jsp

The literature referenced for polarization suggests that there is a gap for Colombia specific analysis of this topic, the relevance of this topic in international context, the linkage of income polarization and other political variables, and the potential usefulness of polarization indices for policy purposes based on variables different to income. In the dissertation, I aim to fill this gap. The next chapter presents the data and analytical approaches take to fill the gap.

3. CHAPTER 3: METHODOLOGIES AND DATA

3.1. The Alkire-Foster (AF) Methodology to Estimate the Size of the Multidimensional Middle-Class (MMC)

In this section, I describe the Alkire-Foster (AF) methodology, also known as the double cut-off methodology (Alkire & Foster, 2009, 2011; Alkire et al., 2015), as the analytical tool for studying the MMC in Colombia. In this section I keep Alkire et al.'s (2015) notation for poverty[27] and adapt the notation to the analysis of the middle segment of society. The AF methodology has been used mainly for poverty measurement, however, it also has been applied to analyze high-income population characteristics (Peichl & Pestel, 2013a, 2013b) and other topics, such as governance (Mitra, 2013).

Two characteristics differentiate my adaptation of the AF methodology from the original description in Alkire et al.'s (2015) book. First, in poverty analysis *deprivation* refers to lack or absence of the individuals' relevant features to achieve the *capabilities* for living a fulfilled life. In the case of the MMC, I will use the word *satisfactory*[28] to indicate each individual owns or possesses features suitable for being included in the MMC. Thus, *deprivation* communicates a negative meaning – lack or absence – while *satisfactory* communicates a positive meaning – ownership or possession –. Both *deprivation* and *satisfactory* can be measured through indicators.

For the second distinct characteristic, no explicit representation exists in terms of notation for the lower bound of *deprivation* because by definition it is zero – absence of

[27] Alkire et al. (2015) chapter 5. See a numerical example of the AF methodology applied to poverty in Appendix 8.

[28] The word is inspired from Frank's (2013) book, chapter five that discusses the characteristics of the middle-class. They [middle-class] are: "working longer hours; reducing savings; increasing indebtedness; having longer commutes; growing sleep deprivation; and cutting public services"

an attribute e.g. running water –. For the notation of *satisfactory*, both the lower and the upper bound should be explicitly represented because ownership of a specific attribute in the MMC has to be bounded.

The AF methodology also is named the dual cut-off approach because it distinguishes two sequential stages, identification stage and aggregation stage (Sen, 1976), before calculating an index. There is (1) a cut-off for each dimension, and after the aggregation, there is (2) another cut-off for overall dimensions. This resembles the Sen's two stages for poverty calculations. In poverty analysis, a *deprivation* cut-off refers to "… an indicator [that] shows the minimum achievement level or category required to be considered non-deprived in that indicator." (Alkire et al. (2015), p. 197). In the case of the MMC, the *satisfactory* cut-offs define the upper and lower bounds to be counted in the *satisfactory* indicator.

Moreover, in the estimation of the MMC, the identification stage determines which *satisfactory* indicators in each dimension are valid for each individual. This is known as the censored approach because only a part of the indicator's distribution is useful for the identification (e.g. variable income, the MIP ranges between 10US/day and 50US/day). In the aggregation stage, it adds the number of all *satisfactory* indicators that are valid for each individual. The researcher determines a cut-off to decide how many *satisfactory* indicators (*k*) classifies an individual in the MMC. Hence, only individuals with at least *k satisfactory* indicators are classified in the MMC.

The AF methodology presents advantages over the traditional unidimensional methodology based on income. In the following section, I present a summary of the empirical challenges discussed in section 2.3.1.2 to the income-related variables. Income

and consumption – and sometimes wealth as well – are the most used variables for poverty and inequality analyses but: a) income measurement is highly sensitive to its information sources (i.e. job income, or governmental transfers), to the time frame defined for its calculation (i.e. daily, or monthly), and to the specific year of selection (i.e. a crisis year such as 2008); b) income used to be underreported or nor reported at all (i.e. either missing values or zeros); c) consumption is preferred because it is a more accurate measure of individuals' life quality patterns. However, because it is based on a normative/external definition of goods individuals' consumption, one unified list of goods does not exist for a specific country or geographical category; d) defining consumption the time frame unit is also challenging because the surveys collect consumption information by different time frames (i.e. weekly, monthly, or biannually), complicating its aggregation (Gasparini et al., 2012); finally, e) the choice of the unit of analysis – individual or household – has implications for calculating indices (e.g. the equivalence scales).

In opposition, the AF methodology can use variables, such as years of education, educational attainment, health insurance possession, and housing ownership, that are clearer and unambiguously defined (i.e. either individuals have them or do not), and they do not fluctuate much over time. In addition, survey respondents are not reluctant to provide this type of information. Regarding the individual/household decision, the spillover effects support the choice of the household as the dissertation unit of analysis.

Second, in the counting identification approaches to measuring poverty, the AF methodology is an intermediate solution between the union criterion and the intersection criterion, the two extreme cases of counting identification approaches. The union

criterion identifies someone as poor if the person has at least one characteristic defined for being poor. This criterion usually overestimates the number of poor individuals. The intersection criterion identifies someone as poor only if the person has all the characteristics defined for being poor. This criterion usually underestimates the number of poor individuals. The AF methodology uses the definition of the number of *satisfactory* indicators (*k*) to obtain the intermediate solution between the two counting criteria (Alkire et al., 2015).

Third, Atkinson and Bourguignon (1982) present the importance of the joint distribution in a multidimensional analysis. They found it is possible for different variables to have the same marginal distributions but at the same time different levels of relationships among those variables. In other words,

> The importance of considering the joint distribution of achievements, which in turn enables us to look at joint deprivations, is best understood in contrast with the alternative of looking at the marginal distribution of achievements, and thus, the marginal deprivation.…From the marginal distribution of each dimension, it is possible to obtain the proportion of the population deprived with respect a particular cut-off. However, by looking at only the marginal distribution, one does not know who is simultaneously deprived in other dimensions. Alkire et al., 2015, p. 35.

Finally, the AF methodology has key properties to keep its theoretical consistency and underline the policy usefulness. The next section expands properties technical details.

3.1.1. Properties of the Alkire-Foster Methodology

The AF methodology has several properties. In the following section, I focus on the three that are fundamental.[29] Because I use Alkire et al.'s (2015) notation properties describe as core population the poor people, however, the properties advantages to any segment of society. In this dissertation, I extend them to the middle segment of the society.

a) Symmetry. Denote X as the achievement matrix and $P(X;z)$ a multidimensional index, if X' is obtained from X as $X' = \Pi X$, where Π is a permutation matrix of appropriate order, then $P(X';z) = P(X;z)$. In other words, a re-arrangement of the rows or columns of achievements matrix does not affect the value of the index. This property usefulness is more empirical and practical than theoretical.

b) Poverty Focus. If X' is an achievement matrix obtained from X such that $x_{ij}' > x_{ij}$ for some pair $(i,j)=(i',j')$ where i' $\notin$ Z, and $x_{ij}' = x_{ij}$ for every other pair $(i,j) \neq (i',j')$, then $P(X';z) = P(X;z)$. In other words, the multidimensional index only captures information of poor population, then changes in deprivations of non-poor people are not reflected in the indicator.

c) Monotonicity from Dominance Properties. The first principle of dominance properties, monotonicity, states that if the achievement of a person in poverty in a deprived dimension increased while other

[29] See a detailed explanation in Alkire et al. (2015) chapter 2.

achievements remain unchanged, then overall poverty should decrease. The principle is complemented by other relevant properties.

c.1) Dimensional monotonicity. It requires that if a person in poverty who is not deprived in all dimensions, becomes deprived in an additional dimension then poverty should increase.

c.2) Transfer principle. If an achievement matrix is obtained from another achievement matrix by reducing inequality among the poor, while the average achievement among the poor remains the same, then poverty decreases.

3.1.2. Formal Representation of the Alkire-Foster Methodology Applied to the MMC

Following Alkire et al.'s (2015) notation, $n \times d$ represents dimensional achievement matrix X where x_{ij} is the achievement of person i in dimension j. By assumption, the achievements are represented by non-negative real numbers (i.e. $x_{ij} \in \mathbb{R}_{+}$) and higher achievements are preferred.

For each dimension j, a lower $z_j^{\,l}$ [30]and an upper $z_j^{\,u}$ thresholds exist such that define the characteristics to be included as a *satisfactory* indicator. In vector notation, these cut-offs are included in the d-dimensional vector $z = (z_1^{\,l}; z_1^{\,u} \ldots z_d^{\,l}; z_d^{\,u})$. If an individual's achievement in a specific dimension x_{ij}, is higher than $z_j^{\,l}$ and lower than $z_j^{\,u}$, the individual is member of the MMC.

[30] The poverty analysis has zero in the lower bound.

Thus, the *satisfactory* matrix g^0 such that $g_{ij}{}^0 = 1$ if $z_j{}^l \leq x_{ij} \leq z_j{}^u$, and $g_{ij}{}^0 = 0$, otherwise, for all j =1, …, d and for all i = 1, …, n. Then, based on the FGT[31] family indices for $\alpha = 0$ the cells of *satisfactory* matrix are created as follow,

$$g_{ij}{}^{\alpha} = g_{ij}{}^{0} = \begin{cases} [(z_d{}^u - x_{ij}) / z_d{}^u]^0 \text{ for } x_{ij} < z_d{}^u, \text{ and } g_{ij} = 0 \text{ for } x_{ij} \geq z_d{}^u \\ [(x_{ij} - z_d{}^l) / z_d{}^l]^0 \text{ for } x_{ij} > z_d{}^l, \text{ and } g_{ij} = 0 \text{ for } x_{ij} \leq z_d{}^l, \end{cases}$$

Equation 7

When each dimension has a different importance, a vector of weights is applied. The vector of weights is denoted as $w = (w_1,\ldots,w_d)$ where w_j denotes the relative importance of that dimension. Then, in the aggregation stage the total number of *satisfactory* indicators valid for each individual across all dimensions becomes an individual's *satisfactory* score.

The benchmark counting scenario in the aggregation stage treats each dimension with the same importance or weight. The differences in dimensions' importance can be justified either theoretically, empirically, or in terms of policy. However, Alkire et al.'s (2015) describes two disadvantages when dimensions' importance (weights) is different. The first disadvantage, from a public policy standpoint is justifying why one dimension is more important than another (e.g. why education is more important than health). Secondly, from empirical perspective interpreting indices becomes cumbersome, hence, communicating their results becomes technically difficult, undermining the advantage of the AF methodology, its intuitive comprehension. In addition, the literature reviewed shows only empirical applications using the benchmark counting scenario of equal

[31] Foster, Greer, and Thorbecke (1984) type of indices.

importance for each dimension. I also apply the benchmark counting scenario[32] in the dissertation.

Formally, the *satisfactory* score is calculated as $c_i = \sum_{j=1}^{d} w_j g_{ij}^0$; thus the vector of *satisfactory* scores for all individuals is $c = (c_1,\ldots,c_n)$, whith $\sum_j w_j = 1$ denoting the normalized weights. The MMC cut-off (k) is implemented using an identification function $\rho_k(x_i;z) = 1$ if $c_i \geq k$ and $\rho_k(x_i;z) = 0$ otherwise.

The AF methodology "creates a class of measures that both draws on the counting approach and extends the FGT class of measures in natural ways" (Alkire et al. (2015), pp. 147). This means that the feasible three indicators calculated based on the AF (the Adjusted Headcount Satisfactory (Poverty) Ratio (M_0), the Adjusted Satisfactory (Poverty) Gap (M_1), and the Adjusted Squared Satisfactory (Poverty) Gap (M_2 or FGT Measure) keep their properties. However, in the dissertation I calculate only M_0 because of its functional and conceptual relationship with the calculation of the size of the MMC. Thus,

$$M_0\,(X,z) = \mu(c(k)) = \frac{1}{n} \times \sum_{i=1}^{n} c_i(k)$$

Equation 8

M_0 is the mean of the censored *satisfactory* vector and ranges between zero and one. M_0 can be broken down into partial indices to capture more detailed information. M_0 can be interpreted as the product of <u>*the percentage of the MMC (H)*</u> times the

[32] From C-MPI application, "This weighting structure was established based on the following points: i) although the weighting structure should ideally take into account correlations between variables, there is still no well-established way to implement this without compromising some of the indicator's other properties, ii) the equal weight assigned to each dimension reflects their equal importance as constituents of quality of life, and iii) in the debate among experts this was the option on which there was greater agreement." (Angulo et al. (2013), p. 16)

intensity of the MMC (*A*). *A* is interpreted as the average *satisfactory* score across the MMC.

$$M_0 = H \times A$$

Equation 9

The MMC or the multidimensional headcount ratio is defined as $H = q / n$; where q is the number of people identified in the MMC using the dual-cut-off approach and n the total population. $A = \sum_{i=1}^{q} c_i(k) \Big/ q$ is the average *satisfactory* score across the MMC. These partial indices present information on people and the number of dimension simultaneously classified in the MMC in higher proportion. After mathematical rearrangements, Equation 9 can be re-written as follows,

$$M_0(X,z) = \mu(c(k)) = H \times A = \frac{q}{n} \times \frac{1}{q} \sum_{i=1}^{n} c_i(k) = \frac{1}{n} \times \sum_{i=1}^{n} c_i(k)$$

$$= \frac{1}{n} \sum_{i=1}^{n} \sum_{j=1}^{d} w_j \, g_{ij}^{0}(k)$$

Equation 10

Hence, Equation 10 is interpreted as the weighted average of the *satisfactory* matrix. In addition, this equation shows that M_0 satisfies the property of *dimensional monotonicity*, which means that if a person achieves a *satisfactory* indicator in an additional dimension, then *A* arises and so does M_0. The MMC does not accomplish this property.

3.1.2.1. Partial and Consistent Sub-Indices of Adjusted Headcount Ratio (M_0)

M_0 – and therefore, H and A –, not only allows analyzing the MMC but also it allows the dimensional decomposition among households features such as others geographical classifications or age groups, or any other analytical category keeping its the methodology properties. The following presentation describes analytical advantages of the index methodology flexibility.

3.1.2.1.1. Sub-Groups Decomposition

Following Alkire et al.'s notation, the principle of sub-group decomposability is formally presented as the population share and the *satisfactory* matrix of subgroup l denoted by $v^l = n^l/n$ and X^l, respectively. M_0 can be denoted as,

$$M_0(X) = \sum_{l=1}^{m} v^l \, M_0(X^l)$$

Equation 11

Using Equation 11, the contribution of subgroup l to overall M_0, $\mathbb{D}_l^0$ can be presented in Equation 12. The contributions of subgroup l depend on M_0 in each group and the share of the subgroup on the population. The sum of contributions is equal to 100%.

$$\mathbb{D}_l^0 = v^l \, M_0(X^l) \Big/ M_0(X)$$

Equation 12

3.1.2.1.2. Dimensional breakdown

Based on the dimensional monotonicity property of the AF methodology, I can quantify each dimensions' contribution to M_0. Dimensions' contribution to M_0 formation shows the percent of the population that is multidimensionally in M_0 and *simultaneously* is counted as *satisfactory* in that dimension (*censored headcount ratio*). Formally, denote the j^{th} column of the censored satisfactory matrix $g^0(k)$ as $g_{.j}^{\ 0}$ and the mean of the column for that chosen dimension as $h_j(k) = \frac{1}{n}\sum_{i=1}^{n} g^0(k)$. Thus, $h_j(k)$ is the censored headcount ratio of dimension j. Then, $h_j(k)$ is the proportion of population that is identified in M_0 ($c_i \geq k$) and is *satisfactory* in dimension j.

In addition, the additive structure of M_0 allows to re-write the index in terms of the weighted sum of the censored headcount ratios, where the weight on dimension j is w_j, the relative weight assigned to that dimension. Based on Equation 10 a reformulation leads the follow expression,

$$M_0 = \frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{d} w_j\, g_{ij}^0(k) \quad = \sum_{j=1}^{d} w_j \left[\frac{1}{n}\sum_{i=1}^{n} g_{ij}^0(k) \quad \right] = \sum_{j=1}^{d} w_j\, h_j(k)$$

Equation 13

Two dimensions can have the same censored headcount ratios but different contributions to the overall M_0. The reason is that the contribution of each dimension depends not only on the censured headcount ratio but also on the weight of each dimension. Therefore, the contribution of dimension j to M_0 is in Equation 14, and the sum of all dimensions' contribution is 100%.

$$\phi_j^{\ 0} = w_j \left[{h_j}/{M_0} \right]$$

Equation 14

3.1.2.1.3. Analysis of Changes Over Time

The analysis over several time periods of M_0, *H and A* has policy relevance because monitoring and keeping track indices helps to assess the effectiveness of policies along time. The following procedure was designed for applications on repeated cross-sectional data which is the most common data structure available in surveys with country scope. The notation will reflect a comparison between two time periods but can be extended to more periods.

Denote t^1 as initial period and t^2 as final period and apply these subscripts to the defined indices. Then, the absolute rate of change (Δ) of M_0 is, $\Delta M_0 = M_0(X_{t2}) - M_0(X_{t1})$. Analogously, $\Delta H = H(X_{t2}) - H(X_{t1})$ and $\Delta A = M_0(A) - M_0(A)$. These are the changes in the indices between the two-time periods. The relative rate of change (δ) compares the absolute rate change to the index in the period one. Thus, $\delta M_0 = \frac{\Delta M_0}{M_0(X_{t1})} \times 100$.

If a study requires comparisons with countries with different time periods for the data, two other measurements are useful to clarify the comparison. The annualized absolute rate of change (Δ^*) is $\Delta^* M_0 = M_0(X_{t2}) - M_0(X_{t1}) / t^2 - t^1$, which is the absolute rate of change corrected by the number of years between the two surveys analyzed. Complementary, the annualized relative rate of change (δ^*) is the compound rate of reduction in M_0 per year between the initial and the final periods, as follows $\delta^* M_0 = \left[\left(\frac{M_0(X_{t2})}{M_0(X_{t1})}\right)^{\frac{1}{t^2 - t^1}} - 1\right] \times 100$. These expressions also can be applied to *H*, *A*, dimensions and subgroups classifications.

Summary. Based on indices described in the previous section, I will calculate the index M_0 or adjusted headcount ratio, the multidimensional headcount ration (*H),* which is equivalent to the multidimensional middle-class (MMC) in this context and the intensity of the MMC (*A*). I also will calculate dimensional breakdown for the contribution of each dimension to the formation of the MMC, the variation of the indices in time, and sub-group decomposition for two analytical categories.

3.2. The Gigliariano and Mosler (GM) Methodology to Calculate the Index of Multidimensional Polarization (IMP)

In this section, I describe the Gigliarano and Mosler's (GM) methodology (Gigliarano & Mosler, 2009a) as the analytical tool to calculate the IMP in Colombia. I follow Gigliarano and Mosler's (2009a) notation. The authors' empirical test of their methodology presents results using two variables, household net income and years of education, and exogenous population grouping based on geographical areas. However, theoretically, they do not exclude the use other relevant dimensions such as health. I also use their empirical application to limit the operationalization to Colombia with the following features: I will only specify continuous/cardinal variables and just one indicator per dimension – as income and years of education – because the authors do not delve into the discussion of the GM usefulness/constrains for either several simultaneous indicator/variables per dimension or variables with measurements different to continuous/cardinal. I will apply as exogenous populations groups based on income as defined in section 3.4.1.1 and groups based on socio-occupational classifications as defined in section 3.4.1.2.

3.2.1. Properties of Indices Based on the Gigliariano and Mosler Methodology

Properties and requirements of indices based on the GM methodology have a resemblance to the unidimensional version of inequality decomposition. In fact, in most of the cases, properties are just the extension from unidimensional to multidimensional cases. However, the main difference between the GM and the unidimensional type of measures is that the GM analyzes dimensions jointly and the interactions between them. Therefore, multidimensional polarization creates a new set of conditions and limits the number of mathematical expressions suitable for its empirical applications.

The GM methodology is grounded on the following assumptions for the construction of indices, i) inequality between groups (*B*), ii) inequality within groups (*W*), and iii) groups' similar sizes (*S*). The general expression for their type of indices is,

$$P(X) = \zeta[B(X),W(X),S(X)],\ X \in M^{N\times K}$$

Equation 15

where X is a matrix $N \times K$ of N individuals and K endowments of their attributes. Thus, x_{ik} represents the endowment of individual i with attribute k, and $M^{N\times K}$ is the set of all N × K matrices represented in a non-negative orthant $\mathbb{R}^K_+$. The endowment of the i-th individual is denoted by $x_i = (x_{i1},\ldots,x_{iK})$ for all $i = 1\ldots N$, and the distribution of the k-th variable is denoted by $x^k = (x_{1k},\ldots,x_{Nk})'$ for all $k = 1\ldots K$. Hence, $\bar{x}_k$ represents the average of the k-th variable and the $\bar{x} = (\bar{x}_1,\ldots,\bar{x}_K)$ the total mean vector. ζ is a function $\mathbb{R}^3 \rightarrow \mathbb{R}$ increasing in B and S, and decreasing in W. Following, I list the first set of properties[33] regarding mathematical consistency.

[33] See details in Gigliarano and Mosler (2009a) p. 448-454.

a) Continuity

b) Anonymity

c) Replication invariance

d) Weak scale invariance

e) Strong scale invariance

f) Translation invariance

The following second set of properties is related to the characterization of the polarization concept[34].

a) Maximum polarization. "… two-groups society shows maximum polarization if it consists of two equally large groups, the individuals in each group have the same endowment vector, and the mean vectors of the two groups are at maximum distance." (Gigliarano and Mosler (2009a), p. 449)

b) Minimum polarization. "… when the population is constituted by only one group and inequality is maximum." (Gigliarano and Mosler (2009a), p. 451)

c) Increased spread. "…whenever two or more groups are shifted such that their means become more disperse in term of [properties p. 451, pp. 4], then polarization increases." (Gigliarano and Mosler (2009a), p. 452)

d) Increased polarity. "…whenever the population in one of the groups is exchanged against the majorizing[35] population type [properties p. 451, pp. 4], respectively." (Gigliarano and Mosler (2009a), p. 452)

[34] Gigliarano and Mosler (2009a) Op. Cit. p. 448-454.

[35] "The Uniform Majorization Principle is the multidimensional analogue to the Pigou-Dalton Transfers Principle." (Chakravarty (2009) p. 126)

Following, the last set of properties regarding the jointly analysis of dimensions and interactions between them[36].

a) Correlation increasing majorizations. "…study the effect on the polarization measures of transfers that increase the correlation between attributes", thus, "it seems necessary to study correlation increasing transfers separately between and within groups."(Gigliarano and Mosler (2009a), p. 453)

3.2.2. Formal Representation of the Gigliariano and Mosler Methodology to Calculate the IMP

Recalling the structure of the Equation 15, the axiomatic properties allow indices with the following mathematical expressions,

$$P_1 = \varphi\left[\frac{B(X)}{W(X)+c}\right]S(X)$$

Equation 16

$$P_2 = \psi[B(X) - W(X)]S(X)$$

Equation 17

$$P_3 = \tau\left[\frac{B(X)}{B(X)+W(X)+C}\right]S(X)$$

Equation 18

Where c is a positive constant, and functions φ, ψ, and τ are assumed to be continuous and strictly increasing, with $\varphi(0)= \tau(0)=0$. These measurements accomplish the property of additively decomposability which allows performing calculations by groups or categories. For the dissertation, I chose that functions φ, ψ, and τ follow the

[36] Ibid. p. 448-454.

logistic function because it fits the conditions described by the GM methodology (Cameron, 2009). In the next section, I present the mathematical form for group size (*S(X)*) that I will apply and three mathematical forms of additive inequality decomposition (*B(X)* and *W(X)*) that I will apply as well.

3.2.2.1. Group Size and Polarization Decomposition Indices

The literature in polarization gives relevance to the relative size of groups. Therefore, the GM methodology adapts the numbers equivalent to measure the group size. The numbers equivalent are mathematical forms equivalent to the inverse of a measure of concentration. The authors posit the normalized numbers equivalent *S* as follows,

$$S(X) = \frac{\phi^{-1}\big(\mathrm{C(X)}\big) - 1}{G - 1}$$

Equation 19

where the population *N* is divided into *G* groups such as $N = \sum_{g=1}^{G} N_g \; \forall$ g = 1, …, N, and ϕ^{-1}(C) is the number equivalent of *C*. Thus, in Table 16, I present the mathematical form that I apply to calculate the relative group size.

Table 16 Relative Group Size Index

Name of concentration measure	**S(X)**	**Concentration measure C(X)**	ϕ^{-1}**(C)**
Entropy	$\dfrac{\left(\prod_{g=1}^{G}\left(\frac{N_g}{N}\right)^{-\left(\frac{N_g}{N}\right)}\right) - 1}{G - 1}$	$\sum_{g=1}^{G} \frac{N_g}{N} \log\left(\frac{N_g}{N}\right)$	Exp(-C)

Source Gigliarano and Mosler (2009a), p. 440.

3.2.2.2. Mathematical Forms of Additive Inequality Decomposition

Theoretically, the general mathematical form for an additively inequality index is,

$$I(X) = f\left(\frac{1}{N}\sum_{i=1}^{N} h(s_i, \bar{s})\right)$$

Equation 20

where $s_i = s_i(x_{i1},\ldots, x_{iK})$, $\bar{s}$ is the average of s_i , and f and h are continuous functions, with f strictly increasing. By assumption, for a specific choice of f, h and s_i , there is a $I(X)$ additively decomposable by subgroups such as,

$$I(X) = B(X) + W(X) = B(X) + \sum_{g=1}^{G} w_g I_g(X)$$

Equation 21

where the between- component among groups and the within- component inside of a given group are respectively,

$$B(X) = f\left(\sum_{g=1}^{G} \frac{N_g}{N} h(\bar{s}^g, \bar{s})\right)$$

Equation 22

$$I_g(X) = f\left(\frac{1}{N_g}\sum_{i\epsilon g} h(s_i, \bar{s}^g)\right)$$

Equation 23

where $\bar{s}^g$ is the mean of s_i in group g, and w_g is the weight of the group g.

From the mathematical forms suitable to these type of indices, I will apply the additive decomposable measurements based on Maasoumi (1986) known as the generalized entropy measures (GEM):

$$\text{GEM}_\gamma\ (\text{X}) = \frac{1}{\gamma(1+\gamma)}\frac{1}{N}\sum_{i=1}^{N}\left[\left(\frac{s_i}{\bar{s}}\right)^{1+\gamma} - 1\right],\ \gamma \neq \text{-1,0.}$$

Equation 24

$$GEM_{-1}(X) = \frac{1}{N}\sum_{i=1}^{N} \log\left(\frac{\bar{s}}{s_i}\right)$$

Equation 25

$$GEM_{0}(X) = \frac{1}{N}\sum_{i=1}^{N} \left(\frac{s_i}{\bar{s}}\right) \log\left(\frac{s_i}{\bar{s}}\right)$$

Equation 26

Where the individuals' attributes are aggregated as follows,

$s_i = \left(\sum_{k=1}^{K} \delta_k \, x_{ik}^{-\beta}\right)^{-1/\beta}$, with $\delta_k \in [0, 1]$ and $\sum_{k=1}^{K} \delta_k = 1$. δ_k weights of the *k*-th attribute and β captures the elasticity of substitution between attributes. Polarization indices based on Equation 24 through Equation 26 range from zero to infinity. Table 17 summarizes the mathematical forms to assess the IMP and their components.

Table 17 Summary of Selected Expression for Multidimensional Polarization Indices[¥]

Additive Decomposable Inequality Index	***f(y)***	s_i	$\bar{s}$ *	$\bar{s}^g$ **	$h\,(t;\bar{t})$	w_g
$GEM_{\gamma\neq -1,0}$	$\frac{y}{\gamma(1+\gamma)}$	$\left(\sum_{k=1}^{K} \delta_k \, x_{ik}^{-\beta}\right)^{-1/\beta}$	$\frac{1}{N}\sum_{i=1}^{N} s_i$	$\frac{1}{N_g}\sum_{i\in g} s_i$	$\left(\frac{t}{\bar{t}}\right)^{1+\gamma} - 1$	$\frac{N_g}{N}\left(\frac{\bar{s}^g}{\bar{s}}\right)^{1+\gamma}$
GEM_{-1}	y	$\left(\sum_{k=1}^{K} \delta_k \, x_{ik}^{-\beta}\right)^{-1/\beta}$	$\frac{1}{N}\sum_{i=1}^{N} s_i$	$\frac{1}{N_g}\sum_{i\in g} s_i$	$\log\left(\frac{\bar{t}}{t}\right)$	$\frac{N_g}{N}$
GEM_{0}	y	$\left(\sum_{k=1}^{K} \delta_k \, x_{ik}^{-\beta}\right)^{-1/\beta}$	$\frac{1}{N}\sum_{i=1}^{N} s_i$	$\frac{1}{N_g}\sum_{i\in g} s_i$	$\left(\frac{t}{\bar{t}}\right)\log\left(\frac{t}{\bar{t}}\right)$	$\frac{N_g \bar{s}^g}{N\bar{s}}$

Source: Gigliarano and Mosler (2009a), p. 445.

[¥]Note on notation: by assumption the population is breaking down into *G* groups and $N = \sum_{g=1}^{G} N_g$

*It is the arithmetic mean of the functions s_i overall *N* individuals.

** It is the arithmetic mean of the functions s_i over the individual in subgroup g.

Summary. Based on the indices described in the previous section, I will calculate the index components (relative group size, between- and within-) for each expression in Table 17. I will use them to calculate polarization indices as *P1*, *P2* and *P3* with the logistic function.

3.3. Data

The source of data for the proposed empirical estimations is the Colombian National Statistics Department (C-NSD).[37] The C-NSD provides free access to the Colombian Living Standards Measurement Surveys (C-LSMS[38]) through its website. The C-LSMS collects information on households' demographics (e.g. age, sex, individuals' position within the household, among others); socioeconomic characteristics (e.g. employment status, income, education, health, among others); and households' features (e.g. household type, utilities and sanitation; and material possessions). These data are available for the years 2003, 2008, 2010, 2011, 2013, 2014 and 2015. These data provide users with an opportunity to conduct cross-sectional time-series analyses. The C-LSMS is statistically representative at the country and region the nine regions. The dissertation's unit of analysis is the household. These datasets are the same ones used by the Colombian government to calculate de C-MPI (Angulo et al., 2013).

3.4. Proposed Operationalization of Dimensions: Construction of Indicators of the Multidimensional Middle-class (MMC) and the Index of Multidimensional Polarization (IMP)

In the next sections, I provide the rationale and empirical support for creating indicators that operationalize each dimension for both the MMC and the IMP. Table 18 summarizes the notation for the dimensions, the indicators and the weights that will be applied in the AF methodology. The defined indicators will fill the *satisfactory* matrix of

[37] Departamento Administrativo Nacional de Estadística (DANE in Spanish). Website http://www.dane.gov.co/.
[38] For more technical information see Appendix 7.

the AF methodology with ones and zeros for each household depending on if it belongs to the MMC. Similarly, Table 19 summarizes the notation for the dimensions and the indicators that I will apply in the GM methodology to calculate the IMP. For the IMP, the entire distribution of the defined indicators is employed in the index calculation.

Dimensions education, health, assets and housing aim to include information about household members different than household heads to support the relevance of the household as the unit of analysis. The criteria for indicators in each dimension aim to find a clear threshold for each characteristic to identify the MMC. However, the limitations on information collected for the C-LSMS cause some indicators to overlap income population or classes, regardless of any proposed definition of classes.[39] In Appendix 6, I present a translation of the actual questions from the C-LSMS used to create each indicator.

Most referenced literature analyzes both the MIP and polarization utilizing a common variable, income, therefore, the linkage and relationship are cleaner and observable, as well as their conclusions. In the case of a multidimensional analysis, the inclusion of different variables simultaneously does not guarantee the same clarity in the linkage of the indices and their patterns. Therefore, I propose to approach the linkage between the MMC and the IMP grounded on selecting indicators from the MMC that I can use to calculate the IMP, taking into account data availability and limitations of the GM methodology discussed in previous section 3.2.

Indicators for the MMC and the IMP are related but are not exactly the same because the AF methodology departs from the GM methodology in a fundamental

[39] For instance, Castellani et al. (2014) using the Colombian-MPI show the proportion of people in the middle and affluent classes that also might be classified as multidimensional poor.

feature. The AF is a censored approach, which means that it focuses only on a section of the indicators' distribution, while the GM applies across the entire distribution of indicators. This is the main argument why the operationalization of indicators, although related and similar, still differs from one approach (AF) to the other (GM).

Table 18 Dimensions, Indicators, Weights, and Cut-Offs of the MMC

Dimensions[40] (weight)	**Indicators Coding (weight)**	**Indicator definition and cut-offs**
Income (1/6)	inc_R1 (1/6)	Middle Income Population (MIP) with income between U$13.6 & U$53.6 US per capita per day. 2011 PPP (Purchasing Power Parity).
Employment (1/6)	emp_R1 (1/6)	The Middle-class (MC) includes employees in the following occupational activities: • In private sector: skilled white-collar employees, office non-managerial employees, selling and administration employees; for both small and large business. • And in public sector: professionals, skilled white-collar employees, office no-managerial employees, selling and administration employees; for both small and large business.
Education (1/6)	edu_R1 (1/12)	Children, teenagers, and young adults whose ages are greater than 5 and lower than 23 years old and report currently being enrolled a private educational institution
	edu_R2 (1/12)	Either the household's head or the household head's partner has a level of education between completed technical degree and completed bachelor degree
Health (1/6)	hea_R1 (1/12)	All household's members have private health insurance coverage
	hea_R2 (1/12)	The mode of a household's health self-perception is good for both MIP and MC among the following options: bad, fair, good and very good
Assets (1/6)	as_R1 (1/12)	The household owns either a car or motorcycle for personal use, but not both
	as_R2 (1/12)	The household owns either a PC and internet connection, or washing machine for laundry, but not both
Housing (1/6)	hou_R1 (1/12)	Crowding indicator (total of household members divided by total of rooms used to sleep) lower than 3 and greater or equal to 1.5
	hou_R2 (1/12)	The household's members pay a mortgage or the household's members pay rent

Source: Author's design.

[40] The benchmark counting scenario in the aggregation stage of the AF methodology discussed in section 3.1.2 treats each dimension with the same importance (weight).

Table 19 Dimensions and Indicators of the Polarization Index

***Exogenous population group from Dimensions Income*: Low Income, Vulnerable, MIP and High Income**		
Dimensions	**Indicators Coding**	**Indicator definition**
Education	edu_P1	Number of years of education of household's head
Health	hea_P1	Average household of self-reported health status
Assets	as_P1	Assets index based on principal components analysis.
Housing	hou_P1	Total of household members divided by total of rooms used to sleep.

***Exogenous population group from Dimensions Employment*: Affluent Class (AC), Lower Affluent Class (LAC), the Middle-class (MC), the less vulnerable (Vul1), intermediate vulnerable (Vul2) and the most vulnerable (Vul3)**		
Dimensions	**Indicators Coding**	**Indicator definition**
Education	edu_P1	Number of years of education of household's head
Health	hea_P1	Average household of self-reported health status
Assets	as_P1	Assets index based on principal components analysis.
Housing	hou_P1	Total of household members divided by total of rooms used to sleep.

Source: Author's design.

3.4.1. Indicators Definitions for the MMC

3.4.1.1. The Income Dimension and Its Indicator: The Vulnerability-To-Poverty Approach to Calculate Upper and Lower Bounds

I followed Lopez-Calva and Ortiz-Juarez's (2013) conceptual framework and methodological stages and adapt them to my research goals. Regarding the conceptual framework, the authors conceptualize middle-class [sic] as the population with "the level of income that allows individuals to protect themselves from falling into poverty over time." (López-Calva and Ortiz-Juarez (2013), p. 26). These author's definition is grounded on the vulnerability to poverty approach. This approach uses people's economic insecurity (Goldthorpe & McKnight, 2006) and their impossibility to face appropriately economic shocks, as distinct characteristics that allow to identify the

vulnerable population. Therefore, the vulnerable population is the population between the poor population and the middle-class.

Lopez-Calva and Ortiz-Juarez's (2013) procedure to estimate the lower bound of the middle-class has three stages. First, they use a panel data to classify people who were non-poor in the first period and poor in the second period. These two groups, non-poor in the first period and poor in the second period, define the dichotomous dependent variable. Secondly, they estimate a logit model to find the probability of falling into poverty throughout time. Thirdly, they use an income equation with the same control variables of the logit estimation to predict the income. Then they compare both predicted probabilities and predicted incomes for individuals. All the variables defined and used in the study are based on information for household heads.

I followed the same three stages with some modifications in this section. The first modification is needed because I have cross sectional data. I circumvent the limitation of not having panel data by using a question that allows me to use retrospective information.[41] The question that collects retrospective information is: *Compared to 5 years ago, currently your standard of living is: a. Better; b. Same; c. Worse.* In addition, to evaluate the heterogeneity of individuals in each of the answers of the retrospective information, I used another question that asks those surveyed about income self-assessment to cover their expenditures. The question about income self-assessment is: *Currently, the household income: a. Is not enough to cover the minimum expenditures; b. Is enough to cover the minimum expenditure; c. Covers more than the minimum*

[41] Retrospective information was used by Angulo et al. (2012) to analyze mobility in Colombia.

expenditure. Table 20 presents a cross tabulation for both questions based on household heads' answers.

Table 20 Colombian Household's Head Perceptions of Living Standards Relative to 5 Years Ago and Income Self-Assessment to Cover Minimum Expenditure to Identify the Model Dependent Variable, Year 2013[42]

		Responses to the question about income self-assessment to cover minimum expenditure			**Total**
		Not enough	***Just covers enough***	Covers more than enough	
		A	B	C	
Responses to the question about perceptions of standards of living compared to 5 years ago	Better (Population)	1,078,155	3,853,842	1,277,958	**6,209,955**
	Percentage (%)	17.36	62.06	20.58	**100**
		D	**E**	F	
	Same (Population)	***1,490,961***	***3,194,441***	***634,135***	***5,319,537***
	Percentage (%)	28.03	60.05	11.92	**100**
		G	H	I	
	Worse (Population)	945,101	894,520	69,032	**1,908,653**
	Percentage (%)	49.52	46.87	3.62	**100**
	Total (Population)	**3,514,217**	**7,942,803**	**1,981,125**	**13,438,145**
	Percentage (%)	**26.15**	**59.11**	**14.74**	**100**

Source: Author's calculations. C-LSMS 2013.

The two questions allow operationalizing of the vulnerability approach because: a) individuals in the middle-class are those who self-report, compared to 5 years ago their current standard of living is the same (answer *Same* in rows, Table 20); b) among individuals described in a), I can analyze the probability of being in any of the three economic situations from the question about income self-assessment[43] to cover minimum expenditure (cells D, E and F, Table 20), and c) unlike Lopez-Calva and Ortiz-Juarez

[42] See Appendix 5, Table 47 for tabulation of the remaining years. Factors Expansion were applied for descriptive statistics.

[43] The relevance of self-perception to measure class size and class membership is pointed out in Lora and Fajardo (2013).

(2013), who use 10%[44] as the probability of falling into poverty to calculate the middle-class' income lower bound, I do not set any probability. My procedure is to find the income level that maximizes the probability of belonging to category E.

For the second modification, based on Table 20 I defined the dependent variable with the following three categories: i) same living standards as 5 years ago and not enough to cover the minimum expenditures (cell D), ii) same living standards as 5 years ago and just enough to cover the minimum expenditures (cell E), and iii) same living standards as 5 years ago and more than enough to cover the minimum expenditures (cell F). Hence, my dependent variable has three categories, not two, as Lopez-Calva and Ortiz-Juarez's study.

For the third modification, I estimated a multinomial logit model[45] to find the probability of falling into any of the three categories defined. Specifically, I interpret the population in cell E as the closest to my conceptual definition of the MIP.

For the fourth modification, I predicted the probabilities for each category and compared each one with the predicted income.[46] However, I depicted only the comparison of predicted probabilities of cell E category with the predicted income for all the remaining years (see Appendix 5, Figure 37).

Figure 22 suggests that the functional form of the relationship between the predicted probabilities of cell E category and the predicted income is quadratic. In fact, Figure 22 shows that the greater the income, the greater the probability of belonging to

[44] Lopez-Calva and Ortiz-Juarez (2013) take this value from Cruces, Elizaveta, et al. (2011).
[45] Castellani et al. (2014) suggest addressing empirically the class analysis with a dependent variable with three categories, which means that a multinomial model is more appropriate for the estimations.
[46] The dependent variable was income per capita per day in logarithm and the equation included the same control variables of the multinomial logit estimation. Estimations for all years of multinomial logit model and income model are in Appendix 5, Table 48.

cell E category but only until some point. Beyond that specific point, the greater the income, the lower the probability of belonging to cell E category. The phenomenon is consistent with the level of income and individuals' transition towards lower and upper classifications of income groups. The quadratic functional shape is an empirical regularity in all other years as shown in Figure 37 in Appendix 5.

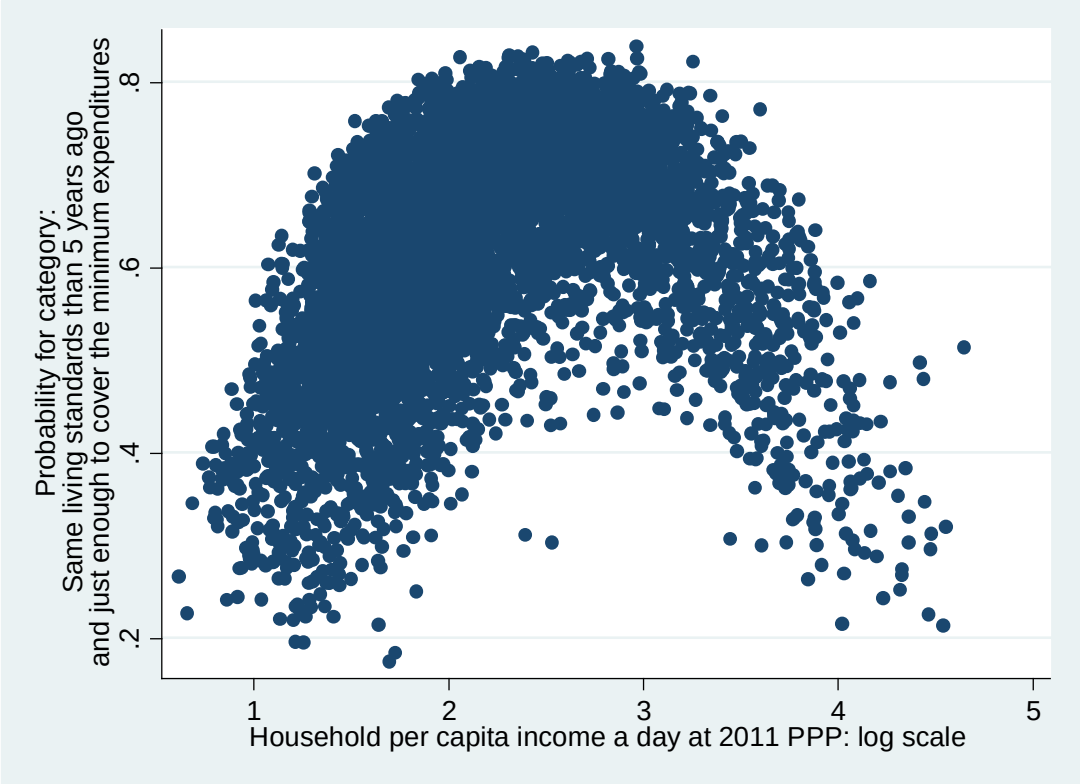

Figure 22 Predicted Probabilities for Cell E Category vs. Predicted Income Per Capita Per Day in Log Scale, 2013[47]
Source: Author's calculations. C-LSMS 2013.

To find the maximization point, I estimated a simple quadratic model where the predicted probability is the dependent variable and the predicted income is the independent variable. This functional specification allows for finding the income that

[47] I contrasted linear specification vs. quadratic specification using the adjusted R-squared. Their results are .11 vs .44 respectively, supporting the quadratic specification. For all years' estimations see Appendix 5, Table 49.

maximizes the probability of belonging to the MIP. In other words, it establishes empirically the lower bound of the MIP or upper bound of the vulnerable population. Therefore, in 2013 the income that maximizes the probability of belonging to the category *same living standards as 5 years ago* and *just enough to cover the minimum expenditure* (cell E, Table 20) is $13.60 US[48] per capita per day. The same procedure was performed for all years. This calculation produces estimates of the lower bound of the MIP in each of them. Table 21 summarizes the income that maximizes the probability in each year.

Table 21 Income that Maximizes the Probability of Belonging to the MIP, 2003 - 2015

	2003	**2008**	**2010**	**2011**	***2013***	**2014**	**2015**
Income that maximizes probability U.S. per capita per day, 2011 PPP	19.45	12.12	17.10	14.10	***13.60***	13.80	12.30

Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

Because each year has a different income that maximizes the probability of belonging to the MIP, I chose on a conceptual basis the 2013 estimation as the middle-class lower bound applicable to all years. The deepest global economic crisis of the recent times occurred in 2008, five years prior to 2013. Therefore, individuals surveyed in 2013 with income equal or more than $13.60 US per day "*protect[ed] themselves from falling into poverty over time*."

Regarding the MIP upper bound, López-Calva and Ortiz-Juarez (2013) set the upper bound in $50 US, which means a $40 US range in the interval. For the purposes of my research, I adopted the $40 US range between my estimated lower bound and the

[48] 2011 PPP

definition of the upper bound. Therefore, the upper bound is $53.60 US per day. Having my estimated lower and upper bounds as a reference, I calculated the trend of the MIP for Colombia for the years analyzed. Table 22 presents the MIP trend. Using these lower and upper bounds, I estimated that by 2015 the size of the MIP was 31.5%, which means an increase of 16.5 percentage points compared to 2003.

Table 22 Trend of the Size of the MIP as Percentage of the Total Population, 2003 - 2015

	2003	**2008**	**2010**	**2011**	**2013**	**2014**	**2015**	**Percentage Points Change 2003 - 2015**
The MIP Lower bound=13.60 Upper bound=53.60	15.0	17.5	23.1	24.1	27.4	28.9	31.5	16.5

Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

I used a similar procedure to calculate the size of the vulnerable population. My goal is estimating the lower bound of the vulnerable population because I already estimated the upper bound. However, I must redefine the dependent variable to calculate the lower bound of the vulnerable population. Recalling Table 20, now the definition of the dependent variable has the following conditions: i) worse living standards than 5 years ago and not enough to cover the minimum expenditures (cell G); ii) same living standards than 5 years ago and just enough to cover the minimum expenditures (cell E); and iii) better living standards than 5 years ago and more than enough to cover the minimum expenditures (cell C). In other words, the corresponding cells in Table 20 are underlined in the diagonal from the bottom-left to the upper-right. The three categories now include the two extreme cases, which are the most unfavorable and favorable outcomes over time.

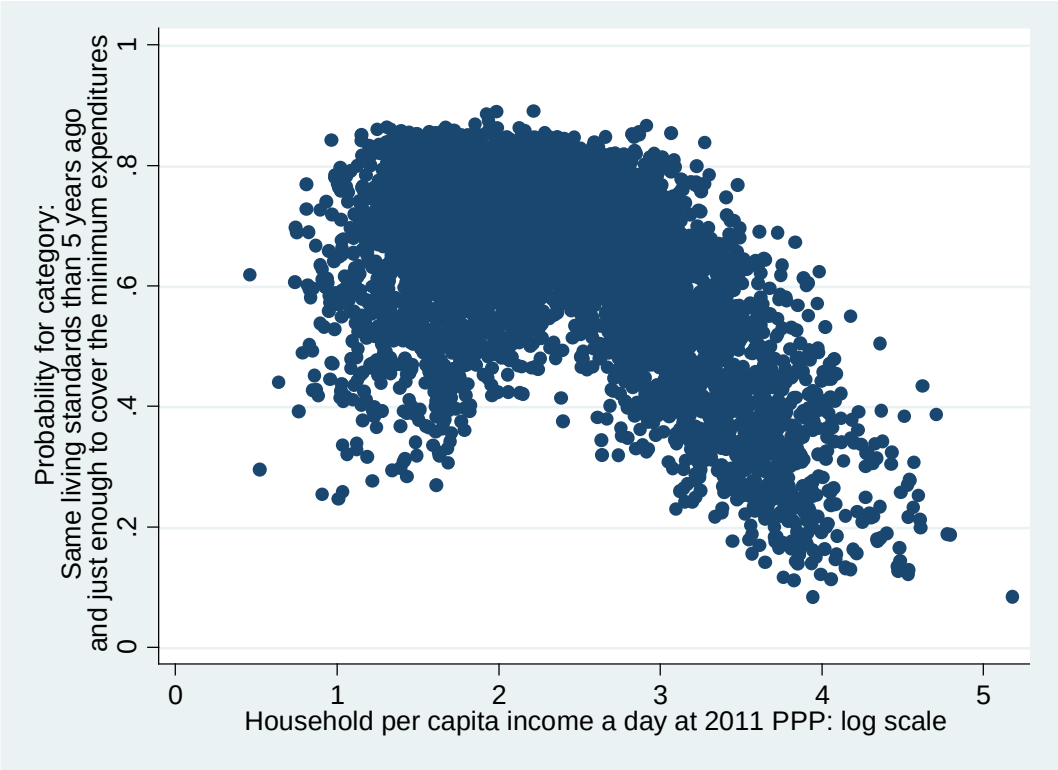

Figure 23 Predicted Probabilities for Cell E in the New Definition of the Dependent Variable vs. Predicted Income Per Capita Per Day in Log Scale, 2013
Source: Author's calculations. C-LSMS 2013.

Based on the definition of the new dependent variable, Figure 23 suggests that the functional relationship between the predicted probabilities of cell E category and the predicted income is also quadratic.[49] In this case, the income that maximizes the probability of belonging to cell E category is $7 US per day[50]. Hence, the vulnerable population includes people with less than $13.60 US per day, and equal or greater to $7 US per day.

[49] I contrast linear specification vs. quadratic specification using the adjusted R-squared, their results are .29 vs .47 respectively, supporting the quadratic modeling. Appendix 5, Table 51 presents estimations for all years of analysis. Appendix 5, Figure 38 shows the same shape for all other years.
[50] Estimations for all years of multinomial logit model and income model in Appendix 5, Table 50.

Table 23 presents the trend of the vulnerable population throughout the period of analysis. The vulnerable population increased by 7.1 percentage points between 2003 and 2015, which represents a 32.6% increase. However, unlike the MIP, an increase in the vulnerable population is not always assessed as a positive signal. An increase of vulnerable population is interpreted as a positive phenomenon when it is a transition stage for upper mobility. This possibility is suggested by Azevedo, Lopez-Calva, Lustig, and Ortiz-Juárez (2015) because of the reduction of inequality and at least moderated economic growth in Latin America. Nonetheless, I do not have empirical information to assess the increase as a positive signal in the dissertation.

Table 23 Trends of the Size of the Colombian Vulnerable Population, the MIP Plus Vulnerable Population, and Poor Population as Percentage of the Total Population, 2003 - 2015

	2003	**2008**	**2010**	**2011**	**2013**	**2014**	**2015**	**Percentage Points Change 2003 - 2015**
Vulnerable Pop. Lower bound= 7 Upper bound<13.6	21.8	22.0	25.3	25.3	26.	27.5	28.9	7.1
The MIP + Vulnerable Pop.	36.8	39.5	48.4	49.4	54.3	56.4	60.4	23.6
Poor Pop. Upper bound<7	61.3	57.3	47.0	45.1	41.1	38.7	34.0	-27.3

Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

In Table 23 I also present a calculation of the size of the poor population, which is defined as the population with less than $7 US per day. I combined the MIP and the vulnerable populations' sizes, which jointly illustrates a 23.6 percentage points increase between 2003 and 2015, equivalent to percent change of 64.1%. Simultaneously, the size of the poor population decreased by 27.3 percentage points in the same period, equivalent to a percent change of 44.5%.

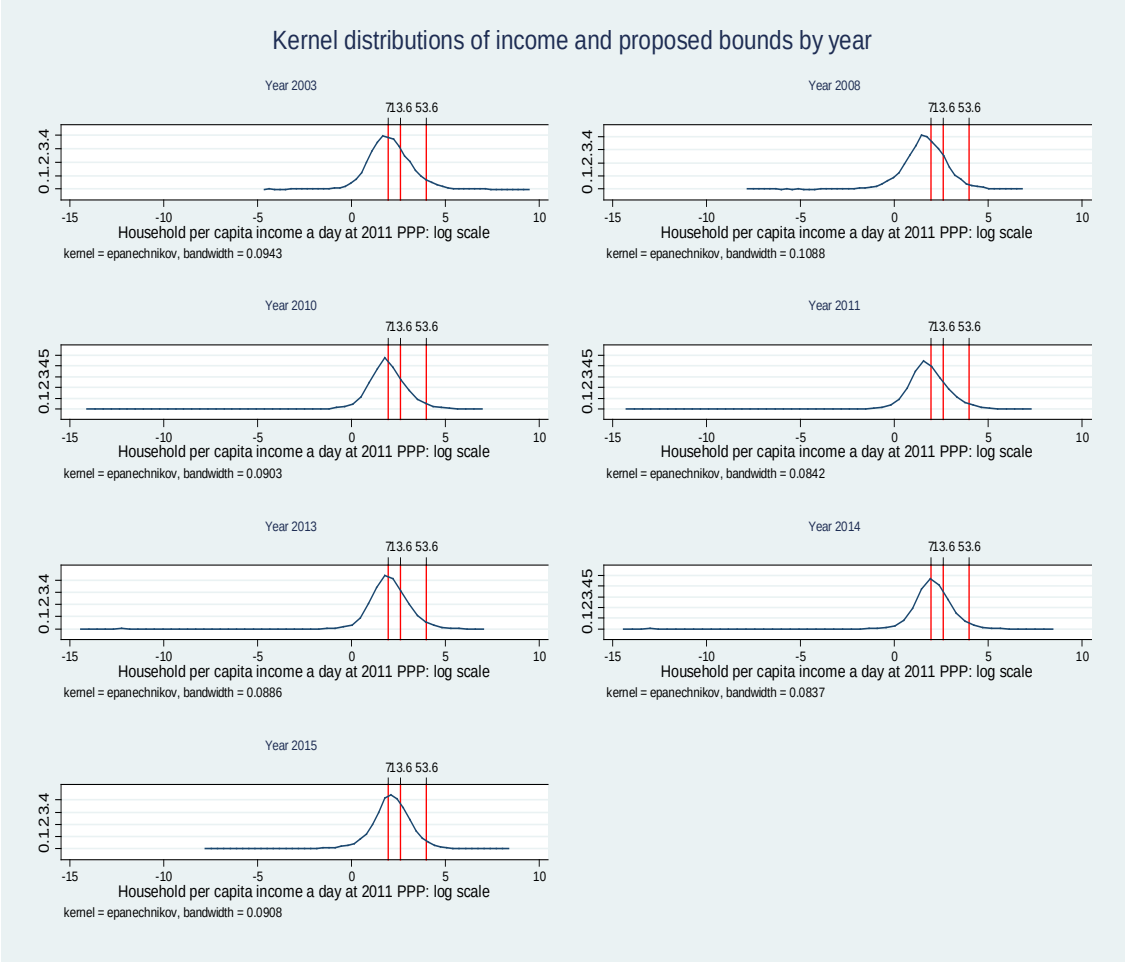

Figure 24 Location into the Income Distribution of the Lower and Upper Bounds for the MIP and Vulnerable Population in Colombian by Year
Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

Finally, following Lopez-Calva's and Ortiz-Juarez's (2013) strategy, in Figure 24 I present the MIP and vulnerable population bounds location in the income distribution in each year. The figure shows that in all years the lower bound of the MIP is greater than the median value of the income distribution. This also was verified with the actual statistics. The implication of this finding aims to strengthen the use of absolute measurements over relative measurements because relative measurements often set bounds with the median as the center of the interval of the MIP. Based on my findings, the relative measurement procedure does not reflect the empirical implementation of the

vulnerability-to-poverty approach to calculate the MIP in the context of Colombia for the period analyzed.

3.4.1.2. The Employment Dimension

Inspired by sociological theories of class, I follow class location strategy to address the definition of the indicator that reflects the employment dimension of the MC. The class location strategy is built upon the interplay between contradictory class locations, where I use both non-manual activities combined with non-authority over the means of production for the conceptual definition of the MC (Pérez et al., 2004; Portes & Hoffman, 2003; Wright, 1983).

Table 24 Socio-Occupational Class Identification

In Public Sector			**In Private Sector**	
Small Business	**Large Business**	**Occupational Categories**	**Small Business**	**Large Business**
LAC	AC	CEO, managers	LAC	AC
MC	**MC**	Professionals	LAC	AC
MC	**MC**	Skilled white-collar employees	**MC**	**MC**
MC	**MC**	Office non-managerial employees	**MC**	**MC**
MC	**MC**	Selling and administrative employees	**MC**	**MC**
Vul1	Vul1	Skilled manual labor employees	Vul1	Vul1
Vul1	Vul1	Unskilled manual labor employees	Vul1	Vul1
Vul2	Vul2	Unskilled services employees	Vul2	Vul2
Vul3	Vul3	Agricultural activities employees	Vul3	Vul3

Note: Affluent Class (AC), Lower Affluent Class (LAC), the Middle-class (MC), Vulnerable levels from the less vulnerable (Vul1) to the most vulnerable (Vul3)[51]

Source: Author's design. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

I use the size of businesses where employees work, differentiation of jobs by the public and the private sectors, and labor occupational activities are recurrent features in literature to identify people's class location (see section 2.3.2). In addition, the household

[51] The C-LSMS does not allow me to identify Wright's (1983) relevant features for contradictory class locations such as levels of responsibilities or supervising jobs.

unit of analysis presents interaction among household members. Therefore, the household class location includes classification of household's head and household's head partner (Deaton, 1997; Gasparini et al., 2012). Consequently, Table 24 summarizes the simultaneous conditions to identify the MC. In the empirical operationalization, I specified the class location of the household's head using the following criteria:

i. Two types of business sizes: I defined small businesses with 50 or fewer employees, and large businesses with more than 50 employees. I set the threshold to this number of employees due to limited information from the C-LSMS. The size of the businesses is useful as a proxy for the class location power over the means of production (Pérez, Andrade-Eekhoff, Bastos, & Herradora, 2004; Portes & Hoffman, 2003).

ii. Two types of economic sectors, the private sector and the public sector (Solimano, 2008).

iii. Occupational categories of employees:[52] agricultural activities employees, unskilled services employees, unskilled manual employees, skilled manual employees, selling and administrative employees, office non-managerial employees, skilled white collar employees, professionals, and CEO and managers (ECLAC - CEPAL, 2000). Conceptually, I defined the MC with the occupations that are not manual and do not have authority over the means of production. Therefore, the MC includes selling and administrative employees, office non-managerial employees, skilled white-collar employees and professionals.

[52] The classification is based on concepts and definitions presented in Appendix 6.

Table 25 Trend of the Proposed Socio-Occupational Classes in Percent, 2003 - 2015

Socio-Occupational Classes	**2003**	**2008**	**2010**	**2011**	**2013**	**2014**	**2015**	**Percentage Points Change 2003 - 2015**
Affluent Class (AC)	1.0	1.6	2.0	2.7	2.3	2.6	3.0	2.0
Lower Affluent Class (LAC)	2.4	4.2	4.7	4.9	4.4	5.5	6.0	3.6
The Middle-class (MC)	***31.7***	***28.1***	***35.1***	***27.7***	***28.6***	***27.6***	***27.4***	***-4.3***
Vulnerable Vul1	23.5	24.7	21.8	22.7	23.8	23.8	23.6	0.1
Vulnerable Vul2	18.8	19.3	19.8	21.1	20.3	20.2	20.2	1.4
Vulnerable Vul3	22.6	22.1	16.6	20.8	20.6	20.4	19.9	-2.7
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	

Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

In Table 25, I present the percent of the population in each one of the proposed socio-occupational classes between 2003 and 2015. AC and LAC have an increasing trend; while the MC fluctuates with a decreasing trend between 2013 and 2015. Between 2003 and 2015 the MC reduces by 4.3 percentage points which is equivalent to a reduction of 13.6%. Despite some minor fluctuations, Vul1 remains relative stable along the period. Vul2 increases 1.4 percentage points, and simultaneously Vul3 decreases 2.7 percentage points in entire period.

3.4.1.3. The Education Dimension

Recall that in the Colombian context, private education is widely considered superior to free public education. Thus, families that pay for private education likely have the financial capital associated with population in the middle segment of society. The following indicators cover the identified characteristics of private education for children to young adults, and post-secondary attainment for at least one of the household adults. Prior research indicates these credentials are reflective of population status in the middle

segment in the Latin American context. Drawing upon the literature referenced in section 2.3.3, I propose the following two indicators:

1. Indicator edu_R1. Children, teenagers, and young adults whose ages are more than 5 and less than 23 years and report currently being enrolled in a private educational institution.

2. Indicator edu_R2. Either the household's head or the household head's partner has a level of education between a completed technical degree and a completed bachelor degree.

3.4.1.4. The Health Dimension

Drawing upon the literature referenced in section 2.3.4, I propose to ascertain the health dimension of the middle segment of the society utilizing private health insurance and health self-perception as the following two indicators:

1. Indicator hea_R1. All household's members have private health insurance coverage.

2. Indicator hea_R2. Populations in both MIP and MC describe the household's health self-perception as good. (Survey answer options for self-perception: bad, fair, good and very good)

3.4.1.5. The Assets Dimension

Drawing upon the literature referenced in section 2.3.5, I propose to ascertain the assets dimension of the middle segment of the society utilizing the following two indicators. In addition, I exclude from the MMC the households that simultaneously

possess all the listed assets (car, motorcycle, PC and internet connection and washing machine for laundry) and the households that lack all these assets.

1. Indicator as_R1. The household owns either a car or motorcycle for personal use, not both.

2. Indicator as_R2. The household owns either a PC and internet connection, or washing machine for laundry, not both.

3.4.1.6. The Housing Dimension

Drawing upon the literature referenced in section 2.3.6, I propose to ascertain the housing dimension of the middle segment of the society utilizing type of ownership over the house and crowding conditions as the following two indicators:

1. Indicator hou_R1. Crowding indicator (total of household members divided by total of rooms used to sleep) between 3 and 1.

2. Indicator hou_R2. The household's members pay a mortgage or the household's members pay rent.

Summary. To measure the size of the MMC applying the AF methodology, I use the dimensions, income, employment, education, health, assets and housing, with their respective indicators as I present in Table 18. Each household respondent's indicator on each dimension is represented in the *satisfactory* matrix (g^0) with the number one (or zero for non- *satisfactory*). Then, the *satisfactory* score *c* is calculated. Finally, depending on the *k* number of *satisfactory* indicators, I calculated the size of the MMC.

3.4.2. Indicators Definitions for the IMP

3.4.2.1. The Income Dimension and the Employment Dimension to Define the Exogenous Population Groups

An empirical advantage of the GM methodology is the group decomposability property. This property means that is possible to decompose the IMP into the between- and within- components. I will present two types of calculations for the IMP, one with the groups defined in the section 3.4.1.1 based on income, and another one with the groups defined in section 3.4.1.2. based on socio-occupational class identification. They are,

a) Income populations: poor, vulnerable, the MIP, and high income.
b) Classes: affluent class, lower affluent class, the MC, vulnerable class with levels from the less vulnerable (vul1) to the most vulnerable (vul3).

3.4.2.2. The Education Dimension

Drawing upon the literature reviewed on education, I use the number of year of education as the traditional indicator to assess the education dimension for individuals. The literature also identifies education of household's head as adequate predictor of the household's current socioeconomic conditions. In addition, this is consistent with the selection of the household as the unit of analysis. Therefore, I proposed the following indicator,

1. Indicator edu_P1. Number of years of education of household's head

3.4.2.3. The Health Dimension

Drawing upon the literature reviewed on health, I used self-reported status as part of their operationalization of the health dimension. In C-LSMS the self-reported health status has a four-level scale from bad (1) to very good (4), thus, I proposed the following indicator,

1. Indicator hea_P1. Average Household self-reported health status.

3.4.2.4. The Assets Dimension

Filmer and Pritchett (2001) applied principal component analysis (PCA) to create an index to approach household wealth through asset ownership indicators to rank households when income/consumption information is not available. The authors suggest using the first factor of the PCA as a reliable proxy for a wealth index. I used the same procedure to create an index[53] of assets for each household. In addition, because the range of the index includes negative values, I re-scaled the index to have a minimum value of zero. Therefore, I proposed the following indicator,

1. Indicator as_P1. Assets index based on PCA.

Using data for C-LSMS, the assets I include to create the index are: the household owns a TV, a refrigerator, a stove, an oven, a microwave, a laundry machine, a water heater, a stereo, an air conditioner, a fan, a car, and a PC.

[53] Alpha Cronbach's reliability coefficient throughout the years of analysis has a minimum value of 0.72 in 2015 and a maximum value of 0.80 in 2003.

3.4.2.5. The Housing Dimension

Drawing upon the literature reviewed on housing and the Colombian government application of the unsatisfied basic needs (UBN) methodology (Feres & Mancero, 2001), I proposed the following indicator to assess the degree of overcrowding,

1. Indicator hou_P1. Total of household members divided by total of rooms used to sleep.

Table 26 Correlation Coefficients Among the Income Indicator and the Remaining Indicators Per Each Year

		2003	**2008**	**2010**	**2011**	**2013**	**2014**	**2015**
Dimensions	**Indicators Coding**	Income per capita	Income per capita	Income per capita	Income per capita	Income per capita	Income per capita	Income per capita
Income per capita		1	1	1	1	1	1	1
Education	edu_P1	0.1802	0.4173	0.3906	0.3896	0.3882	0.2688	0.3308
Health	hea_P1	0.0968	0.1772	0.1867	0.1830	0.1443	0.1088	0.1369
Assets	as_P1	0.2461	0.5063	0.5187	0.4744	0.4418	0.3110	0.3754
Housing	hou_P1	-0.0779	-0.1978	-0.1691	-0.1783	-0.1780	-0.1287	-0.1658

Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

Table 26 presents the correlation coefficients among the income per capita and the remaining indicators per each year in this dissertation's scope. I use income as a reference indicator because it offers an intuitive interpretation and is the commonly use proxy for the MIP as discussed in section 2.3.1. For all years, the sign of the correlation coefficients was the expected. It means that empirical literature associates income with higher educational attainment of household' heads, better health status and more ownership of durable goods. Conversely, income associates inversely with high overcrowding.

Summary. To calculate the IMP applying the GM methodology, I use the dimensions, income, employment, education, health, assets and housing, with their respective indicators as defined in section 3.4.2. The next chapter presents the results of these calculations.

4. CHAPTER 4: RESULTS AND ANALYSIS

4.1. The Sizes of the MIP and the MC

In order to contextualize my findings from the MMC, in this section I present results of calculating the MIP and the MC with C-LSMS for the years of analysis. The results of the MIP and the MC contribute to compare sizes and trends of latter results of the MMC.

The size of the MIP is calculated in Table 27, based on other scholars' definitions summarized in Table 3. As for relative measurements, in 2008 all measurements show a reduction in the size of the MIP. In some cases, the trends fluctuate until 2011, but after this year the MIP either expands or shrinks modestly from 2013 to 2015. The change in the size of the MIP for relative measurements between 2003 and 2015 shows modest changes ranging from -1.3% to 0.2%.

As far as absolute measurements, almost all measurements show an increase in the size of the MIP, and just two of them present reductions (Banerjee and Duflo's, and Ravallion's measurements are the only ones that show negative changes). However, compared to relative measurements, absolute measurements show greater changes in the period of analysis ranging from 18.3% to 23.0%. The results in Table 27 show how sensitive the MIP is to its operationalization, which is a relevant feature for public policy purposes.

I also calculated and compared the size of the MC using selected occupational schemes posited in the sociological analysis applied to Latin America. The selected schemes are the Portes' and Hoffman's (Table 9) and ECLAC's (Table 14).

Table 27 The Size of the MIP for Relative and Absolute Measurements

Definitions Description		**2003**	**2008**	**2010**	**2011**	**2013**	**2014**	**2015**	**Percentage Points Change 2003- 2015**
Relative Definitions of the MIP									
Percentiles of Income Distribution									
Thurow (1984) & Birdsall et al. (2000)	$.75y(p_{50})\leq y_i\leq 1.25y(p_{50})$	22.8	19.2	23.3	20.5	22.0	21.9	22.9	0.1
Blackburn and Bloom (1985)	$.60y(p_{50})\leq y_i\leq 2.25y(p_{50})$	52.5	46.4	51.8	48.7	51.1	51.9	52.7	0.2
Leckie (1988)	$.85y(p_{50})\leq y_i\leq 1.15y(p_{50})$	14.1	11.5	13.9	12.1	12.7	13.0	13.4	-0.7
Davis and Huston (1992)	$.50y(p_{50})\leq y_i\leq 1.50y(p_{50})$	45.7	39.4	45.0	42.9	43.9	44.8	45.9	0.2
Atkinson and Brandolini (2013)	$.75y(p_{50})\leq y_i\leq 2.0y(p_{50})$	40.2	35.0	39.2	36.6	38.9	39.4	40.2	0.0
Alesina and Perotti (1996)	$p_{40}\leq p(y_i)\leq (p_{80})$	28.4	24.0	25.9	24.3	27.0	27.7	27.7	-0.7
Partridge (1997)	$p_{40}\leq p(y_i)\leq (p_{60})$	22.1	19.3	20.6	19.4	21.2	21.5	21.6	-0.5
Barro (2000) & Easterly (2001)	$P_{20}\leq p(y_i)\leq (p_{80})$	59.7	53.7	57.8	55.6	58.2	58.7	59.0	-0.7
Solimano (2008)	$P_{20}\leq p(y_i)\leq (p_{90})$	42.8	36.9	39.9	38.1	41.0	41.2	41.5	-1.3
Absolute Definitions of the MIP*									
Milanovic and Yitzhaki (2002)	$U\$12\leq y_i\leq U\$50$ a day	17.7	21.1	26.8	27.9	31.4	33.0	36.0	18.3
Banerjee and Duflo (2008)	$U\$2\leq y_i\leq U\$10$ a day	62.3	53.1	54.7	51.5	50.7	49.3	45.7	-16.6
Kharas (2010)	$U\$10\leq y_i\leq U\$100$ a day	24.9	29.1	36.2	38.7	41.7	43.7	47.9	23.0
Ravallion (2010)	$U\$2\leq y_i\leq U\$13$ a day	69.9	61.6	63.4	61.1	60.6	59.6	56.9	-13.0
López-Calva and Ortiz-Juarez (2013) & Ferreira et al. (2012)	$U\$10\leq y_i\leq U\$50$ a day	23.4	27.1	33.2	30.7	38.5	40.3	44.0	20.6

Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015. * 2011 US$ PPP per day (World Bank, 2015).

Recalling Portes' and Hoffman's definition of the MC which is composed of the petty bourgeoisie and the non-manual formal proletariat, the size of MC ranges between 22.2% and 27.0% (Table 28), these values are lower than the calculation based on income definitions. Nonetheless, the variation in the period of analysis is positive which means the MC increased 4.8% between 2003 and 2015.

Table 28 Replication of Portes' and Hoffman' Scheme in Percent, 2003 - 2015

	2003	**2008**	**2010**	**2011**	**2013**	**2014**	**2015**	**Percentage Points Change 2015-2003**
I. Capitalists	0.14	0.11	0.16	0.17	0.11	0.15	0.12	-0.02
II. Executives	3.6	4.1	5.4	8.0	8.3	7.0	8.8	5.2
III. Elite workers	7.4	5.4	7.0	5.9	6.6	5.9	7.0	-0.4
IV. Petty bourgeoisie	**2.9**	**2.5**	**3.7**	**3.6**	**3.2**	**3.0**	**3.8**	**0.9**
Va Non-manual formal proletariat	**19.3**	**21.0**	**21.7**	**20.7**	**22.3**	**23.7**	**23.1**	**3.8**
Total MC	***22.2***	***23.5***	***25.4***	***24.3***	***25.5***	***26.7***	***27.0***	***4.8***
Vb Manual formal proletariat	58.8	55.7	50.4	51.2	47.6	49.3	48.4	-10.4
VI. Informal proletariat	7.7	11.2	11.7	10.3	11.9	10.9	8.7	1.0
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	

Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

Table 29 presents the ECLAC's scheme adapted for Colombia. To approach the size of the MC, I use the occupation categories that are non-manual and have no power over the means of production, which means the MC is composed by retail workers, administrative employees and professionals. The size of the MC based on this operationalization ranges between 30.7% and 33.0%, and its variation along the period of analysis is -0.7% which means the MC has expanded very slowly.

Table 29 ECLAC-CEPAL Classification of Occupational Activities Adapted to Colombia* in Percent, 2003 - 2015

	2003	**2008**	**2010**	**2011**	**2013**	**2014**	**2015**	**Percentage Points Change 2015-2003**
Employers	3.6	8.0	8.2	7.6	8.2	8.5	7.7	4.1
Directors manager and CEOs	1.6	2.2	2.4	2.8	2.4	2.4	3.3	1.7
Professionals	**8.8**	**9.9**	**10.5**	**11.8**	**11.6**	**12.0**	**12.9**	**4.1**
Administrative Employees	**5.7**	**7.8**	**8.4**	**7.3**	**7.8**	**7.9**	**8.5**	**2.8**
Retail Workers	**17.8**	**12.9**	**12.7**	**13.0**	**12.6**	**12.3**	**11.7**	**-6.1**
Total MC	***32.3***	***30.7***	***31.6***	***32.1***	***32.0***	***32.1***	***33.0***	***0.7***
Workers, craftsmen, drivers	24.7	26.6	25.8	26.3	27.0	26.4	26.1	1.4
Workers of personal services	14.5	14.0	15.2	14.3	13.5	13.4	13.7	-0.8
Agricultural workers	23.3	18.6	16.8	16.9	17.0	17.1	16.2	-7.1
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	

Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.
*Colombia's categories do not allow identifying technicians.

4.2. The Selection of *k* for Calculating the MMC

As I discussed in section 3.1, the AF methodology has two stages, the second stage or the aggregation stage where a cut-off is applied to overall dimensions. This cut-off determines how many *satisfactory* indicators (*k*) classify an individual in the MMC. Setting *k* also provides an intermediate solution between the union criterion (*k equal at least of one satisfactory* indicators) and the intersection criterion (*k equal to all satisfactory* indicators simultaneously), which are the two extreme cases of counting identification approach in poverty analysis. For calculation purposes, the score (*c*) for each household is between zero and one, thus, *k* is normalized to be between zero and one as well.

There is no deterministic method for choosing this second cut-off. Nevertheless, a single estimation based on *k* must be chosen in order to implement policies. Alkire et al.

(2015) propose some procedures/criteria, within the *normative economics*, to determine *k*: political or deliberative participatory exercise, ranking of priorities about policy goals, or coherence between the topic and its attributes.

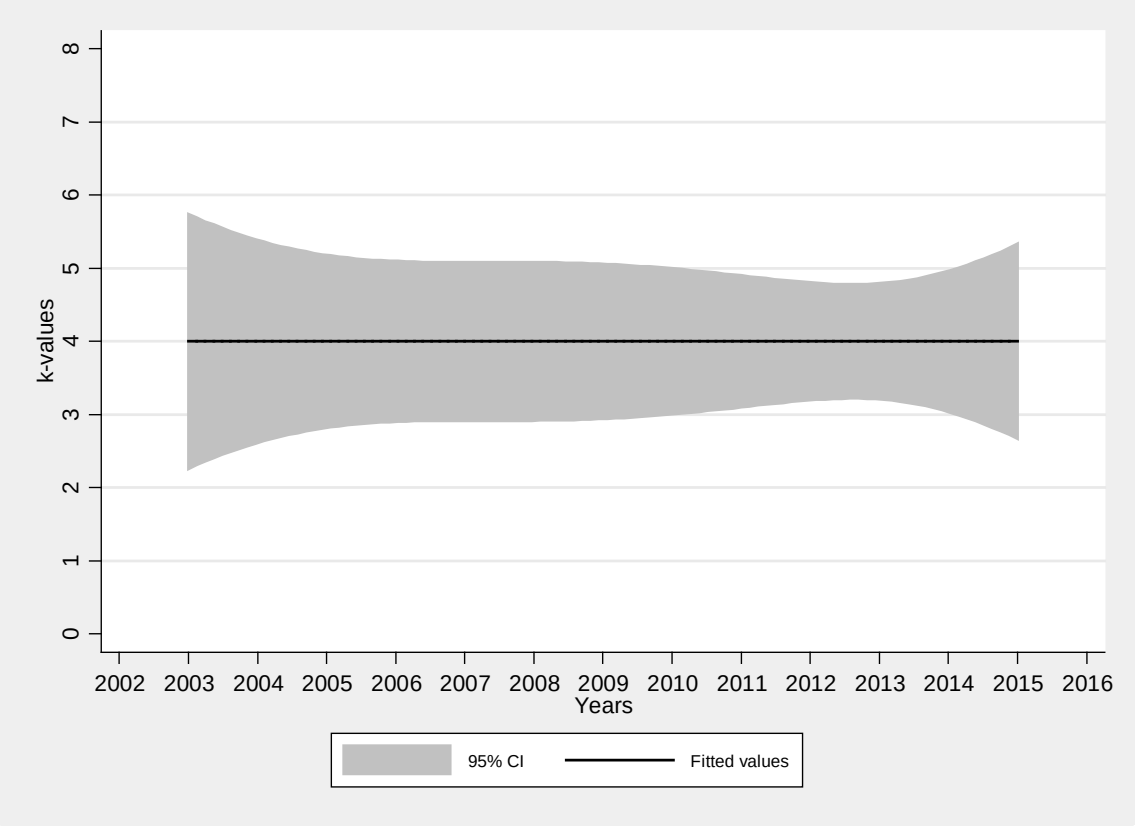

Figure 25 Pooled Analysis of Confident Intervals at 95% for Selecting *k*
Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

I follow the steps applied for Angulo et al. (2013) to determine k for the C-MPI. First, conceptually, *k* should be greater than one because it means that a household is classified in the MMC if it is classified as satisfactory in more than one indicator. Second, authors suggest a combination of statistical method and empirical data. They analyze the coefficient of variation (cv) of the MMC estimations for all values of k and exclude the k-values with higher cv that weaken accuracy of estimations. I analyzed the distribution of cv values of the MMC. Results suggest that *k* values greater or equal to

eight should be excluded (on average equivalent to cv equal of 4.4%). Third, within the remaining range between *k*=2 and *k*=7, a pooled analysis of confident intervals at 95% yield a value of *k* equal to 4 (see Figure 25). This result is close to values calculated for poverty, analysis such as López-Calva and Ortiz-Juarez (2009) *k* = 2/6, Alkire and Santos (2010) *k* = 1/3 and Angulo et al. (2013) *k* = 33%. Thus, I chose *k* = 4/10, which means that the household that have four out ten *satisfactory* indicators is counted in the MMC.

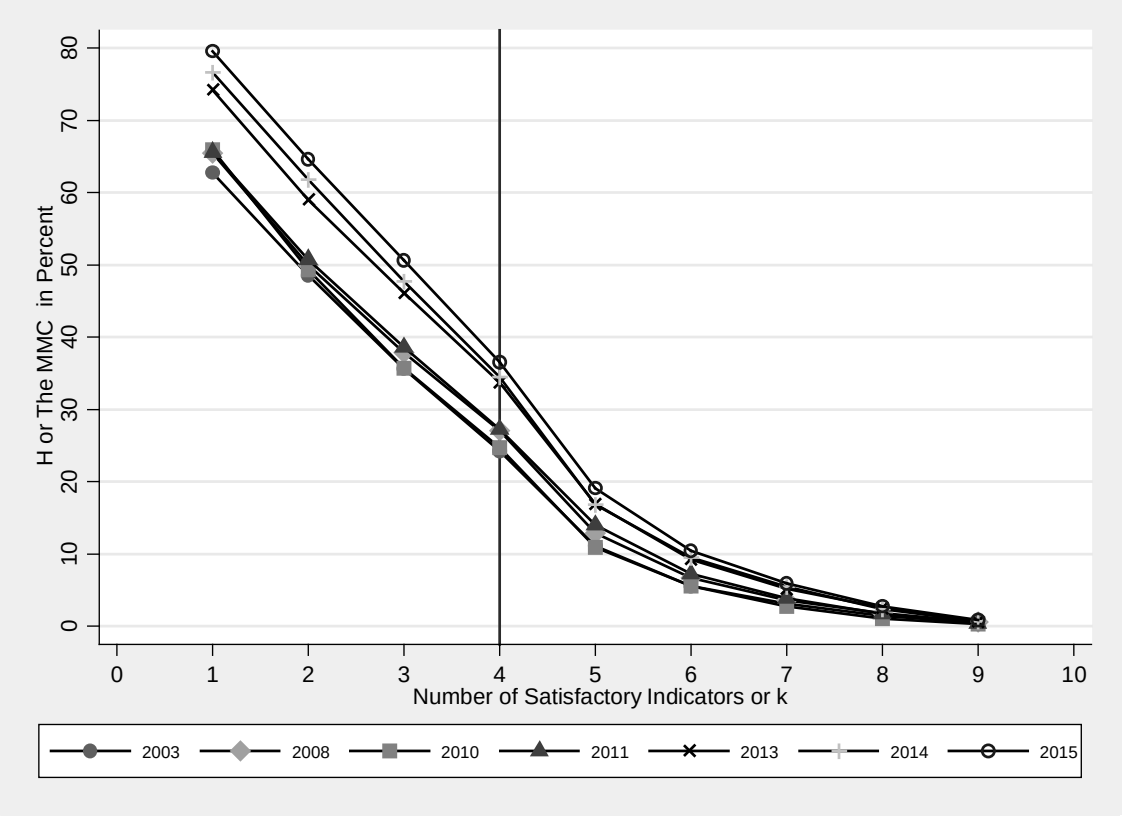

Figure 26 The Size of the MMC for Different Values of *k*, 2003 – 2015
Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

Figure 26 shows the MMC in percentage for different values of *k* and each line represents each year of analysis. The downward slope indicates that the more attributes are assigned to the MMC, the lower proportion of population can enjoy them simultaneously. Two groups of years are identifiable, first group with years 2003, 2008,

2010 and 2011, which present the lowest values of the MMC for any value of *k*; and the group of remaining years with closer percentages to each other, where the size of the MMC in 2015 is the highest when *k* equals to 4.

4.3. The Size of the MMC and Its Characteristics

Before presenting final results of the MMC based on the AF, in Table 30 I present the percentage of population in the MMC within the indicator with respect to the threshold. These are statistics only for the population considered and in the estimations not the entire population because as I mentioned the AF is a censored approach. Regarding the income dimension, its indicator (inc_R1) shows a reduction from 2003 to 2008, from 13.4% to 10.4%. In the following years, this indicator shows a slow recovery and increases until 21.3%, still slightly below that indicator's value in 2003. The employment dimension indicator (emp_R1) increases from 2003 to 2008, then, it decreases from 2008 to 2010. However, by 2011 indicator's value is 1.9% greater than in 2008. Between 2011 and 2015, percentage of population remains relatively stable with no less than 25.3% (2015) and no more than 26.1% (2013).

Regarding the education dimension, its first indicator (edu_R1) increases by 0.3% percentage points from 2003 (17.2%) to 2008 (17.5%), and decreases in 2010 by 3 percentage points and in 2011 by 0.9 percentage points. 2011 shows the minimum value of indicator's series (13.6%) and following years show positive variation, although at a moderate pace to reach the value of 16.7% in 2015. Education's second indicator (edu_R2) presents the minimum value of its series in 2003 (8.5%). Despite fluctuations, indicator edu_R2 in 2015 is 16.4, almost two time greater than its value in 2003.

Table 30 Descriptive Information of Indicators in the MMC in Percent

Dimension(s) - indicator(s)	2003	2008	2010	2011	2013	2014	2015
Income - inc_R1	13.4	10.4	14.1	13.6	17.8	18.6	21.3
Employment - emp_R1	23.6	25.7	17.7	25.5	26.1	25.6	25.3
Education - edu_R1	17.2	17.5	14.5	13.6	15.6	16.4	16.7
Education - edu_R2	8.5	11.2	8.8	12.0	14.4	14.9	16.4
Health - hea_R1	38.5	43.5	41.8	40.1	46.6	46.8	49.3
Health - hea_R2	30.9	28.9	29.4	33.5	36.1	39.9	40.2
Assets - as_R1	19.9	22.3	23.5	24.6	32.4	33.5	34.9
Assets - as_R2	21.8	30.5	33.1	32.5	39.8	41.7	47.2
Housing - hou_R1	48.0	53.0	53.1	52.5	56.9	57.2	58.4
Housing - hou_R2	30.7	29.2	30.0	25.4	30.4	30.8	31.3

Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

As for the health dimension, its first indicator (hea_R1) increases from 2003 to 2008, then, decreases until 2011. It stabilizes around 46% in 2013 and 2014 and reaches 49.3% in 2015, which is a significant improvement in term of policy implementation. The percentage of population measured using health's second indicator (hea_R2) drops by 2.0 percentage points between 2003 and 2008. But since 2010, it increases consistently until 40.2% in 2015, or 9.3 percentage points higher than 2003.

The assets dimension's first indicator (as_R1) shows constant upward trend for the entire period with a final growth or 15 percentage points increase. For instance, in 2013 its value was 7.8 percentage points higher than 2011 and it increases yearly until it reaches 34.9% in 2015. Assets' second indicator (as_R2) fluctuation is equivalent to 35.2 percentage points increase, on average. Similar in trend to the previous indicator, its increase was 7.3 percentage points in 2013, compared to 2011 and increases yearly until 47.2% in 2015.

The housing dimension's first indicator (hou_R1) has a positive trend that increases from 48.0% to 58.4% between 2003 and 2015, excluding a small reduction in 2011. In contrast, the housing dimension's second indicator (hou_R2) shows sharp drop from 2010 to 2011, with a relatively stable trend overall. After 2011 – the year when it reaches the minimum value of the series – it increases by 5 percentage points in 2013, keeping stable around 31% on average until 2015.

4.4. The Size of the MMC and the Indices Related

Table 31 shows the size of the MMC in Colombia for the years of analysis, in other words. The MMC has a maximum percentage of 36.5% in 2015 and a minimum percentage of 24.3% in 2003. Between 2003 and 2010, the MMC expands and shrinks reaching 24.8 in 2010. However, since 2011 the MMC has expanded consistently each following period and by 2015 its size is 36.5%. In the overall period of analysis, the MMC expanded 12.2 percentage points, which is equivalent to an increase of 50.2%. Despite its small fluctuation, the last five years of analysis present an increasing trend.

Table 31 The Colombia's Multidimensional Middle Class for *k*=4 in Percent, 2003 - 2015[54]

	2003	**2008**	**2010**	**2011**	**2013**	**2014**	**2015**	**Percentage Points Change 2003 – 2015**	**Percentage Growth 2003 – 2015**
The MMC	24.3	27.0	24.8	27.2	33.7	34.5	36.5	12.2	50.2

Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

[54] All calculations were obtained using the Stata module developed by Pacifico and Pöge (2015)

The MMC analysis is complemented with the indices M_0 and *A* presented in Table 32. The intensity of the MMC (*A*) means the average percentage of people in the MMC that enjoys a *satisfactory* indicator. Thus, on average, at least 53.4% of people (2010 percentage, minimum value in the series) in the MMC enjoy a *satisfactory* indicator in all years of analysis. In fact, the trend of *A* is similar to the trend of MMC because *A* starts the period with 53.9% in 2003 fluctuates until 2010. However, it increases from 2011 to 2015 between 53.7% and 54.2%. In the overall period, there was a positive change of 2.0 percentage points occurred in the proportion of people who on average enjoy a *satisfactory* indicator.

Remember that the MMC does not accomplish dimensional monotonicity property, which means it does not capture changes in the size of the MMC if households enjoy a *satisfactory* indicator in an additional dimension. Thus, I calculated M_0 that it does accomplish the property. The greater the M_0, the better in terms of the multidimensional middle class analysis. M_0 – or the MMC adjusted by the intensity – presents the same trend of the MMC. It fluctuates between 2003 and 2010, then it increases to the end of the period. M_0 is an index between zero and one, and between 2003 and 2015 the index increased by 0.7 percentage points.

Table 32 Indices Related to the MMC, M_0 and A, for *k*=4, 2003 - 2015

	2003	**2008**	**2010**	**2011**	**2013**	**2014**	**2015**	**Percentage Points Change 2003 – 2015**	**Percentage Growth 2003 – 2015**
M_0 – Range [0,1]	0.13	0.14	0.13	0.15	0.18	0.19	0.20	0.7	53.8
A in %	53.9	54.6	53.4	55.1	55.3	55.3	55.9	2.0	3.1

Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

4.4.1. The MMC and its Changes Over Time

The C-LSMS survey is not available for every year between 2003 and 2015, therefore, I use the annualized absolute rate of change (Δ^*) and the annualized relative rate of change (δ^*) to smooth period variations. Both the annualized absolute rate of change (Δ^*) and the annualized relative rate of change (δ^*) present negative changes just in the period 2010-2008. After this period, variations are positive. The periods 2011-2010 and 2013-2011 describe the best performance for the MMC because their growth is substantially greater than other periods. Thus, I hypothesize that the policies implemented in each dimension after 2010, may have had a positive effect on recovering the level of the MMC from the negative period and expanding its size for the last years of the period of analysis.

Table 33 The MMC Variation Adjusted by the Annualized Absolute Rate of Change (Δ^*) and the Annualized Relative Rate of Change (δ^*)

Change in Years	**Annualized absolute rate of change (Δ^*)**	**Annualized relative rate of change (δ^*)**
2008-2003	0.55	2.18
2010-2008	-1.13	-4.30
2011-2010	2.46	9.96
2013-2011	3.25	11.29
2014-2013	0.74	2.19
2015-2014	2.05	5.95

Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

4.4.2. M_0 and the Application of the Dimensional Breakdown Property

One of the advantages of M_0 is the possibility of calculating the contribution of each indicator and dimension to its outcome. In other words, M_0, indirectly, helps to analyze how each one of the selected indicators explains the formation of the MMC. Thus, Table 34 presents the contribution of each dimension and indicator to its calculation in terms of percentage for all years of analysis.

Table 34 Indicators and Dimension Contribution to M_0 in Percent, 2003 - 2015

Dimension/Indicator Contribution to the M_0	**2003**	**2008**	**2010**	**2011**	**2013**	**2014**	**2015**
inc_R1	14.2	10.5	14.6	12.8	13.9	13.9	14.9
emp_R1	20.0	20.8	17.8	21.3	19.0	18.6	17.8
edu_R1	7.0	6.6	6.1	5.2	5.3	5.3	5.2
edu_R2	3.9	5.4	4.5	5.7	5.5	5.6	5.7
Total Contribution of Education Dimension	11.0	11.9	10.6	10.9	10.9	10.9	10.9
hea_R1	10.5	12.3	12.6	11.7	12.2	11.9	12.0
hea_R2	10.4	10.4	9.9	10.9	9.9	10.3	9.8
Total Contribution of Health Dimension	20.9	22.7	22.5	22.6	22.1	22.2	21.8
as_R1	7.2	7.2	7.6	7.4	8.0	8.2	8.0
as_R2	8.5	9.1	9.1	8.6	9.0	9.1	9.6
Total Contribution of Assets Dimension	15.7	16.2	16.7	16.0	17.0	17.3	17.6
hou_R1	10.0	10.0	10.3	9.9	10.1	10.0	10.0
hou_R2	8.1	7.8	7.6	6.6	7.0	7.1	7.0
Total Contribution of Housing Dimension	18.1	17.8	17.8	16.5	17.1	17.1	17.1
Total Contribution of all Dimensions	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

Dimensions income and employment are operationalized by just one indicator each, therefore, indicators contribution is equivalent to dimensions contributions. For the years of analysis, income dimension contribution to M_0 ranges from a minimum value of 10.5% (2008) to a maximum value of 14.9% (2015). In the same period, the employment dimension contribution to M_0 ranges from a minimum value of 17.8% (2010 and 2015) to a maximum value of 21.3% (2011). However, these two dimensions combined contribute to almost one-third (32.7%) of M_0 outcome, on average, in the period of analysis.

The dimension alone that contributes the most to the M_0 outcome is health, with 22.1% on average in the period of analysis. Within the health dimension, the indicator

that contributes the most is the one capturing information about self-reported health status. Its average contribution in the period of analysis was 12%.

Health dimension's contribution is followed by housing dimension's contribution. Housing dimension's contribution in the period of analysis is, on average, 17.2%, being very stable from 2013 to 2015. Within the housing dimension, the indicator that contributes the most is the one referring to household members per room used to sleep. This indicator is on average 9.9%.

The next in ranking of contribution to M_0 is the assets dimension. Assets dimension's contribution in the period of analysis is, on average, 16.5%. The indicator that captures information about home appliances (hou_R2) leads the dimension, with 9% more participation, on average.

Finally, the education dimension contributes on average 11.5% in the period of analysis. This dimension reduced its contribution to M_0 in 2008 and 2010, then, it stabilizes for the remaining of the period.

The previously described results indicate that based on the indicators I proposed for measuring the MMC, income and employment are the most important dimensions to the M_0 outcome, thus, these are the most important dimension to the formation of the MMC.

4.4.3. M_0 and the Application of the Group Decomposition Property

In order to emphasize the usefulness of the group decomposition property for policy purposes, I present property applicability to two groups. The group decomposition property allows comparison between the groups in light of the M_0 and its linkage to the

MMC formation. Decomposition allows me to distinguish which one contributes the most to the country's size of the MMC. I will present two decompositions: first decomposition by urban and rural populations, and second decomposition by a proxy of the life cycle based on the household's head age. For the second decomposition, the ranges for household's head age are based on Peichl and Pestel's (2013a, 2013b) operationalization as follows: ages equal or lower than 29 years (young), ages between 30 and 59 years (middle age), and ages equal or more than 60 years (elderly). Results based on decomposition urban and rural populations and life cycle allows profiling the country in terms of each category and their respective dimension contribution for the entire period. This will allow to Colombian government prioritize policies depending on its goals.

4.4.3.1. Decomposition by Urban and Rural Populations

Table 35 presents the size of the MMC and the indices M_0 and A by urban and rural areas in Colombia for the years of analysis. The urban MMC is markedly greater than the rural MMC. However, interestingly, the gap between the urban and rural MMC consistently decreased over the period of analysis. The urban MMC fluctuates between 2003 and 2010 and then consistently expanded until 2015. Nonetheless, the rural MMC consistently increased in size during the entire period of analysis. In fact, in 2003 the urban MMC was 5.1 times the rural MMC. However, in 2015 the urban MMC was 3 times the rural MMC.

The intensity of the MMC (A) presents that in the urban area, on average 55.9% of people in the MMC enjoy a *satisfactory* indicator over the entire period of analysis. In the rural area, the intensity of the MMC shows, on average, 49.7% of people in the MMC

enjoy a *satisfactory* indicator. Population classified in the MMC in the urban area, on average, enjoy more features of the MMC than population in the rural area, although the gap between these populations is not very wide. The M_0 index describes that urban population is in a better situation in terms of multidimensional middle class compared to rural population. However, the gap has reduced significantly because in 2003 the urban M_0 was 6 times the rural M_0. By 2015, the urban M_0 was 3.4 times the rural M_0.

Table 35 The MMC, A and M_0 by Urban and Rural Populations

	2003	**2008**	**2010**	**2011**	**2013**	**2014**	**2015**
The MMC_Urban	34.2	40.9	36.2	41.1	47.5	48.6	49.7
The MMC_Rural	6.6	8.1	8.5	8.6	13.7	14.9	16.5
*A*_Urban	54.6	55.3	54.1	55.9	56.3	56.3	57.0
*A*_Rural	47.2	50.2	49.4	50.0	50.2	50.6	50.7
M_0_Urban	0.186	0.226	0.196	0.230	0.268	0.273	0.283
M_0_Rural	0.031	0.041	0.042	0.043	0.069	0.075	0.084

Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

Table 36 presents which population contributes the most to M_0, therefore, to the formation of the MMC. As can be seen from the table (above), the urban population contributes significantly to the M_0 index, more than 80%. Interestingly, the percentage contribution of rural population has increased from 8.5% to 16.2% in the period of analysis.

Table 36 Percentage Contribution to M_0 , 2003 - 2015

	2003	**2008**	**2010**	**2011**	**2013**	**2014**	**2015**
M_0_Urban	91.5	88.3	86.9	87.8	85.0	83.4	83.8
M_0_Rural	8.5	11.7	13.1	12.2	15.0	16.6	16.2

Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

Regarding indicators and dimensions contribution to M_0 index by rural and urban areas, Table 37 presents all contributions in terms of percentage. Employment is the

dimension that contributes the most in both urban and rural populations. Over the years of analysis, the average contributions are 18.7% and 21.8%, respectively. In contrast, the education dimension in the rural area contributes the lowest over the years – on average 7.3% – while the education dimension in the urban area contributes on average 12.1%.

Despite fluctuation of income dimension for rural populations, its contribution has an overall increasing trend. It starts the period with 10% and ends with 12.9% and its average is 12.2%. Income dimension for urban populations also fluctuates but its contribution in the last period is almost the same as the initial year – 15.4% in 2003 and 15.3% in 2015 – with an average over the years of 14.1%.

The health dimension contributes around one-fifth in both types of populations. However, interestingly, the indicator of health self-perception (hea_R2) contributes more in rural populations than urban populations in all years. Assets dimension has an increasing trend for both types of populations. However, in rural population this dimension contributes the most, compared to urban population. Finally, I can identify two specific times for housing dimension trend for both types of populations. Before 2011, this dimension contributes slightly more in rural than urban populations. After 2011, the trend is the opposite, with the dimension contributing more in urban than rural populations.

Table 37 Indicators and Dimension Contribution to M_0 in Percent by Urban and Rural Areas, 2003 - 2015

Indicators/Dimensions	Urban 2003	Rural 2003	Urban 2008	Rural 2008	Urban 2010	Rural 2010	Urban 2011	Rural 2011
inc_R1	14.6	10.0	10.8	7.8	15.3	10	13.3	8.9
emp_R1	19.4	26.9	20.3	24.7	17.7	18.6	20.7	25.4
edu_R1	7.2	4.8	6.9	4.4	6.2	5.3	5.5	3.3
edu_R2	4.1	2.1	5.6	3.8	4.8	2.3	5.9	3.7
Total Education Dimension	11.3	6.9	12.5	8.2	11	7.6	11.4	7
hea_R1	10.6	9.3	12.4	11.3	12.6	12.5	11.8	11
hea_R2	10.2	12.8	10.1	12.6	9.4	12.8	10.6	13.1
Total Health Dimension	20.8	22.1	22.5	23.9	22	25.3	22.4	24.1
as_R1	7.2	7.5	7.1	7.9	7.5	8.4	7.3	8.2
as_R2	8.6	8.0	9	9.5	8.7	12	8.3	10.4
Total Assets Dimension	15.8	15.5	16.1	17.4	16.2	20.4	15.6	18.6
hou_R1	9.7	12.8	9.7	12.3	9.9	12.6	9.7	11.8
hou_R2	8.4	5.7	8.1	5.8	7.9	5.7	6.9	4.2
Total Housing Dimension	18.1	18.5	17.8	18.1	17.8	18.3	16.6	16

Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

(continued)

Table 37 (continued) Indicators and Dimension Contribution to M_0 in Percent by Urban and Rural Areas, 2003 - 2015

Indicators/Dimensions	Urban 2013	Rural 2013	Urban 2014	Rural 2014	Urban 2015	Rural 2015
inc_R1	14.4	11.1	14.5	11.2	15.3	12.9
emp_R1	18.9	19.7	18.3	20	17.8	17.7
edu_R1	5.7	3.5	5.7	3.5	5.5	3.4
edu_R2	5.8	4.1	5.9	3.7	6.1	3.6
Total Education Dimension	11.5	7.6	11.6	7.2	11.6	7
hea_R1	12.2	12.2	11.9	11.6	12	11.9
hea_R2	9.6	12.1	9.9	12.4	9.5	11.3
Total Health Dimension	21.8	24.3	21.8	24	21.5	23.2
as_R1	7.8	9.2	7.9	10	7.5	10.3
as_R2	8.5	11.6	8.6	11.6	9.2	11.9
Total Assets Dimension	16.3	20.8	16.5	21.6	16.7	22.2
hou_R1	9.8	11.8	9.6	12.1	9.6	12
hou_R2	7.4	4.8	7.7	4	7.5	4.9
Total Housing Dimension	17.2	16.6	17.3	16.1	17.1	16.9

Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

4.4.3.2. Decomposition by Household's Head Life Cycle

This section replicates the decomposition analysis of a previous section by a proxy of the life cycle. I believe analysis using a proxy of the life cycle is relevant because a household head and the family composition will have different features, depending on what moment in the person's life is being analyzed based on survey answers. Obvious examples of household head different features depending on life cycle are: educational attainment, job experience, housing ownership or assets possession, among others. Thus, it seems intuitive that those features that correlate with age will make up a smaller proportion of a population in younger ages.

Table 38 The MMC, A and M_0 by Proxy of the Life Cycle Populations

	2003	**2008**	**2010**	**2011**	**2013**	**2014**	**2015**
The MMC_Young	20.2	23.3	23.5	20.0	30.7	30.2	33.7
The MMC_Middle Age	25.5	28.7	24.5	29.4	35.6	36.8	38.8
The MMC_Elderly	18.5	20.7	26.5	20.6	26.5	26	28.2
*A*_Young	58.4	53.8	54.0	53.9	55.6	53.7	55.6
*A*_Middle Age	53.3	55.4	53.4	55.6	56.0	56.0	56.6
*A*_Elderly	51.9	50.4	53.8	52.1	51.5	52.0	51.6
M_0_Young	0.118	0.125	0.127	0.108	0.171	0.162	0.187
M_0_Middle Age	0.136	0.159	0.131	0.163	0.199	0.206	0.220
M_0_Elderly	0.096	0.104	0.143	0.107	0.137	0.135	0.146

Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

Excluding the year 2010, the MMC for the middle-age category is higher than the other two categories in the remaining years (Table 38). Before 2010, the percentage of the MMC for the young category is higher than the percentage of the MMC for the elderly category. However, the trend of these two categories after 2010 is the opposite, elderly category is higher than young category. The year 2010 is atypical because the percentage of the MMC ranks categories with elderly first, followed by middle-age and young. Over the period of analysis, the size of the MMC for the middle-age category is,

on average, 33.4%; for the young category 27.7%; and for the elderly category 25.9%. Between 2003 and 2015, the size of the MMC for the young category grew 13.5 percentage points. However, for the middle-age and elderly categories decreased 13.3 and 9.7 percentage points, respectively.

Again, the intensity of the MMC (*A*) ranks the middle-age category in first place in most of the years. It is followed by the young category and the elderly category, respectively. In 2010, the young category ranks first, the elderly category second and the middle-age category last place. For the middle-age category, on average, 55.6% of population in the MMC enjoy a *satisfactory* indicator over the period of analysis. The intensity of the MMC (*A*) for the young category it is 54.7% and for the elderly category is 52.4%. However, trends for the middle-age and the young categories grow after 2010, while for elderly category decreases. The ranking of the categories based on the M_0 index matches the same order of the ranking based on the size of the MMC. The index values at the end of the period for all categories reflect an upward trend.

Table 39 shows that fourth-fifths of the M_0 index outcome is due to the middle-age category, therefore, to the formation of the MMC as well. The contribution to the M_0 index outcome is followed by the elderly category at 13.8%, on average, and the young category at 5.2%, on average. Both categories show an increasing trend, however, the young category shows a faster growth compared to the elderly category.

Table 39 Percentage Contribution Life Cycle to M_0, 2003 - 2015

	2003	**2008**	**2010**	**2011**	**2013**	**2014**	**2015**
M_0_you	4.7	5.3	5.0	4.6	5.6	5.7	6.4
M_0_mid	81.5	82.7	79.1	83.0	81.6	81.7	80.7
M_0_old	13.8	11.9	15.9	12.5	12.7	12.6	12.9

Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

Regarding indicators and dimensions contribution to M_0 index by proxy of life cycle, Table 40 presents all contributions in terms of percentage. With the exception of 2010, over the period 2003 – 2015 the employment dimension contributes the most among the young category and its trend is close to the middle-age category trend. In contrast, a relatively wide gap exists between these two categories and the elderly category. Income dimension contributes the most to M_0 index for the elderly category during all years of analysis, followed by the middle-age category and the young category, respectively. The gap between the elderly category and the other two categories widens after year 2008 and keeps relatively stable after 2010.

Both employment and income dimensions contribute, on average over the period of analysis, with 30.2% for the young category, 32.8% for the middle-age category, and 33.4% for the elderly category.

Consistent with the analysis for the entire country, the health dimension contributes no less than one-fifth for all categories. On average during all years of analysis, the contribution in descending order shows the elderly category with 23.2%, the young category with 22.2% and the middle-age category with 21.9%. Average contribution in the housing dimension shows the young category with 21.6% in first place, the middle-age category with 17.4% in second place, and the elderly with 14.4% last place. Interestingly, in the assets dimension I found similar values for young and middle-age categories. On average, they contribute 16.4% and 16.2%, respectively. The elderly category contributes on average of 18.2%. Finally, the education dimension, on

average, contributes more in the middle-age category (11.7%), followed by the elderly category and the young category in the same order.

Table 40 Indicators and Dimensions Contribution to M_0 in Percent by Life Cycle Category

Indicators/Dimensions	You_03	Mid_03	Eld_03	You_08	Mid_08	Eld_08	You_10	Mid_10	Eld_10
inc_R1	9.0	13.9	16.7	8.9	10.2	13.1	10.8	14.6	15.9
emp_R1	23.7	20.6	16.5	23	21.5	15.3	16.6	17.5	20.1
edu_R1	7.0	6.7	7.5	5.1	6.5	8.2	6.3	6.2	5.3
edu_R2	2.2	4.0	3.8	3.7	5.7	3.4	2.3	4.7	3.9
Total Education Dimension	9.2	10.7	11.3	8.8	12.2	11.6	8.6	10.9	9.2
hea_R1	11.6	10.0	12.5	11.7	12	14.9	11.6	12.5	13.4
hea_R2	11.9	10.5	10.3	11.1	10.4	10.4	11.6	9.7	10.3
Total Health Dimension	23.5	20.5	22.5	22.8	22.4	25.3	23.2	22.2	23.7
as_R1	6.8	7.5	6.6	6.1	7.1	8.3	6.4	7.8	6.8
as_R2	6.3	8.5	8.8	9.2	8.8	10.6	11.3	8.9	9.6
Total Assets Dimension	13.1	16.0	15.4	15.3	15.9	18.9	17.7	16.7	16.4
hou_R1	9.8	9.9	11.4	9.9	9.9	10.7	11.5	10.3	9.5
hou_R2	11.6	8.3	5.9	11.4	8	5.1	11.5	7.8	5.1
Total Housing Dimension	21.4	18.2	17.3	21.3	17.9	15.8	23	18.1	14.6

Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

(continued)

Table 40 (continued) Indicators and Dimensions Contribution to M_0 in Percent by Life Cycle Category

Indicators/Dimensions	Mid_11	Eld_11	You_13	Mid_13	Eld_13	You_14	Mid_14	Eld_14	You_15	Mid_15	Eld_15
inc_R1	12.3	18	8.9	13.6	17.9	8.4	13.6	18.5	12.2	14.4	19.7
emp_R1	21.9	16.8	20.8	19.5	15.1	21	19	15.3	17	18.6	12.7
edu_R1	5.1	6.3	4.1	5.3	6	3.2	5.2	7.2	3.7	5.1	6.4
edu_R2	5.9	4	6	5.8	3.8	5.4	5.9	3.4	5.8	6	3.7
Total Education Dimension	11	10.3	10.1	11.1	9.8	8.6	11.1	10.6	9.5	11.1	10.1
hea_R1	11.4	13.7	10.6	12	14	11	11.7	13.2	11.4	11.7	14.4
hea_R2	11	10	10.5	10.1	8.9	11.3	10.4	9.5	10.1	9.9	8.6
Total Health Dimension	22.4	23.7	21.1	22.1	22.9	22.3	22.1	22.7	21.5	21.6	23
as_R1	7.4	7.6	8	8	8.5	8.4	8.1	8.8	7.7	8	8.2
as_R2	8.3	9.8	10.2	8.6	11.2	9.5	8.9	10.2	10.4	9.2	11.8
Total Assets Dimension	15.7	17.4	18.2	16.6	19.7	17.9	17	19	18.1	17.2	20
hou_R1	9.9	9.8	9.9	10.1	10.2	10.1	10	10.2	11	9.9	10.3
hou_R2	6.8	3.8	11.1	7.2	4.3	11.7	7.2	3.8	10.7	7.2	4.3
Total Housing Dimension	16.7	13.6	21	17.3	14.5	21.8	17.2	14	21.7	17.1	14.6

Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

4.5. Income Polarization Indices and the IMP

4.5.1. Income Polarization

Income polarization has been more extensively studied than other type of polarization, therefore, I calculated some of the most common income polarization indices in order to contrast their trends with the index of multidimensional polarization. In Appendix 4, I present a discussion of income polarization indices properties and equations.

Wolfson's (1994) index[55] of bipolarization (PW) ranges from zero to one, where one means the highest bi-polarization. The highest bi-polarization implies that half of the population does not have income and the other half has twice as much income as the average income value. Thus, higher bi-polarization means a smaller MIP. PW calculations for Colombia are in Table 41. The PW index presents a decreasing trend overall period of analysis. However, its values are close or above 0.5 which is considered a high level of polarization. Based on PW trend it is logical to infer that the MIP in Colombia is expanding.

Table 41 Wolfson Index of Bi-Polarization (PW) for Colombia, 2003 - 2015

Year	**2003**	**2008**	**2010**	**2011**	**2013**	**2014**	**2015**
PW	0.480	0.511	0.453	0.484	0.468	0.439	0.453

Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

Another index, Esteban and Ray's (1994) index (ER),[56] includes in its specification a parameter that captures the degree of polarization (α); thus, the greater the

[55] All calculations were obtained using the Stata module developed by Abdelkrim and Duclos (2007)
[56] ER calculations were obtained using the Stata module developed by Gradín (2014)

value of α, the more aversion to polarization.[57] Hence, it is customary presenting ER for different values of α. In Table 42, I present calculations for selected values of α. For all selected values, ER describes the same patterns in the period of analysis but in a different scale or intensity. Initially, polarization increases substantially from 2003 to 2008, then, in 2010 ER reduces but still their values are higher than 2003. In 2011 the polarization increases again, however, between this year and 2015, and despite fluctuations, the overall trend shows a reduction in the polarization of the country.

Table 42 Esteban and Ray Index of Polarization (ER) for Colombia, 2003 - 2015

ER(alpha)	2003	2008	2010	2011	2013	2014	2015
ER(1.0)	0.000340	0.002092	0.000643	0.001189	0.000796	0.000914	0.000770
ER(1.2)	0.000078	0.000733	0.000173	0.000371	0.000229	0.000270	0.000229
ER(1.4)	0.000020	0.000268	0.000049	0.000121	0.000069	0.000084	0.000072
ER(1.6)	0.000005	0.000101	0.000014	0.000041	0.000022	0.000027	0.000023

Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

The income polarization indices of Esteban et al.'s (2007) – index (EGR) – and Duclos et al.'s (2004) – index (DER) – are also affected for parameters that determine their behavior. Thus, like ER, it is relevant to present different values for its calculations. Recall EGR is composed by the ER index corrected by the weighted (β) difference between Gini coefficient ($G(f)$) on all the population and the Gini coefficient ($G(p^*)$) on the groups defined endogenously. Therefore, in addition to assumptions for α values, I made assumptions for β and the groups. EGR also requires setting the number of groups to perform its estimations. Thus, I used the groups' classifications based on income with four groups (low income, vulnerable, the MIP and high income from section 3.4.1.1), and socio-occupational activities with six groups (affluent class, lower affluent class, the MC,

[57] Due to theoretical restrictions, α only can take values in the interval (0, 1.6]

vulnerable levels from the less vulnerable (vul1) to the most vulnerable (vul3) from section 3.4.1.2).

Table 43 Esteban, Gradin and Ray Index of Polarization (EGR) by Income Groups and Socio-Occupational Groups for Colombia, 2003 - 2015

		Income Groups						
α	β	**2003**	**2008**	**2010**	**2011**	**2013**	**2014**	**2015**
1	2	0.087	0.110	0.083	0.088	0.082	0.079	0.077
1.3	2	0.045	0.057	0.043	0.045	0.042	0.04	0.04
1.6	2	0.017	0.022	0.016	0.017	0.016	0.015	0.015
1	3	0.069	0.087	0.066	0.069	0.064	0.062	0.061
1.3	3	0.026	0.034	0.025	0.026	0.024	0.023	0.023
1.6	3	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.001

		Socio-Occupational Groups						
α	β	**2003**	**2008**	**2010**	**2011**	**2013**	**2014**	**2015**
1	2	0.113	0.127	0.111	0.121	0.117	0.121	0.120
1.3	2	0.058	0.066	0.057	0.063	0.060	0.064	0.063
1.6	2	0.025	0.029	0.024	0.029	0.026	0.029	0.028
1	3	0.099	0.110	0.096	0.106	0.101	0.106	0.105
1.3	3	0.044	0.050	0.042	0.048	0.045	0.049	0.048
1.6	3	0.010	0.013	0.010	0.013	0.011	0.014	0.013

Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

Table 43 presents results of EGR index by income groups and socio-occupational groups. Results for both types of groups confirm the decreasing trend of polarization for each value selected of α and β. A comparison of the trends for both type of groups shows that for any value of α and β, polarization with socio-occupational groups is higher than polarization with income groups. However, polarization with socio-occupational groups is more stable – fewer fluctuations – than polarization with income groups.

Table 44 Duclos, Esteban and Ray Index of Polarization (DER) for Colombia, 2003 - 2015

α	2003	2008	2010	2011	2013	2014	2015
0.25	0.382	0.396	0.375	0.388	0.376	0.371	0.374
0.50	0.313	0.321	0.308	0.320	0.307	0.304	0.307
0.75	0.280	0.282	0.275	0.289	0.274	0.271	0.275
1.0	0.263	0.259	0.258	0.276	0.256	0.253	0.259

Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

DER index is a version of ER that uses income densities instead discrete – every individual – income. Thus, DER also depends on α, however, in this case α only can take values for interval the [0.25, 1]. Table 44 presents results of DER index for selected values of α. DER index trend also confirms a reduction in income polarization in Colombia for the period of analysis.

The overall conclusion about the downward trend of the income polarization indices appears to confirm the linkage between Gini coefficient and polarization. As I discussed in Appendix 4 Fundamental Properties of Income Polarization Indices, there is a positive correlation between Gini coefficient and polarization indices. Therefore, the decreasing trend in income inequality (Figure 16, Chapter 2 on Colombia's economic profile) implies a reduction in income polarization. Thus, all the empirical test on income polarization show lead the same conclusion. The next section's calculations on the IMP will contribute to verifying this outcome.

4.5.2. Indices of Multidimensional Polarization based on the GM Methodology

As previously discussed, the components of multidimensional polarization index from the GM methodology (section 3.2.2) are: relative group size (*S*), between (*B*) and within (*W*) components. Table 45 includes the values for the multidimensional polarization indices of *P1*, *P2* and *P3* for values of $\beta = 10$. I assume that the dimensions –

attributes – can be interpreted as complementary in economics sense. This means that household members will rather have the attributes simultaneously that having to choose one over another (or substitution in economics sense). Thus, a value of $\beta = 10$ indicates that households' dimensions are interpreted as complementary.[58]

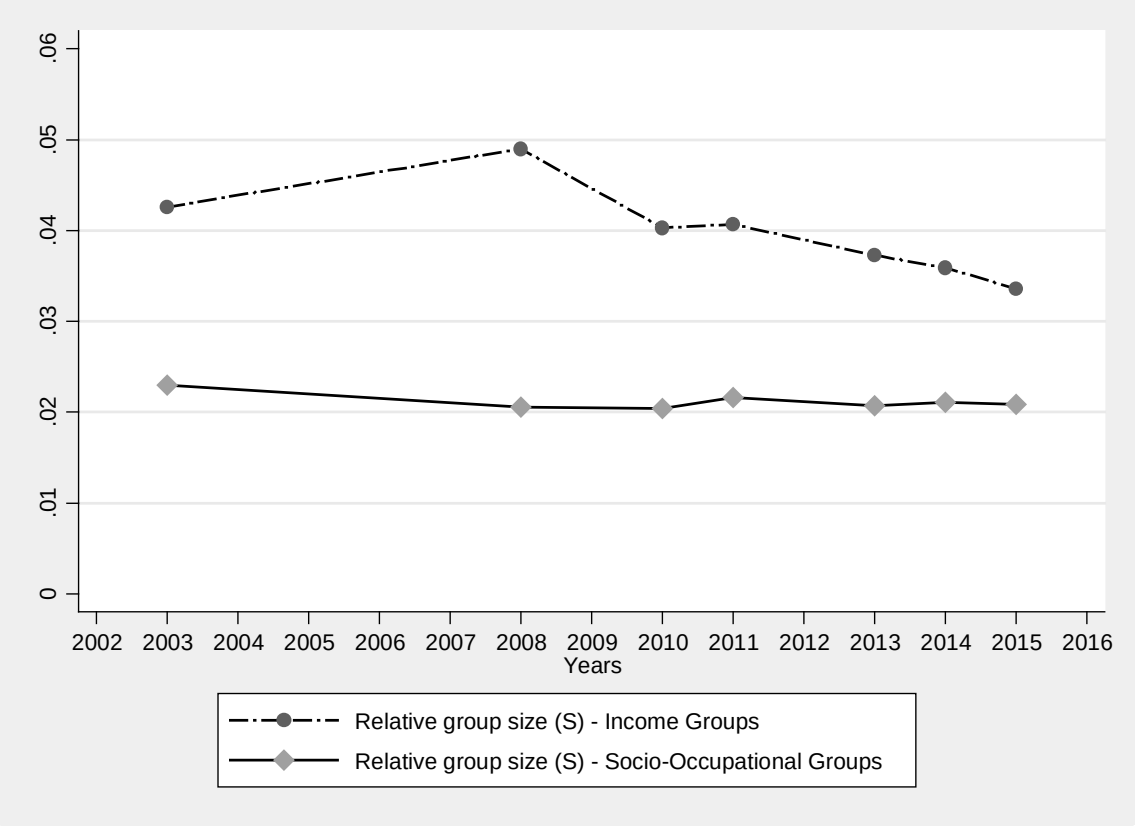

Figure 27 Relative Group Size for Income Groups and Socio-Occupational Groups, 2003 – 2015
Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

Figure 27 describes the trends of the relative group sizes (*S*) for both types income groups and socio-occupational groups. Higher values of *S* mean more unequal distribution of population among the groups while lower values mean less unequal distribution of population among the groups. *S* for income groups shows greater

[58] Interpreting dimensions as substitutes implies a $\beta = -1$. Results for $\beta = -1$ are in Appendix 9. Conclusions about the trends of *P1*, *P2* and *P3* do not change for the entire period. Proportions of *B* and *W* change for income groups and for socio-occupational groups.

inequality compared to *S* for socio-occupational groups. *S* for income groups increases until 2008, after this it shows a downward trend despite a minor fluctuation. In contrast, *S* for socio-occupational groups remains relatively stable overall years. Its downward trend is much less sharp than with income groups. Therefore, while socio-occupational groups do not change their relative composition, income groups do change their relative composition to a more balanced proportion over each group.

Table 45 Indices of Multidimensional Polarization for Income Groups and Socio-Occupational Groups[59]

	Income Groups						
	2003	**2008**	**2010**	**2011**	**2013**	**2014**	**2015**
Relative Group Size (*S*)	0.043	0.049	0.040	0.041	0.037	0.036	0.034
Between Groups Inequality (*B*)	0.016	0.015	0.018	0.021	0.019	0.007	0.009
Within Groups Inequality (*W*)	0.247	0.222	0.225	0.246	0.203	0.146	0.166
GEM Index: B + W, for $\gamma = 1$, $\beta = 10$	0.264	0.237	0.244	0.266	0.222	0.153	0.175
$P_1 = \varphi\left[\frac{B(X)}{W(X)+c}\right]S(X)$ ¥	0.022	0.027	0.022	0.023	0.021	0.02	0.019
$P_2 = \psi[B(X) - W(X)]S(X)$	0.019	0.023	0.019	0.02	0.019	0.018	0.017
$P_3 = \tau\left[\frac{B(X)}{B(X)+W(X)+C}\right]S(X)$ ¥	0.022	0.026	0.022	0.023	0.021	0.020	0.019

	Socio-Occupational Groups						
	2003	**2008**	**2010**	**2011**	**2013**	**2014**	**2015**
Relative Group Size (*S*)	0.023	0.021	0.020	0.022	0.021	0.021	0.021
Between Groups Inequality (*B*)	0.010	0.011	0.012	0.015	0.018	0.005	0.007
Within Groups Inequality (*W*)	0.256	0.23	0.23	0.255	0.207	0.151	0.171
GEM Index: B + W, for $\gamma = 1$, $\beta = 10$	0.265	0.241	0.242	0.27	0.225	0.155	0.178
$P_1 = \varphi\left[\frac{B(X)}{W(X)+c}\right]S(X)$ ¥	0.013	0.014	0.013	0.015	0.014	0.014	0.014
$P_2 = \psi[B(X) - W(X)]S(X)$	0.011	0.012	0.012	0.012	0.012	0.013	0.012
$P_3 = \tau\left[\frac{B(X)}{B(X)+W(X)+C}\right]S(X)$ ¥	0.013	0.014	0.013	0.015	0.014	0.014	0.014

Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.
¥ Value of *c* is zero.

The three indices of multidimensional polarization calculated by types of groups are strongly influenced by the values of *S.* It means that the overall trend of *P1, P2* and *P3* follows the same conclusions of *S*, although with different final values. In other

[59] Estimations for $\gamma = 0$ and $\beta = 10$, and $\gamma = -1$ and $\beta = 10$ are in Appendix 10. Analysis and conclusions based on these estimations are in the same direction and meaning than those based on Table 45.

words, multidimensional polarization with income groups tends to decrease after 2008, and with socio-occupational groups is relatively stable. Nonetheless, a comparison between the two types of groups of multidimensional polarization indices shows that polarization with income groups is higher than polarization with socio-occupational groups.

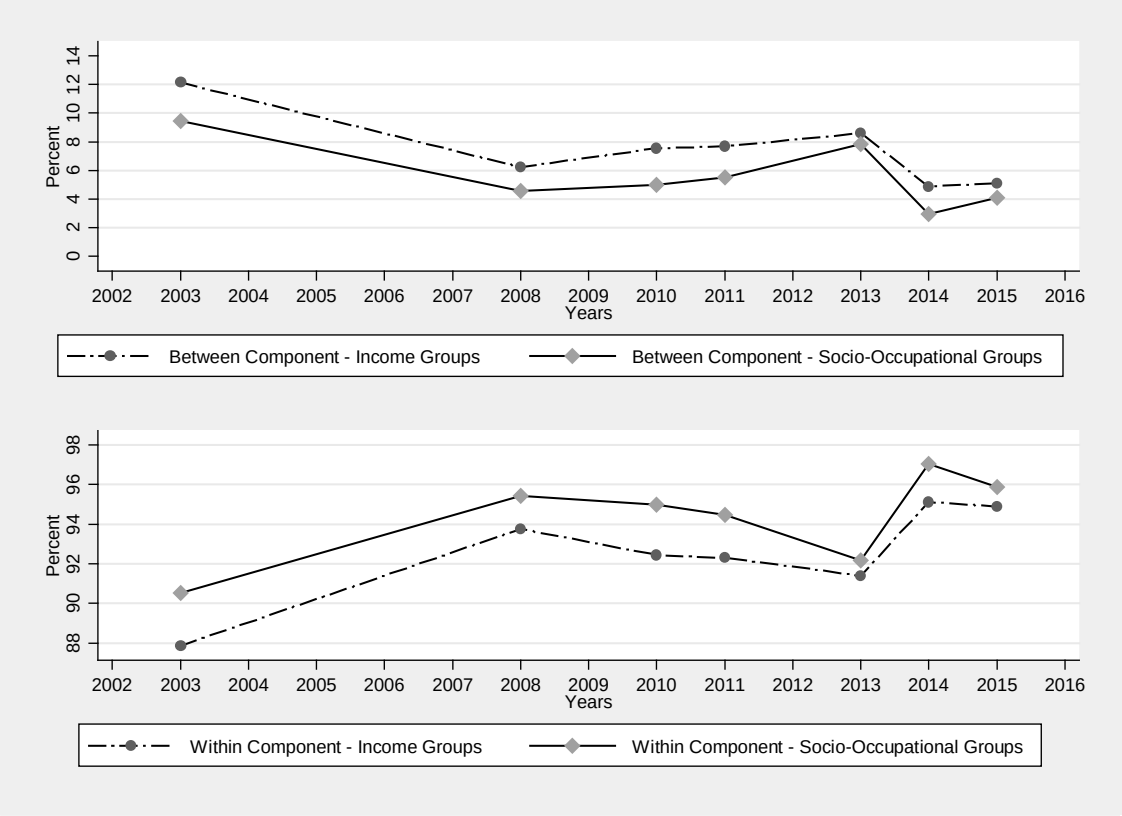

Figure 28 Between and Within Components as Percentages of Index
Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

P1, *P2* and *P3* with income groups have similar trends because all are monotonic transformations of the original values using a logistic function. The same argument applies for *P1*, *P2* and *P3* with socio-occupational groups. However, *P1* and *P3* values and trends are very close (virtual the same); this is because between (*B*) component represents a lower proportion of overall index decomposition – recall the arbitrary

constant *c* is set to zero –. Therefore, in Figure 28 I present the between (*B*) and within (*W*) components as a percentage of the total index.

The within (*W*) component in both types of groups presents an increasing trend, therefore, the opposite happens with the between (*B*) component, it describes a decreasing trend. In addition, *W* for both types of groups represent more than 90% on average, this is a robust outcome which should be analyzed jointly with *S* component.

For income groups, a reduction in relative group size (*S)* is consistent with fewer differences between the groups – reduction in *B* –, in other words, the population tends to distribute more equitable in each group. This is also consistent with the reduction in income inequality. Thus, the existing polarization is mainly explained because of the heterogeneity within the groups.

For socio-occupational groups, *B* (and *W*) follows the same trend that for income groups, however, its percentage is always lower (and greater) the entire period of analysis. This outcome jointly with the relative stability of *S* after 2008 suggests that socio-occupational groups are more homogeneous. In other words, the criteria used to define them make groups internally consistent. It also means policies that affect income groups do not affect socio-occupational groups in the same proportion.

Interestingly, polarization shows a contrast depending upon the type of groups – higher for income and lower for socio-occupational – but their similarities regarding *B* and *W* trends confirms a tendency towards reduction of multidimensional polarization or at a minimum no increase over the period under study.

5. CHAPTER 5: DISCUSSION, CONCLUSIONS AND POLICY IMPLICATIONS

5.1. Overview

The purpose of the dissertation is to demonstrate the analytic relevance of the definitions of the middle segment of the society and polarization both with a multidimensional framework inspired by Sen's approach. I proposed a novel operationalization for each concept, the MMC and the IMP, in order to perform a more comprehensive and accurate estimation of both concepts. I restricted the empirical testing of this goal to Colombia and to selected years between 2003 and 2015 due to data availability. Importantly, the period includes the 2008 economic recession, an event with direct implications for changes on any socio-economic measure or indicator.

The dissertation's goal of demonstrating the analytic relevance of the definitions of the middle segment of the society and polarization and their operationalizations the MMC and the IMP are significant and superior to their unidimensional counterparts at two levels. First theoretically, the measures are superior because the measures allow including more capabilities and functionings, as expressed by Sen's approach to measure poverty. Similarly, the multidimensional measures I created capture more heterogeneity in the middle segment of the society.

Second empirically, for the operationalization of the middle segment of the society, the AF methodology presents several advantages including avoiding limitations of the definitions of income and occupational jobs, the inclusion of different types of variables, and maintenance of the decomposability property by groups. For operationalization of polarization, the GM methodology presents advantages including

the capacity to compare by different type of groups, decomposing into between and within components, and capacity for a sensitivity analysis that allows treating dimensions as complementary or substitutes attributes as economics defines.

During the period of analysis, outcome trends of the MIP and income polarization support Colombia's improvements in terms of inequality. However, comparisons with other Latin America countries show that Colombia has challenges to overcome for both the MIP and income polarization.

Therefore, reaching the dissertation main goal demands deriving additional specific goals. These are: i) to assess the MMC trends, ii) to assess the IMP trends, and iii) to describe and compare the MMC and IMP trends with traditional unidimensional measures of middle class and polarization.

The several conceptual and alternative empirical measures of the MIP and the MC presented in the previous chapters depict different trends in the size of both constructs. In general, results from different operationalizations of the MIP show an increasing trend in its size regardless of relative or absolute type of measures. This conclusion is also consistent with the corpus of research referenced on this topic in the early chapters of this dissertation.

Although less studied in Latin American countries, the MC shows different trends depending on which occupational categories are included in its operationalization. However, my estimations show the size of the MC using alternative measures is lower than the size of the MIP. In fact, my calculations indicate either the MC is expanding as well – as I show with the ECLAC's scheme adapted for Colombia – or it has a very low

expansion rate during the overall period of analysis – as I show with Portes' and Hoffman's scheme.

The results of several unidimensional measures of income polarization confirm a decreasing trend in income polarization for Colombia, regardless of any combination of parameters used in their estimations. This is a robust outcome. However, as I discussed in the section about methodological aspects of polarization, this outcome could be anticipated due to the similarity between the mathematical formulas of the polarization indices and Gini coefficient mathematical formula. In fact, this similarity assures a positive correlation between polarization and inequality. Therefore, the decreasing trend of Gini coefficient in Colombia created a consequence of a decreasing trend in income polarization. Consequently, the inverse relationship between the trends of the MIP and income polarization are observable and consistent with the aforementioned referenced literature. However, the actual percentage of the MIP for policy purposes and its implications for polarization are still matter of discussion.

To this point, I argue that a comprehensive measure demands including more than one dimension, and I supported that claim theoretically and empirically. In fact, the discussion about the multidimensionality of poverty in Europe and Latin America in the past decades and its relevance nowadays suggests the discussion about multidimensionality can be extended to the definition of middle class and to polarization due to the linkage between both concepts. In addition, a more comprehensive and accurate estimation of both constructs has important policy implications in Colombia and other countries in Latin America. Taking into account specificities of the results, I discuss in the following section the extent expected outcomes were confirmed or rejected.

5.2. Hypotheses and the Empirical Results

The research questions that motivated this dissertation were: i. What is the size – in percentage – of the Colombian middle class if the concept of the middle class is operationalized by a multidimensional perspective? Thus, is the middle class expanding or shrinking in the analysis period? ii. What is the trend of the Colombian index of polarization, if the polarization concept is operationalized by a multidimensional perspective? iii. How does the size of the middle class fluctuate, compared to the polarization trend in the analysis period? Do trends suggest a linkage between both concepts after their multidimensional framed operationalization?. I proposed to investigate the following hypotheses derived from the research questions:

1. Hypothesis 1: The size of the multidimensional middle class (MMC) in Colombia has decreased during the period of analysis.
2. Hypothesis 2: The index of multidimensional polarization (IMP) in Colombia has increased during the period of analysis.
3. Hypothesis 3: If hypotheses 1 and 2 are corroborated and ratified, trends of the MMC and IMP will suggest that the inverse relationship between the size of the middle class and polarization is still an empirical regularity, even under a multidimensional framework.

I found no support for the first hypothesis. First hypothesis underlying assumption is that the MMC's trend will be linear – as it happens with the trend of the MIP – and its slope negative for the entire period. However, the size of the MMC has a minimum value

of 24.3% in 2003 and a maximum value of 36.5% in 2003. Therefore, excluding year 2008, the MMC has an upward trend; thus, I found no support for my first hypothesis. In fact, the MMC expanded by 12.2 percentage points, equivalent to a growth of 50.2%, between 2003 and 2015.

I found partial support for the second hypothesis. Second hypothesis underlying assumption is that the IMP's trend will be linear and its slope positive for the entire period. Although income polarization indices show decreasing trends, the IMP does not show a linear trend with income groups or with socio-occupational groups. The IMP with income groups increases from 2003 to 2008, then shows a decreasing trend. The IMP with socio-occupational groups shows a slightly downward trend but mostly relatively stable for the entire period of analysis. Nonetheless, the multidimensional polarization with income groups is higher than multidimensional polarization with socio-occupational groups. Therefore, I found support for my hypothesis just until 2010. With socio-occupational groups I found no support for my hypothesis for the entire period, despite some fluctuations.

I found partial support for the fourth hypothesis. Fourth hypothesis underlying assumption uses income outcomes for the MIP and income polarization and extends the same empirical relationship to the multidimensional analysis. The empirical relationship is kept mainly because analyses of both the MIP and income polarization use income as a common variable. Therefore, the linkage and relationship are cleaner and observable. Although simultaneous inclusion of different dimensions and variables does not guarantee the MMC and the IMP still show time trends with the same patterns of unidimensional analysis, I explained in section 3.4 how and why the operationalization of

indicators for both multidimensional concepts are linked, despite their methodological differences and data availability.

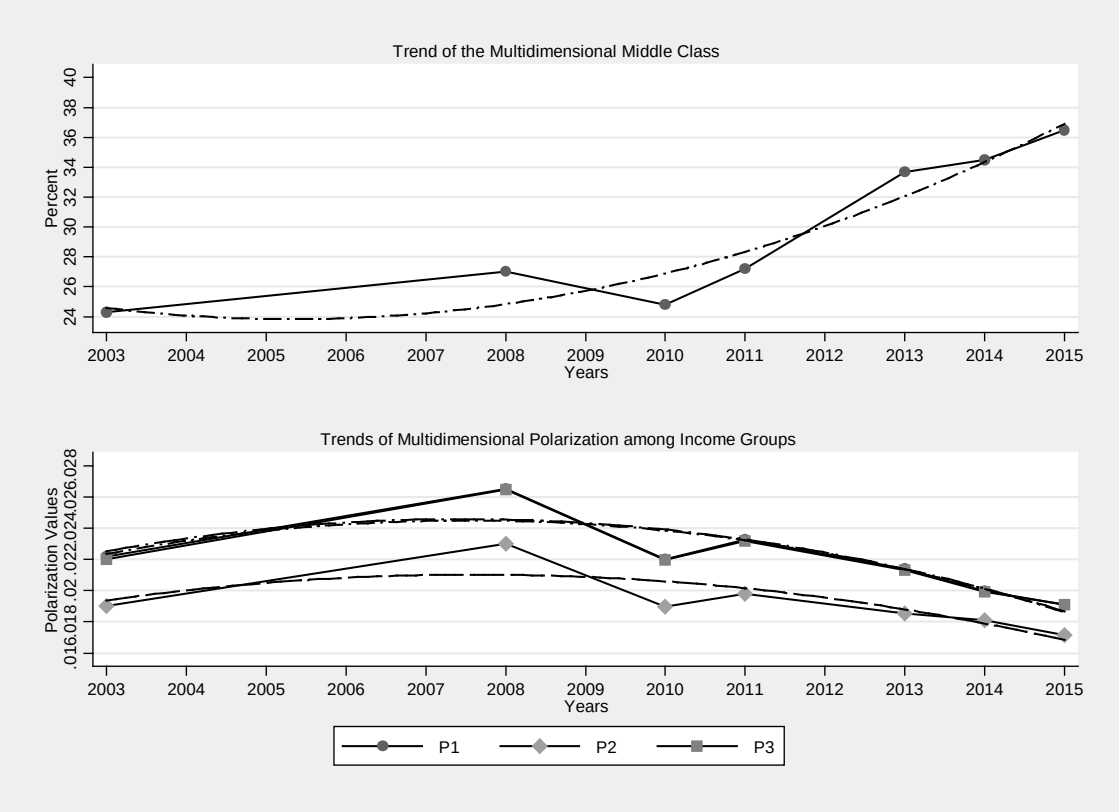

Figure 29 Comparison of the MMC trend and the IMP by Income Groups trend, 2003 - 2015
Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

Figure 29 and Figure 30 show the quadratic trend as the best fit for the overall period (dashed line) to compare the MMC and the IMP by income groups and socio-occupational groups, respectively. Figure 29 shows the IMP reflects the opposite trend of the MMC for almost all the years. As I expected, a perfect inverse relationship does not exist; however, an increase in the MMC results in a reduction in the IMP.[60] Figure 30 shows the same relationship, although trends relationship is relatively weaker[61] compared

[60] Correlation coefficients between the MMC and *P1*, *P2* and *P3* are -0.590, -0.568 and -0.599, respectively.
[61] Correlation coefficients between the MMC and *P1*, *P2* and *P3* are -0.541, -0.420 and -0.542, respectively.

with Figure 29. Thus, it is clear the MMC and the IMP trends are not linear, but I can still observe a linkage between the trends of the two multidimensional constructs.

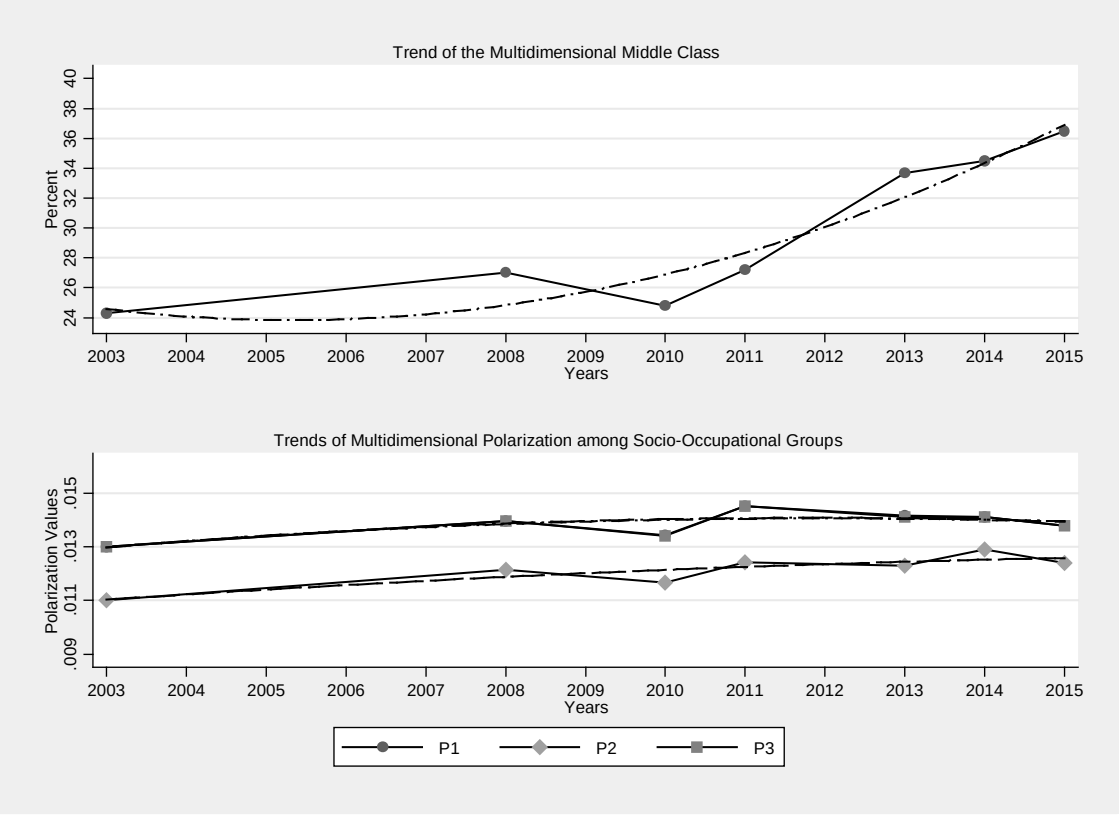

Figure 30 Comparison of the MMC trend and the IMP by Socio-Occupational Groups trend, 2003 - 2015
Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

In addition, the analysis of the MMC and the IMP allowed me to conclude specific features for each concept as follow:

1. The MMC is mainly composed of urban population, although the proportion of rural population has increased in the MMC composition. This result is consistent with the amenities associated with urban areas and with the government policies to expand fundamental services to rural areas.

2. The MMC is mainly composed of household heads between the ages of 30 and 59. This result is consistent with literature showing that individuals' higher levels of productivity and key life decisions occur during this life cycle period.
3. Jointly, dimensions employment and income represent a significant proportion of the MMC in all years, on average one-third.
4. The subjective indicator of health self-assessment (hea_R2) contributes the most to forming the MMC because a high proportion of the population claims to have good health.
5. The IMP with income groups is decreasing after 2008. The IMP with socio-occupational groups does not present substantial variations.
6. The IMP is higher with income groups than with socio-occupational groups.
7. For both types of groups, the multidimensional polarization is explained mainly by the within component.

Based on the literature I referenced, I can affirm the analysis I presented in the dissertation for both concepts the middle segment of the society and polarization and their linkage previously has not been done for Colombia. Hence, I use Franco, Hepnhayn, and Leon's (2011) findings from ECLAC for the middle class in some Latin American countries (Colombia included) to complement and contextualize my findings.

I found theoretical and empirical similarities between my analysis of the MMC and Franco et al.'s (2011) analysis mainly because theoretically the authors define the middle class with a bi-dimensional framework, with the two dimensions being income and occupational status. My analysis of the MMC confirms the relevance of considering

these two dimensions simultaneously to perform any analysis of the middle segment of society. In addition, as do I, the authors define household as the unit of analysis and the household head[62] to operationalize their concept. Franco et al.'s (2011) analysis found the middle class size for Colombia was 43% in 1990 and 39% in 2005. Their findings are different from mine but they analyze a different period.

Franco et al.'s (2011) analysis identifies the following features to describe transformations the middle class has experienced. First, non-manual jobs have expanded since the end of the 80s. Second, the middle class has expanded due to the increase of consumption capacity (measured through GDP per capita); access to consumption of goods previously limited to other income populations; and self-identification based on consumption patterns. Third, there are changes in demographic composition, particularly, the dependency ratio. Fourth, an increase in human capital has occurred, but also a depreciation of education to access the job market. Fifth, individual's income lost relevance as a differentiator factor between manual and non-manual activities. In the following section, I describe some features I addressed as part of the MMC's definition.

For Colombia non-manual categories, such as professionals, skilled white-collar workers and office non-managerial workers increase their job market participation during the analysis period. In contrast, the category of selling and administration workers shows a reduction of 7.5 percentage points (see Table 46).

[62] For the authors household head is defined by the member of household with the highest income.

Table 46 Employment Classification in Percent, 2003 - 2015

	2003	2008	2010	2011	2013	2014	2015	Percentage Points Change 2003-2015
CEO, managers	1.9	3.1	3.4	3.8	3.3	3.6	4.3	2.4
Professionals	2.7	3.8	5.3	5.6	5.5	6.0	6.2	3.5
Skilled white-collar workers	7.2	8.6	9.5	9.0	8.7	9.2	9.7	2.5
Office no-managerial workers	6.5	13.0	13.1	11.9	12.6	12.3	11.3	4.8
Selling and administration workers	15.6	9.1	9.8	9.1	9.0	8.4	8.1	-7.5
Skilled manual workers	16.5	16.7	16.3	15.4	16.5	16.0	16.0	-0.5
Unskilled manual workers	6.1	7.6	6.4	6.9	7.4	7.4	7.5	1.4
Unskilled services workers	19.1	19.7	19.4	21.3	19.8	19.9	20.1	1.0
Agricultural activities workers	24.4	18.4	16.7	17.2	17.4	17.2	16.9	-7.5
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	

Size of the MC with two alternative groups	**2003**	**2008**	**2010**	**2011**	**2013**	**2014**	**2015**	
The MC with selling and administration workers, office non-managerial workers and skilled white-collar workers	29.3	30.6	32.4	29.9	30.3	29.9	29.1	-0.2
The MC with selling and administration workers, office non-managerial workers, skilled white-collar workers and professionals	32.0	34.5	37.7	35.5	35.7	35.9	35.3	3.3

Source: Author's calculations. C-LSMS 2003, 2008, 2010, 2011, 2013, 2014 and 2015.

I also confirm the improvement in consumption capacity of the Colombian population, as shown by the increasing trend of GDP per capita (see Figure 6 in Chapter 1). This trend, combined with a reduction in goods' prices mainly due to lower costs of

imports, have expanded assets acquisition for different income populations. Hence, I indirectly addressed this issue and supported its conclusion because the contribution of dimension assets to the MMC's formation increased by 3 percentage points. However, I did not address specific consumption patterns in the dissertation.

Franco et al.'s (2011) pointed out the increase in female population in labor market and the reduction in dependency rate as features that positively affected household income. For Colombia, both features are trending in the same direction, as is shown in Figure 7 for female unemployment rate and the reduction of dependency rate from 66.9 in 1995 to 51.8 in 2015 (Acosta et al., 2015; DANE, 2017a). Demographic changes have reflected decisions on family composition, therefore, also have impacted living conditions as I assess through the crowding indicator.

Colombia's indicators on human capital accumulation reflect improvements in average years of education for population (see Figure 12). However, the depreciation of education to access the job market implies more years of education are needed to obtain the same jobs than would have been obtained in previous decades. This phenomenon is also described by Goldin and Katz (2009) for the United States. Nonetheless, the education dimension's contribution stabilizes in the MMC after a sharp drop in this dimension participation between 2008 and 2010. Hence, this dimension does not follow the conclusion observed by Franco et al.'s (2011) paper.

Finally, middle-class jobs associated with public sector and long-term contracts were changed by jobs in private sector short-term contracts and independent job activities (Portes & Hoffman, 2003). Thus, the clear threshold provided by income to differentiate groups is now fuzzier. I found this related with my analysis of polarization, which shows

relative stability for the IMP with socio-occupational groups but a decreasing IMP trend with income groups.

It seems especially challenging to identify the middle segment of society due to its heterogeneity. Attempts to identify it have demonstrated the diversity of conceptualizations and their respective measures, as well as a tendency to generalize from a reduced population segment based on subjective perceptions of what it means to be *middle class*. Thus, literature and my outcomes support the relevance of the multidimensional perspective to address this concept. Based on my analysis, though, I support classifying Colombian society segments in at least six types of classes (affluent class, lower affluent class, the middle-class, the less vulnerable (vul1), intermediate vulnerable (vul2) and the most vulnerable (vul3)), as I proposed through socio-occupational groups. Regarding socioeconomic polarization, it is interpreted theoretically as an indirect signal of conflictive situations in a society,[63] thus, it should be important for policy purposes.

Conclusion 1. Results support that a multidimensional framework to measure the middle segment of the society and polarization capture better population's heterogeneity.

Conclusion 2. Results support that a multidimensional approach to measure the middle segment of the society and polarization is feasible and relevant.

[63] As part of the motivation of their research, Esteban and Ray (1994) quote Sen's opening line of his book *On economic Inequality* that states "the relation between inequality and rebellion is indeed a close one, and it runs both ways" (Sen and Foster (1997), p. 1).

5.3. Policy Implications

The Colombian Constitution states that is government's responsibility to design and implement policies that improve Colombia's population wellbeing. The policies should be also compatible with the economic growth and country's stability. The Colombian Multidimensional Poverty Index (C-MPI) based on the AF methodology (CONPES, 2012) is the most recent tool developed to contribute to government's constitutional mandate of improving Colombia's population wellbeing, specifically, it targets the most deprived segment of society. Because the middle segment of the society is also subject to improvement, I believe that the MMC contributes to reach government's constitutional mandate utilizing the advantages of the Sen's inspired AF methodology. In addition, the linkage between the MMC and polarization, measured by the IMP, would complement the country's comprehensive picture.

Therefore, based on Colombian government's description of which are useful features to include an index in its dashboard of official policy monitoring indices, I present the following applications for the MMC and the IMP.

1. The MMC and the IMP allow synthesizing simultaneous dimensions in one index.
2. The MMC and the IMP allow identifying population patterns different from those described by income-based indices.
3. The MMC and the IMP are composed by variables and indicator that can be directly influenced by government's policies.
4. The MMC allows monitoring and following up indicators to assess features of population in the middle segment.

5. The MMC uses the household as unit of analysis, which implies that if a household member is multidimensionally in the middle class, other all members are also multidimensionally in the middle class.
6. The MMC and the IMP allow comparisons between groups or application of decomposability property (e.g. urban vs. rural areas).
7. The MMC allows observing dimensions' contributions within the groups (e.g. income and employment contribution for urban area)
8. The MMC and the IMP allow using data available and frequently used for policy reports.
9. The MMC flexibility allows updating *satisfactory* indicators' thresholds and/or the number of *satisfactory* attributes (k), in order to adapt the index to the evolving socioeconomic context.
10. The MMC and the IMP allow performing simulations with different scenarios modifying economic and social variables as well as their weights, in order to anticipate undesirable outcomes.
11. As the C-MPI and income poverty index are not mutually excludable and are presented as complementary (Angulo et al., 2013), I consider that income-based measures of the middle class can be complemented by the presentation and analysis of the MMC and the IMP for policy purposes.

These previous policy implications are more practical than substantive. In terms of more substantive implications based on my results are:

1. Colombian government should include decidedly the measure and analysis of the middle segment of the society from a multidimensional perspective, not only because of its inverse relationship with polarization but also because expanding the size of the Colombia's MMC will suggest that the country is on the correct track to becoming a developed country and to reach the high income classification based on World Bank or OECD criteria (IDB, 2016).
2. Policies to expand the middle segment of the society are directly linked to the policies that affect the low segment or poor, and to the high segment or affluent, which imply the comprehensive analysis of all societal segments. Thus, Colombian government explicit commitment to programs that benefit country's transition towards a more egalitarian, equitable and inclusive society, ultimately, reflects the society's values that ground its own class formation.
3. In international context, Colombia still needs to improve substantially. The goal of a more equitable society demands tackling simultaneously different sources of inequity looking for complementarity in the policy strategy. Specifically, human capital policies should increase the percentage of population between 5 and 23 years old in public educative institutions. Also, the dimension education's trend suggests that education of household heads and their partners will be less associated to belong in the middle segment because the devaluation of education to access the job market. Thus, only individuals who can continuously update their education will barely hold their current status (Castillo, 2007; Dominguez, 2009). In contrast, those whose

cannot increase their human capital stock will move towards the more vulnerable segments of society.

4. The fact the MMC is mainly urban and with ages between 30 and 59 years means that the MMC can be expanded improving conditions of population less 30’s and living in rural areas.

Finally, governmental accountability with their constituents is the main reason for governments inform and communicate the positive outcomes of their policies, so, advertising socioeconomic statistics is a standard strategy of political communication. These statistics also have an important impact on international entities, most of all for developing countries. The statistics are signals to access international funding and are used as a comparison with benchmark models. Thus, it is essential clearly stating the measure applied to calculate the size of the middle class and presenting the statistics accurate as possible to avoid misinterpretations.

5.4. Limitations and Future Research

The dissertation findings are encouraging, but several limitations were identified. Regarding the middle segment of the society, theoretically relevant dimensions cannot always be operationalized (also known as missing dimensions, e.g. access to financial services, leisure, or “consumption” of cultural goods/services). Secondly, selection of dimensions and definitions of indicators that present clear-cuts for the MMC (no income-class overlapping) seem elusive due to the heterogeneity of the income-based middle class, as presented by Castellani et al. (2014) and their discussion about application of the

C-MPI. Thirdly, the methodology to choose the number of *satisfactory* attributes (*k*) and weights is still ad-hoc, so, the MMC outcomes are sensitive to the value of *k.*

Regarding polarization, it is important to explore the scope of the GM because the authors do not delve into discussing the GM's usefulness/constraints for either several simultaneous indicators/variables per dimension or variables with measurements different to continuous/cardinal. Secondly, more polarization definitions exist to explore with additional advantages as the multiplicative decomposition property. Thirdly, endogenous definitions of upper and lower bounds can also be applied to this methodology.

Nonetheless, the main theoretical limitation of the dissertation is that I did not address social mobility also from a multidimensional perspective. Empirically, it was not possible due to data constraints, but further research can take advantage of synthetic panel techniques to study changes in social mobility. The middle segment of the society and polarization are intrinsically related to social mobility, and the outcome on social mobility also shows Colombia as a very rigid society in international contexts (Ferreria & Meléndez Arjona, 2012). It's crucial to calculate the size of the classes and the corresponding society polarization, but it's also important to assess upward and downward movement of the population, showing those leaving or entering poverty and becoming part of the next upper class.

I believe that the discussion of class formation and stratification also has implications on Colombian system of socioeconomic stratification (SES), which ranks dwellings from one to six to calculate utilities (public services) rates. Colombia's SES is a policy instrument for subsidizing public services among income populations. Based on SES, local governments charge differentially household utilities, allowing to allocate

subsidies and collect taxes per geographical area. Thus, high-income populations pay more for public services and contribute to subsidizing utilities charges of low-income populations. Although useful for redistributive purposes, it has been criticized because its technical deficiencies (Sepúlveda, López, & Gallego, 2014) and undesirable consequences such as geographical segregation (Bogliacino, Jiménez, & Reyes, 2015; Bogliacino & Reyes, 2017; Uribe-Mallarino, 2008).

5.5. Dissertation's Significance

In this dissertation I contributed to the body of knowledge in the following aspects:

1. I present to the academic community and Colombian government the indicator that I developed as part of the current exploratory process to proposing methodologies to calculate the middle segment of the society that are both relevant for policy purposes and feasible for empirical measurement with potential application to other Latin American countries.
2. I present an inverse relationship between the MMC and the IMP as an empirical regularity that supports the conclusion that societies with large middle segments have lower level of polarization.
3. I confirm the flexibility of the Alkire-Foster methodology after its application to a different segment of society.
4. I calculate an index of multidimensional polarization for Colombia.

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Appendix 1 Official Answer from the Colombian National Planning Department (NPD) regarding the study that supports calculations of the Size of the Middle-Class

DNP Departamento Nacional de Planeación

TODOS POR UN NUEVO PAÍS
PAZ EQUIDAD EDUCACIÓN

Bogotá D.C.,jueves, 26 de enero de 2017

20175380044941
Al responder cite este número

Señor(a)

Mauricio Quinones

mquinone@uncc.edu

Asunto: Derecho de petición

Respetado Señor:

En atención a su Derecho de petición radicado en esta entidad bajo el N° **20176000013672**, nos permitimos informar lo siguiente:

El documento técnico que se ha utilizado para hacer estimaciones de clase media consolidada en Colombia fue elaborado en el Banco Mundial, año 2011, por los autores López Calva Luis F. y Ortiz Juárez Eduardo y se titula "A Vulnerability Approach to the Definition of the Middle Class", el cual se adjunta. El documento contiene la metodología utilizada y los criterios para definir los umbrales que dividen la población en cuatro grupos: Pobres, Vulnerables, Clase Media y Clase Alta.

Al respecto, comentamos que las estimaciones realizadas para Colombia son, en principio, preliminares, hasta tanto culmine un ejercicio de validación o ajuste de los mencionados umbrales que se está haciendo conjuntamente entre el DNP y el DANE, con información de Colombia, lo cual permitirá, o ratificar los umbrales utilizados por los

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autores, o ajustarlos según los resultados del ejercicio.

Atentamente
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Appendix 2 Variables and Weights of the Colombian Multidimensional Poverty Index (C-MPI)

Dimensions	Indicator	Weight (w)
Educational Conditions	Educational Achievement	0.1
	Literacy	0.1
Childhood and Youth Conditions	School Attendance	0.05
	No School Lag	0.05
	Access to Childcare Services	0.05
	Children Not Working	0.05
Employment	Absence of Long-Term Unemployment	0.1
	Formal Employment	0.1
Health	Insurance Coverage	0.1
	Access to Health Services in Case of Need	0.1
Access to Public Utilities and Living Conditions	Access to Improved Potable Drinking Water	0.04
	Satisfactory Elimination of Sewer Waste	0.04
	Satisfactory Floors	0.04
	Satisfactory Exterior Walls	0.04
	No Critical Overcrowding	0.04

Source: Author's adaption based on DANE (2014), p. 6.

Appendix 3 Dimensions, Indicators, Deprivation Cutoffs, and Weights of the Global Multidimensional Poverty Index (MPI)

Dimensions	Indicator	Weight (w)	Deprivation cutoff (z)
Education	Schooling (Sc)	1/6	No household member has completed at least five years of schooling.
	Attendance (At)	1/6	Any school-aged child in the household is not attending school until grade 8.*
Health	Nutrition (N)	1/6	Any adult or child in the household with nutritional information is undernourished.**
	Mortality (M)	1/6	Any child has passed away in the household.***
Standard of Living	Electricity (E)	1/18	The household has no electricity.
	Sanitation (S)	1/18	The household' sanitation facility is not improved or it is shared with other households.
	Water (W)	1/18	The household does not have access to safe drinking water or safe water is more than a 30-minute walk (round trip).
	Floor (F)	1/18	The household has a dirt, sand, or dung floor.
	Cooking Fuel (C)	1/18	The household cooks with dung, wood, or charcoal.
	Assets (A)	1/18	The household owns at least one of the following: radio, telephone, TV, bike, motorbike, or refrigerator; and does not own a car or truck.

Source: Alkire et al. (2015), pp. 169.

* If a household has no school-aged children, the household is treated as non-deprived.

**An adult with a Body Mass Index below 18.5 m/kg^2 is considered undernourished. A child is considered undernourished if his or her body weight, adjusted for age, is more than two standard deviations below the median of the reference population.

***If no person in a household has been asked this information, the household is treated as non-deprived.

Appendix 4 Fundamental Properties of Income Polarization Indices

Wolfson's (1994) index of bipolarization (PW) assumes population dived in two groups, each one at each side of the median value of the income distribution. The degree of polarization can be calculated as follows,

$$PW = 2\frac{\mu}{m}\left[2\left(0.5 - L(0.5)\right) - G\right]$$

Equation 27

Where μ is average income, *m* is median income value, *L(0.5)* is Lorenz curve value at the median income value, and G is the Gini coefficient.

For the following polarization indices, denote income logarithm by *y* for income classes from *i=1,…,n*. The identification function is denoted by $I(n_i)$ of the number of n_i of individual in their income class *i*. The function is increasing which means the more individual in class *i* the more identification. Denote the distance between two individual *i* and *j* by $\delta(y_i, y_j)$; and the alienation between the two individual as a function $a[\delta(y_i, y_j)]$. Therefore, and effective antagonism experienced between individuals *i* and *j* is represented by the function *T(I,a)*. The general formulation of the Esteban and Ray's polarization index is,

$$ER(n,y) = \sum_{i=1}^{n}\sum_{j=1}^{n} n_i n_j T[I(n_i), a[\delta(y_i, y_j)]]$$

Equation 28

Therefore, polarization index only depends of the effect antagonism among individuals in society. However, several mathematical specifications fit this condition, hence Esteban and Ray narrow down its possibilities imposing some behavioral restrictions. First, the condition H or homotheticity condition states that "polarization

orderings should not change if population sizes are all multiplied by the same number" (Duclos and Taptue (2015), p. 311). In addition, the axioms that complements the restrictions are,

Axiom 1, based on Figure 31, a society with three income groups (*p*, *q*, and *q*); if the two smaller and closer groups join together at the average of their incomes, polarization increases.

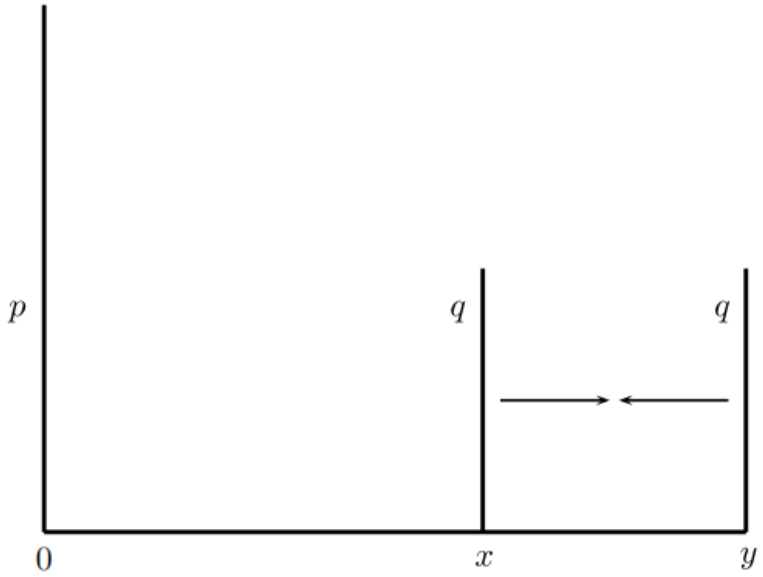

Figure 31 Graphical Representation Axiom 1
Source: Duclos and Taptue (2015), p. 311.

Axiom 2, based on Figure 32, a society with three income groups (*p*, *q*, and *r*); if *q* moves towards *r*, polarization increases.

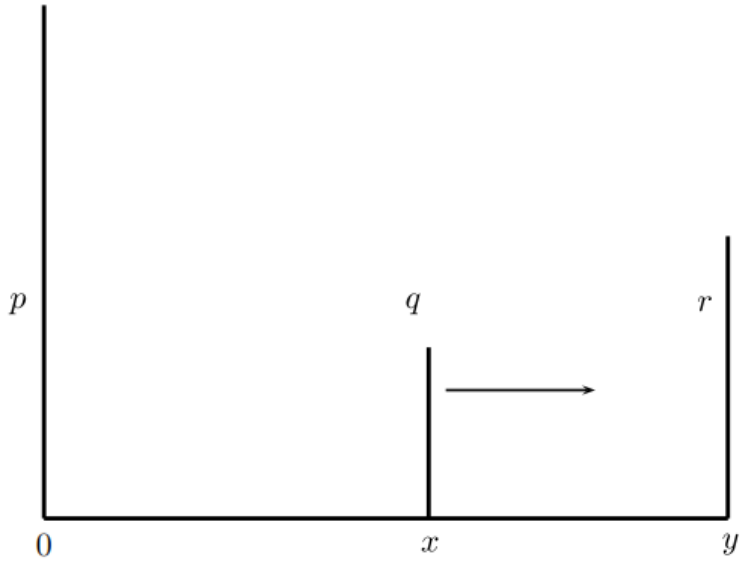

Figure 32 Graphical Representation Axiom 2
Source: Duclos and Taptue (2015), p. 312.

Axiom 3, based on Figure 33, “any new distribution formed by shifting population mass form a central mass of size *q* equally to two lateral masses each of the size *p* an equally distant away from the central mass increases polarization”.

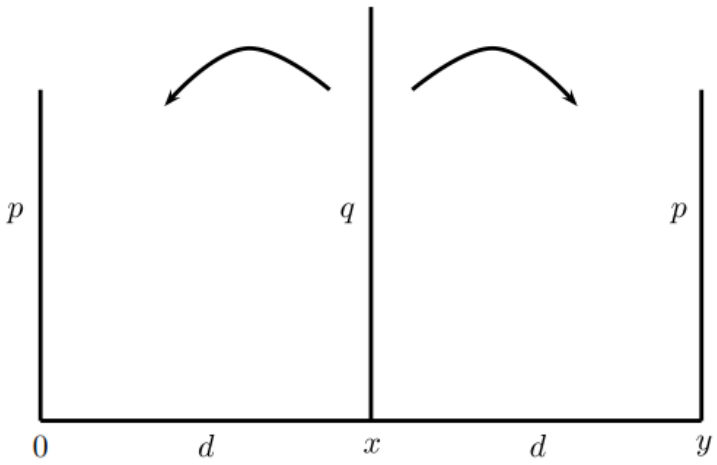

Figure 33 Graphical Representation Axiom 3
Source: Duclos and Taptue (2015), p. 313.

Theorem 1, “a class of polarization measure satisfies condition *H* and the three Axioms if and only if Equation 28 has the form,

$$ER(\alpha,F) = K \sum_{i=1}^{n} \sum_{j=1}^{n} n_i^{1+\alpha} n_j |y_i - y_j|$$

Equation 29

Where $K > 0$ is a normalization constant, $\alpha \in (0, 1.6]$, and $T[I(n_i), a[\delta(y_i, y_j)]] = n_i^{\alpha}|y_i - y_j|$. K has no effect on ordering of the distribution, and α captures the degree polarization, the greater, the more aversion to polarization. This definition of polarization demands defining the number of groups before applying it – exogenous definition –. However, Esteban et al. (2007) propose defining the number of groups endogenously minimaxing the intra-group heterogeneity. Based on this procedure, the authors posit the polarization index (EGR), that is composed by the ER index corrected by the weighted (β) difference between Gini coefficient ($G(f)$) on all the population and the Gini coefficient ($G(p^*)$) on the groups defined endogenously.

$$EGR(\alpha,F,\beta) = ER - \beta[G(f) - G(p^*)]$$

Equation 30

As I mentioned in the introduction, there is a link between Equation 29 and Gini coefficient. One of the mathematical representations of the Gini coefficient (G) is (Lambert, 2001),

$$G = \sum_{i=1}^{n} \sum_{j=1}^{n} \frac{|x_i - x_j|}{2N^2\mu}$$

Equation 31

Gini would be equal to ER if α is equal to zero, the constant K contain the remaining parameter that are also constants, and the variable is income instead of income logarithm. Hence, this is the reason why a decreasing trend in Gini coefficient will be positive correlated to the ER.

Duclos et al. (2004) extend the axiomatic structure for continuous variables with important similarities but meaningful differences. The continuous expression for the polarization index (DER) is,

$$\text{DER} = \iint T[f(x), |x - y|]f(x)f(y)dxdy$$

Equation 32

"Where *f(x)* is the (unnormalized) density function – capturing identification – and $|x\text{-}y|=a$ is the distance between individuals of income *x* and *y* – capturing alienation. The antagonism function *T(I,a)* is increasing in its second argument, an *(I,0)=T(0,a)=0*." (Duclos and Taptue (2015), p. 314). The axiomatic structure of DER refers to densities as follows,

Axiom 1, "a squeeze of distributions made of only one basic density does not increase polarization." See Figure 34.

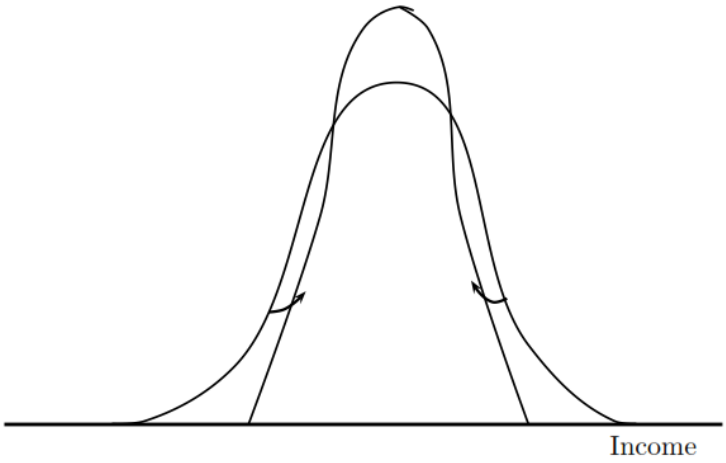

Figure 34 Graphical Representation Axiom 1 for Continuos Income
Source: Duclos and Taptue (2015), p. 315.

Axiom 2, "If the distribution of a symmetric density has three poles, a squeeze of the outer poles does not decrease polarization." See Figure 35.

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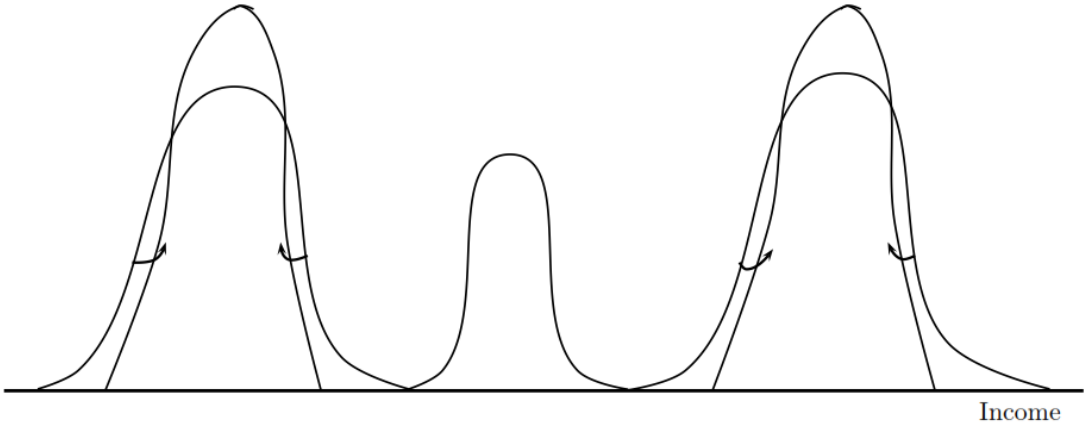


Figure 35 Graphical Representation Axiom 2 for Continuos Income
Source: Duclos and Taptue (2015), p. 315.

Axiom 3, “if a symmetric density has four poles and if each of the two middle poles shifts to the nearer outer pole, then polarization must go up.” See Figure 36.

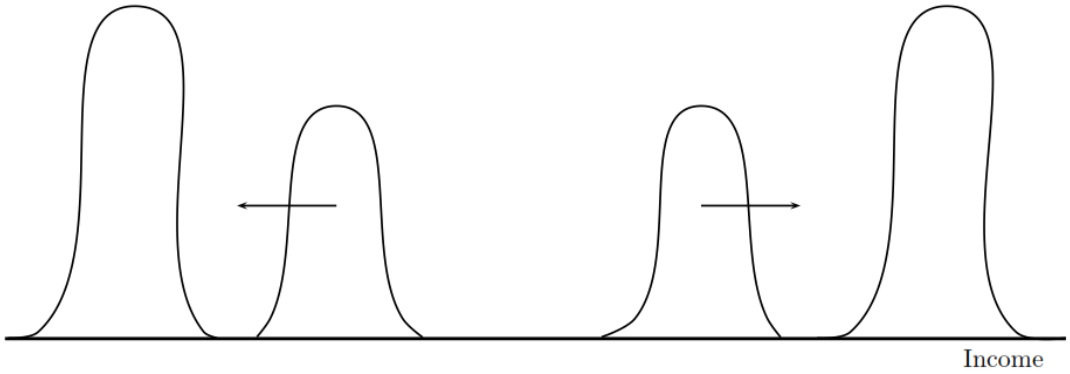


Figure 36 Graphical Representation Axiom 3 for Continuos Income
Source: Duclos and Taptue (2015), p. 316.

Axiom 4, “if the polarization index for one distribution is higher than for another one, then it remains higher when both populations are identically scaled.”

Theorem 2, an index that satisfies the previous four axioms fits the Equation 32 if and only if has the form,

$$\text{DER} = \iint f(x)^{1+\alpha} f(y)|x-y|dxdy$$

Equation 33

Where $\alpha \in [0.25, 1]$, and $T[f(x),|x-y|]=f(x)^{\alpha}|x-y|$. For $\alpha=0$ DER will be equal to the continuous expression of Gini coefficient.

On other hand Duclos et al. (2004) adapted the ER excluding income, to the categorical variables obtaining the following index expression,

$$DER_S\ (\alpha,F) = \sum_{i=1}^{n}\sum_{j=1}^{n}\pi_j{}^{1+\alpha}\pi_k\delta_{jk}$$

Equation 34

Where $\alpha \in [0,\infty]$, and the alienation value is denoted by δ_{jk} for a pair of groups j and k, and $\delta(y_i,y_j)$ is,

$$\delta(y_i,y_j) = \begin{cases} 0\ if\ y_i = y_j \\ 1\ if\ y_i \neq y_j \end{cases}$$

Appendix 5 Statistics Dimension Income

Table 47 Household's Head Answers to Both Questions and Identification of the Dependent Variable (Percent Below), Years 2003, 2008, 2010, 2011, 2014 and 2015.

	Not enough	**Just covers**	**Covers more**	**Total**
Year: 2003				
Better living cond 5yr ago	1,028,933	1,861,535	380,383	3,270,851
	31.46	56.91	11.63	100
Same living cond 5yr ago	1,212,875	1,597,527	210,501	3,020,903
	40.15	52.88	6.97	100
Worse living cond 5yr ago	1,640,568	968,405	56,918	2,665,891
	61.54	36.33	2.14	100
Total	3,882,376	4,427,467	647,802	8,957,645
	43.34	49.43	7.23	100

Year: 2008	Not enough	Just covers	Covers more	Total
Better living cond 5yr ago	1,405,155	3,038,880	972,390	5,416,425
	25.94	56.1	17.95	100
Same living cond 5yr ago	1,596,105	2,415,322	491,490	4,502,917
	35.45	53.64	10.91	100
Worse living cond 5yr ago	1,134,590	678,337	60,624	1,873,551
	60.56	36.21	3.24	100
Total	4,135,850	6,132,539	1,524,504	11,792,893
	35.07	52	12.93	100

Year: 2010	Not enough	Just covers	Covers more	Total
Better living cond 5yr ago	1,493,556	3,323,711	903,747	5,721,014
	26.11	58.1	15.8	100

(continued)

	Not enough	Just covers	Covers more	Total
Same living cond 5yr ago	1,784,892	2,593,124	461,767	4,839,783
	36.88	53.58	9.54	100
Worse living cond 5yr ago	962,880	729,223	48,145	1,740,248
	55.33	41.9	2.77	100
Total	4,241,328	6,646,058	1,413,659	12,301,045
	34.48	54.03	11.49	100

Year: 2011	Not enough	Just covers	Covers more	Total
Better living cond 5yr ago	1,515,544	3,356,871	1,122,878	5,995,293
	25.28	55.99	18.73	100
Same living cond 5yr ago	1,710,880	2,839,069	555,589	5,105,538
	33.51	55.61	10.88	100
Worse living cond 5yr ago	965,980	675,059	69,849	1,710,888
	56.46	39.46	4.08	100
Total	4,192,404	6,870,999	1,748,316	12,811,719
	32.72	53.63	13.65	100

Year: 2014	Not enough	Just covers	Covers more	Total
Better living cond 5yr ago	1,060,759	3,833,548	1,321,954	6,216,261
	17.06	61.67	21.27	100
Same living cond 5yr ago	1,683,014	3,780,229	583,437	6,046,680
	27.83	62.52	9.65	100
Worse living cond 5yr ago	840,102	609,504	60,588	1,510,194
	55.63	40.36	4.01	100
Total	3,583,875	8,223,281	1,965,979	13,773,135
	26.02	59.71	14.27	100

(continued)

	Not enough	Just covers	Covers more	Total
Year: 2015	Not enough	Just covers	Covers more	Total
Better living cond 5yr ago	1,089,493	4,314,048	1,390,576	6,794,117
	16.04	63.5	20.47	100
Same living cond 5yr ago	1,409,236	3,671,330	673,337	5,753,903
	24.49	63.81	11.7	100
Worse living cond 5yr ago	767,597	726,055	62,743	1,556,395
	49.32	46.65	4.03	100
Total	3,266,326	8,711,433	2,126,656	14,104,415
	23.16	61.76	15.08	100

Source: Author's calculations. LSMS 2003, 2008, 2010, 2011, 2014 and 2015.

Table 48 Estimations Results: Multinomial Model

Variable	2003	2008	2010	2011	2013	2014	2015
Reference category: Same living standards than 5 years ago and just enough to cover the minimum expenditures							
Category: same living standards than 5 years ago and more than enough to cover the minimum expenditures							
Education of the head	0.0909***	0.1435***	0.1105***	0.1418***	0.1408***	0.1535***	0.1299***
Age of the head	0.0290	-0.0786**	-0.0302	-0.0537*	-0.0756***	-0.0576*	-0.0564*
Age of the head squared	-0.0003	0.0010***	0.0002	0.0006**	0.0008***	0.0007**	0.0007**
Sex of the head (1=Female)	-0.6953*	-0.1738	-0.2554	-0.4353**	-0.6699***	-0.5184**	-0.5873***
Marital status of the head (1=Married)							
Single	1.0756***	0.1549	0.0701	0.1504	0.1632	0.0681	0.2373
Living together_No married	0.1600	-0.2179	-0.3085	-0.0136	-0.0583	-0.0265	-0.0358
Other	0.5038	-0.0689	-0.0091	0.0863	0.1186	-0.0674	0.0524
Health insurance of the head (1=Private)							
Public Ins.	-1.0921	-0.8340***	-0.8252***	-0.8739***	-1.0853***	-0.8034***	-1.1742***
Other	0.1506	0.8269**	0.1184	0.3871	0.2818	0.3824	0.1962
No insurance	-0.9983**	-0.0553	-0.6368*	-0.8426***	-0.3704	-0.4322	-0.4553

(continued)

Table 48 (continued) Estimation Results: Multinomial Model

Variable	2003	2008	2010	2011	2013	2014	2015
Household floor type (1=No floor)							
Low quality floor	14.0500***	0.5896	-0.27	-0.0233	-0.0645	-0.3568	0.07
Medium quality floor	14.7528***	0.6163	0.3568	0.61	0.4774	0.1175	0.6164
High quality floor	15.4451***	1.5418*	1.3033	1.1245**	0.6508	0.745	1.2168
Household sanitation (1=No sanitation)							
Unsatisfactory sanitation	-0.0277	-0.8142	-0.1357	0.0334	0.5567	0.4406	-0.3832
Satisfactory sanitation	0.2285	-0.4218	-0.5405	0.188	0.9581	1.0784	0.1401
Occupational activity of head (1=Agricultural)							
Unskilled services	0.0748	-0.1029	0.8203	-0.3289	0.2025	-0.0696	0.4601
Unskilled manual	-0.1253	-0.2103	0.2602	-0.1858	0.2021	0.4802	0.3567
Skilled manual	0.5413	-0.1928	0.5918	-0.2467	0.2869	0.2117	0.6157
Supervising	0.3996	0.0757	0.375	-0.162	0.616	0.5183	0.1432
Office no-manage	0.5382	0.5904	0.9923*	0.392	0.7907	0.4788	0.8811*
White collar	-0.2041	0.0856	1.2420**	-0.2446	0.2	0.276	0.7753*
Professionals	0.3028	0.736	1.7782***	0.539	0.9702*	1.2578**	1.0676**
Directors, manag	0.7589	1.1072*	1.8171***	0.6379	1.0524*	1.0400*	1.0957**

(continued)

Table 48 (continued) Estimation Results: Multinomial Model

Variable	2003	2008	2010	2011	2013	2014	2015
Economics sector of head (1=Agricultural)							
Mining	-15.1709***	0.5454	0.8032	0.7994	0.8407	-0.0336	0.4905
Industry & Manuf	-1.9125**	0.0491	-0.5464	-0.1775	-0.4562	-0.0766	-0.3482
Elect,Water,Gas	-17.2851***	-0.8887	0.4685	-0.7564	-0.7613	-0.8301	-0.9363
Construction	-0.9936	0.00001	-0.7235	-0.327	-0.1783	0.0348	-0.7552
Commerce & Hotel	-1.0847	-0.3875	-0.8627	-0.3567	-0.4768	-0.0203	-0.2216
Transp & Commun	-1.3772	-0.3599	-1.0188	-0.5048	-0.3164	-0.1246	-0.2207
Financ & Real Esta	-0.9501	-0.155	-0.5013	-0.5399	-0.2435	-0.5987	-0.2261
Social Services	-0.6819	-0.3431	-0.7991	-0.1537	-0.2117	-0.025	-0.2592
Urban=1	0.6820	0.1699	-0.0491	0.079	0.1225	-0.0831	0.1478
Region (1=Main region Bogota)							
Antioquia	0.2009	-0.049	0.6779*	0.0426	0.103	-0.0063	-0.1943
Valle	0.3680	0.2179	-0.1251	0.2789	-0.198	0.1622	0.0358
Atlantica	0.1033	0.3654	-0.2651	0.0026	-0.1537	0.0941	-0.209
Oriental	0.1838	0.2118	0.5468	0.0444	-0.1143	-0.1856	-0.2378
Central	0.7991	0.174	0.5203	0.0516	-0.2208	-0.022	0.4425*
Pacifica	0.4557	0.016	-0.2533	-0.3591	-0.6024**	-1.1118***	-0.4413*
San Andres	-0.2183	0.297	0.5862	0.7913**	0.1594	0.7590**	-0.8067**
Orinoco_Amazonas	0.7770	0.59	0.6547	0.1847	-0.0743	-0.0559	-0.0255

(continued)

Table 48 (continued) Estimation Results: Multinomial Model

Variable	2003	2008	2010	2011	2013	2014	2015
Constant	-18.2546***	-1.9367*	-1.4411	-2.4388***	-2.5971**	-3.4060***	-2.6879**
Category: Same living standards than 5 years ago and not enough to cover the minimum expenditures							
Education of the head	-0.0552**	-0.0799***	-0.0322*	-0.0594***	-0.0686***	-0.0626***	-0.0664***
Age of the head	0.0199	0.0123	0.0062	0.0036	-0.0091	-0.0089	-0.0023
Age of the head squared	-0.0001	0.0000	0.0000	0.0000	0.0001	0.0002	0.0001
Sex of the head (1=Female)	0.1606	0.5474***	0.3219**	0.4827***	0.6784***	0.6430***	0.3571***
Marital status of the head (1=Married)							
Single	-0.1322	-0.2671	-0.0329	-0.1675	-0.0162	-0.0242	0.0391
Living together_No married	0.0772	0.1997*	0.1518	-0.0171	0.0703	0.1189	0.0891
Other	0.3194	-0.2902*	0.1801	-0.0756	0.0773	-0.1521	0.2486*
Health insurance of the head (1=Private)							
Public Ins.	0.6848***	0.5134***	0.9016***	0.5640***	0.6295***	0.5674***	0.4568***
Other	-0.2618	-0.2269	-0.718	-0.1219	-0.4217	-0.6866*	-0.0631
No insurance	0.6949***	0.5215***	0.7593***	0.5921***	0.6234***	0.3223*	0.6463***

(continued)

Table 48 (continued) Estimation Results: Multinomial Model

Variable	2003	2008	2010	2011	2013	2014	2015
Household floor type (1=No floor)							
Low quality floor	0.3342	0.0993	-0.3400*	-0.4473***	-0.1804	-0.2455*	-0.4710***
Medium quality floor	-0.2523	-0.2137	-0.6151**	-0.8775***	-0.4685***	-0.6789***	-0.7874***
High quality floor	-0.7525	-0.1266	-0.9099*	-1.1847***	-0.6803	-0.7158*	-0.385
Household sanitation (1=No sanitation)							
Unsatisfactory sanitation	-0.0418	-0.2673	0.0864	-0.2549*	-0.2511	-0.2835	-0.1074
Satisfactory sanitation	-0.2448	-0.3470**	-0.1948	-0.1693*	-0.2637*	-0.5532***	-0.2017
Occupational activity of head (1=Agricultural)							
Unskilled services	0.0561	0.4630*	0.6125	0.1273	-0.0398	-0.2699	0.0573
Unskilled manual	-0.6685	-0.2285	0.0946	-0.0337	-0.082	-0.343	-0.1086
Skilled manual	0.0315	0.3502	0.5789	-0.2121	-0.0301	-0.3546	-0.2852
Supervising	-0.2597	0.4016	0.663	0.137	0.1706	-0.2446	-0.2429
Office no-manage	-0.5183	-0.176	0.5729	-0.0274	-0.324	-0.5266*	-0.5015*
White collar	-0.5732	0.4315	0.2864	-0.0832	-0.3505	-0.4666	-0.1567
Professionals	-0.417	0.3541	-0.266	-0.1462	-0.2143	-0.4379	-0.1609
Directors, manag	-0.6005	-0.2515	-0.0667	-0.6559*	-0.7358*	-0.9396**	-0.6479*

(continued)

Table 48 (continued) Estimation Results: Multinomial Model

Variable	2003	2008	2010	2011	2013	2014	2015
Economics sector of head (1=Agricultural)							
Mining	1.3406*	0.2574	-0.4009	-0.2849	0.4247	1.0589**	0.5331
Industry & Manuf	0.2382	-0.2454	-0.3795	0.0645	-0.2074	0.0416	-0.0106
Elect,Water,Gas	0.3594	-0.4993	-14.2398***	0.4716	0.313	0.881	0.4473
Construction	0.2386	-0.155	-0.5862	-0.1026	0.2304	0.3345	0.1626
Commerce & Hotel	0.29	-0.1685	-0.7613*	-0.2473	-0.0709	0.2371	0.1957
Transp & Commun	-0.1631	-0.0033	-0.1962	-0.1619	-0.0936	0.371	0.1574
Financ & Real Esta	-0.4873	-0.3256	-0.3982	0.0326	0.1701	0.3725	0.0463
Social Services	0.3931	-0.252	-0.3081	-0.1348	0.0042	0.2705	0.0064
Urban=1	0.4883**	0.0906	0.1149	0.0567	0.0545	0.0719	0.0648
Region (1=Main region Bogota)							
Antioquia	0.3171	0.2538	-0.3907	0.1801	0.3299	0.4605*	0.1775
Valle	-0.154	0.5565**	-0.6107**	0.1595	0.1439	0.3265	-0.0367
Atlantica	0.4692	0.6984***	-0.3725	0.0674	0.5834***	0.1524	0.7491***
Oriental	0.1179	0.2109	-0.5565*	0.0464	0.5196**	0.3012	0.0175
Central	0.1199	-0.0182	-0.4683*	-0.0823	0.0067	0.1426	0.198
Pacifica	0.5191*	0.7395***	-0.2398	0.1726	0.7573***	0.0798	0.3285*
San Andres	-1.8768***	-0.1481	-0.7304*	-0.1112	0.8354***	1.0589***	0.6244**
Orinoco_Amazonas	-0.1322	-0.0436	-0.8980**	-0.3872	-0.1908	0.3794	-0.0072

(continued)

Table 48 (continued) Estimation Results: Multinomial Model

Variable	2003	2008	2010	2011	2013	2014	2015
Constant	-1.5611*	-0.9033*	-0.3423	0.1159	-0.6744	-0.1638	-0.5352
Statistics							
Observations	1588	3862	2567	7927	6368	6457	6210
Pseudo R2	0.1749	0.1412	0.1520	0.1294	0.1498	0.1396	0.1404

Source: Author's calculations. LSMS 2003, 2008, 2010, 2011, 2014 and 2015.

Linear model

Variable	2003	2008	2010	2011	2013	2014	2015
Education of the head	0.0475***	0.0624***	0.0451***	0.0494***	0.0464***	0.0438***	0.0473***
Age of the head	0.0212**	0.0084	0.0305***	0.0176***	0.0140***	0.0230***	0.0252***
Age of the head squared	-0.0001	0.0000	-0.0003***	-0.0001	-0.0001	-0.0001**	-0.0002**
Sex of the head (1=Female)	-0.2769***	-0.3812***	-0.3030***	-0.2546***	-0.3880***	-0.3432***	-0.4031***
Marital status of the head (1=Married)							
Single	0.4858***	0.5534***	0.4543***	0.4008***	0.4876***	0.4726***	0.5823***
Living together_No married	0.0361	-0.0165	-0.0163	0.0015	0.0238	0.0349	0.034
Other	0.3391***	0.4538***	0.2700***	0.3138***	0.3799***	0.4114***	0.3378***
Health insurance of the head (1=Private)							
Public Ins.	-0.7453***	-0.5191***	-0.6102***	-0.5780***	-0.5596***	-0.5445***	-0.4842***
Other	-0.0024	0.2807**	0.1256	0.3298***	0.3806***	0.3225***	0.4846***
No insurance	-0.5406***	-0.3804***	-0.4195***	-0.4606***	-0.4384***	-0.3593***	-0.4098***

(continued)

(continued) Linear Model

Variable	2003	2008	2010	2011	2013	2014	2015
Household floor type (1=No floor)							
Low quality floor	0.1321	0.0383	0.1628**	0.1971***	0.1508***	0.1479***	0.2619***
Medium quality floor	0.4456***	0.2679***	0.3791***	0.4076***	0.3146***	0.3041***	0.4298***
High quality floor	0.9381***	0.5287***	0.8155***	0.7547***	0.7192***	0.5544***	0.8893***
Household sanitation (1=No sanitation)							
Unsatisfactory sanitation	0.0773	0.1695*	-0.0768	0.0558	0.1724**	0.0667	-0.0187
Satisfactory sanitation	0.0630	0.2278***	-0.0496	0.0473	0.2214***	0.1862***	0.1039
Occupational activity of head (1=Agricultural)							
Unskilled services	0.0942	-0.0347	-0.0822	-0.0908	0.0106	-0.0483	0.1679
Unskilled manual	0.2394	0.0322	0.2146	-0.0313	0.0184	0.0309	0.2364*
Skilled manual	0.0623	0.0296	0.0232	-0.0063	0.0274	0.0222	0.2776*
Supervising	0.0669	0.0122	0.0719	0.022	0.1249	0.0977	0.2701*
Office no-manage	0.2304	0.0769	0.182	0.2038**	0.1766**	0.1214	0.3120**
White collar	0.4067**	0.2022*	0.3074*	0.2084**	0.2003**	0.1862*	0.4574***
Professionals	0.7114***	0.5838***	0.7172***	0.5109***	0.5444***	0.4620***	0.6034***
Directors, manag	0.8464***	0.7274***	0.7860***	0.3871***	0.5326***	0.3603***	0.5605***

(continued)

(continued) Linear Model

Variable	2003	2008	2010	2011	2013	2014	2015
Economics sector of head (1=Agricultural)							
Mining	-0.008	-0.0706	0.1058	0.3564***	0.3392**	0.1262	0.2649*
Industry & Manuf	-0.2642*	0.0097	-0.0995	0.0961	-0.0187	0.0458	-0.2893**
Elect,Water,Gas	0.0631	0.2601	0.3307	0.1313	0.2290*	0.0006	-0.0491
Construction	-0.2736	0.0699	0.0453	0.2028**	0.0768	0.1472*	-0.1336
Commerce & Hotel	-0.2570*	0.025	-0.1461	0.0488	-0.0984	-0.0418	-0.2638*
Transp & Commun	-0.2556	-0.0293	-0.2802*	0.0936	-0.0312	0.0129	-0.2648*
Financ & Real Esta	-0.0726	0.0719	-0.0944	0.0802	0.0331	0.0459	-0.2305*
Social Services	-0.2037	0.0626	-0.0055	0.0812	0.1012	0.1305*	-0.0575
Urban=1	0.1755**	0.0742	0.0743	0.0383	0.0954***	0.0319	-0.2016***
Region (1=Main region Bogota)							
Antioquia	-0.3534***	-0.2629***	-0.2810***	-0.1659**	-0.1274**	-0.2000***	-0.5069***
Valle	-0.0609	-0.1894**	-0.2043*	-0.2398***	-0.1779***	-0.1532***	-0.3758***
Atlantica	-0.0703	-0.2872***	-0.2069**	-0.2500***	-0.1737***	-0.1788***	-0.3486***
Oriental	-0.0761	-0.2754***	-0.1121	-0.2403***	-0.1785***	-0.1595**	-0.4276***
Central	-0.1381	-0.0677	-0.1325	-0.1669**	-0.1445**	-0.1292**	-0.1702***
Pacifica	-0.1981**	-0.4426***	-0.3496***	-0.4119***	-0.3905***	-0.3811***	-0.4322***
San Andres	0.2871**	-0.0508	0.3339***	0.0596	0.1267*	0.0769	-0.0896
Orinoco_Amazonas	0.2665*	-0.0327	-0.0097	-0.0456	-0.0946	-0.1438	-0.4098**

(continued)

(continued) Linear Model

Variable	2003	2008	2010	2011	2013	2014	2015
Constant	1.0402***	1.0342***	1.3604***	1.1550***	1.2339***	1.1098***	1.2965***
Observations	1582	3852	2563	7918	6354	6437	6207
Adj. R2	0.5519	0.4204	0.4434	0.4404	0.4753	0.3982	0.2856

Source: Author's calculations. LSMS 2003, 2008, 2010, 2011, 2014 and 2015.

Table 49 Linear Specification vs. Quadratic Specification, and Adjusted R-squared Comparison

Variable	lin_pre2003	quad_pre2003	lin_pre2008	quad_pre2008	lin_pre2010	quad_pre2010	lin_pre2011	quad_pre2011
Log_income	0.0692***	0.3944***	0.0752***	0.4708***	0.0568***	0.6615***	0.1003***	0.6082***
Log_income squared		-0.0664***		-0.0947***		-0.1176***		-0.1149***
Constant	0.4206***	0.0732**	0.3831***	0.0324***	0.3905***	-0.3182***	0.3469***	-0.1518***
Observations	1588	1588	3862	3862	2567	2567	7927	7927
Adj. R2	0.1436	0.2814	0.1835	0.4689	0.1009	0.4601	0.3244	0.6293

Source: Author's calculations. LSMS 2003, 2008, 2010, 2011, 2014 and 2015.

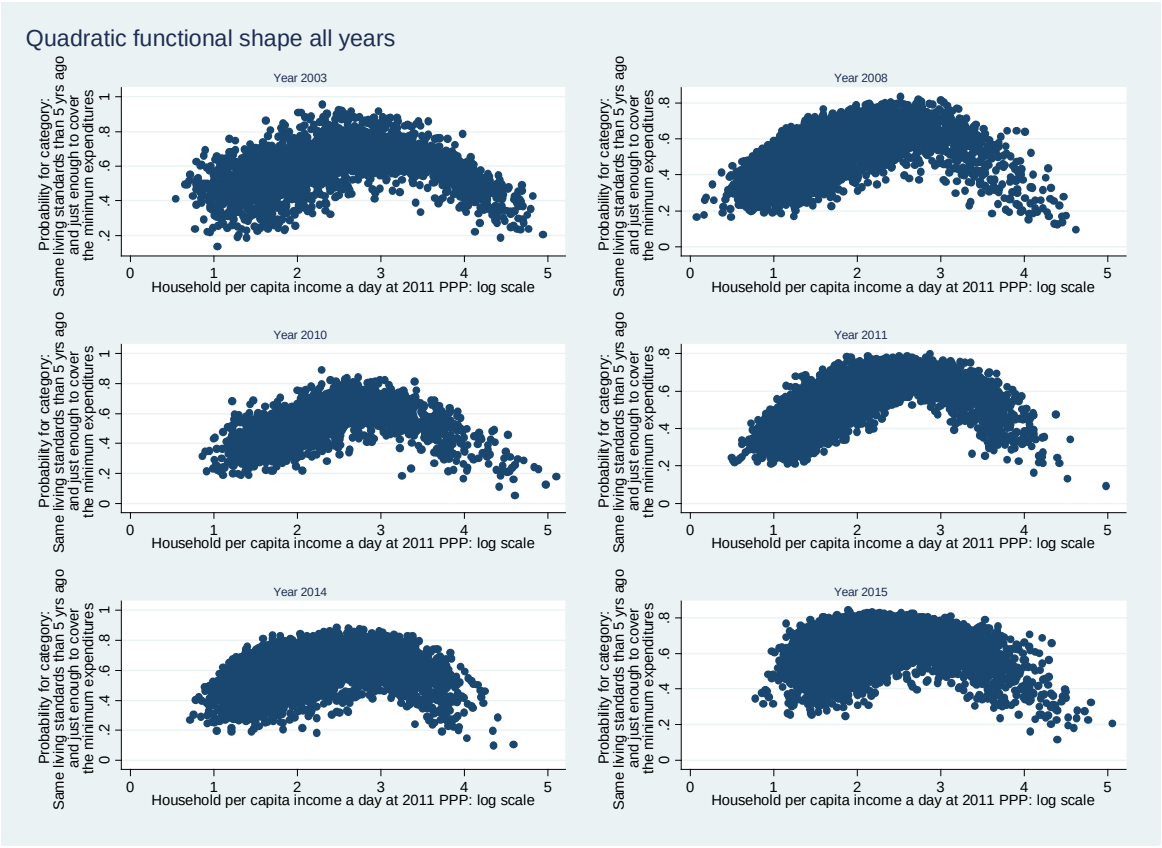
(continued)

Table 49 (continued) Linear Specification vs. Quadratic Specification, and Adjusted R-squared Comparison

Variable	lin_pre2013	quad_pre2013	lin_pre2014	quad_pre2014	lin_pre2015	quad_pre2015
Log_income	0.0600***	0.6433***	0.0672***	0.6711***	0.0013	0.5474***
Log_income squared		-0.1234***		-0.1281***		-0.1088***
Constant	0.4801***	-0.1470***	0.4641***	-0.1936***	0.6448***	0.0071
Observations	6368	6368	6457	6457	6210	6210
Adj. R2	0.1111	0.447	0.1172	0.3589	0.4734	0.2988

Source: Author's calculations. LSMS 2003, 2008, 2010, 2011, 2014 and 2015.

Figure 37 Quadratic Functional Shape as an Empirical Regularity All Years



Source: Author's calculations. LSMS 2003, 2008, 2010, 2011, 2014 and 2015.

Table 50 Estimations Results: Multinomial Model Using New Definition of Dependent Variable

Variable	2003	2008	2010	2011	2013	2014	2015
Reference category: Same living standards than 5 years ago and just enough to cover the minimum expenditures							
Category: better living standards than 5 years ago and more than enough to cover the minimum expenditures							
Education of the head	0.0747***	0.1137***	0.0963***	0.1134***	0.1308***	0.1186***	0.1133***
Age of the head	0.0195	-0.0196	0.0045	-0.0131	-0.0216	0.0205	-0.0258
Age of the head squared	-0.0005	0.0002	-0.0002	0.0000	0.0001	-0.0003	0.0002
Sex of the head (1=Female)	-0.3152	-0.3521*	-0.3216	-0.2615*	-0.2997**	-0.5503***	-0.5776***
Marital status of the head (1=Married)							
Single	0.0816	-0.1459	-0.11	-0.187	-0.5034***	0.2536	0.0963
Living together_No married	-0.3264	-0.2520*	-0.1022	-0.3270**	-0.1294	-0.1104	-0.0305
Other	-0.2849	-0.4808*	-0.131	-0.1626	-0.5350***	-0.1066	0.0465
Health insurance of the head (1=Private)							
Public Ins.	-1.2646**	-1.0284***	-0.6939***	-0.8741***	-0.8811***	-0.9141***	-0.9323***
Other	-0.0377	0.3584	0.0392	0.2781	0.4837**	0.0057	0.294
No insurance	-0.8625***	-0.6150**	-0.4006	-0.7083***	-0.6627***	-0.6570**	-0.5818**

(continued)

Table 50 (continued) Estimations Results: Multinomial Model Using New Definition of Dependent Variable

Variable	2003	2008	2010	2011	2013	2014	2015
Household floor type (1=No floor)							
Low quality floor	1.1261	1.1677**	0.1263	0.0687	1.8161**	1.1160*	0.776
Medium quality floor	1.9961	1.5713***	0.893	0.5392*	2.2787***	1.6865***	1.2720**
High quality floor	2.2174*	2.0437***	1.4181*	0.4829	2.3857***	2.0671***	1.7042***
Household sanitation (1=No sanitation)							
Unsatisfactory sanitation	-1.1109	-0.7383	0.5337	0.1781	0.7923	1.1864*	0.5189
Satisfactory sanitation	-1.1675	-0.5227	0.1639	0.1576	0.4733	1.0990*	0.5582
Occupational activity of head (1=Agricultural)							
Unskilled services	0.2006	0.47	-0.332	0.6203	-0.0132	-0.0694	0.2104
Unskilled manual	-0.3849	0.0276	-0.2502	0.416	0.2375	0.1375	0.2223
Skilled manual	0.043	0.1316	-0.1439	0.6635*	0.3297	0.078	0.1344
Supervising	0.4535	0.2523	0.1204	0.7804*	0.5828	0.0231	0.2345
Office no-manage	0.8907	0.5834	0.041	1.2650***	0.4144	0.5261*	0.5614*
White collar	0.6438	0.2752	0.2014	0.9136**	0.174	0.2858	0.5510*
Professionals	0.7208	1.0975**	0.5288	1.3853***	0.6185*	0.7351**	0.9164***
Directors, manag	0.8072	1.0376**	0.7048	1.3085***	0.8483*	1.0577***	0.8373**

(continued)

Table 50 (continued) Estimations Results: Multinomial Model Using New Definition of Dependent Variable

Variable	2003	2008	2010	2011	2013	2014	2015
Economics sector of head (1=Agricultural)							
Mining	-0.3508	0.6963	0.5751	0.3095	0.5913	0.6824	1.0318**
Industry & Manuf	0.1775	-0.3929	0.1693	-0.4978	-0.1044	-0.1383	0.1258
Elect,Water,Gas	-14.5925***	-0.825	1.027	-0.9451	0.1335	0	-0.2217
Construction	-0.2793	-0.3049	0.3873	-0.677	0.1619	-0.0783	-0.0504
Commerce & Hotel	-0.0325	-0.3696	-0.0632	-0.7091*	-0.1095	0.0701	0.0117
Transp & Commun	0.0273	-0.5296	-0.029	-0.4331	-0.2419	-0.1813	0.0737
Financ & Real Esta	0.3925	-0.6285	0.0943	-0.5871	0.1095	-0.0223	-0.0507
Social Services	0.3876	-0.5518	0.2226	-0.6993*	0.2293	0.2599	-0.0356
Urban=1	0.7156*	0.0181	0.2189	0.2925*	0.1904	0.0779	0.1428
Region (1=Main region Bogota)							
Antioquia	0.226	0.0495	0.2902	0.0912	-0.2895	0.0978	0.3310*
Valle	0.4833	0.1375	-0.1296	0.0883	-0.4222**	-0.0225	0.3279**
Atlantica	0.4253	0.3803	0.1771	0.4175**	0.0853	0.3305	0.3035
Oriental	0.4378	-0.2526	0.307	0.0207	-0.3132*	-0.4961**	0.0513
Central	0.6235	-0.1267	0.2166	0.2853	-0.3706*	-0.0165	0.3264*
Pacifica	-0.1366	-0.4148	-0.6442*	-0.2652	-0.8064***	-0.5347**	0.0172
San Andres	-0.6558	-0.4451	0.6360*	0.4393	-0.2383	0.274	-0.4569*
Orinoco_Amazonas	1.5344***	0.7770**	0.0771	0.6250*	0.2684	1.0450***	0.4985*

(continued)

Table 50 (continued) Estimations Results: Multinomial Model Using New Definition of Dependent Variable

Variable	2003	2008	2010	2011	2013	2014	2015
Constant	-3.3981*	-1.8234**	-2.4586**	-2.3905***	-3.9431***	-5.1110***	-3.3364***
Category: Worse living standards than 5 years ago and not enough to cover the minimum expenditures							
Education of the head	-0.0457**	-0.0541***	-0.0441**	-0.0395***	-0.0355**	-0.0235	-0.0360*
Age of the head	0.0805***	0.0405*	0.0774***	0.0430**	0.0574***	0.0321	0.0351
Age of the head squared	-0.0007**	-0.0003	-0.0007**	-0.0003*	-0.0004*	-0.0001	-0.0002
Sex of the head (1=Female)	0.2581	0.4935***	0.2454	0.5360***	0.5642***	0.4639***	0.5674***
Marital status of the head (1=Married)							
Single	-0.2627	-0.2022	-0.0299	-0.0771	0.2351	0.0145	0.1968
Living together_No married	-0.1293	0.2028	0.0548	0.2323*	-0.1067	0.0821	0.0456
Other	0.04	0.2	0.0847	0.3745***	0.2083	0.1781	0.4231***
Health insurance of the head (1=Private)							
Public Ins.	0.9924***	0.7110***	0.6713***	0.5664***	0.8965***	0.5975***	0.6438***
Other	0.0306	-1.0582	-0.7184	-0.4397	-0.2763	-1.6557*	-0.1939
No insurance	0.8992***	1.0119***	1.2005***	0.9590***	0.9838***	0.9694***	1.0644***

(continued)

Table 50 (continued) Estimations Results: Multinomial Model Using New Definition of Dependent Variable

Variable	2003	2008	2010	2011	2013	2014	2015
Household floor type (1=No floor)							
Low quality floor	0.0336	0.0527	-0.2977	-0.1654	-0.3483**	-0.4288**	-0.1685
Medium quality floor	-0.6026*	-0.188	-0.8472***	-0.6457***	-0.9045***	-0.9097***	-0.7260***
High quality floor	-0.8494*	0.3911	-1.9056*	-1.4490***	-0.8422*	-0.7209	-0.5103
Household sanitation (1=No sanitation)							
Unsatisfactory sanitation	-0.0335	-0.3727	-0.4544	-0.5066***	-0.6051***	-0.2092	-0.4545*
Satisfactory sanitation	-0.2493	-0.1872	-0.7882***	-0.4935***	-0.6007***	-0.3917*	-0.6097***
Occupational activity of head (1=Agricultural)							
Unskilled services	-0.1389	0.2344	0.1782	0.158	-0.189	0.1722	-0.0588
Unskilled manual	-0.0764	-0.3369	-0.1154	-0.0185	-0.3541	-0.0572	-0.1369
Skilled manual	0.2377	0.431	0.1204	0.1	-0.3695	0.2096	-0.3266
Supervising	0.0642	0.3547	0.2033	0.2534	-0.0975	0.4874	-0.3501
Office no-manage	-0.4388	-0.1334	-0.2785	0.2061	-0.6154*	-0.1497	-0.3067
White collar	-0.6382	0.2646	0.3579	-0.0247	-0.4893	-0.01	-0.2748
Professionals	-0.4806	0.4247	-0.7193	0.2557	-1.0733*	0.1191	-0.3143
Directors, manag	0.3209	-0.4411	-1.0132	-0.4304	-0.6749	-0.2622	-0.9345*

(continued)

Table 50 (continued) Estimations Results: Multinomial Model Using New Definition of Dependent Variable

Variable	2003	2008	2010	2011	2013	2014	2015
Economics sector of head (1=Agricultural)							
Mining	0.635	0.4125	0.5562	-0.1696	0.482	1.0664*	0.1588
Industry & Manuf	0.1223	-0.1243	-0.0452	-0.0452	0.1747	-0.2297	0.2754
Elect,Water,Gas	0.2461	-0.0855	0.0525	0.5062	0.6999	-0.6142	1.2662*
Construction	0.3547	-0.0014	0.0632	-0.0821	0.2622	-0.1706	-0.0224
Commerce & Hotel	0.2228	-0.2337	0.1121	-0.2264	0.1931	-0.0946	0.2497
Transp & Commun	0.2682	0.244	0.5146	0.0106	0.2643	0.4067	0.167
Financ & Real Esta	0.3805	0.1455	-0.115	0.0078	0.5519	0.3116	0.0089
Social Services	0.7414*	-0.1618	0.2018	-0.0617	0.1641	-0.025	0.1783
Urban=1	0.4155*	0.238	0.5583***	0.4717***	0.4415***	0.1638	0.2218*
Region (1=Main region Bogota)							
Antioquia	0.3038	0.5592*	-0.031	-0.2214	0.1565	0.7714**	0.7775**
Valle	-0.073	0.6525**	0.3215	0.066	0.4023*	0.5261*	0.6781**
Atlantica	0.0416	0.6840**	-0.1454	-0.6800***	0.2041	0.2988	1.2417***
Oriental	0.0654	-0.225	-0.2661	-0.6212***	-0.1007	-0.0956	0.4044
Central	0.1114	0.0026	0.346	-0.1303	0.0325	0.6153**	0.5656*
Pacifica	-0.0373	0.7158**	-0.0231	-0.0615	0.3759	0.0757	0.3923
San Andres	-1.4930***	-0.8949*	-0.9561*	-0.5806*	-0.4336	-0.8621	-0.7553
Orinoco_Amazonas	-0.4866	0.1046	-0.4438	-0.7326**	-0.3459	-1.6735**	-0.2869

(continued)

Table 50 (continued) Estimations Results: Multinomial Model Using New Definition of Dependent Variable

Variable	2003	2008	2010	2011	2013	2014	2015
Constant	-2.6948***	-2.6587***	-2.8428***	-2.1703***	-2.9354***	-2.7321***	-3.0232***
Statistics							
Observations	1855	3562	2207	6720	6119	5859	6127
Pseudo R2	0.1928	0.1686	0.18	0.1635	0.1981	0.1859	0.1780

Source: Author's calculations. LSMS 2003, 2008, 2010, 2011, 2014 and 2015.

Linear Model in New Definition of Dependent Variable

Variable	2003	2008	2010	2011	2013	2014	2015
Education of the head	0.0537***	0.0695***	0.0458***	0.0572***	0.0557***	0.0485***	0.0576***
Age of the head	0.011	0.0259***	0.0237***	0.0140**	0.0136**	0.0249***	0.0208***
Age of the head squared	-0.0001	-0.0001	-0.0002**	0.0000	0.0000	-0.0002**	-0.0001
Sex of the head (1=Female)	-0.3124***	-0.3597***	-0.2877***	-0.2652***	-0.3371***	-0.2916***	-0.4151***
Marital status of the head (1=Married)							
Single	0.5232***	0.5821***	0.4330***	0.3917***	0.4777***	0.4821***	0.6567***
Living together_No married	-0.0184	-0.0159	-0.041	-0.0786**	0.0227	-0.0066	0.033
Other	0.2992***	0.3272***	0.2218***	0.2400***	0.3139***	0.3455***	0.3677***
Health insurance of the head (1=Private)							
Public Ins.	-0.7834***	-0.6219***	-0.6186***	-0.5947***	-0.5545***	-0.5527***	-0.5082***
Other	-0.0923	0.4220***	0.2353*	0.2800***	0.3132***	0.2766***	0.4333***
No insurance	-0.5552***	-0.4256***	-0.4567***	-0.4492***	-0.3744***	-0.4342***	-0.4447***

(continued)

(continued) Linear Model in New Definition of Dependent Variable

Variable	2003	2008	2010	2011	2013	2014	2015
Household floor type (1=No floor)							
Low quality floor	0.0948	0.1889**	0.2290**	0.1928***	0.2419***	0.0639	0.2446***
Medium quality floor	0.4047***	0.4337***	0.4430***	0.4484***	0.4361***	0.2478***	0.4373***
High quality floor	0.8577***	0.6739***	0.7760***	0.7588***	0.8278***	0.5524***	0.8314***
Household sanitation (1=No sanitation)							
Unsatisfactory sanitation	0.0824	0.0115	-0.1306	0.1164*	0.1367*	0.1209	0.0742
Satisfactory sanitation	0.0968	0.0638	-0.1052	0.0477	0.1940***	0.1492**	0.1515*
Occupational activity of head (1=Agricultural)							
Unskilled services	0.0574	-0.0519	-0.1956	-0.1215	0.0513	-0.1203	0.0498
Unskilled manual	0.0466	-0.054	-0.0105	-0.1084	0.147	-0.0669	0.1521
Skilled manual	-0.0466	-0.0137	-0.2017	-0.0598	0.0997	-0.1254	0.0786
Supervising	0.0402	0.0000	-0.1163	-0.0253	0.1731*	0.0724	0.1677
Office no-manage	0.1296	0.0118	-0.0564	0.1534*	0.2455***	0.0883	0.1876
White collar	0.4677***	0.1372	0.1685	0.1107	0.3031***	0.1437	0.2592**
Professionals	0.5548***	0.5844***	0.5271***	0.4509***	0.4715***	0.3487***	0.4836***
Directors, manag	0.6996***	0.7285***	0.5393***	0.3709***	0.6653***	0.4275***	0.4913***

(continued)

(continued)Linear Model in New Definition of Dependent Variable

Variable	2003	2008	2010	2011	2013	2014	2015
Economics sector of head (1=Agricultural)							
Mining	0.0474	0.1252	0.4480*	0.4111***	0.1511	0.3075*	0.3449**
Industry & Manuf	-0.1424	-0.0413	0.1264	0.0945	-0.081	0.1273	-0.1053
Elect,Water,Gas	0.1556	0.0999	0.4966*	-0.1126	0.0957	0.2632*	-0.0351
Construction	-0.1635	0.0856	0.218	0.2472***	-0.0091	0.1674*	0.017
Commerce & Hotel	-0.0941	-0.0333	0.0491	0.0592	-0.1940**	0.0094	-0.1255
Transp & Commun	-0.1603	-0.0531	-0.1555	0.1103	-0.1509	0.0645	-0.1453
Financ & Real Esta	0.1237	-0.1006	0.1007	0.0997	-0.1151	0.1078	-0.061
Social Services	-0.0892	-0.0848	0.145	0.0815	-0.0014	0.1745*	0.1173
Urban=1	0.1741**	0.0783	0.0014	0.0078	0.0821**	0.0371	-0.2251***
Region (1=Main region Bogota)							
Antioquia	-0.2225***	-0.2017**	-0.3498**	-0.0879	-0.081	-0.2327***	-0.3915***
Valle	0.1387*	-0.2229**	-0.2929***	-0.1629***	-0.1937***	-0.1780***	-0.3219***
Atlantica	-0.0249	-0.2548***	-0.3092***	-0.1319**	-0.1260**	-0.1193*	-0.2782***
Oriental	0.0179	-0.1601*	-0.1914*	-0.1304**	-0.1476***	-0.0955*	-0.3404***
Central	0.0463	-0.0664	-0.2556***	-0.1213*	-0.1654***	-0.1292**	-0.1437***
Pacifica	-0.0074	-0.4145***	-0.3953***	-0.3001***	-0.3842***	-0.3707***	-0.3825***
San Andres	0.3798***	0.04	0.2097*	0.2029**	0.1364*	0.083	-0.115
Orinoco_Amazonas	0.5187***	0.0504	-0.068	0.1028	-0.0586	-0.106	-0.4374**

(continued)

(continued) Linear Model in New Definition of Dependent Variable

Variable	2003	2008	2010	2011	2013	2014	2015
Constant	1.1806***	0.7190***	1.7239***	1.2474***	1.1559***	1.2222***	1.2712***
Observations	1850	3556	2207	6713	6098	5840	6121
Adj. R2	0.5659	0.4635	0.4329	0.4485	0.5027	0.4025	0.3243

Source: Author's calculations. LSMS 2003, 2008, 2010, 2011, 2014 and 2015.

Table 51 Linear Specification vs. Quadratic Specification, and Adjusted R-Squared Comparison Using New Definition of Dependent Variable

Variable	lin_pre2003	quad_pre2003	lin_pre2008	quad_pre2008	lin_pre2010	quad_pre2010	lin_pre2011	quad_pre2011
Log_income	0.0313***	0.3307***	-0.0542***	0.2595***	-0.0850***	0.3776***	-0.0892***	0.3213***
Log_income squared		-0.0614***		-0.0700***		-0.0856***		-0.0863***
Constant	0.4201***	0.1016***	0.6685***	0.3703***	0.8156***	0.2406***	0.8298***	0.3925***
Observations	1855	1855	3563	3563	2207	2207	6720	6720
Adj. R2	0.0327	0.1549	0.1123	0.3017	0.1966	0.3517	0.2523	0.4203

Source: Author's calculations. LSMS 2003, 2008, 2010, 2011, 2014 and 2015.

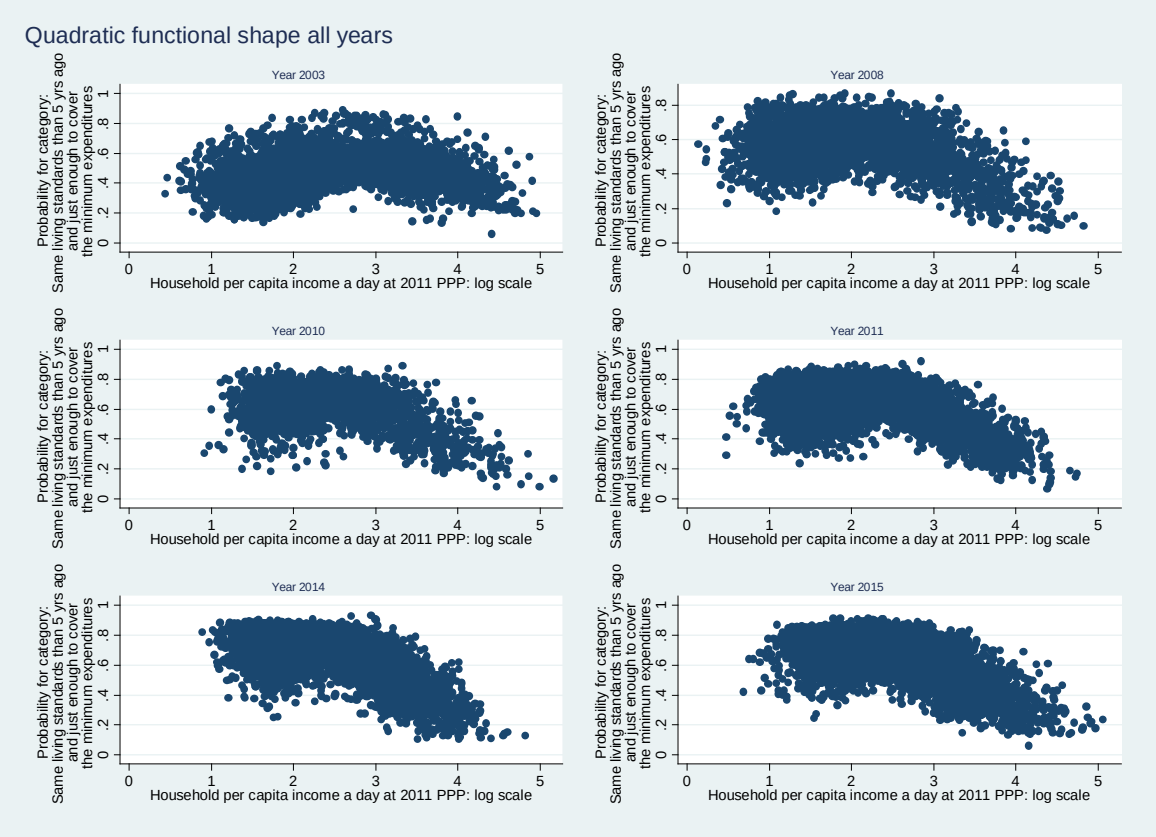
(continued)

Table 51 (continued) Linear Specification vs. Quadratic Specification, and Adjusted R-Squared Comparison Using New Definition of Dependent Variable

Variable	lin_pre2013	quad_pre2013	lin_pre2014	quad_pre2014	lin_pre2015	quad_pre2015
Log_income	-0.1057***	0.3720***	-0.1447***	0.3339***	-0.1379***	0.2474***
Log_income squared		-0.0952***		-0.0940***		-0.0730***
Constant	0.8828***	0.3380***	1.0156***	0.4515***	0.9945***	0.5232***
Observations	6119	6119	5859	5859	6127	6127
Adj. R2	0.2873	0.4664	0.4325	0.538	0.4054	0.4909

Source: Author's calculations. LSMS 2003, 2008, 2010, 2011, 2014 and 2015.

Figure 38 Quadratic Functional Shape as an Empirical Regularity New Definition of Dependent Variable All Years



Source: Author's calculations. LSMS 2003, 2008, 2010, 2011, 2014 and 2015.

Appendix 6 Survey's Questions and Answers Options

Following are the questions and answers in the surveys used for the creation of indicators. The options selected are underlined.

For the MMC

Employment

emp_R1 Official Colombia's National Occupational Classification (NOC[64]) is the result of comparing and adapting Colombia's definitions of occupational classifications and the International Standard Classification of Occupations (ISCO) (ILO, 2012). The first NOC was created based on ISCO-68, then it has been updated to the ISCO-88 and the last version ISCO-08. Currently, the NOC conceptual framework aligns to ISCO's conceptual framework of job and skill, where job is "a set of tasks and duties performed, or meant to be performed, by one person, including for an employer or in self-employment" (ILO (2012), p. 11); thus occupation "is a set of jobs whose main tasks and duties are characterized by a high degree of similarity" (ILO (2012), p. 11). While skill "is the ability to carry out the tasks and duties of a given job." (ILO (2012), p. 11). Skill concept is subdivided into two other concepts: skill level and skill specialization. Skill level "is a function of the complexity and range of the tasks and duties to be performed in an occupation" (ILO (2012), p. 11). Skill specialization has four level supported in the same number of concepts: "i) the field of knowledge required, ii) the tools and machinery

[64] Clasificacion Nacional de Ocupaciones (C.N.O. in Spanish)

used, iii) the material worked on or with, and iv) the kinds of goods and services produced" (ILO (2012), p. 11).

Colombia's adaptation has led two main concepts: qualification level and performance/function field. There are four qualification levels and ten performance/function fields (SENA, 2015). Based on both concepts a Colombian government cross-tabulated the concepts creating a grid that provides the current occupational classification for statistical and policy purposes. Thus, the NOC widest categories are 39 performance/function fields (encoded with two digits); a lower level of categories are 141 occupational fields (encoded with three digits), and final level of categories are 518 occupations (encoded with four digits) (SENA, 2015). The Colombian Living Standards Measurement Surveys (C-LSMS) only provides information for occupational classification until two digits.

Education

edu_R1 Construction based on the following questions

Q. Currently, do you go to school, college, or university? 1. Yes 2. No

Age range (5> & <23 years old)

Q. Relationship with household head or information for: son/daughter or grand-son/daughter or step-son/daughter

Q. The institution where you are currently enrolled is: 1. Public 2. Not Public

edu_R2 Construction based on the following questions

Q. What is the highest educational level reached and approved? 1. None 2. Pre-school 3. Elementary (1-5) 4. Secondary (6-9) 5. High School (10-13) 6. Technical-No title 7. Technical-Title 8. Technology-No title 9. Technology-Title 10. Undergraduate-No title 11. Undergraduate-Title 12. Graduate-No title 13. Graduate-Title

Health

hea_R1 Q. Which one of the following is your health insurance coverage plan: 1. Private insurance plan 2. Military and special governmental regimens 3. Public-Governmental insurance plan 4. Don't know, don't answer

hea_R2 Q. In overall, the health status is: 1. Very Good 2. Good 3. Fair 4. Bad. **Note**: I recoded the variable, thus the categories applied were: 4. Very Good 3. Good 2. Fair 1. Bad.

Assets

as_R1 Construction based on the following questions

Q. Do you own a car for personal use? 1. Yes 2. No

Q. Do you own a motorcycle for personal use? 1. Yes 2. No

as_R2 Construction based on the following questions

Q. Does the household own a desktop PC? 1. Yes 2. No

Q. Does the household own internet service? 1. Yes 2. No

Q. Does the household own laundry machine? 1. Yes 2. No

Housing

hou_R1 Construction based on the following questions

Q. Total members of the household

Q. In how many of the house rooms do the household members sleep?

hou_R2 Q. Financial condition of the household is: 1. Ownership, fully paid 2. Ownership, paying mortgage 3. Paying rent 4. Living no paying with owner authorization 5. Ownership with not property title

For Polarization

Education

edu_P1 Construction based on the following questions

Q. What is the highest educational level reached and approved? 1. None 2. Pre-school 3. Elementary (1-5) 4. Secondary (6-9) 5. High School (10-13) 6. Technical-No title 7. Technical-Title 8. Technology-No title 9. Technology-Title 10. Undergraduate-No title 11. Undergraduate-Title 12. Graduate-No title 13. Graduate-Title

Health

hea_P1 Q. In overall, the health status is: 1. Very Good 2. Good 3. Fair 4. Bad.

Note: I recoded the variable, thus the categories applied were: 4. Very Good 3. Good 2. Fair 1. Bad.

Assets

as_P1 Construction based on the following questions

Q. Does the household owns any of the following items?

TV 1. Yes 2. No

Refrigerator 1. Yes 2. No

Stove 1. Yes 2. No

Oven 1. Yes 2. No

Microwave 1. Yes 2. No

Clothe washer 1. Yes 2. No

Water heater 1. Yes 2. No

Stereo 1. Yes 2. No

Air conditioner 1. Yes 2. No

Fan 1. Yes 2. No

Car 1. Yes 2. No

PC 1. Yes 2. No

Housing

hou_R1 Construction based on the following questions

Q. Total members of the household

Q. In how many of the house rooms do the household members sleep?

Appendix 7 Datasets Technical information on the Colombian Living Standards Measurement Surveys (LSMS)

The following section is based on the technical reports from the NSD (DANE-DIMPE, 2003, 2008, 2010, 2011, 2013, 2014, 2015). The Colombian National Statistics Department (NSD) is the governmental bureau responsible for the planning, collection, processing, analysis, and dissemination of Colombia's official statistics. As part of the executive branch of Colombian government and with over 50 years of experience, NSD complies with the highest quality standards in statistics collection and processing. NSD has participated in more than 30 research projects in the fields of economics, industry, population, agriculture, and quality of life, among others, within the country and overseas.

The NSD designs and develops the tools required for coordination and regulation of the National Statistical System, to ensure compliance with good statistical practice and generation of quality statistics for policy implementation in the country. In this regard, the NSD implemented the National Data Archive (NDA) which is a catalog that users can browse, search, compare, and request access to download information related to censuses, sample surveys and statistics from administrative records. The NDA contains metadata operations that produces statistics for and from different governmental entities. Also, some of the available microdata files are publicly accessible which is the case of LSMS.

The information published in the NDA is documented under the international standards DDI (1) and Dublin Core (2); this strengthens the transparency, comparability, quality, reliability and credibility of the statistics produced by the National Statistical System.

(1) The Data Documentation Initiative (DDI for short) is an international standard for describing data from social, behavioral and economic sciences. Expressed in XML file, the DDI metadata specification supports the entire life cycle of research data, including its conceptualization, collection, processing, dissemination, analysis and storage. It is used to document the methodology of the statistical operation and databases.

(2) Dublin Core is a standard used to describe and identify information resources. It allows users to search and information retrieval. It is used to document related materials such as manuals, guides, instructions and other documents or reports generated during the development of the statistical operation.

Report on the Colombian Living Standards Measurement Surveys (LSMS)

Study Type: Living Standards Measurement Study

Kind of Data: Sampling Survey

Units of Analysis: households, and people.

Sampling Unit: the sampling unit is a measure of size or segment. The segment corresponds to an area of approximately ten (10) households.

Geographic Coverage: LSMS were established nine (9) domains or regions: Bogotá, Antioquia, Valle, Atlantic Region, Eastern Region, Central Region, Pacific Region, San Andrés Island and Orinoco-Amazon.

Study Universe: the study universe for the survey is the civilian non-governmental population living inside the country.

Target Population: the target population the civilian non-governmental population living inside the country, excluding the rural part of the new departments.

Sampling Procedure

Sampling Framework: the sampling framework is constituted by cartography, and household to the block level. This is for main cities, middle level cities and population centers. The remaining is aggregated to cartography level map. All these units are based on the information of the General Census of Population and Housing 2005.

Sample Design: probabilistic sampling, stratified, multistage, and clustered.

Content

The LSMS includes the following modules:

1. Household features and current conditions
2. Household composition and demography
3. Health
6. Childcare below five years old
7. Education
8. Information and communication technologies
9. Labor market
10. Other sources of income

Database configuration

The LSMS is composed by two databases: people database and household database. The is a key variable to merge the two datasets. Both the household database and the people database include the expansion factors.

Appendix 8 Example of the AF Methodology Applied to Poverty Analysis

Example taken from Alkire et al. (2015) p. 153. Hypothetical Society with four people and multidimensional poverty is analyzed using four dimensions: standard of living as measured by income, level of knowledge as measured by years of education, nutritional status, and access to public services as measured by access to improved sanitation. The achievements matrix X 4x4 or four people by four dimensions is,

	Income (units)	**Years of Schooling Completed**	**Malnourished**	**Has Access to Improved Sanitation**	
X =	700	14	No	Yes	Person 1
	300	13	No	No	Person 2
	400	3	Yes	No	Person 3
	800	1	No	Yes	Person 4

All dimensions are equally weighted, thus w = (0.25, 0.25, 0.25, 0.25)

The deprivation cut-offs vector z = (500, 5, Not malnourished, Has access to improved sanitation).

Person 1 is not deprived in any of the dimensions, while Person 3 is deprived in all dimensions.

Based on the vector z it is calculated deprivation matrix g^0. Where deprivation is 1 and non-deprivation is Zero.

$$g^0 = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 \end{bmatrix}$$

In matrix notation, $g^0 w = c$, c is the deprivation score vector.

$$c = \begin{bmatrix} 0 \\ 0.5 \\ 1 \\ 0.25 \end{bmatrix}$$

If $k >= 0.5$ then, based on vector c, Person 2 and Person 3 are multidimensional poor. Thus,

The multidimensional headcount ratio is $H = q / n = 2 / 4 = 0.5$

The intensity of multidimensional poverty $A = \sum_{i=1}^{q} c_i(k) \Big/ q = (0.5 + 1) / 2 = 0.75$

The adjusted headcount ratio (M_0) $M_0 = H \times A = 0.5 \times 0.75 = 0.375$

Interpretations: 50% of the population is poor (incidence of poverty or the multidimensional headcount ratio (H)). On average, poor people are deprived in 75% of the weighted indicators (intensity of poverty(A)). The index of multidimensional poverty is 0.375 (M_0)

Appendix 9 Indices of Multidimensional Polarization for Income Groups and Socio-Occupational Groups when beta equal to minus one

	Income Groups						
	2003	**2008**	**2010**	**2011**	**2013**	**2014**	**2015**
Relative Group Size (*S*)	0.043	0.049	0.040	0.041	0.037	0.036	0.034
Between Groups Inequality (*B*)	0.021	0.0143	0.0359	0.0198	0.0203	0.0193	0.0209
Within Groups Inequality (*W*)	0.587	0.1133	0.2679	0.1059	0.0952	0.0942	0.1288
GEM Index: B + W, for $\gamma = 1$, $\beta = -1$	0.609	0.1276	0.3038	0.1257	0.1155	0.1134	0.1498
$P_1 = \varphi\left[\frac{B(X)}{W(X)+c}\right]S(X)$ ¥	0.022	0.0273	0.0226	0.0244	0.0226	0.0215	0.0201
$P_2 = \psi[B(X) - W(X)]S(X)$	0.015	0.0244	0.0187	0.0213	0.0197	0.0187	0.0176
$P_3 = \tau\left[\frac{B(X)}{B(X)+W(X)+C}\right]S(X)$ ¥	0.022	0.0271	0.0224	0.0241	0.0222	0.0211	0.0199

	Socio-Occupational Groups						
	2003	**2008**	**2010**	**2011**	**2013**	**2014**	**2015**
Relative Group Size (*S*)	0.023	0.021	0.020	0.022	0.021	0.021	0.021
Between Groups Inequality (*B*)	0.938	0.3135	0.6539	0.3043	0.3282	0.3426	0.3471
Within Groups Inequality (*W*)	1.068	0.1604	0.5659	0.1493	0.1360	0.1373	0.1776
GEM Index: B + W, for $\gamma = 1$, $\beta = -1$	1.0778	0.4738	1.2198	0.4535	0.4642	0.4799	0.5247
$P_1 = \varphi\left[\frac{B(X)}{W(X)+c}\right]S(X)$ ¥	0.018	0.0239	0.0199	0.0250	0.0249	0.0257	0.0237
$P_2 = \psi[B(X) - W(X)]S(X)$	0.011	0.0147	0.0137	0.0152	0.0149	0.0153	0.0146
$P_3 = \tau\left[\frac{B(X)}{B(X)+W(X)+C}\right]S(X)$ ¥	0.015	0.0180	0.0165	0.0187	0.0182	0.0187	0.0178

Source: Author's calculations. LSMS 2003, 2008, 2010, 2011, 2014 and 2015. ¥ Value of *c* is zero.

Appendix 10 Indices of Multidimensional Polarization for Income Groups and Socio-Occupational Groups when beta equal ten, and gamma equal zero and minus one.

Gamma zero	**Income Groups**						
	2003	**2008**	**2010**	**2011**	**2013**	**2014**	**2015**
Relative Group Size (*S*)	0.043	0.049	0.040	0.041	0.037	0.036	0.034
Between Groups Inequality (*B*)	0.0265	0.0142	0.0174	0.0196	0.0189	0.0072	0.0087
Within Groups Inequality (*W*)	0.1879	0.2078	0.2130	0.2289	0.1975	0.1434	0.1643
GEM Index: B + W, for $\gamma = 0$, $\beta = 10$	0.2145	0.2220	0.2304	0.2485	0.2163	0.1507	0.1730
$P_1 = \varphi\left[\frac{B(X)}{W(X)+c}\right]S(X)$ ¥	0.0222	0.0265	0.0220	0.0233	0.0214	0.0200	0.0191
$P_2 = \psi[B(X) - W(X)]S(X)$	0.0191	0.0232	0.0191	0.0200	0.0186	0.0181	0.0172
$P_3 = \tau\left[\frac{B(X)}{B(X)+W(X)+C}\right]S(X)$ ¥	0.0220	0.0265	0.0219	0.0232	0.0213	0.0199	0.0191

	Socio-Occupational Groups						
	2003	**2008**	**2010**	**2011**	**2013**	**2014**	**2015**
Relative Group Size (*S*)	0.023	0.021	0.020	0.022	0.021	0.021	0.021
Between Groups Inequality (*B*)	0.0203	0.0105	0.0118	0.0141	0.0175	0.0043	0.0070
Within Groups Inequality (*W*)	0.1968	0.2147	0.2179	0.2369	0.2024	0.1487	0.1690
GEM Index: B + W, for $\gamma = 0$, $\beta = 10$	0.2171	0.2252	0.2297	0.2510	0.2199	0.1530	0.1759
$P_1 = \varphi\left[\frac{B(X)}{W(X)+c}\right]S(X)$ ¥	0.0100	0.0140	0.0134	0.0145	0.0142	0.0141	0.0138
$P_2 = \psi[B(X) - W(X)]S(X)$	0.0087	0.0123	0.0117	0.0126	0.0123	0.0129	0.0124
$P_3 = \tau\left[\frac{B(X)}{B(X)+W(X)+C}\right]S(X)$ ¥	0.0100	0.0140	0.0134	0.0145	0.0141	0.0141	0.0138

Gamma minus one	**Income Groups**						
	2003	**2008**	**2010**	**2011**	**2013**	**2014**	**2015**
Relative Group Size (*S*)	0.043	0.049	0.040	0.041	0.037	0.036	0.034
Between Groups Inequality (*B*)	0.0267	0.0138	0.0167	0.0189	0.0188	0.0071	0.0086
Within Groups Inequality (*W*)	0.2266	0.2399	0.2477	0.2660	0.2374	0.1768	0.2027
GEM Index: B + W, for $\gamma = -1$, $\beta = 10$	0.2533	0.2537	0.2644	0.2848	0.2562	0.1838	0.2113
$P_1 = \varphi\left[\frac{B(X)}{W(X)+c}\right]S(X)$ ¥	0.0220	0.0264	0.0219	0.0231	0.0212	0.0199	0.0190
$P_2 = \psi[B(X) - W(X)]S(X)$	0.0187	0.0228	0.0187	0.0196	0.0182	0.0178	0.0168
$P_3 = \tau\left[\frac{B(X)}{B(X)+W(X)+C}\right]S(X)$ ¥	0.0218	0.0264	0.0218	0.0230	0.0212	0.0198	0.0190

(continued)

Appendix 10 (continued) Indices of Multidimensional Polarization for Income Groups and Socio-Occupational Groups when beta equal ten, and gamma equal zero and minus one.

	Socio-Occupational Groups						
	2003	**2008**	**2010**	**2011**	**2013**	**2014**	**2015**
Relative Group Size (*S*)	0.023	0.021	0.020	0.022	0.021	0.021	0.021
Between Groups Inequality (*B*)	0.0198	0.0101	0.0116	0.0136	0.0176	0.0041	0.0066
Within Groups Inequality (*W*)	0.2376	0.2471	0.2521	0.2733	0.2438	0.1831	0.2079
GEM Index: B + W, for γ = -1, β = 10	0.2574	0.2572	0.2637	0.2868	0.2614	0.1872	0.2145
$P_1 = \varphi\left[\frac{B(X)}{W(X)+c}\right]S(X)$ ¥	0.0099	0.0139	0.0134	0.0145	0.0141	0.0141	0.0137
$P_2 = \psi[B(X) - W(X)]S(X)$	0.0085	0.0120	0.0115	0.0123	0.0121	0.0127	0.0122
$P_3 = \tau\left[\frac{B(X)}{B(X)+W(X)+C}\right]S(X)$ ¥	0.0099	0.0139	0.0134	0.0145	0.0140	0.0141	0.0137

Source: Author's calculations. LSMS 2003, 2008, 2010, 2011, 2014 and 2015. ¥ Value of *c* is zero.