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Understanding the Relationship among Durable Goods, Academic Achievement, and School Attendance in Colombia

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UNDERSTANDING THE RELATIONSHIP AMONG DURABLE GOODS, ACADEMIC ACHIEVEMENT, AND SCHOOL ATTENDANCE IN COLOMBIA

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ABSTRACT

A joint report from the United Nations Development Program and the Oxford Poverty and Human Development Initiative indicates that while the number of people living with less than $1.90 a day declined globally, dropping from 2 billion in 1990 to 736 million in 2015, the number of people who experienced non-income poverty reached 1.3 billion in 2020. Non-income poverty, referred to as multidimensional poverty, assesses the extent to which people are deprived from accessing basic services such as health or education, despite having income levels well above $1.90.

Research on development economics points to *assets* as the missing piece in the poverty puzzle because they can build capacity. In general, assets can be used to generate income or to enhance quality of life. Income-generating assets such as credit or home ownership help people prepare for economic shocks and acquire other assets. Quality-of-life-enhancing assets help people improve their living standards and develop agency. Examples of quality-of-life-enhancing assets include education, social capital, and durable goods such as computers or washing machines.

Most research on assets examines the relationship either between financial assets and poverty or between financial assets and education. An exploration of durable goods and education was the focus of this dissertation. Although not a nascent field, most studies in this area have analyzed how durable goods relate to academic achievement mainly in African and Asian countries. From a methodological standpoint, these studies have modeled durable goods utilizing a binary approach, where ownership of durable goods is measured as possession of *any* durable good, or as an index, using principal component analysis (PCA), which research suggests is not the most robust method for index creation. Such methodological decisions have provided only a partial understanding of the relationship between durable goods and education.

Hence, this study explored the relationship among durable goods, academic achievement, and school attendance in Colombia through three methodological approaches to operationalize durable goods: inventory, attributional, and index approaches. Data come from the 2017 SABER test, a nation-wide examination that assesses reading and math skills, for fifth and ninth grade students, ($N = 621{,}218$). Students with complete durable goods information ($N = 364{,}436$) were included. This research added to the existing literature on this field by using different methodological approaches to model durable goods, including the construction of a durable goods index employing exploratory factor analysis (EFA), and by expanding the geographic scope to Latin America. By using multilevel modeling, this study found that, overall, durable goods were positively associated with reading and math outcomes, particularly for fifth graders. Similarly, results indicated that students whose families owned washing machines, computers, or who had Internet access were more likely to go to school.

Keywords: Wealth, poverty, assets, education, durable goods, factor analysis, multilevel modeling

DEDICATION

I dedicate this dissertation to God, my family, my friends from Colombia and from abroad, and to my neighborhood. I would not be the person I am today, had it not been for the tenacity, audacity, and compassion that I cultivated while growing up in poverty. To my grandmothers, *Rosita and Eliodora*, thank you for taking care of my brother and me while my parents had to work. I wish you both were here!

I would also like to thank Willow Moon Hecht for bringing music to my life. Thank you for your unconditional love. I love you! Also, special thanks to Anya Hunter for taking the role of a nurturing mother during these four years. Your words of wisdom and your compassionate love were food for my soul!

I also dedicate this work to the many mentors, teachers, and professors who believed in my potential and mentored me throughout this journey, in particular Bruce Anderson and Mike Schoenfeld. Similarly, I would also like to extend my gratitude to Fulbright Colombia for giving me the opportunity to pursue this dream.

I would also like to dedicate this dissertation to Jacqueline Pery D'Alincourt (December 20, 1919 – April 21, 2009) with whom I lived in Paris in 2008. Her story as a heroine of the *French Resistance* has guided my philosophy of action.

Lastly, I would like to dedicate this work to James Stepney (February 7, 1987 – March 18, 2020), a great friend who taught me that living is a matter of choices, and that, therefore, we should always choose the ones that spark our passion. Thanks brother! This route has certainly been bumpy, but I have found that spark!

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This expedition did not start in 2018, when I enrolled in the Ph.D. program. This began in 2003, when I was in high school. Trained as an electrician, my career path was to work in construction. The idea of working in such field did not bother me. Indeed, I was elated I was going to be the first person in my family to complete high school.

However, in 2003, a group of college students came to our school to talk about a scholarship program called *United World Colleges*. As I listened, I could not help but think that they did not know their audience. We were low-income students attending a school operated by an NGO. Let alone, they mentioned that there were only three full scholarships and that the program was in English, a language none of us spoke.

Encouraged by *Lucho*, my chemistry teacher, I applied. After an arduous selection process, I was awarded a full scholarship to study in Norway. I spent two years in the beautiful fjords of *Flekkle* surrounded by great friends, teachers, and mentors. Many people helped me throughout this process, but six stand out: Daniel Toa-Kwampong and his beloved wife Helen Barbara, Mariano Giampietri, Angie Toppan, Asim Shrivastava, and Bruce Anderson, who passed away in 2008. I would not have made it had it not been for their stubborn belief in my potential.

A few months before graduation, admission officers from different colleges and universities from the United States would visit our school to talk about scholarships. Our student counselor, Bruce Anderson, told me that someone from Middlebury College was going to give a talk and that I should go. Next day, I met Mike Schoenfeld, admissions director at Middlebury College. The following morning, I saw Bruce and I told him about

my meeting with Mike. Bruce encouraged me to apply to Middlebury and told me to leave things in God's hands, so I did. Thus, in 2005, I graduated from Norway and was awarded a Davis United World College Scholarship to attend Middlebury College. Mike became my mentor and my big brother. Thank you for giving me the "lucky ticket!"

After Middlebury, I returned to Colombia on a scholarship to pursue a master's degree in government and public policy at *La Universidad de Los Andes*. I am grateful for the guidance and support that I received from Dr. Sandra García, my thesis advisor, Dr. Amy Ritterbusch, and Dr. Maite Careaga Tagüeña (1970-2020). Your teachings on quantitative research methods, participatory-action research, leadership, and ethics are the foundations of my work.

After four years in the Ph.D. program, I can frankly say that my hopes and expectations were surpassed. The faculty from the College of Education and Social Services as well as from other departments contributed significantly to my learning experience. In the writing of this dissertation, I am forever indebted to my dissertation committee for all the valuable comments and recommendations. My advisor, Dr. Bernice Garnett, played a pivotal role in the unfolding of this work.

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To my family, thank you for your prayers, love, and for being my source of inspiration. This dissertation is a tribute to your hardships. It is my way to portray, through research, that grit is the secret ingredient to success.

TABLE OF CONTENTS

ABBREVIATIONS

CA	Conditional Approach
CDAs	Children Development Accounts
CFA	Confirmatory Factor Analysis
C-MPI	Colombian Multidimensional Poverty Index
DNP	Departamento Nacional de Planeación (Department of National Planning)
EFA	Exploratory Factor Analysis
FA	Factor Analysis
GDP	Gross Domestic Product
Global-MPI	Global Multidimensional Poverty Index
ICC	Intraclass Correlation Coefficient
MPI-LA	Multidimensional Poverty Index – Latin America
OECD	Organization of Economic Development and Cooperation
OLS	Ordinary Least Square
OPHI	Oxford Poverty and Human Development Initiative
PC	Personal Computer
PCA	Principal Component Analysis
RCT	Randomized Control Trial
SDG	Sustainable Development Goals
UC	Unconditional Approach
UN	United Nations
UNDP	United Nations Development Program
UNICEF	United Nations Children's Fund

DEFINITIONS OF KEY TERMS

Assets: Stock of resources or capital that are used to improve one's well-being and living conditions. This definition diverts from the one used in financial accounting, which treats assets as the resources owned by a company in terms of their monetary value. In this dissertation, the concept of assets is based on their contribution to economic welfare (tangible or intangible). As such, assets can be divided in two categories: income-generating assets and quality-of-life-enhancing assets.

Income-generating assets: Assets that contribute to increase financial wealth. These include physical and natural capital such as farmland, minerals, or properties; and financial capital such as savings, bonds, or credit (Sherraden, 1991).

Quality-of-life-enhancing assets: Assets that improve social and economic welfare. This includes education, social capital, cultural capital, political capital, and durable goods (Kumaraswamy et al., 2020).

Durable goods: Assets that produce utility over time and that improve the efficiency of certain tasks (e.g., TVs, washing machines, computers, cars, bicycles, microwaves).

Wealth: Refers to the accumulation of different types of assets. Human and financial assets are considered the building blocks for generating wealth because they can enhance access to other assets.

Poverty: Denotes lack of assets. Deprivation of any type of assets reduces the opportunities to achieve well-being and improve living conditions. Poverty can be experienced in absolute or relative terms. This definition combines monetary poverty and multidimensional poverty (United Nations Development Program & Oxford Poverty and Human Development Initiative, 2020).

Absolute poverty: Refers to total deprivation of assets and resources (Sen, 1983, 1984).

Relative poverty: Refers to not being able to achieve specific outcomes despite having assets or resources (e.g., being undernourished despite having access to food) (Sen, 1983, 1984).

Well-being: Refers to a state of satisfaction with life. It "requires meeting various human needs, some of which are essential, as well as the ability to pursue one's goals, to thrive and feel satisfied with their life" (OECD, 2011 p. 18).

Quality of life: Denotes a person's ability to achieve social, emotional, psychological, economic, cultural, and political well-being as well as agency by accessing basic goods and services. Reflects the material aspect of freedom (Sen, 1984).

Agency: Refers to the right to pursue one's individuality without harming others (Mill, 1859/2002) and to the ability to use that individuality to strengthen civic engagement (Arendt, 2018).

CHAPTER ONE: INTRODUCTION

Imagine for a moment that you are Laura, a 14-year-old girl who lives with her family in a marginalized city in Colombia. Like Laura, you are currently in ninth grade and attend a public school, which operates from 6:30 a.m. to 12:30 p.m. Before the COVID-19 pandemic, you would start your day by waking up at 5:20 a.m. to get ready to go to school. You love biology, Spanish, and gym class. You enjoy writing poems and drawing portraits of your cat and dog as well as spending time with your friends. By 1:00 p.m. you would return home. Once at home, you would have to heat lunch by using the gas stove. After lunch, you would have to help with some household chores such as sweeping the floor and washing dishes. Sometimes, you would also have to help washing your school uniform in case your parents came home late.

After cleaning the house, you would start doing homework. Depending on the complexity, some schoolwork would take a long time to complete, particularly if it involved research projects because you did not have Internet access at home. When research was the task at hand, you would go to an “Internet café” and pay 40 cents to use a computer for thirty minutes, a costly activity given your parents did not make much money. On a good day, you would finish homework by 7:00 p.m. On a hectic one, which would usually involve washing clothes and completing a research project, you would be done by 10:00 p.m. In cases where you could not finish homework or when your school uniform did not dry well, you would be absent from school.

The pandemic exacerbated this situation. With no computer or money to print school assignments and a mounting pile of household tasks, you gradually began to fall behind with your schoolwork. And while schools across the country were beginning to reopen, it was uncertain whether you would return. Laura's story personifies the lives of thousands of children in Colombia for whom lack of access to durable goods may hinder their capability to be educated.

1.1. Going Beyond Income: Redefining Wealth

Wealth has been conceived as an important component of development because it provides people with the means to improve their quality of life and avoid poverty. This has given rise to the belief that wealth is attained by earning more income. However, economic theory defines wealth as the value of capital and assets[1] and income as the amount of money made in a specific period of time which results from paid labor (Keeley, 2015; Smith, 1776/1976). Unless income is used to acquire capital or assets (e.g., properties, investment, or saving), it does not contribute to wealth accumulation. On the contrary, capital and assets can be used to generate income (e.g., renting a house or starting a business) and to buy additional assets. Such distinction suggests that wealth could be a more accurate estimate of social and economic well-being because it represents what families possess (Brandolini et al., 2010; Carter & Barrett, 2006; Narayan & Kapoor, 2008). Nonetheless, income remains the most widely used indicator

[1] In the field of development economics, the terms assets, capital, and resources are used interchangeably. Thus, in this dissertation, these terms are treated as synonyms.

to measure wealth in censuses and household surveys. Perhaps it is time to re-assess how we understand wealth and its role in enhancing social and economic development.

In its simplest form, wealth can be expressed as accumulation of different types of assets, not just income (Smith, 1776/1976). Wealth, therefore, comprises all the financial, human, natural, physical, social, political, and cultural capital, that people or communities can access or acquire throughout their lives, and which together define their experience of well-being (Brandolini et al., 2010; Carter & Barrett, 2006; Farley et al., 2002; Moser, 1998, 2006, 2008; Narayan & Kapoor, 2008; Rames, 2004; Siegel, 2005).

From a macroeconomic perspective, wealth contributes to economic growth (Smith, 1776/1976) and fosters sustainable development (Hoekstra, 2019; Ratner, 2019; Scott, 2012). Regarding economic growth, wealth accumulation is possible because of the division of labor, which entails the existence of a market where producers and consumers exchange goods and services according to their needs (Smith, 1776/1976). In relation to improving sustainable development, wealth can be used for future consumption, which means that it can be invested in the well-being of future generations (Scott, 2012). This conceptualization explains why countries use different tools to measure their internal wealth (Hoekstra, 2019). Although Gross Domestic Product (GDP), a measure of total production, is the most widely used indicator, organizations such as the United Nations and the World Bank have advocated for the implementation of alternative measures of wealth that include other types of assets. Examples of such measures are the Global Assessment of Environmental-Economic Accounting, the Inclusive Wealth Index, the

Sustainable Well-being Index, the Human Capital Index, and the Better Life Index (Hoekstra, 2019).

At the microeconomic level, wealth provides people the means to subsistence (Smith, 1776/1976) and gives them opportunities to achieve agency by allowing them to engage in non-productive activities (e.g., leisure, social cohesion, or political activity) (Arendt, 2018; Maslow, 1943; Sen, 1983, 1984; Thaler & Sunstein, 2009). This is based on the notion that wealth creates capabilities that can help people achieve goals (Cohen, 1993; Sen, 1983, 1984). As such, wealth creates three types of capabilities: 1) the capability to attain a minimum living standard (Cohen, 1993; Sen, 1983, 1984); 2) the capability to exercise *will* in the form of civic engagement and political action (Arendt, 2018; Marx, 1845/1998); and 3) the capability to exercise the right to pursue ones' eccentricity without harming others (Mill, 1859/2002). It stems from this that agency can be achieved only when people can meet their basic needs (e.g., food, housing, and clothing in adequate quality and quantity) (Marx, 1845/1998; Meyers, 2014). Therefore, a minimum level of wealth is necessary to achieve agency and to engage in activities besides production. Lack of wealth, on the contrary, can result in unmet basic needs and a lack of personal agency among people, which may force them to live in a state of economic, social, and political deprivation or *poverty*.

Research on development economics and social policy suggests the implementation of a social welfare system to create capacity-building opportunities for low-income families to improve their social and economic well-being (Lerman & McKernan, 2008; Nam et al., 2008; Shapiro & Wolff, 2001; Sherraden, 1991). However, the social welfare system that has predominated in most developed and emerging economies (e.g., United States, Europe, and some countries in Latin America) is based on the Keynesian economic model that insisted that increasing consumption would eradicate poverty (Shapiro & Wolff, 2001; Sherraden, 1991). As such, most social policies and welfare programs that were implemented since 1970 in countries such as the United States, Chile, or Colombia, to mention a few, have been aimed at increasing household income via government transfers, subsidies, or tax cuts (Attanasio & Székely, 2001; Shapiro & Wolff, 2001; Sherraden, 1991). The expected result of these policies and programs was that by giving low-income families "additional income" in the form of subsidies or tax cuts, they would increase consumption of basic goods and services, hence achieving better standards of living and reducing poverty (Shapiro & Wolff, 2001; Sherraden, 1991).

Sherraden (1991), Moser (1998, 2006, 2008), Shapiro and Wolff (2001), and Attanasio and Székely (2001) advocated for the implementation of an asset-based approach to social welfare because assets constitute a more accurate estimate of wealth than income. While income refers to the flow of resources, assets represent a "stock" of resources that can be used or developed, as well as transferred across generations (Shapiro & Wolff, 2001; Sherraden, 1991; Moser, 1998, 2006, 2008). Moreover, assets are less time-variant than income, which means that they are not dependent on a cross-sectioned financial position (e.g., job); they represent more accurately how people live based on what they possess, and they can cushion income shocks that happen with major illnesses or job losses (Nam et al., 2008; Sherraden, 1991). Additionally, assets have effects beyond consumption which can create capacity-building opportunities for low-income families to overcome poverty. For example, assets can improve household stability, improve the efficiency of household tasks, or increase personal efficacy (Sherraden, 1991).

In general, assets can be categorized by nature and purpose. In terms of nature, assets can be tangible and intangible, which means that they can have physical substance (e.g., house) or lack physical substance (e.g., access to credit) (Belsky & Calder, 2005; Shapiro & Wolff, 2001; Sherraden, 1991). Regarding purpose, assets can be productive and non-productive depending on whether they generate income (Attanasio & Székely, 2001; Sherraden, 1991). Although useful, this distinction fails to consider a key trait of assets: their potential to improve quality of life. Thus, in this study, assets were classified in two macro-categories: income-generating and quality-of-life-enhancing assets (Kumaraswamy et al., 2020). Income-generating assets refer to all the physical and financial resources that allow individuals to generate income and accumulate wealth. It encompasses tangible, intangible, and productive assets. Quality-of-life-enhancing assets refer to the physical, human, and social capital that individuals can use to improve their quality of life. It entails tangible, intangible, and non-productive assets. Examples of such assets include durable goods (e.g., washing machines, microwaves, refrigerators, or cars), housing quality (e.g., number of rooms in the house), education, social, cultural, and political capital (Kumaraswamy et al., 2020; Shapiro & Wolff, 2001; Sherraden, 1991).

Research on assets has primarily focused on understanding the relationship between income-generating assets and poverty. The rationale for this is that ownership of these types of assets gives people more choices and creates opportunities to exercise agency (Belsky & Retsinas, 2005). For example, studies about the relationship among home ownership, access to credit, and poverty indicate that families who own homes or who have access to credit are less likely to fall into poverty than families who rent houses or who do not have access to credit (Attanasio & Székely, 2001; Belsky & Calder, 2005; Belsky & Retsinas, 2005; Leibovich & Núñez, 2001; Trejos & Montiel, 2001). This may explain why one of the goals of the 2030 Sustainable Development Agenda is to ensure that low-income families have not only access to basic services, but also that they can acquire income-generating assets such as property and credit (Hidrobo et al., 2018; United Nations, 2021).

In relation to quality-of-life-enhancing assets, most research has been devoted to examining the extent to which education and social capital contribute to reduce poverty. Findings from Latin America (Attanasio & Székely, 2001; Contreras & Larrañaga, 2001; ECLAC, 2019; García et al., 2013) and from around the world (Poverty and Shared Prosperity, 2018, 2020; United Nations, 2021; World Bank, 2020a; World Development Report, 2018) indicate that education plays a key role in reducing poverty because it builds capacities to achieve wealth and attain agency. In relation to wealth, education improves skills and productivity, which can increase people's income-earning potential. Income, in turn, can be used to fulfill basic needs and to access other assets (Sherraden, 1991; Smith, 1776/1976). In relation to agency, education strengthens the development of critical thinking skills and social awareness, thereby preparing people to engage in social and political activity (Arendt, 2018). As to social capital, most research has focused on analyzing how group membership relates to poverty. Findings suggest that families who are members of groups (e.g., community-based organizations) are less likely to fall into poverty (Collier, 2002; Contreras & Larrañaga, 2001). This is explained, partly, because social capital creates informal institutional arrangements that can enhance opportunities for people to access jobs.

Recent empirical and conceptual studies have explored the relationship among durable goods, education, and poverty. The rationale for this is that durable goods offer a concrete representation of household wealth and living conditions. Additionally, durable goods constitute tangible and productive assets that can be used to increase the efficiency of domestic activities or to generate income. Examples of durable goods that increase the efficiency of household tasks are washing machines or refrigerators. Such assets increase efficiency by reducing the time spent and the effort needed to complete the tasks. This efficiency effect, in turn, gives people additional time to engage in other activities. Durable goods that may generate income are cars or motorbikes because in many developing countries people use them as a tool for employment (e.g., short distance transportation). Regarding the relationship between durable goods and poverty, in 2010, the United Nations and the Oxford Poverty and Human Development Initiative (OPHI) developed a tool to measure non-income poverty that includes ownership of durable goods. This tool, the Global Multidimensional Poverty Index (Global-MPI), assesses how families experience poverty in other dimensions of development (Alkire & Santos, 2010; United Nations Development Program & Oxford Poverty and Human Development Initiative, 2019). For example, the index measures household living standards by examining whether families have access to basic services and durable goods such as radios, TVs, computers, telephones, bicycles, motorbikes, car, trucks, animal carts, and refrigerators (Vollmer & Alkire, 2018). According to the Global-MPI, lack of durable goods is a risk factor for falling into multidimensional poverty.

Research suggests a positive association between durable goods and educational outcomes. Studies conducted in Africa and China, for example, show that ownership of durable goods is positively associated with academic achievement and school attendance (Chowa et al., 2013; Elliott et al., 2011; Fang et al., 2020; Kafle et al., 2018), and reducing child labor in rural settings (Filmer & Pritchett, 1999; Gray-Molina et al., 2001; Levison et al., 2017). Overall, findings reveal that children whose families own durable goods are more likely to go to school, perform better in reading and math, and are less likely to engage in child labor than children who do not have any durables goods. Additionally, research on families in developing countries suggests that possession of durable goods, and assets in general, offer women more opportunities to engage in non-household activities such as employment, job training, or school, which in turn may enable them to have more power in intrahousehold decision-making (Amendola & Vecchi, 2014; Deere & Doss, 2006; Figal et al., 2019; Mujahid-Mukhtar et al., 1991; Polato e Fava & Arends-Kuenning, 2013; Tewari & Wang, 2021). Durable goods, thus, can have an important role in improving educational and social outcomes.

As highlighted in this section, defining wealth in terms of assets offers an opportunity to identify different paths to solve the poverty puzzle. For example, it may be that in some contexts financial assets are more important for reducing poverty than social capital, or that access to durable goods is more salient for improving educational outcomes than access to credit or savings. The main issue is that access to assets and asset ownership allow families, particularly low-income families, to attain adequate standards of living and to build capacity (Yadama & Dauti, 2010). Assets can build capacity by increasing the range of choices that families have regarding consumption of different goods and services, promoting accumulation of other assets, improving decision making patterns among family members, and strengthening agency and resiliency (Yadama & Dauti, 2010). The goal of such capacity-building opportunities is to empower individuals and families so that they can accumulate wealth. Asset deprivation, on the contrary, can lead to a reduction in the quantity and quality of goods and services that families consume, lower living standards, and a loss of human capital. Therefore, asset deprivation can hinder the ability of individuals to achieve social and economic well-being, which puts them at risk of falling into poverty.

1.2. Problem Statement

Traditional measures of social and economic well-being have focused on assessing the degree to which people experience poverty. One measure is monetary poverty, which considers income as the most important factor in determining whether people achieve minimum levels of well-being (Poverty and Shared Prosperity, 2018; 2020). Research on this area and the work of organizations such as the World Bank and the United Nations established a benchmark of $1.90 a day (adjusted to purchasing power parity) as the cut-off to define who classifies as poor. As such, people whose daily income is less than $1.90 are considered income poor. According to the World Bank, in

2015, there were 736 million people living with less than $1.90 a day globally (Poverty and Shared Prosperity, 2018; 2020). In Latin America, it is estimated that 185 million people live in monetary poverty (ECLAC, 2019).

Another measure of social and economic well-being is the Global Multidimensional Poverty Index (Global-MPI), designed jointly by the United Nations Development Program and the Oxford Poverty and Human Development Initiative (OPHI), that considers factors other than income to estimate how people experience poverty (United Nations Development Program & Oxford Poverty and Human Development Initiative, 2020). Information on the Global-MPI is available yearly and countries are encouraged to use it as a tool to drive their policy agenda. The index is composed of three dimensions: health, education, and living standards. Each dimension is, in turn, comprised of a set of indicators. In relation to health, the index assesses whether people in the household are undernourished and if families have experienced the death of children under 18 within the last five years. In the case of education, it measures years of schooling and whether school-aged children are enrolled in school. Living standards is measured by six indicators: use of cooking fuel such as dung, wood, or charcoal; access to sanitation; access to safe drinking water; access to electricity; access to adequate housing materials; and ownership of *assets*. It is important to stress that the assets indicator is restricted to possession of *durable goods* such as radios, TVs, telephones, computers, animal carts, bicycles, motorbikes, or refrigerators. Using the Alkire and Foster methodology (Oxford Poverty and Human Development Initiative, 2021), which consists of assigning weights to each indicator, a cut-off is set. People are considered "multidimensionally poor" if they fall below that cut-off. In the context of the Global-MPI, people are defined as multidimensionally poor if they are deprived in at least one third or more of the indicators (United Nations Development Program & Oxford Poverty and Human Development Initiative, 2019; 2020).

According to the Global-MPI report for 2020, 1.3 billion people were identified as experiencing multidimensional poverty; half of which were children under the age of 18. Additionally, the report indicated that the share of people who were classified as multidimensionally poor lived in middle-income countries and rural areas, 60% and 84.2% respectively (United Nations Development Program & Oxford Poverty and Human Development Initiative, 2020). The report also highlighted that of the 1.3 billion people who experienced multidimensional poverty, 98.8% were deprived in at least three indicators at the same time. This entailed, for example, that of the 761 million people deprived of access to assets, as measured by possession of durable goods, 98.3% were deprived in at least one additional indicator (United Nations Development Program & Oxford Poverty and Human Development Initiative, 2020). Since its inception, the Global-MPI has been used to identify not only how many people live in poverty, but also the specific elements that contribute to their state of poverty. In that regard, the Global-MPI complements and does not substitute traditional income-based poverty assessments.

Although both measures of poverty are crucial, the Global-MPI is a more comprehensive tool because it conceives poverty as a multifaceted phenomenon. It stems from this that the dimensions and indicators that compose the Global-MPI are interconnected. For instance, one could argue that unless children achieve adequate levels of nourishment, school attendance and school completion will be negatively affected. Similarly, one could make the case that deprivation of basic services such as drinking water can have a negative impact on nutrition. In both cases, deprivation of one indicator can lead to deprivation in one or multiple other indicators, which, in turn, can increase the likelihood that families fall in multidimensional poverty. A great body of research has shown, for example, that the socioeconomic returns of education and adequate health services have a positive impact on reducing poverty, particularly for low-income families (World Development Report, 2018). Similarly, studies on the relationship between living standards and poverty suggest that providing access to basic services such as electricity, drinking water, and sanitation is essential for reducing poverty (Poverty and Shared Prosperity, 2018; 2020; WHO & UNICEF, 2019).

Although some research has attempted to shed light on how the dimensions and indicators of the Global-MPI relate to each other, most has been devoted to health and education (Behrman, 1996; Chowa et al., 2010; Devaux et al., 2011; Groot & van den Brink, 2006; Feinstein et al., 2006; Zajacova & Lawrence, 2018). One potential explanation is that health and education constitute the building blocks of human development (Poverty and Shared Prosperity, 2018; 2020). As such, health is indispensable for human survival and education is a key instrument to enable social and economic development. On the contrary, the living standards dimension seems to be treated with less earnestness. One potential explanation may be that as opposed to education, which is provided by the state in most countries because it is a human right, the types of goods and services that compose the living standards dimension (e.g., electricity, drinking water, or assets) are not considered essential. As such, these goods and services are delivered through distorted market systems that do not reach low-income households. For example, the latest Global Multidimensional Poverty report indicated that, in 2021, 678 million people did not have access to electricity and 550 million people were deprived of at least seven of the eight assets listed under the Global-MPI (United Nations Development Program & Oxford Poverty and Human Development Initiative, 2021a). Unless such deprivations are corrected, health and educational outcomes will be negatively impacted, which suggests that the dimension *living standard* has a key role in enhancing development (Maslow, 1943).

Of interest to this study was to examine the interlinkage between assets, defined under the Global-MPI as possession of durable goods, and educational outcomes among children in Colombia. The rationale for this is that research on this subject is limited and that the Colombian version of the Global-MPI, known as C-MPI, does not include assets as an indicator of multidimensional poverty (García et al., 2013; Salazar et al., 2013). Regarding limited scholarship, it is important to highlight that few studies have been devoted to analyzing the relationship between durable goods and educational outcomes, with the majority focusing in African and Asian countries. For example, Chowa et al. (2013), Fang et al., 2020, and Kafle et al. (2018) show that ownership of household durable goods is positively associated with school attendance and academic achievement. Methodologically, these studies have operationalized durable goods using two approaches: a binary approach and an index approach. In the binary approach, durable goods are measured as possession of *any* durable good regardless of the type. In the index approach, principal component analysis (PCA), a statistical technique to reduce the number of variables in a sample, is used to create an index based on all the different durable goods that a household owns. Although useful, such methodological decisions have only provided a partial depiction of the role played by durable goods in improving educational outcomes. For example, questions remain as to whether different types of durable goods have differential effects on school performance.

In relation to the decision of the Colombian government to exclude assets in the form of durable goods from the C-MPI, two potential explanations emerge. The first explanation may be that asset-deprivation is not a poverty issue in Colombia, which would entail that most people own a wide range of durable goods. However, a government household survey on use of information and communication technologies (ICT) showed that, in 2020, more than 40% of the population did not have Internet access nor had a computer at home (DANE, 2021). The second explanation may be that there is not enough evidence about the relationship among durable goods, education, and poverty. Of the two, the latter explanation seems more plausible.

Hence, the limited research on durable goods and education in Colombia and the methodological limitations associated with operationalizing durable goods constituted important reasons for conducting the present study.

1.3. Significance and Purpose

Most studies on the relationship between education and poverty use income, parental education, or parental occupation as proxies for wealth or socioeconomic status (World Development Report, 2018). However, research on social welfare policy and development economics points to assets as a more comprehensive estimate of wealth because they provide a more specific picture of what people possess (Sherraden, 1991). As highlighted in previous sections, asset ownership is positively associated with poverty reduction. For example, families who own assets or have access to assets are less likely to be poor and are better able to deal with economic shocks (Attanasio & Székely, 2001; Leibovich & Núñez, 2001; Trejos & Montiel, 2001). Furthermore, children whose parents own a house or durable goods do better in school than children whose parents do not have any of those assets (Deere & Dos, 2006; Chowa et al., 2013; Elliott et al., 2011; Filmer & Pritchett, 1999; Kafle et al., 2018). Similarly, studies on the impact of financial assets on education show that youth who participate in financial savings account programs attend school more often and perform better in reading and math than children who do not have access to such programs (Ansong et al., 2018; Fang et al., 2020; Kim et al., 2017; Loke & Sherraden, 2009; Sherraden 1991).

Although not a nascent field of scholarship, research about the relationship between durable goods and educational outcomes is limited. One potential explanation is that studies on durable goods have not been conducted as an independent line of research, but as part of a broad research agenda on assets. This, in turn, has restricted the scope and depth of scholarly work devoted to examining the role of durable goods in education and in social policy. In addition, methodological decisions regarding how to model durable goods have also limited our understanding of how these commodities relate not only to different educational outcomes, but also among each other. As such, most research on durable goods and education have modeled possession of durable goods using a *binary* *approach* or an *index approach*. In the binary approach, durable goods have been operationalized as possession of *any* durable good regardless of its attribute or utility. In the index approach, durable goods have been combined into one indicator using principal component analysis (PCA) as the main statistical technique for index construction. Findings from both approaches indicate that, overall, students whose families own durable goods perform better academically than students who do not have access to durable goods. Although useful, a major limitation of these approaches is the assumption that there are not differential effects associated with the types of durable goods that families possess. For example, these approaches do not consider the individual effect of owning a TV, a radio, a computer, or a washing machine. Thus, statements about the role of durable goods in education, which are based on the information generated by these approaches, are partial. Such conceptual and methodological limitations provided a good opportunity to develop a research study that could unveil the role of durable goods in improving educational outcomes in Colombia.

The purpose of this study was to explore the relationship among durable goods, academic achievement, and school attendance among fifth and ninth grade students in Colombia. In particular, this study aimed to answer the following questions: 1) To what extent are durable goods associated with academic achievement and school attendance in Colombia? 2) In what ways do different methodological approaches to modeling durable goods explain the relationship between durable goods and educational outcomes? and 3) In what ways are durable goods differentially related to students' academic achievement and school attendance by sex and school grade? This study contributed to academic literature from both a conceptual and a methodological standpoint. Conceptually, this is one of the first studies to focus exclusively on durable goods by applying concepts and theories from the fields of consumer and development economics, including the capability approach to poverty reduction. In addition, it is important to stress this study expanded the geographical scope of previous research in this field by including Colombia. As such, it offered useful information about the potential use of durable goods as a component of future asset-based welfare policies in Colombia. Additionally, this study provided evidence about the linkages between indicators of the Global-MPI, particularly assets and education. Although this study used academic achievement and school attendance, different educational outcomes from the ones reported in the Global-MPI, it showed that durable goods played a key role in education. This is an important finding given that current measures of poverty in Colombia, including the Multidimensional Poverty Index for Colombia (C-MPI), do not include durable goods. Hence, this study represents a unique opportunity to close the gap in the literature by exploring the relationship among durable goods, academic achievement, and school attendance for children in Colombia.

Moreover, this research focused on fifth and ninth grade students because they represent two different stages of development and learning. In relation to development, fifth graders were children between the ages of 9 and 12, which corresponds to an intermediate period of child development between childhood and adolescence (Eccles, 1999; UNHCR, 2001). On the contrary, ninth graders encompassed students between the ages of 13 and 15, which corresponds to adolescence (Eccles, 1999; UNHCR, 2001).

Regarding learning, fifth grade represents the culmination of elementary education, which is the building block for developing literacy, numeracy, and social emotional skills. Thus, skills learned in this grade are fundamental for performing well in middle and high school (Entwisle & Hayduk, 1988; Kern & Friedman, 2008; World Development Report, 2018). In Colombia, ninth grade embodies the beginning of high school. Dropout rates are relatively high in ninth grade, with low academic achievement and teenage pregnancy as some of the main factors (Gómez et al, 2016). As such, ninth grade constitutes a key target group for this study. These developmental and learning differences may play an important role vis-à-vis students' experiences with durable goods. For example, it is possible that while fifth graders have access to durable goods, they do not operate them directly (e.g., cars, washing machines, or computers). Ninth graders, on the contrary, may operate them directly and on a regular basis because they may be asked to help with domestic activities.

From a methodological point of view, this study employed three different approaches to model durable goods: inventory, attributional, and index approaches. The rationale for this is that the existing literature on durable goods and education does not differentiate between different types of durable goods and that the there is a drawback associated with using PCA for index construction because this method assumes no measurement error, which can generate overestimated values of the variance that is explained by each of the components. The inventory approach entailed including all seven of the durable goods in the estimation models. The attributional approach was used to cluster durable goods that shared a similar utility or attribute in three categories:

information good, household efficiency goods, and entertainment goods. Information goods encompassed computers and Internet access. Household efficiency goods included washing machines and microwaves. Entertainment goods comprised TVs, videogame consoles, and ownership of a car. The index approach consisted of the creation of a durable goods index by using exploratory factor analysis (EFA), which according to the literature on development economics is the most appropriate method for index construction (Vollmer & Alkire, 2018).

1.4. Context: Colombia at a Glance

According to the 2018 Census, Colombia has an estimated population of 49 million people, of which 51.2% are women (DANE, 2020a). The age distribution of the population is as follows: 22.6% are children between the ages of 0-14; 68.2% are people between the ages of 15-65; and 9.1% are people 65 years old and older (DANE, 2020a). Ethnographically, most of the population is Mestizo while 9.3% of the population is of African descent, 3.9% of the population belongs to indigenous communities, and 0.005% is of Romani origin (DANE, 2020b). In 2020, total GDP was $271,500 million, of which 12.9% accounted for agricultural products and exploitation of natural resources, 17.6% for industry, and 69.5% for services (Ministry of Commerce of Colombia, 2021). In the political arena, Colombia is a representative democracy, with government officials elected every four years (Government of Colombia, 2002).

Measures of poverty indicate that the percentage of people living in monetary and multidimensional poverty increased between 2018 and 2020, partly due to the COVID-19 pandemic. For example, monetary poverty augmented from 34.7% in 2018 to 35.7% in

2019, which resulted in an additional 662,000 people who fell in monetary poverty in only one year (World Bank, 2021b). Similarly, multidimensional poverty increased from 17.5% in 2019 (DANE, 2020c) to 18.1% in 2020 (Multidimensional Poverty Peer Network, 2021).

According to Amarante et al. (2016), between 2002 and 2012, Colombia remained one of the most unequal countries in Latin America, measured by the Gini coefficient, an estimate of inequality based on income distribution within a country. This is not surprising given that Colombia suffered the consequences of an armed conflict that lasted more than 60 years (from 1960 until 2016) that left millions of people living in extreme poverty, particularly in rural areas (Centro Nacional de Memoria Histórica, 2018). Although the conflict took a toll on different areas of social and economic development, education was severely affected. For example, it is estimated that throughout the duration of the conflict close to two million children and youth were forced to drop out of school (Galvis, 2021; Munevar et al., 2019; Watch List on Children and Armed Conflict, 2004) and hundreds of schools and school facilities were destroyed (Galvis, 2021). Because most of the conflict took place in rural areas, this entailed that achievement gaps for rural students have increased over time, despite the cessation of the conflict (Watch List on Children and Armed Conflict, 2004). For example, it is estimated that for every 100 students that enroll in first grade in rural areas, only 35 complete elementary education, only 16 continue middle school, and only seven complete high school (Gaviria, 2017).

1.5. Territorial Management and Development in Colombia

Colombia is divided into 32 departments (or states), which are in turn subdivided into 1,101 municipalities. Financial resources, generated from taxes and other sources of revenue, are administered by the central government, which distributes them to the departments (DNP, 2015). Departments are then responsible to allocate those resources to the municipalities. As such, departments constitute the largest political and administrative units of government in the country (DNP, 2015).

Act 617 of 2000, which designed a methodology to classify departments and municipalities based on their population and income (capacity to collect taxes and economic growth), determined that municipalities with a population of less than 10,000 people would require direct government assistance to deliver social services (DNP, 2015). This entails, for example, that policy formulation and funding in education or healthcare is decided by the central government. On the contrary, municipalities with high economic and social development, which usually are the ones with the largest populations, have more administrative and fiscal autonomy (DNP, 2015). Similarly, Act 617 of 2000 and Act 1617 of 2013 established that of the 1,101 municipalities, 10 would be considered *especial districts* because of their contribution to the GDP or social development of the country. These 10 districts enjoy full autonomy at the legal, administrative, policy, and fiscal level (DNP, 2015). For example, Bogotá, which is the capital of Colombia, has the highest government budget of any municipality and, thus, does not receive funding from the central government. Figure 1 shows a map of Colombia with its political and administrative organization.

Figure 1

Political and Administrative Organization of Colombia by Departments

Note. Map used with permission from the Instituto Geográfico Agustín Codazzi, government agency responsible for issues pertaining to geography and territorial planning. Retrieved November 22, 2021. Available at https://geoportal.igac.gov.co/sites/geoportal.igac.gov.co/files/geoportal/politicoseg.pdf

1.5.1. Multidimensional Poverty in Colombia and Latin America

The Global Multidimensional Poverty Index is a measure that assesses how people experience non-income poverty at the household level. The index conceptualizes poverty as a problem of capability deprivation in three dimensions of development: health, education, and standard of living. Regarding health, the index assesses two indicators: nutrition and child mortality. In relation to education, it measures years of schooling and whether school-age children attend school. Standard of living evaluates if the household has access to basic services such as electricity, adequate housing materials, drinking water, cooking fuel, sanitation, and assets (United Nations Development Program & Oxford Poverty and Human Development Initiative, 2019; 2020). Under this index, lack of access to any of the services contained within each dimension constitutes a risk factor to become multidimensionally poor.

Of interest to the researcher is the *assets* indicator, which assesses ownership of durable goods, because there is a growing body of research that suggests a positive association between possession of durable goods and educational outcomes (Chowa et al., 2013; Fang et al., 2020; Figal et al., 2019; Kafle et al., 2018; Kerr, 2019). Colombia has been participating in the Global-MPI since it was first launched in 2010. International reports indicated that multidimensional poverty in Colombia has declined over the years from 10% in 2010 to 4.8% in 2020, from 5 million to 2.4 million people (Alkire & Santos, 2010; United Nations Development Program & Oxford Poverty and Human Development Initiative, 2020). While the information generated by the Global-MPI does not compel governments to act, it has served as a guiding tool for public policy.

Colombia and many countries in the Latin American region have used the Global-MPI as a baseline to identify the different types of deprivations that people living in poverty experience as well as obtain input to develop regional multidimensional poverty assessments that could account for within country variation and serve for cross-country comparisons.

Inspired by the results from the Global-MPI, researchers conducted two studies to assess multidimensional poverty *within* the country. The first study was conducted by Angulo et al. (2011), and funded by the government of Colombia, to assess the applicability of the indicators of the Global-MPI at the local level. Therefore, in 2011, the government of Colombia launched the Multidimensional Poverty Index for Colombia (C-MPI), a national measure of acute poverty that captures how Colombian people experience deprivations in different dimensions of development (United Nations Development Program & Oxford Poverty and Human Development Initiative, 2021b). Drawing from national living standards surveys such as the Unmet Basic Needs Index (Índice de Necesidades Básicas Insatisfechas)[2], the Life Condition Index (Índice de Condiciones de Vida)[3], the System to Identify Potential Social Program Beneficiaries (Sistema de Identificación de Potenciales Beneficiarios de Programas Sociales –

[2] This is a composed indicator of household living conditions. It assesses quality of housing, access to water and sanitation, overcrowding, employment, and school enrollment. Households with deprivation in any of these indicators are considered as not having their basic met.

[3] This is a standard measure of quality of life which is composed of four dimensions: access to basic household utilities, human capital, household sociodemographic characteristics, and quality of housing. The index ranges from 0 to 100, with scores close to 100 meaning that the household has a good life condition.

SISBEN)[4], and the National Quality of Life Survey (Encuesta Nacional de Calidad de Vida)[5], international indicators such as the Human Development Index and the Human Opportunity Index as well as consultations with experts, Angulo et al. (2011) developed an adjusted version of the global MPI for Colombia. Each indicator was given a specific weight depending on how it contributed to each dimension. To assess who classifies as multidimensionally poor, researchers employed the Foster-Alkire (AF) method.[6] According to this methodology, people in Colombia live in multidimensional poverty if they experience 33% of deprivations in the 15 indicators (Angulo et al., 2011).

Thus, the C-MPI is composed of 15 indicators distributed in five dimensions, as follows (see Figure 2 for more details):

1) education conditions: average education level for people 15 and older living in the household, and percentage of people living in the household 15 and older who can read and write.

2) child conditions: percentage of children between the ages of 6 and 16 who attend school, no school lag, access to childcare services, and percentage of children not working.

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[4] This is an index that assesses standard of living and vulnerability. The index ranges from 0 to 100, with the lower scores being associated with highest poverty levels. This index is used as the main tool to target social assistance programs.

[5] This survey captures household information on different domains: sociodemographic, financial assets, education, health, living conditions, employment.

[6] This methodology consists of counting all the deprivations that people experience simultaneously in the different indicators. People are then classified as experiencing multidimensional poverty if the weighted sum of their deprivations is bigger than a specific cut-off (e.g., 20%, 30%, or 40% of deprivations).

3) employment: no one in long-term unemployment, percentage of household members from the economically active population (EAP) employed and affiliated to a pension fund.

4) health: percentage of household members over the age of five that are insured by the Social Security Health System, percentage of people within the household that have access to a health institution in case of need.

5) household utilities and living conditions: access to a water source, access to sanitation, adequate floors, adequate external walls, and number of people sleeping per room.

By using the C-MPI, the government of Colombia was able to identify that there were more people living in multidimensional poverty than the number reported by the Global-MPI. As such, for example, in 2019, there were 8.5 million people experiencing multidimensional poverty in Colombia, more than three times the number indicated in the Global-MPI report (DANE, 2020b).

The second study was a joint effort between the United Nations Children's Emergency Fund (UNICEF) and Los Andes University to assess child poverty in Colombia (García et al., 2013). The study, which was based on information contained on the National Quality of Life Survey and the Unmet Basic Needs Index, national-based surveys that capture information related to living conditions, employed a mixed-methods approach to analyze children's experiences of poverty. There were two key objectives of this study. The first was to assess the extent to which the indicators of the C-MPI measured child poverty. The second objective was to develop new indicators that could account for child poverty. The qualitative component of this research served as a consultation ground for making decisions about which indicators to include. Focus groups with children and youth from different parts of the country as well as with policy makers and experts were used as the method for selecting the indicators. Once validated, the researchers employed the Foster-Alkire (AF) method to set up a multidimensional poverty cut-off of 25%, which entailed that if children experienced deprivations in at least 25% of the indicators they would be classified as multidimensionally poor. Findings from this study revealed that in addition to education, health, water and sanitation, housing, and access to information, measures of child poverty in Colombia needed to account for economic safety, domestic violence, and out-of-school time (García et al., 2013).

Similarly, Santos and Villatoro (2018) developed an index to assess multidimensional poverty across the Latin American region. The index, called the Multidimensional Poverty Index for Latin America (MPI-LA), was designed to provide comparable information about multidimensional poverty in the region. The MPI-LA is comprised of five dimensions and 13 indicators, as follows (see Figure 2 for more details):

1) housing materials: households with dirt floors or precarious roof or wall materials, people per room, home ownership status.

2) basic services: improved water source in urban and rural areas, improved sanitation in urban and rural areas, households with no access to electricity or which use wood or charcoal as cooking fuel.

3) living standard: income, and possession of durable goods.

4) education: households where there is at least one child (ages 6-17) who is not attending school, school lag, and households where no member 20 years old or older has achieved a minimum school level (secondary school for people between 20 and 59 years old; primary school for people 60 years or more).

5) employment and social protection: households where at least one member between the age of 15 and 65 is unemployed, employed without pay, or discouraged worker (e.g., a person who is eligible to work, but has not found a job in a long time, and thus, has given up looking for employment); households where members have no access to health insurance or social security benefits.

Drawing from multiple datasets and national surveys, Santos and Villatoro (2018) employed exploratory factor analysis as the primary statistical method to explain the underlying nature of the relationship between the different indicators. Additionally, by using the Foster-Alkire (AF) method, the authors set a multidimensional poverty cut-off of 25%. This entailed that people would be considered multidimensionally poor in Latin America if they experienced deprivations in at least one dimension. According to this index, for example, in 2012 there were 159.2 million people experiencing multidimensional poverty, with living standards as the dimension with most deprivations. According to Santos and Villatoro (2018), this occurred because income deprivation was the largest contributor to multidimensional poverty in the region.

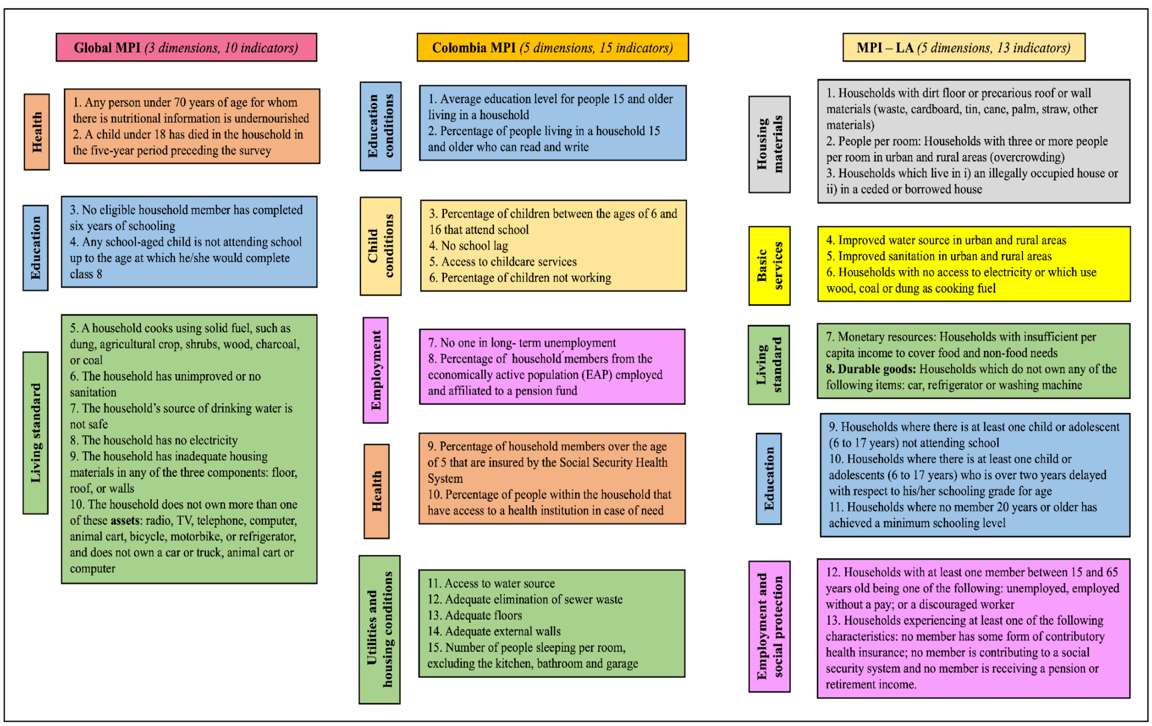
As observed in Figure 2, the initial set of indicators that were developed for the Global-MPI have been adjusted to reflect the most pressing issues concerning poverty either at the country level or at the regional level. In the case of Colombia, the list of indicators was adjusted, in comparison with the Global-MPI, to include information about child services, access to the Social Security Health System, and employment. In case of the multidimensional poverty index for Latin America, the list of indicators was also extended to comprise information about home ownership and housing materials (e.g., property rights), household income, and access to social security. Similarly, Figure 2 shows that while the Global-MPI and the MPI-LA included possession of durable goods as a proxy to measure living standards, which is a key dimension of social and economic well-being, the C-MPI did not include it. Although the C-MPI provides a technical document that explains how the different dimensions and indicators were selected as well as the methodological approach to define weights and cut-offs, nowhere in the document did the authors provide a justification to clarify why the durable goods indicator was not included in the final version of the index. I offer two possible explanations. On the one hand, it could be possible that the indicator was not included when the index was developed because most households had access to the durable goods referred to in the Global-MPI. On the other hand, it may be possible that the indicator was excluded because there was not enough information about the relationship between durable goods and poverty reduction. Based on in-depth analysis of government reports and the available research on the field, the latter explanation seems the most plausible.

As highlighted, neither the C-MPI nor the study on child poverty in Colombia included *possession of durable goods* as an indicator, which is curious because most government data do capture this information. Similarly, it is interesting that while the

Global-MPI and the MPI-LA consider durable goods as key assets (capacity building tools) among low-income families, Colombia has not conducted enough research to examine whether they relate with poverty and other development outcomes. This is precisely why the goal of this study was to explore the relationship between durable goods and educational outcomes, particularly academic achievement and school attendance. Findings will open the floor for conversations about the role of durable goods in the formulation of asset-based policies or poverty reduction strategies. My hope is to bring the topic of durable goods to the policy agenda, so that more research can be done to further understand its effect/benefits in improving educational outcomes and poverty alleviation.

Figure 2

Comparing Multidimensional Poverty Indicators Across Three Indices



1.5.2. Connecting the Global Agenda with Colombia's Development Program

Because poverty is a global issue, solving it requires multinational cooperation. This is precisely why, in 2000, the United Nations (UN) launched the Millennium Development Goals (MDGs), a 15-year global strategy between United Nations member states to foster social and economic development (United Nations, 2015). The strategy included eight development goals and 60 indicators. The United Nations urged countries to include the MDGs in their local development agendas and allocate the corresponding resources, with the hope that in a span of 15 years most of the goals would be achieved. Although much progress was attained between 2000 and 2015, such as reducing the number of people who live in extreme monetary poverty, decreasing the proportion of people who are undernourished from 23.3% in 1990 to 12.9% in 2016, or increasing school enrollment and completion for girls (United Nations, 2015); the fight against poverty was still far from over.

Thus, in 2015, the United Nations launched the Sustainable Development Goals (SDGs), a new strategy aimed at expanding the work undertaken with the MDGs but with a particular focus on sustainability. The strategy is composed of 17 development goals and 247 indicators. Although all the indicators are crucial to achieve sustainable social and economic development, of interest to the present research are the ones related to poverty reduction and quality of education. In relation to poverty reduction, two SDGs were designed to urge countries to reduce monetary poverty and multidimensional poverty, as measured by the Global-MPI. Regarding education, the fourth SDG, called Quality of Education, was developed to help countries reach not only universal inclusive education, but also to achieve minimum proficiency levels in reading and math (United Nations, 2020a).

Implementing the global development agenda at the local level has required leadership and a strong commitment. Colombia is a good example of such commitment because as a member state of the United Nations since 1945, when the organization was founded (United Nations, 2006), it has adhered to all the international agreements pertaining the protection of human rights and the promotion of social and economic development. Hence, the government of Colombia has included the different development goals defined in the MDGs and the SDGs in the *Plan Nacional de Desarrollo* (National Development Plan) of every administration (DNP, 2021; Government of Colombia, 2018). The National Development Plan is a government bill that every new administration must present to congress within the first three months of taking office. The plan contains all the government goals and the different programs that will be implemented during the four-year term as well as the fiscal management plan to achieve them (Government of Colombia, 1994; Congress of Colombia, 2019).

Of interest to this study were the goals and programs associated with improving education and promoting access to assets, particularly durable goods. The National Development Plan for the office term 2018-2022, called *Pacto por Colombia, pacto por la equidad* (Pact for Colombia, pact for equity), contained three strategies, or pacts, distributed in 20 development goals to promote social and economic development (DNP, 2019). In relation to education, the plan defined 26 indicators related to improving quality of education. Of those, four were closely associated with the subject-matter of this study:

increasing preschool enrollment rates, strengthening the national school meal program, improving proficiency levels in reading and math, and increasing access to information and communication technologies (ICT) in schools, including Internet access (DNP, 2019; DNP, 2021).

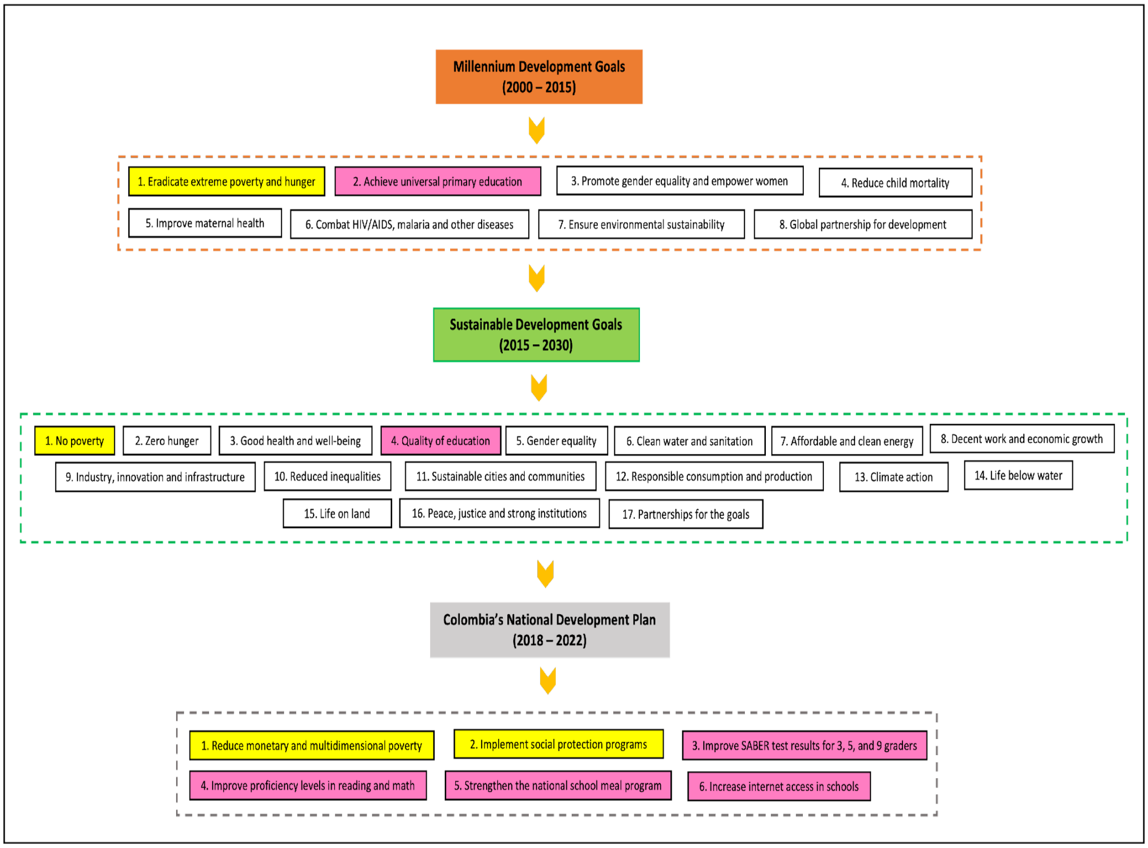
According to the High-Level Government Commission for the implementation of the Development Agenda 2030 for Colombia, a government agency created in 2015 to monitor progress towards the fulfillment of the SDGs, these five education indicators were on track as of 2021 (DNP, 2021; Government of Colombia, 2016; SDG Commission, 2021). In relation to preschool enrollment, the percentage of children who attended preschool increased from 34.2% in 2015 to 92.3% in 2018 (SDG Commission, 2021). Regarding universal school meals, more than 5 million children have benefitted from the national school meal program between 2016 and 2019 (Ministry of Education of Colombia, 2021a). Related to academic achievement, between 2012 and 2017 proficiency levels in the reading and math SABER tests improved for fifth and ninth grade students. In the case of fifth grade students, data indicated that, in 2017, the percentage of students who were proficient in reading reached 43% surpassing the 36.2% reported in 2012. In math, the percentage of students who were proficient increased from 26.3% in 2012 to 28% in 2017 (SDG Commission, 2021). Regarding ninth grade students, the data showed that, in 2017, 48% of students were proficient in reading, compared to 42% in 2012. In math, the percentage of students who were proficient went from 22.3% in 2012 to 26% in 2017 (SDG Commission, 2021). As to Internet and ICT services, available data indicated that the percentage of public-school students with access to the Internet in their schools has remained steady between 2011 and 2019, reaching only 62% (SDG Commission, 2021). Although progress has been made in these areas, the recent COVID-19 health crisis has had a negative impact in the achievement of these goals.

However, the National Development Plan 2018-2022 did not include any development goal or program tailored to promote access to assets, particularly durable goods. Because promotion of asset ownership is closely related to poverty reduction, the most similar development goals had to do with reducing monetary and multidimensional poverty, and the implementation of social protection programs. Data from the High-Level Government Commission for the implementation of the Development Agenda 2030 for Colombia on this subject indicated that, in 2019, 6% of the population lived in extreme monetary poverty[7], a slight increase in comparison to the 5.1% reported in 2018 (SDG Commission, 2021). Similarly, the data reported a reduction in multidimensional poverty between 2018 and 2019, as measured by the C-MPI, dropping from 19.6% to 17.5%, respectively (SDG Commission, 2021). Like the quality of education indicators, the COVID-19 crisis has taken a toll in the reduction of monetary and multidimensional poverty. Findings from this study will shed light on the potential role of durable goods in improving educational outcomes. Figure 3 illustrates that the implementation of the global development agenda in Colombia has been effective. The rationale for this is that the strategic objectives of the National Development Plan were formulated to match those promoted by the United Nations' development agenda.

[7] Defined as living with less than $1.90 a day.

Figure 3

Implementation of the Global Development Agenda in Colombia: From Macro to Local Policy Formulation



1.6. Education in Colombia

The education system in Colombia is organized into five components: early childhood; preschool, elementary and middle school (K-9); high school education (grades 10-11); and university (Ministry of Education of Colombia, 2018a). According to the Constitution and to the Education Act 115 of 1994, education in Colombia is a fundamental human right, thus, it is universal and free of charge from early childhood education to high school (from 0 to 18 years of age) (Congress of Colombia, 1994).

According to the Education Act 115 of 1994, education can be provided by the state or by private organizations with the approval of the Ministry of Education. If provided by the state, it is free of charge; if provided by private institutions, families must pay a fee set by each school. In 2019, the total student population was 10,036,440 (DANE, 2020d), of which 8,074,130 attended public schools (OECD, 2018). Because public schools receive funding from the central government, they must implement the curriculum developed by the Ministry of Education. Private schools, on the contrary, have more administrative and academic freedom regarding topics such as curriculum development, teacher hiring processes, or instruction.

According to a report on education by the Organization of Economic Development and Cooperation (OEDC) (2018), Colombia devotes an above-average share of its gross domestic product (GDP) to education: 6.2% compared to 5% on average across OECD countries. However, annual per-pupil spending in Colombia is only about $3,700, which is lower than the OECD average ($10,400), but not that far from other Latin American countries such as Chile ($6,000) or Brazil ($4,500) (OECD, 2018).

Because of lack of infrastructure (not enough schools or classrooms), public schools in Colombia operate either on a half day or a full-day format (Government of Colombia, 2015). Half day programs encompass morning and afternoon shifts which operate for six hours a day, of which only 75% is devoted to instructional time (Government of Colombia, 2015). Morning shifts usually run from 6:30 a.m. to 12:30 p.m., while afternoon shifts start from 12:30 p.m. to 6:30 p.m. In contrast, full day programs operate for eight hours a day, of which more than 85% is allotted to instructional time (DNP, 2019; Ministry of Education of Colombia, 2018b). A report by UNESCO (2010) highlighted that many countries have adopted similar policies regarding the length of school day. In countries such as Spain, France, and Germany, for example, half day school programs with morning shifts are common in primary and secondary education. Other countries such as Portugal, Italy, and Greece also have afternoon shifts (UNESCO & IIPE, 2010). In the Latin American region, countries such as Chile, Brazil, Uruguay, Venezuela, and Argentina have implemented full-day school programs. Findings from multiple impact evaluations indicate that lengthening the school day is positively associated with academic achievement (Alfaro et al., 2015; Holland, 2012; UNESCO & IIPE, 2010).

A report by the government of Colombia indicated that there was a deficit of 51,134 classrooms countrywide, particularly in rural areas (Government of Colombia, 2015). As a result, public education is mostly delivered through half day school programs. For example, in 2013, 63.4% of students in all grade levels attended schools that operated in the morning shift; 25.4% attended schools in the afternoon shift; and only 11.2% attended schools that offered a full-day program, which are mostly located in urban areas (Government of Colombia, 2015; Ministry of Education of Colombia, 2018b). According to the National Development Plan 2018-2022, it is expected that by the end of 2022 the percentage of students enrolled in a full-day program will be increased from 12% to 24% (DNP, 2019). The rationale for this is that students participating in full-day school programs perform better on reading and math test than students who attend half day programs (Hincapie, 2016).

Academic achievement is measured by a set of national standardized exams at different school grades called *Pruebas SABER (SABER tests)*. At the elementary and middle school level, the test assesses proficiency in reading and math for students in grades 3, 5 and 9 (see Appendices A through C). At the high school level (grade 11^{th}), the test measures proficiency in math, reading, natural sciences, social sciences, and civic engagement (ICFES, 2018). According to a government report, in 2017, only 43% of fifth grade students and 48% of ninth graders were proficient in reading (ICFES, 2018). Similarly, only 28% of fifth graders and 25% of ninth graders were proficient in math (ICFES, 2018). In a study about inequality of education in Colombia, Duarte et al., (2012) found that family income, school leadership, and school setting were the most important factors predicting academic achievement across all school grade levels. For example, authors found that rural students from low-income backgrounds performed lower than their more affluent peers from urban settings. Similarly, students who attended schools which lacked administrative leadership, as measured by commitment from school principals to improve learning environments and the well-being of teachers and students, were more likely to obtain lower scores in the SABER tests in comparison to students who attended schools where principals and staff were more engaged with student learning.

Expanding on the work of Duarte et al. (2012), the present study aimed at exploring the relationship between household wealth, as measured by possession of durable goods, and educational outcomes. By using durable goods in lieu of income, this study provided useful insights about the role that assets play not only in wealth accumulation or poverty reduction, but in creating capabilities. For example, possession of durable goods such as a washing machines or microwaves may enable children to spend less time on domestic activities, and thus, more time studying. It is important to highlight that the present study focused on fifth and ninth graders because, as previously indicated, these groups represent two different stages of development and learning. In addition, the SABER tests for fifth and ninth graders were specifically developed to assess literacy and numeracy skills, which are the outcomes of interest of this research.

In summary, this portion of Chapter One articulated the role of assets in improving social and economic well-being and the need to include them in assessments of non-monetary poverty. Particular attention was given to the role of two types of assets: durable goods and education. The rationale for this is that these assets are included in the Multidimensional Poverty Index (MPI), which is one of the most comprehensive measures of non-income poverty, as indicators of non-income poverty. There is limited research that explores how these two indicators relate to each other.

1.7. Dissertation Outline

Exploring the relationship among durable goods, academic achievement, and school attendance in Colombia required a well-structured study that could yield clear and useful findings. This dissertation attained these goals and in the following chapters I will guide the readers through the process. Therefore, this dissertation is divided in six chapters. In Chapter One, I provide an overview of the subject-matter of this research, which includes the definition of the problem, the significance of the study, and contextual information about Colombia. Chapter Two presents the conceptual framework that guides this research and provides an overview of the relevant literature associated with the topic. Chapter Three describes the research methods. This chapter covers the researcher positionality, general assumptions about the study as well as its limitations, the research questions, the research design, and the steps that were taken to conduct data analysis. Chapter Three concludes by assuring readers that the results of this study were obtained using the highest standards of academic research and ethical integrity. The results of this study are spread over two different journal-style articles, Chapters Four and Five. Chapter Four presents a journal-style article that examines the relationship among durable goods, school attendance, and academic achievement in Colombia, which responds to the first research question. Chapter Five presents another journal-style article that explores the ways in which durable goods are differentially related to students by sex and school grade, hence addressing the second research question of this study. It is important to stress that from a narrative perspective, these articles were designed as independent products because I want to submit them individually for publication. Thus, you may notice that Cabra (2022a) refers to Chapter Four and Cabra (2022b) refers to Chapter Five of this dissertation. Chapter Six provides conclusions about the study, its limitations, and specific policy recommendations. Overall, this dissertation produces a strong argument for the need to include assets, particularly durable goods, in the development of wealth and poverty assessments in Colombia while highlighting the importance of durable goods in improving educational outcomes.

CHAPTER TWO: LITERATURE REVIEW

The purpose of this chapter is to explore and identify the gaps in the available literature on the topics related to assets, asset-based welfare policy, durable goods, and educational attainment. Although the literature on these topics has focused primarily on developed countries, I provide an analytical overview of the research that has been conducted and applied in these topics for developing countries. I synthesize existing literature and theory to show how durable goods relate to educational attainment. I draw from theories that range from consumer economics, welfare economics, and a small portion of studies on poverty, which focus mainly on the work of Amartya Sen and Jean Drèze on hunger and famines. As such, the present study is based on two theoretical frameworks: welfare economics and the capability approach. This chapter is organized as follows. First, I explain how each theoretical framework can be used to examine the relationship between assets and educational attainment. Then, I present literature that highlights the role of assets, particularly durable goods, in fostering social and economic development and improving academic achievement and school attendance. I conclude by showing that durable goods play an important role in creating capabilities and developing agency. Together, these sections pave the way for the next chapter where I connect the literature to the selection of methods for this dissertation.

2.1. Conceptual Framework

In this research, I employed various economic theories to explain the role of durable goods in decreasing poverty, improving quality of life, and fostering social and economic development. Theories of welfare and development economics are the starting point for this framework because they conceptualize durable goods as assets, important resources, or capital for wealth accumulation. Next, consumer and behavioral economic theories explain the relationship between durable goods, which are regarded as commodities, and living standards. Then, by employing the capability approach, which suggests that the goal of consuming goods and services is to develop capabilities so that people can achieve agency, I argue that durable goods can enhance different capabilities because, like assets, they have welfare effects. If durable goods can improve living standards and enhance capabilities, they may constitute key pieces in the poverty puzzle. This may explain why durable goods are included as an indicator to assess multidimensional poverty. Similarly, if durable goods are important building blocks for poverty reduction, it is likely that they are related to other areas of development such as education. Therefore, this conceptual framework provides a roadmap to explore the relationship between durable goods and educational outcomes in Colombia. In what follows, I explain the conceptual framework in more detail.

After a brief overview of the framework, I explain each element in full. Then, at the conclusion of this section, I offer Figure 4 as a graphic depiction of all the elements of the framework.

2.2. From Income to Assets: Expanding our Understanding of Wealth

Studies on poverty and economic development have used household income as the main variable to represent or describe wealth. But is income the most accurate estimate of wealth? According to Adam Smith, famous economist and philosopher, no. In his renowned work, *An Inquiry into the Nature and Causes of the Wealth of Nations*, which laid out the foundations of classical economics, Smith referred to income as the *monetary value* that people get in exchange for their labor (value of labor/return of labor). Given that people have different occupations (division of labor) and that the market regulates what goods and services are most needed and thus commercialized, the income obtained for their labor (skills and products) will vary greatly (Smith, 1776/1976). In its simplest form, Smith equates income to money, which is the unprofitable part of wealth (Smith, 1776/1976). According to Smith, people do not desire money for its own sake, but for the sake of what they can buy with it (Smith, 1776/1976).

Wealth, in Smith's view, accounts for all the resources that people have that allow them not only to afford a minimum level of subsistence, but also to enjoy life (Smith, 1776/1976). Two important ideas stem from this observation. The first idea is that *resources or capital* are the basis of wealth. According to Smith, resources are assets in the form of property or stocks, which individuals can use for consumption, exchange, and use for income generation (e.g., savings and investment) (Smith, 1776/1976). Attanasio and Székely (2001) and Sherraden (1991) further included human, social, political, and cultural resources, or capital as *assets*. As such, assets constitute a more comprehensive picture of the social and economic well-being of families because they represent what people possess and the leverage for acquisition of additional resources or assets. Additionally, given that assets can be accumulated and transmitted intergenerationally, they offer protection to the well-being of future generations (Smith, 1776/1976). This is supported by the work of Attanasio and Székely (2001), Shapiro and Wolff (2001), Sherraden (1991), and Moser (1998, 2006, 2008), who underscored that assets are highly associated with poverty reduction because they help low-income families plan for the future. Access to credit, for example, nudges behavioral changes in relation to how families use the credit and regarding how they plan to pay it back (Belsky & Calder, 2005; Thaler & Sunstein, 2009). Such decisions are based on the utility and profitability that can be obtained from the purchase and use of a specific asset. In most countries in Latin America, low-income families use credit to buy income generating assets such as motorbikes or equipment that can be used for entrepreneurial activities (e.g., food carts, juice trucks) (Attanasio & Székely, 2001). Such strategic planning allows families to make a living and to pay back the credit.

Smith (1776,1976) also purported that the purpose of wealth is not just consumption, but also improving quality of life. Depending on what societies establish as a threshold for *living well*, people can be either well off or worse off. The quality and quantity of goods or assets that people can access comprises a reasonable estimate of their well-being. Although some goods are essential for survival, others improve quality of life because they make life easier, more efficient, or more decent, which in the medium- and long-term allow people to exercise their agency (Smith, 1776/1976). Take assets such as a house or a car, for example. Home ownership guarantees the survival of families by providing them shelter, which can help them improve their quality of life. A car can be used for leisure, for transportation, or to generate income, which in turn can contribute to improved well-being. Thus, wealth (in the form of assets) can support people not only in attaining a better quality of life, but also enjoying it.

By enjoyment, Smith referred to the ability to exercise *agency* and engage in activities different from the ones that are related to income generation (Smith, 1776/1976). This idea of wealth as means to achieve agency is also found in the work of Karl Marx, Hannah Arendt, and John Stuart Mill. In his essay *On Liberty* (1859/2002), Mill argued that agency is achieved when people can exercise their individuality, which is the ability to be oneself. According to Mill, individuality is a key element of well-being because by choosing a way of life that satisfies the individual, and which does not harm others, people are developing their human faculties (Mill, 2002). However, as Marx explained it in *The German Ideology: Including Theses on Feuerbach and Introduction to the Critique of Political Economy* (1845/1998) and as Maslow described in *A Theory of Human Motivation* (1943), choosing a way of life is only possible when people's needs have been taken care of. According to Marx and Maslow, people cannot attain individuality unless basic needs such as food, housing, or education have been fulfilled to a degree that allows them to engage in non-productive activities (Marx, 1845/1998; Maslow, 1943). This is exactly a key theme in Hannah Arendt's *The Human Condition* (2018): agency is achieved when people can stop thinking about the fulfillment of their immediate economic necessities and engage in activities that bring about social change. According to Arendt, this transition is possible only when people can escape worldliness, the realm where goods and services are exchanged (the marketplace) and enter the realm of political action, where ideas and deeds are the exchange currency (Arendt, 2018).

People have, therefore, moved from engaging in labor and work for the purpose of survival (e.g., accessing food) to using it as means to improve their quality of life. This has been done by accumulating wealth in the form of assets and income. Because assets constitute different forms of resources, they have the potential to help people avoid or overcome poverty, thus contributing to overall social and economic well-being (Smith, 1776/1976). This can have important implications in child development because children whose parents have assets are less likely to experience intergenerational poverty, which can better equip them to engage in activities that are deemed highly valuable to improve well-being and promote agency (e.g., postsecondary education, employment, entrepreneurship). In a study about assets and poverty in Brazil, Côrtes et al. (2001) found that families that have access to multiple assets are less likely to fall into poverty. By employing a binary approach to model possession of assets (access vs. no access), except for education, which is measured as years of schooling, authors built a logit logistic regression model to evaluate the relationship between assets and poverty. Findings indicated that families that have access to assets such as human capital in the form of education, housing, durable goods, and social capital are less likely to fall in poverty (Attanasio & Székely, 2001). Leibovich and Núñez (2001), in a similar study about the poverty gap between urban and rural households in Colombia, modeled the association between access to public and private credit and poverty by using multiple logit models and found that more years of education and access to credit reduce the probability of falling in poverty because they enhance economic activity in the long and short term, respectively. This suggests that assets can be important factors in determining the status of poverty, but they may be pivotal in reducing the incidence of poverty, especially among low-income families.

2.2.1. Welfare Effects of Assets

According to Sen (1983, 1984) and Shapiro and Wolff (2001), poverty is not so much a function of low income, but of "capability deprivation." In this case, capability refers to all the human, civil, and financial abilities or entitlements needed to achieve well-being (Sen, 1983, 1984). Capability deprivation can happen in two forms: absolute and relative. Absolute deprivation occurs when a person is deprived in terms of commodities, income, and *resources*. Relative deprivation occurs when a person, albeit accessing a capability, achieves less than others (Sen, 1983, 1984). In this view, for example, if a particular society declares education to be its measure of well-being, people can be classified as *absolutely poor* if they are deprived of it (do not access it) or *relatively poor* if despite attending school, they do not achieve minimum levels of proficiency in reading or mathematics. Although slightly different conceptualizations of poverty, both approaches stress that for people to live well, and avoid poverty, they need to access different resources or assets in adequate quantity and quality. In this study, I used both definitions of poverty because I was interested in examining how lack of ownership of durable goods (absolute poverty) related to lack of academic achievement and decreased school attendance (relative poverty). This allowed me to understand the extent to which differences in academic achievement and school attendance may be attributed to ownership of durable goods.

Research on development economics and social policy indicates that the reason why assets have such a pivotal role in poverty alleviation is because besides serving as a "cushion" for economic shocks, they have social and psychological effects. At its basic form, “assets are a stock that can be drawn upon, built upon, or developed, as well as a resource that can be shared or transferred across generations” (Shapiro & Wolff, 2001, p. xii). This means that assets constitute the majority of physical, human, financial, social, political, and cultural resources that people can use to achieve well-being.

A recent study by the Consultative Group to Assist the Poor and the World Bank suggested that assets can be classified as income-generating or improving quality of life (Kumaraswamy et al., 2020). Income-generating assets refer to the physical and financial resources or capital that allow individuals to generate income. According to Shapiro and Wolff (2001), this includes all the tangible, intangible, and productive assets that a household possesses. Productive assets refer to assets that have the potential to generate profit. Examples of income generating assets are savings, stocks, bonds, property, real estate, machines, equipment, farmland, oil, and minerals. *Quality-of-life-enhancing assets* are all the physical, human, social, political, and cultural resources that individuals can use to improve their well-being. This includes tangible, intangible, and non-productive assets. Non-productive assets represent assets that do not produce any profit nor economic value. Examples of quality-of-life-enhancing assets are human capital (in the form of education), social, cultural, and political capital, durable goods (e.g., washing machines, microwaves, TVs, cars), housing quality and non-productive assets (e.g., furniture, paintings, jewelry) (Kumaraswamy et al., 2020; Shapiro & Wolff, 2001; Sherraden, 1991).

Asset ownership has been documented to be highly associated with social and economic development because it creates capacity-building opportunities that allow families to generate income, overcome economic crises, and make investments towards the future, thus improving their quality of life. Sherraden (1991), a pioneer in the field of asset-based welfare policy, suggested that assets have different welfare effects such as improving household stability, creating orientation toward the future, stimulating the development of other assets, or enabling focus and specialization, among others (Sherraden, 1991). In relation to improving household stability, home ownership has been shown to have positive effects on raising property values, educational attainment, and achievement (Shapiro & Wolff, 2001). In a study on the relationship between assets and children's educational achievement in female-headed households, Zhan and Sherraden (2003) found that home ownership and savings of $3,000 or above were positively associated with academic performance and parental expectations. For example, children whose mothers owned a house or who had savings of $3,000 or above were more likely to graduate from high school and obtain better grades than children whose mothers did not have such assets.

Regarding creating an orientation toward the future, possession of assets fosters the development of strategic planning skills. Parental savings, for example, can help people make informed decisions about investment and well-being. A family who decides to use savings to purchase income-generating assets or for postsecondary education for their children, for example, is aware of the potential return that such assets can have on their socioeconomic well-being. In a program evaluation about the effect of child development accounts (CDAs) and parental savings on parental educational expectations, Kim et al. (2017) found that after controlling for socioeconomic status, parental savings and assets are significantly associated with the educational expectations parents have for their children. By using path analysis, the authors identified that mothers who have access to CDAs and savings have higher educational expectations about their children than mothers who do not have any. In a secondary analysis about the relationship among assets, parental expectations and involvement in children's educational activities, Zhang (2006) found that after controlling for family income and sociodemographic characteristics, possession of parental assets such as a house, a business, or a credit card was positively related to children's well-being and academic achievement. The study also revealed that families who had assets showed higher expectations about their children's educational outcomes and were more involved in school activities than families without such assets. These studies underline that asset ownership has the potential to nudge parental decision-making to invest on their children's future.

Possession of assets also stimulates the development or acquisition of other assets because of their expected productivity effect or their return on investment. A clear example is access to credit. Families access credit to acquire different types of assets (Belsky & Calder, 2005). Another example is house ownership or farmland. People who own a house or farmland are more likely to invest on its maintenance, so that they can sell or rent it for a higher price (Sherraden, 1991). Assets also enable focus and specialization because they provide people with opportunities to engage in diverse income-generating activities. In low-income households, for example, assets such as credit or durable goods can be used to start small businesses. In many developing countries, for instance, women use credit to start beauty shops, restaurants, or tailoring shops. Similarly, durable goods such as cars or motorbikes can be used for self-employment. In an exploratory study about the factors associated with gender asset gaps and wealth inequality among women, Deere and Doss (2006) highlighted that asset ownership can be empowering for women because it gives them opportunities to become self-employed. Self-employment, in turn, allows women to have more leverage in decision making at the household level.

As observed, assets have social welfare effects beyond income which make them a particularly interesting policy tool for addressing poverty or improving specific educational and social outcomes. Scholars such as Attanasio and Székely (2001), Kratz (2001), Moser (1998, 2006, 2008), Shapiro and Wolff (2001), Sherraden (1991), Siegel and Alwang (1999), and Siegel (2005) support the implementation of a social policy model that combines income assistance and asset accumulation as part of the "package" of socioeconomic benefits. Similarly, organizations such as the World Bank, the Inter-American Development Bank, United Nations, and the United States Agency for International Development have designed policy frameworks and implemented development programs that promote asset accumulation among low-income families to reduce poverty. The rationale for this is that assets can create capacity-building opportunities for families to attain agency, thus allowing them to overcome poverty. Assets, therefore, have the potential to empower families because they give people command over resources, which in turn may enhance decision making skills. Such skills can be useful in community development processes because they enhance participation. Although most programs have been geared towards human capital accumulation in the form of education and training, there has been a push for the implementation of other asset-based programs such as conditional cash transfers, micro-loans, and Children Development Accounts. The purpose of an asset-based social policy model is to incentivize the acquisition of assets so that households can improve their quality of life, and hence reduce the likelihood of falling into poverty.

2.2.2. Assets and Development

Research on development economics highlights that considering poverty exclusively as a monetary issue falls short of explaining a complex, multi-faceted phenomenon. The Global Multidimensional Poverty Index (Global-MPI) was designed to account for such complexities. As such, the Global-MPI measures the overall experience of poverty using the household as the unit of analysis. As stressed in Chapter One, whether considering poverty as strictly monetary or a more multidimensional issue, the reality is that there are between 700 million and 1.3 billion people who experience some form of poverty, with children under the age of 15 and women the most affected (Poverty and Shared Prosperity, 2018; 2020; United Nations Development Program & Oxford Poverty and Human Development Initiative, 2019). In response to this, in 2015 the United Nations launched a 15-year global agenda to promote sustainable development, which constituted a continuation of the work that was initiated in 2000 with the implementation of the Millennium Development Goals (United Nations, 2021).

Therefore, the 2015-2030 global agenda encompasses a set of 17 development goals that range from areas such as social and economic welfare, environmental protection to political and cultural participation (United Nations, 2021). Defined as the

Sustainable Development Goals (SDGs), these 17 goals are deemed indispensable for the achievement of well-being in a sustainable manner (United Nations, 2021). Two sustainable goals are of particular interest in understanding the relationship between assets and development:

SDG 1: *"Ending poverty in all its forms everywhere"*

SDG 4: *"Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all"*

To fulfill SDG 1, one key input is to guarantee that marginalized communities have access to basic services and assets (United Nations, 2021). Achieving SDG 4 entails that students complete equitable and quality primary and secondary education as well as achieve minimum proficiency levels in reading and math (United Nations, 2021). By showing that assets in the form of durable goods can play a key role in improving educational outcomes, the present study provided evidence supporting the need to re-assess current measures of poverty in Colombia.

Assets have been shown to have positive effects on wealth accumulation and socioeconomic development. In relation to wealth accumulation, access to assets such as housing or credit motivate people to acquire other assets. Owning a house, for example, motivates people to invest in its maintenance or renovation so that they can get income from it (by renting it or selling it). In a study about poverty and assets in Costa Rica, Trejos and Montiel (2001) found that house ownership and the quality of the house are associated with lower probability of being poor. Similarly, access to credit allows people to invest in other assets such as housing, vehicles, education, equipment and machinery or durable goods (Belsky & Calder, 2005). Findings from a study about urban-rural poverty gaps in Colombia suggested that access to credit is key to reducing rural poverty (Leibovich & Núñez, 2001).

Regarding socioeconomic development, a growing body of research shows a positive association among assets, education, and employment. Concerning education, there is evidence of the positive impact of assets in improving academic achievement and school attendance. For example, Filmer and Pritchett (1999), who examined the effect of household wealth in educational outcomes for 35 countries, including the Latin American region, found a positive association. To account for educational attainment, researchers developed a composite variable that captured information on school enrollment (e.g., Have children/people in the house ever attended school?) and school completion (e.g., What is the highest level of school completed?; What is the highest grade/years completed at that level?). To model household wealth, Filmer and Pritchett (1999) created a wealth index, using principal component analysis, that contained information about ownership of durable goods, housing quality (e.g., rooms in the house and household materials), and access to household utilities (e.g., electricity, safe drinking water). Findings indicated that households that scored lower on the wealth index, had lower educational attainment, thus showing the existence of education gaps across the wealth distribution.

Moreover, Elliot et al. (2018), who conducted a systematic review of the relationship between assets and educational outcomes, indicated that financial assets can improve children's academic performance and school attendance. According to Elliot et al. (2018), financial assets such as children development accounts (CDAs), which are savings or investment accounts that receive public and private funding to benefit children from low- and moderate-income backgrounds from birth to age 18, can improve school outcomes as well as parental involvement in school because they create positive expectations about the future. Similarly, the work of Ansong et al. (2018), Loke and Sherraden (2009), Kim et al. (2017), Kim and Sherraden (2011), and Shanks et al. (2010) related to the impact of financial assets on school outcomes showed positive effects. Indeed, evidence from randomized control trials and quasi-experimental designs from longitudinal data suggested that children who benefit, directly or indirectly, from financial savings programs miss fewer classes and do better in reading than children who do not have access to such programs. In another study, Fang et al. (2020) examined the relationship between family assets and educational outcomes in China by using longitudinal data and multivariate regression models. Authors found that family assets, in particular savings, were positively associated with parental expectations about their children's education, which in turn was positively associated with children's academic achievement. Hence, asset accumulation may have positive psychological effects such as nudging families and students to think about the future in positive terms, which can lead to more commitment to school.

Regarding employment, assets can provide people with income and job stability, which can improve self-perception and increase economic well-being. A study about asset gaps by gender indicates that when opportunities to own assets are available to women, their self-perception improves which allows them to gain more control and leverage in intrahousehold relationships (Deere & Doss, 2006; OECD, 2012b). By the same token, assets such as education can increase income potential and reduce poverty. In a secondary analysis of data in Peru, Escobal et al. (2001) found that human capital, in the form of education, explains the poverty reduction that Peru experienced from 1986 to 1997. A similar study about the relationship between education and income in Chile found that poverty is highly concentrated among households with low levels of educational attainment (Contreras & Larrañaga, 2001). Using ordinary least squares and logistic regression models, the authors also identified that families with higher levels of income matriculate their children in high performing schools. This provides evidence about the intergenerational transmission of education, an asset that has been proven to be one of the most effective tools to reduce all forms of poverty (World Development Report, 2018).

2.3. Role of Durable Goods in Development

Classical economic theory assumes that if information were equally shared among consumers and producers, they would make perfectly rational choices (Lancaster, 1966). However, this assumption rarely holds true. Consumer choice theory suggests that utility and people's preferences are what drive the decisions people make in relation to the goods they purchase. While utility refers to the benefits that people obtain from a particular good, preference denotes the possibility to choose from a set of goods (Lancaster, 1966). In an ideal scenario, the choice to consume a good would result from comparing the expected utility of the good with the satisfaction that it gives to the person who makes the choice. In theory, the optimal decision would be one where utility and satisfaction are fulfilled. Such assessment, however, seldom occurs because besides utility and preferences, other elements such as price and information asymmetries also play a key role in defining the set of available choices available. Among low-income households, for example, decisions pertaining to consumption of basic goods such as food or clothing are mainly driven by utility and price. In more affluent households, this pattern shifts a bit: preferences become salient for choosing specific brands of clothing or types of food (e.g., organic, free trade products). The rationale for this is that as wealth increases, people have greater access to different goods, hence more choices. Such exposure to the market allows consumers to leverage the information asymmetry problem, thus making informed decisions about what they want to consume. In what follows, I explain the different mechanisms by which durable goods may foster development.

2.3.1. Capability Approach

The notion of wealth as enhancing choices finds its roots in the capability approach, which was developed by Nobel laureate Amartya Sen. This theoretical framework was designed to explain how goods and services contribute to improve well-being *by enhancing capabilities*. As such, this framework provided an additional lens for my study, besides utility and preferences, to understand whether possession of goods was a *sufficient condition* to guarantee a decent quality of life. In Sen's view, goods need to be assessed in terms of whether they enhance capabilities, which are defined as the different beings and doings that a person can achieve (Nussbaum & Sen, 1993; Sen, 1983, 1984). This entails, for example, that goods and services such as education, food, or transportation need to be evaluated not in terms of whether people have access to them, but on whether those goods allow people to be well-educated, be well-nourished, or travel to places they need or want to visit (Cohen, 1993; Drèze & Sen, 1989). This implies that only when people can achieve personal goals and make choices, can they attain true living standards (Cohen, 1993; Nussbaum & Sen, 1993; Sen, 1993, 1994). Such a conceptualization is useful when studying issues like poverty because it suggests that poverty is not so much a question of lack of resources or money, but more a function of *capability deprivation.* In this view, for example, people are considered poor because despite having access to some goods or services, they are not able to use them to achieve specific goals (Nussbaum & Sen, 1993). The capability approach, therefore, stresses that goods and services are key to fostering social and economic development when they allow people to achieve agency, which entails the ability to genuinely choose a life that satisfies their needs and aspirations (Nussbaum & Sen, 1993).

Durable goods have been conceived in classical and consumer economics as commodities that are used to improve the efficiency of domestic activities. Commodities such as refrigerators or stoves, for example, were created to keep food fresh longer and to prepare food. Other commodities such as washing machines, computers, or cars, to mention a few, have enhanced capabilities to achieve better living conditions, thus contributing to improving social well-being (Nussbaum & Sen, 1993; Sen, 1983, 1984, 1993). Washing machines, for example, have enhanced the ability to maintain personal hygiene without the time burden related to the act of washing clothes, an activity that has been traditionally delegated to women due to patriarchal social structures. Before the appearance of washing machines, average time spent on washing clothes was close to six hours a day up to two or three times a week (Sandra, 2017). As a result, women had less time to dedicate to personal development activities. Such unequal distribution of household chores explains, to a great extent, much of the social, economic, and political gender disparities in the world.

By employing the capability approach to understand the role of durable goods, one can argue, for example, that washing machines have enhanced women's ability to achieve personal goals and to participate in society by saving time (Hoekstra, 2019). Similarly, computers have enhanced the ability to be educated by providing access to information and opportunities to learn, and cars have given people the capability to move to specific places (Figal et al., 2019). Moreover, the capabilities generated by these commodities can be used to enhance other capabilities such as the ability to achieve a terminal degree or the ability to get to work or travel. Therefore, the introduction of such commodities has allowed families to improve their quality of life by increasing their living standards. This has been accomplished, as suggested by Sen (1983, 1984, 1993), because commodities can enhance personal agency.

2.3.2. The Welfare Effects of Durable Goods

Durable goods have four welfare effects: improve household stability; stimulate the development/acquisition of other assets; increase social influence; and enhance the welfare of offspring (Sherraden, 1991). In relation to improving household stability, durable goods can be used to cushion economic crises or to generate income. In some countries, for example, durable goods are used as collateral to obtain small loans

(McCants, 2007). Similarly, durable goods such as washing machines, cars, videogame consoles, and computers have been used as a source of revenue. In Colombia, for example, there are people who rent washing machines (Barral, 2018) or who use their cars or motorbikes to provide transportation services in areas where public transportation is not available or is inefficient (Medina, 2019). Also, videogames, computers, and mobile phones have increasingly gained momentum as profitable business ventures in many developing countries. In Latin America, for example, the number of videogame lounges, and the videogame industry in general, has experienced a high demand (Luzardo et al., 2019). Internet cafés and phone repair shops have also become essential businesses in Latin America because while Internet penetration is moderate, particularly among low-income households and in rural settings, ownership of mobile phones has reached higher numbers (GSMA, 2020; López-Calva, 2021; Pavez, 2014).

Regarding development of other assets, possession of durable goods can nudge people to acquire other durable goods, particularly when their utilities are symbiotic (Thaler & Sunstein, 2009). For example, it is very likely that when households purchase Internet services, they will be nudged to buy a computer or a mobile phone. The rationale for this is that to benefit from the Internet, one needs to have a devise to use it, and vice versa. In relation to increasing social influence, durable goods can enhance peer recognition or social status. This may happen in cases where possession of durable goods is rare or non-existent. For instance, there are cases in remote villages across the world where few people or families own a television or a computer (Jensen & Oster, 2009; World Development Report, 2016). Possession of such durable goods may grant them a distinguished status among the community, which they can use to leverage decision-making. As to enhancing the welfare of offspring, durable goods can also be transferred across generations. Vehicles, with a comparatively longer lifespan than other goods, are perhaps the most common durable goods passed on to family members. Additionally, when households upgrade their stock of durable goods, they may transfer the old ones to family members who do not have any.

2.3.3. Durable Goods and Social Development

Although there is literature that touches upon the role of durable goods in reducing poverty, most of it has been conducted under the umbrella of assets. For example, in a study about the distribution of capital among low-income families in Peru, Escobal et al. (2001) modeled the relationship between assets and poverty in urban and rural settings by using logit models. Findings indicated that families with higher levels of education, who owned homes and durable goods, and who had financial savings were less likely to fall in poverty than families who did not have any assets. Regarding durable goods, Escobal et al. (2001) treated this variable as the average monetary value of the different durable goods owned by each household as well as the possession of a telephone. When compared with other assets, results showed that the probability of falling in poverty was lower for households who owned durable goods (including possession of telephones) than for households who owned homes. Similarly, in a study about the relationship between poverty, resource distribution, and asset markets in Brazil, Neri et al. (2001) used five durable goods, in addition to other variables, to estimate the probability of falling into poverty. By including all the durable goods in the estimation models, authors estimated the individual effect of each commodity in the probability of falling in poverty. Findings suggested that families who owned telephones, refrigerators, washing machines, or TVs were less likely to fall into poverty than families who owned radios. Overall, the results indicated that possession of durable goods was associated with a lower probability of falling into poverty.

Durable goods, particularly in developed countries, have played a key role in improving quality of life (Amendola & Vecchi, 2014; Figal et al., 2019; Tawari & Wang, 2021). Durable goods such as televisions or radios, for example, have made information more accessible to people (Figal et al., 2019; Kafle et al., 2018). In some developing countries, televisions and radios have also been used for educational purposes, which means that they have expanded their utility (Marinelli et al., 2020; World Bank, 2021a). Similarly, personal computers (PCs) and Internet access have allowed people not only to partake in the knowledge economy, but also to reap its benefits (Figal et al., 2019). The use of PCs and the Internet, whether jointly or separately, have made it easier for people to access education and employment opportunities. Regarding education, for instance, PCs and the Internet have facilitated completion of secondary and postsecondary education, thus contributing to the formation of human capital. In relation to employment, PCs and the Internet have become key inputs for connecting people with labor market opportunities and entrepreneurial ventures.

Other durable goods have also contributed to improve quality of life and well-being by increasing the efficiency of household tasks. Washing machines, dryers, microwaves, and refrigerators, for instance, have allowed families to reduce the time burden allocated to perform tasks such as washing clothes or cooking, chores which have been disproportionally assigned to women. This time efficiency effect has enabled women to partake in educational and economic activities or leisure, thus helping them to gain intra-household decision-making power (Figal et al., 2019; Rosling, 2011; Tawari & Wang, 2021). In a randomized control trial about intra-household relations in Colombia, García-Jimeno and Peña (2016) explored the effect of having washing machines in nudging men to help with household chores. Preliminary findings indicated that men from the treatment group, which corresponded to the households that received the washing machines, were more engaged in household activities than men from the control group. According to García-Jimeno and Peña (2016), this may be attributed to the efficiency effect generated by the washing machine, which allowed women to partake in economic activities. This efficiency effect, particularly in relation to time, may allow people to engage in other activities besides household chores. For women, and particularly for low-income female-headed households, this may result in increased access to education and employment opportunities, which in the long-term may level the playing field in intrahousehold relationships. Thus, durable goods may play an important role in improving social and economic well-being.

2.3.4. Measures Used to Study the Relationship Between Durable Goods and Education

Understanding the relationship between durable goods and education requires re-conceptualizing how durable goods relate to standard of living and overall social well-being. Besides increasing household efficiency tasks and serving as a source of entertainment, durable goods have also been associated with educational outcomes. Nevertheless, most studies in this field have focused on specific durable goods. For example, Barrera-Osorio and Linden (2009) conducted a randomized control trial to evaluate the effect of a computer for school program in academic achievement in Colombia. Findings indicated that computers had a positive effect on achievement, although small. Similarly, in a study about the impact of computer and Internet at home on academic achievement in Colombia, Barrios et al. (2021) found that ownership of computers and Internet access were positively associated with performance in English language in the SABER test for high school students. Another study about the effects of computers on children's socioemotional development and school engagement, Fairlie and Kalil (2017) found that possession of computers at home was positively associated with children's social interactions and engagement in afterschool activities. According to the authors, a potential explanation for this finding is that children use computers and Internet to communicate with their friends and to form new friendships. Concerning TVs, Adelantado-Renau et al. (2019) found that children who spent more than seven hours per day watching TV were less likely to perform well in school than children who spent fewer than three hours. Regarding radios, a USAID-funded impact evaluation of a radio instruction program in Zanzibar found a positive association between ownership of radios and academic achievement (USAID, 2009). The recent COVID-19 crisis provided an opportunity to demonstrate that radios and TVs could enhance learning. Given that close to 50% of children who were kept out of school during the pandemic (some 826 million students) did not have access to a computer at home (UNESCO, 2020), radios and TVs became key tools to deliver remote instruction, particularly for low-income families in rural areas (Marinelli et al., 2020; World Bank, 2021a).

Empirical evidence about the effect of multiple durable goods in educational outcomes is limited, with only two studies conducted in developing countries. The first study explored the relationship between household possessions and academic achievement among students in Ghana using propensity score matching. In this study, Chowa et al. (2013) found that durable goods were positively associated with academic achievement in English, but not in math. It is important to stress that the variable *household possessions* was operationalized using a binary approach. In this approach, ownership of durable goods was measured as possession of *any* durable good. The second study examined whether different types of assets, including household durable goods, had a differential effect in educational outcomes among students in Tanzania. In this study, Kafle et al. (2018) assessed the impact of three types of assets: agricultural assets, household durables, and housing quality on highest grade completed and academic achievement. Authors used an index approach to model ownership of these types of assets. In this approach, an index was constructed to account for the different types of assets that families own. High scores on the index denoted that the family has access to a wider range of assets, and vice versa. Although there are many statistical techniques for index construction, principal component analysis (PCA) is one the most used in this field. By employing PCA, Kafle et al. (2018) created different indices to represent family assets. The household durable index, for instance, was composed of durable goods such as TVs, radios, vehicles, and kitchen appliances. Findings from the regression models showed that at the aggregate level (taking all the indices together), the asset index was positively associated with highest grade completed. When considering each index separately, authors found that agricultural assets were negatively related to highest grade completed and academic achievement, while household durables and housing quality were each positively associated. Additionally, authors found that the effect of different types of assets on educational outcomes varied by sex, setting, poverty level, and parental occupation. For example, the negative effect of agricultural assets on highest grade completed was larger for women, for rural students, and for low-income students (Kafle et al., 2018). A potential explanation for this, authors argued, was that these groups of students engage in non-paid farming activities. As such, agricultural assets create a potential trade-off scenario between going to school and participating in agricultural labor to support family needs, which disproportionally affects rural girls from low-income backgrounds.

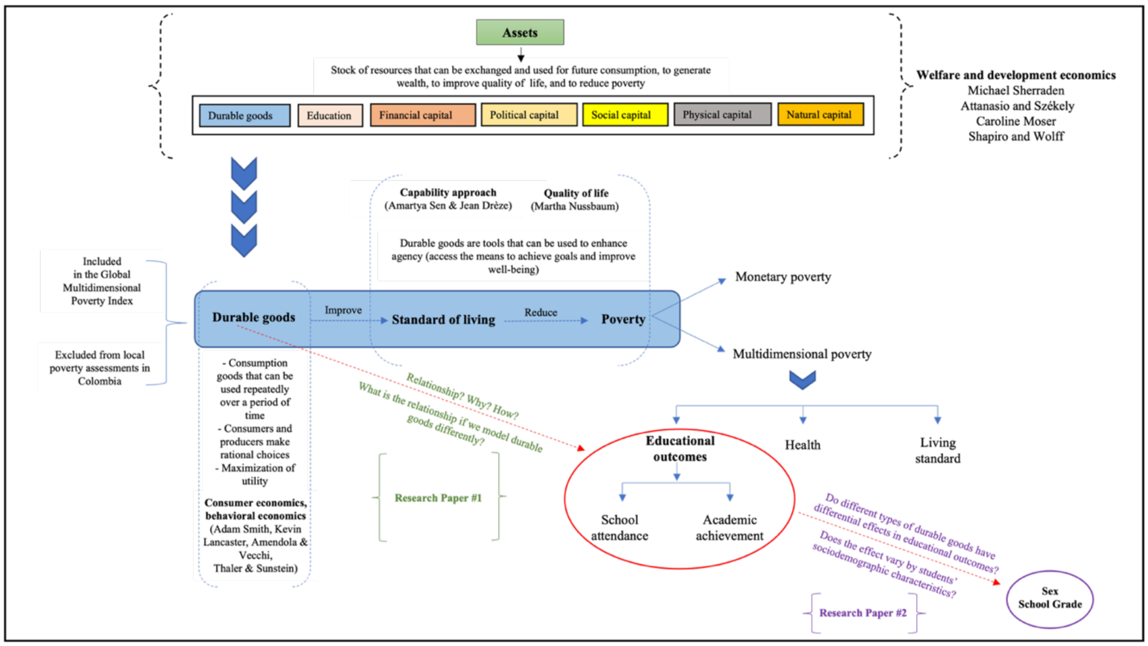
Although the work of Chowa et al. (2013) and Kafle et al. (2018) constitutes one of the most comprehensive attempts to show how different types of assets relate to educational outcomes, it provides only a partial depiction of the role of durable goods. In the case of Chowa et al. (2013), it does not explain whether different types of durable goods have differential effects on academic achievement. Hence, it does not differentiate between having a TV, radio, computer, or refrigerator. In the case of Kafle et al. (2018), there is a methodological drawback associated with using PCA for index construction because this method assumes no measurement error, which can generate overestimated values of the variance that is explained by each of the components (Schmitt, 2011).

Research in the field of development economics, particularly in relation to multidimensional poverty, strongly recommends the use of exploratory factor analysis (EFA) as the main method for index construction (Vollmer & Alkire, 2018) and confirmatory factor analysis (CFA) for addressing issues such as testing hypotheses and model fit of EFA solutions (Henson & Roberts, 2006). Such gaps in the literature provided a great opportunity for conducting this dissertation. Hence, this study used three different methodological approaches to model durable goods: inventory, attributional, and index approaches. The inventory approach, also known in the econometrics as the full specification model, entailed using all the durable goods in the estimation models (Stock & Watson, 2015). The attributional approach consisted of grouping durable goods by attribute or type. The index approach comprised the construction of a durable goods index using exploratory factor analysis (EFA). These approaches were selected for two reasons. The first was to strengthen estimations by using more advanced statistical techniques. For example, by employing EFA instead of PCA for index construction, this study addressed the issue of measurement error, hence improving accuracy of estimations. Similarly, by classifying durable goods in categories, this research enhanced our understanding of the relationship between different types of durable goods and educational outcomes. The second reason was to provide evidence in support of the formulation of asset-based social policies that promote equitable access to durable goods, particularly those that can improve academic achievement and school attendance. By using the inventory approach, for example, this study showed that different types of durable goods had differential effects on education, and they affected children differently.

From a research and policy standpoint, these methodological approaches provided a comprehensive understanding of the nature of the relationship between durable goods and educational outcomes, which constituted a significant contribution in the field.

Figure 4

Conceptual Framework



This Conceptual Framework displays the interlinkage between durable goods and educational outcomes within the context of multidimensional poverty. Durable goods are a type of assets that can be used to improve living conditions and reduce poverty. Regarding living conditions, durable goods can increase household efficiency. Because domestic chores have traditionally been assigned to women, this efficiency effect may generate opportunities for women to engage in activities such as personal development, leisure, or employment. This, however, may create an adverse effect on household responsibilities as older children may have to contribute to domestic activities. In relation to poverty reduction, durable goods can be used to generate income, as collateral for small loans, or to build capabilities. Consumer and behavioral economics help us understand the first two alternatives as they suggest that people's choices are not only driven by utility maximation, but also by future-oriented behavior, which is one of the welfare effects of asset ownership. A potential explanation to the third alternative finds its roots in the capability approach developed by Amartya Sen. In this approach, poverty is not lack of money, but rather a problem associated with capability deprivation. The rationale for this is that when people are deprived of capabilities, they cannot achieve agency. Lack of agency entails that people cannot genuinely choose a life; instead, they are trapped in a cycle of survival, which may lead to poverty. For example, if children cannot achieve adequate proficiency levels in reading, despite having access to education, they experience poverty because they are deprived of the capability of being educated. This, in turn, can create achievement gaps, which in the long-term may perpetuate poverty.

Because this dissertation is part of the extensive studies which are being conducted on multidimensional poverty and development, durable goods are conceived as key inputs for capacity building. The rationale for this is that durable goods reduce the time burden associated with domestic activities. In turn, this time may be used for other activities that can be conducive to agency development, like studying, for instance. Given that research on durable goods and education is a new topic in Colombia with limited evidence, this study aimed at understanding the relationship among durable goods, academic achievement, and school attendance among fifth and ninth grade students.

CHAPTER THREE: METHODS

In this chapter, I present the methodological plan for this dissertation. By using a quantitative research design, which includes using three different methodological approaches to model durable goods and multilevel linear and nonlinear estimation, this study will fill the gaps in the literature identified in the previous chapters. This chapter is organized as follows. First, I offer a self-exploration narrative to explain my interest in this topic as well as my researcher positionality. Following this, I present the research questions that constitute the subject-matter of this dissertation. Then, I provide a four-step outline for conducting quantitative research to better understand the relationship among durable goods, academic achievement, and school attendance in Colombia. Finally, I conclude by reviewing the study's limitations to lay out a robust and transparent foundation for the dissertation's two main journal articles (Chapters Four and Five).

3.1. Researcher Positionality

Hans Cabra
Age: 4
Location: Cuidad Bolivar, Bogotá – Colombia

My research is motivated by questions related to poverty, economic development, and quality of education. Spanning various disciplines and methods, my research explores how asset accumulation, particularly in the form of education and access to durable goods, can improve socioeconomic well-being. My interest in this area stems from my lived experience and my involvement as a qualitative research assistant for a UNICEF-funded research project to assess multidimensional child poverty in Colombia. In this position, I developed the qualitative component of the study, which included selecting sites and participants, designing the methodology for the implementation of focus groups, and conducting data analysis. This research project was special to me because it constituted my first academic exercise to understand how poverty had shaped my life. In this project I had two roles. On the one hand, I was a researcher conducting a study about poverty in my neighborhood. On the other hand, I was *Cabrita*, as people knew me in the neighborhood, the guy who lived in block 19. Although it was difficult to balance these roles at times, the intersection of those identities helped me cultivate a passion for development and for social justice. Indeed, after the UNICEF project was completed, I became involved in community-based initiatives related to substance use prevention, youth development, and social entrepreneurship.

I grew up in one of the most marginalized neighborhoods in Bogotá, Colombia, believing that the future ahead of me was a dead end. That changed in 2003 when I was awarded a two-year scholarship to finish high school in Norway. I embarked on an international academic career that I had never envisioned and that began to shape my belief that creating opportunities to mitigate the effects of poverty are the foundation for promoting equity. The formative experience of my upbringing has shaped the values driving my every action in university, community, and professional spaces: working against the injustices and inequalities that I faced growing up. In what follows, I explain why I am interested in studying the role of durable goods and education in improving quality of life and reducing poverty.

As I gaze at the picture above, I cannot help but reminisce about the hardships that my family and I had to endure to make ends meet. The picture was taken when I was four years old in the streets of Cuidad Bolivar, one of the most impoverished neighborhoods in Bogotá, Colombia. We moved to Cuidad Bolivar because rent, utilities, and food were cheaper than in other places. One thing I remember very vividly is the house we lived in. It was probably a 12 m^2 hut made of wood and situated on a muddy terrain. The roof was made of corrugated galvanized steel panels, a common housing trait in the slums of Colombia, which made a lot of noise during the rainy season and got very hot during the dry season. The floor…well, there was only mud underneath our feet. We were five people sharing two beds. The house did not have a bathroom, so we had to use a pit latrine that was located towards the back of the house. Food was cooked on a small red one-burner kerosene stove. While my father worked as a freelance graphic designer making business cards, posters for commercial businesses and calendars, my mother worked as a domestic employee in different houses located in the more affluent places of the city. Neither of my parents completed high school. Indeed, my mother completed only elementary education and my father only ninth grade. While my parents were at work, my grandmother took care of my little brother and me. We both went to the local public school. Even though we did not have much, life did not seem that bad. I was certainly not aware that growing up in poverty could potentially set me up for a life of poverty. Scholars call it “the poverty trap” or “intergenerational poverty” because it is hard to overcome.

We moved out of Ciudad Bolivar almost six years after that picture was taken. We moved because my mother obtained a government subsidy to buy a small house in another low-income neighborhood. It was a 2-bedroom house with a bathroom and a kitchen. The government subsidy was used toward a 30% down payment on this public housing project. She had to get a loan to cover the rest. It was a 15-year mortgage. As the only person with a stable job and who made a minimum wage of $150 a month, paying that loan seemed unmanageable to my mother. However, I would never forget her facial expression when she told us that we would finally have a house. She spoke with agency! Fifteen years after she took the loan, the house was finally hers. She paid the loan in full, and she acquired an asset. Getting a loan to buy a house motivated my mother to acquire other assets, but it took time. Four years into the mortgage, when I was 14, my mother bought a washing machine. That was an experience in itself! Before the washing machine arrived, I had to handwash my school uniforms as well as my brother’s once a week. It took me more than four hours to complete that task and I had to pray that it did not rain. Rain meant that the uniforms would not dry on time, so we would skip school. We were too embarrassed to go to school with smelly clothes. The arrival of the washing machine was a game changer: it saved us time and guaranteed that our school uniforms were almost dried by the time the wash cycle was complete. I did not have to worry about the rain anymore! Having that stability certainly played a key role in my conceptualization of poverty because I was aware that I was neither as poor as before nor as poor as other children in my neighborhood.

However, growing up in two of the most dangerous neighborhoods in Bogotá instilled a gloomy idea about life: that the future was not a choice but a curse. As I was approaching high school, I realized that my chances of going to college were very slim. Nonetheless, that idea changed when in 2003 I was awarded a scholarship to attend the Red Cross Nordic United World College, an international school in Norway, to complete the International Baccalaureate program. Though the language was an impediment at first, as I did not speak English, it did not restrain me from learning. In Norway, I learned that education is a process of self-discovery oriented to build resilience and foster leadership. This idea would subsequently be confirmed. After Norway, I got a scholarship to study at Middlebury College in the United States. At Middlebury, I became curious about studying issues such as poverty, inequality and cultural diversity, and their relationship with social justice. This curiosity was further fueled by the fact that though coming from a very poor family, I was attending one of the most prestigious schools in the United States. This made me realize that such problems needed to be analyzed from a holistic approach.

This profound inquiry took me one step closer to home: I returned to Colombia. I was awarded a scholarship to study public policy. This transition was not easy because I had to confront myself with a harsh reality: I was attending a private university while still living in a place where most people (included my family and friends) had to struggle to make a living. Being mindful about my position motivated me to learn about inequality and poverty from the standpoint of children and youth in my neighborhood. Hence, I wrote my master's thesis on substance abuse in young people in Bogotá (including my neighborhood) using a mixed-methods approach. I chose this topic because, while growing up, I witnessed many of my friends trapped in a vicious cycle of drugs and delinquency, but I never understood why. My research took me far: I identified major risk and protective factors associated with substance use such as lack of out-of-school programs in vulnerable neighborhoods and lack of family involvement. Encouraged by the results of my thesis, and after attending a program on social entrepreneurship and leadership at Georgetown University, I implemented (along with my longtime friends and my brother) an after-school program in my neighborhood. Activities ranged from playwriting, music composition and sports to workshops on how to design a life project. The results were stunning: Kids began to develop skills such as empathy, assertiveness, compassion, ability to listen, perseverance, and a hope about the future.

Such educational opportunities allowed me to access jobs where I have been able to work on social issues. Ranging from volunteering at the Ridderrennet Special Ski Olympiads in Norway (a winter sports week for people who have visual impairments and disabilities) to being a policy advisor, I have always dreamed of unlocking the potential of individuals and communities to become opportunity makers. For example, I have worked on corporate social responsibility projects for the private sector to design employment inclusion programs for women. Furthermore, I have served as a policy advisor for the government of Colombia to formulate and implement policies that foster youth participation in politics, financial inclusion, and arts education. I have also worked with NGOs to provide out-of-school activities for children in Chile and Colombia. All these jobs have required me to “candidly put myself into someone else’s shoes” before making a recommendation about a policy or program. By doing so, I have gained a better understanding of my role in society. Though diverse, all my professional experiences have taught me one important lesson: the purpose of education is to serve others. In addition, these experiences bolstered my concerns about poverty, inequality and lack of opportunities, and their relationship with social justice.

Growing up in poverty and studying poverty have made clear to me that access to assets and asset ownership are key to achieving well-being. As I write this dissertation, now in the position of a Ph.D. candidate, I cannot help but think about the effect that asset accumulation has had in my life. What a journey this has been! Assets, specifically in the form of home ownership, education, and durable goods, have given me the opportunity to escape poverty and to build capacity for the accumulation of financial and social capital (Yadama & Dauti, 2010).

My lived experience along with limited research about the relationship between durable goods and educational outcomes in Colombia as well as the lack of a research agenda in Colombia on this topic (despite robust data) led me to employ a quantitative research paradigm. Quantitative research seeks to investigate the relationships between variables of interest (Osborne, 2008). Conducting a quantitative study allowed me to test some of the hypotheses that were found in the literature (Osborne, 2008) and to explore new ones, some of which came about from my own lived experiences. Similarly, through a quantitative research design I was able to build the foundations for a line of research that is still emerging in the field of development economics and education, particularly for Colombia and for the Latin American region. Overall, the selection of a quantitative research design was motivated by a desire to use best practices to understand complex social phenomena (Osborne, 2008).

I hope that the results of this dissertation will not only shed light about the relationship between durable goods and educational outcomes, but also contribute to strengthening current assessments of multidimensional poverty in Colombia and provide evidence supporting the formulation of asset-based welfare policies to mitigate poverty. As an emerging scholar, it was my responsibility to be transparent and honest with the methods that I used and to guarantee integrity and high ethical standards when reporting results. I hope that this work launches me into a long-lasting career in development and social policy.

3.2. Research Questions

The purpose of this study was to contribute to the growing but small body of research on the relationship among durable goods, academic achievement, and school attendance in Colombia. Additionally, this study aimed to present and discuss three methodological approaches to model ownership of durable goods. The rationale for this was to provide a comprehensive analysis of how durable goods related to educational outcomes, particularly by comparing their differential effects. Table 1 outlines the components of the research design.

Table 1

Research Questions and Data Strand Matrix

Research Question	Data Strand	Hypotheses	Sample	Independent Variables	Outcome Variables	Estimation Method
RQ 1: To what extent are durable goods associated with academic achievement and school attendance in Colombia?	Quantitative	H0: no statistically significant relationship exists between durable goods and academic achievement HA: there is a statistically significant relationship between durable goods and academic achievement	2017 SABER test for fifth and ninth graders (*N* = 364,436)	Durable goods index Durable goods (all commodities) Durable goods by type (e.g., information, household efficiency, and entertainment)	2017 SABER reading scores for fifth and ninth graders 2017 SABER math scores for fifth and ninth graders	Multilevel linear regression (HLM)
		H0: no statistically significant relationship exists between durable goods and school attendance HA: there is a statistically significant relationship between durable goods and school attendance			Being absent from school	Multilevel logistic regression (HLM with binary outcome)
RQ 2: In what ways are durable goods differentially related to students' academic achievement and school attendance by sex and school grade?	Quantitative	H0: no statistically significant relationship exists between durable goods and academic achievement by sex and school grade HA: there is a statistically significant relationship between durable goods and academic achievement by sex and school grade	2017 SABER test for fifth and ninth graders (*N* = 364,436)	Durable goods index Durable goods (all commodities) Durable goods by type (e.g., information, household efficiency, and entertainment)	2017 SABER reading scores for fifth and ninth graders 2017 SABER math scores for fifth and ninth graders	Multilevel linear regression (HLM)
		H0: no statistically significant relationship exists between durable goods and school attendance by sex and school grade HA: there is a statistically significant relationship between durable goods and school attendance by sex and school grade			Being absent from school	Multilevel logistic regression (HLM with binary outcome)

As observed in Table 1, I provided different hypotheses for the research questions and the estimation methods that were used for testing those hypotheses. Hypothesis testing is a method used to test assumptions about the characteristics of a particular phenomenon by looking at relevant data (Howell, 2007). In general, hypothesis testing involves a null hypothesis and an alternative hypothesis. The null hypothesis (H_0) represents no difference between the means of two variables of interest or two groups. By contrast, the alternative hypothesis (H_A) indicates that there is a statistically significant difference between the means of the two variables or groups (Howell, 2007). The goal of hypothesis testing is to define a critical value that allows the researcher to know whether the difference between the means of two variables or groups is likely to be due to chance (Howell, 2007).

In the traditional approach of hypothesis testing, researchers can only reject or fail to reject the null hypothesis. Rejecting the null hypothesis entails that there is a statistically significant difference between the means of the two variables or groups, suggesting that there is enough statistical evidence in favor of the alternative hypothesis (Howell, 2007). Failing to reject the null hypothesis indicates that there is not enough statistical evidence in favor of the alternative hypothesis, suggesting that there may be no relationship between the variables of interest or groups (Howell, 2007). For this study, hypothesis testing was used to assess whether there were statistically significant relationships among durable goods, academic achievement, and school attendance for fifth and ninth grade students in Colombia. Regarding the estimation methods, this study employed multilevel linear and logistic regression because data were nested in four levels of analysis: students, schools, municipalities, and departments. In what follows, I list the research questions that were addressed in this study.

3.2.1. List of Research Questions

Research Question 1: *To what extent are durable goods associated with academic achievement and school attendance in Colombia?*

Particularly, I hypothesized that students who have access to durable goods perform better in reading and math and are less likely to be absent from school than children who do not have access to durable goods.

Sub-Question 1. *In what ways do different methodological approaches to modeling durable goods explain the relationship between durable goods and educational outcomes? To what extent does this relationship vary when we model durable goods differently?*

Research Question 2: *In what ways are durable goods differentially related to students' academic achievement and school attendance by sex and school grade?*

The overall hypothesis here is that the relationship among durable goods, academic achievement, and school attendance varies by student sex and school grade. Regarding sex, I hypothesized that boys who have access to durable goods perform better academically and are less likely to be absent from school than girls who have access to durable goods. In relation to school grade, the hypothesis is that fifth graders who have access to durable goods perform better academically and are less likely to be absent from school in comparison with ninth graders who also have access to durable goods.

Sub-Question 1. *Are there gender achievement gaps among students whose families own durable goods? Why? Why not?*

3.3. Research Design

It is important to stress that this study was cross-sectional, and thus, no causation can be inferred. Given that there is limited research on this topic in Colombia, I was seeking a relationship or association among durable goods, academic achievement, and school attendance. Being able to determine whether durable goods were related to educational outcomes seemed to me the first step in the process of paving the way for conducting research on this area in a developing country in the Latin American region.

My research design was crafted from three considerations. The first was a desire to better understand the factors that drive socioeconomic achievement gaps in Colombia. The rationale for this is because studies on achievement gaps in Colombia have primarily used income, parental education, and socioeconomic status as main proxies for household wealth (Duarte et al., 2012). However, as argued in Chapters One and Two, assets have the potential to create capacity-building opportunities and to foster agency. Thus, assets may constitute a more comprehensive measure of wealth because they represent the different resources or capital that families possess. As stressed in Chapter Two, durable goods can play an important role in improving educational and social outcomes because they provide families and children with opportunities to reduce domestic activities, which in turn may free up time for studying (Kafle et al, 2018) or for engaging in employment activities (Figal et al., 2019).

The second consideration was access to relevant data coupled with my interest in using best practices to explore social phenomena (Osborne, 2008). In 2019, I enrolled in a multilevel linear research course at the University of Vermont. For the final project, I conducted research on socioeconomic achievements gaps among fifth graders in Bogotá, Colombia. To carry out this project, I contacted the government of Colombia and requested permission to use a de-identified dataset which captures academic and sociodemographic information about students, including possession of durable goods.

Government officials responded positively to my request, and I obtained the data. By using a two-level hierarchical model, I found that length of school day, mother's education, ownership of washing machines at home, and Internet access were positively associated with reading and math scores for fifth graders in Bogotá. The findings associated with length of school day and mother's education were not surprising because they corroborated previous research on the subject (Alfaro et al, 2015; Chmielewski, 2019; Dominguez & Ruffini, 2020; Hincapie, 2016; Orkin, 2013; Pires & Urzua, 2011). However, I was intrigued by the results related to possession of washing machines and Internet access. Thus, I delved deeper into the topic and discovered that this was an area of research with much potential for innovation. For example, I discovered that despite evidence in support of including durable goods as an indicator of multidimensional poverty (United Nations Development Program & Oxford Poverty and Human Development Initiative, 2020), Colombia does not include it in current assessments of poverty (Angulo et al., 2011; García et al., 2013). Therefore, I decided to conduct a more rigorous study by using four-level multilevel linear and nonlinear modeling to explore the relationship among durable goods, academic achievement, and school attendance for fifth and ninth grade students in Colombia.

The third consideration that guided my research design was the way in which previous studies have operationalized or modeled durable goods. As highlighted in Chapters One and Two, there is limited research about the relationship between durable goods and educational outcomes, with most evidence coming from the African region and China. In general, the researchers who have attempted to explain the relationship between household durable goods and educational outcomes, such as school attendance and academic achievement, have done so by using two methodological approaches to operationalize durable goods: a binary and an index approach. In the binary approach, researchers have modeled durable goods as a binary explanatory variable that assesses possession of any durable good. From an applied research perspective, this methodological approach seems coherent given that the variable of interest is categorical (YES/NO format). This approach, common in contexts with data limitations, may hinder understanding of how different or multiple durable goods relate to educational outcomes. Chowa et al. (2013), for example, conducted a propensity score analysis to examine the impact of durable goods in academic achievement among youth in Ghana. Using ownership of any durable good as a proxy for household possessions, the authors found a small positive association with reading achievement, but not a statistically significant relationship with math. Although useful, results from this study pose methodological questions related to the optimal way to model durable goods. For instance, it is worth asking if different durable goods have differential effects on academic achievement (e.g., computers vs. televisions) or whether the number of durable goods matters for academic performance. As such, the binary approach may provide a distorted assessment of the underlying nature of the relationship between durable goods and educational outcomes.

In the index approach, durable goods have been operationalized through the creation of indices, scales, or composite variables (Filmer & Pritchett, 1999). The rationale for this is that most of the data used in this type of research capture information about possession of numerous durable goods. By using statistical techniques such as principal component analysis or exploratory factor analysis, researchers have been able to explain the underlying nature of the relationships between multiple durable goods. This approach, widely used in studies about multidimensional poverty, has allowed researchers to account for the number and type of assets owned at the household level by grouping them in one indicator or a set of indicators, fewer than the number of original variables (Alkire et al., 2015; Filmer & Pritchett, 1999).

Although the index approach seems to be a more robust method to model durable goods than the binary approach, it still does not help identify how each durable good relates to a particular outcome. In the study conducted by Kafle et al. (2018) in Tanzania, for example, it is difficult to assess which of the different durable goods within the agricultural, household, or housing quality indices was positively or negatively associated with academic achievement. As such, we have a partial understanding of the nature of the relationships between durable goods and educational outcomes. To correct for this and build on the existing literature, the present study contributed to the field by using three different methodological approaches—inventory, attributional, and index—to operationalize durable goods. In what follows, I explain each of the methodological approaches and then provide an overview of the procedures that were implemented to conduct this study.

3.3.1. Inventory Approach

It is important to underline that this approach is also known in econometrics as the *full specification model* because all the variables of interest are included in the estimation models. The purpose of this approach was to understand how each durable good related to academic achievement and school attendance. This entailed including all the durable goods in the estimation models. The inventory approach has been used in the field of welfare economics to estimate the effect of asset ownership in reducing poverty (Attanasio & Szekely, 2001; Moser, 1998, 2006, 2008; Shapiro & Wolff, 2001; Sherraden, 1991). Given that households and people can accumulate different assets throughout their lives, it is important, from a research and policy perspective, to identify whether different assets have differential effects on poverty reduction. From a statistical point of view, one of the drawbacks of this method is that putting all the durable goods in an estimation model takes away degrees of freedom (Kukuk & Baty, 1979). Nonetheless, given my interest in exploring how different durable goods related to different educational outcomes, this drawback seemed a reasonable tradeoff for this research. Similarly, it is likely that these variables are highly correlated, which could introduce issues of multicollinearity. Moreover, it is important to highlight that one of the conceptual assumptions of this approach is that it treats durable goods as unrelated and independent commodities. A policy implication of this assumption is that it may strengthen public policy formulation because it provides governments with clear evidence about which durable goods are more beneficial to improve educational outcomes. In turn, policymakers can use this information to conduct cost-benefit or cost-effectiveness analyses, which are key steps in the process of selecting a policy option.

3.3.2. Attributional Approach

The attributional approach models possession of durable goods based on their attributes. In practice, it functions like the binary approach with the only difference that it classifies durable goods by type. This approach has been used in the field of development economics to analyze the relationship between household possessions and education outcomes (Chowa et al., 2013; Kafle et al., 2018). In the present study, I used the attributional approach to cluster durable goods that shared similar utility (e.g., enhance leisure or increase household efficiency) or goods that could be considered complementary such as computers and Internet access. As such, and based on Kafle et al. (2018), I grouped durable goods into three categories: information goods; household efficiency goods; and entertainment goods. Information goods encompassed computers and Internet access. Household efficiency goods included washing machines and microwaves. Entertainment goods comprised televisions, videogame consoles, and ownership of a car. Because durable goods are a proxy for household wealth, I used two options to model the attributional approach. The first option, hereafter named unconditional approach (UA), comprised assessing whether students *owned at least one of the durable goods* in the household efficiency and entertainment categories (Chowa et al., 2013). The second option, hereafter named conditional approach (CA), measured if the students *possessed all the durable goods* in the household efficiency and entertainment categories. Because computers and Internet access are complementary commodities, they were treated as one durable good. As such, students were considered to have information durable goods only if they owned a computer and had Internet access. Students who did not fulfill this requirement were considered deprived of information durable goods. This methodological decision provided useful insights about household wealth distribution. For example, the UA represented low-income Colombian households, where ownership of at least one of the durable goods in each category is customary. On the contrary, the CA depicted more affluent households. It is important to stress that one of the conceptual assumptions of this approach is that different types of durable goods are differentially related to educational outcomes. Like the inventory approach, a policy implication of this assumption is that it can help policymakers identify which types of durable goods that are most likely to improve academic achievement and school attendance, particularly among low-income households. As such, governments can improve public spending and service delivery by formulating evidence-based policies.

3.3.3. Index Approach

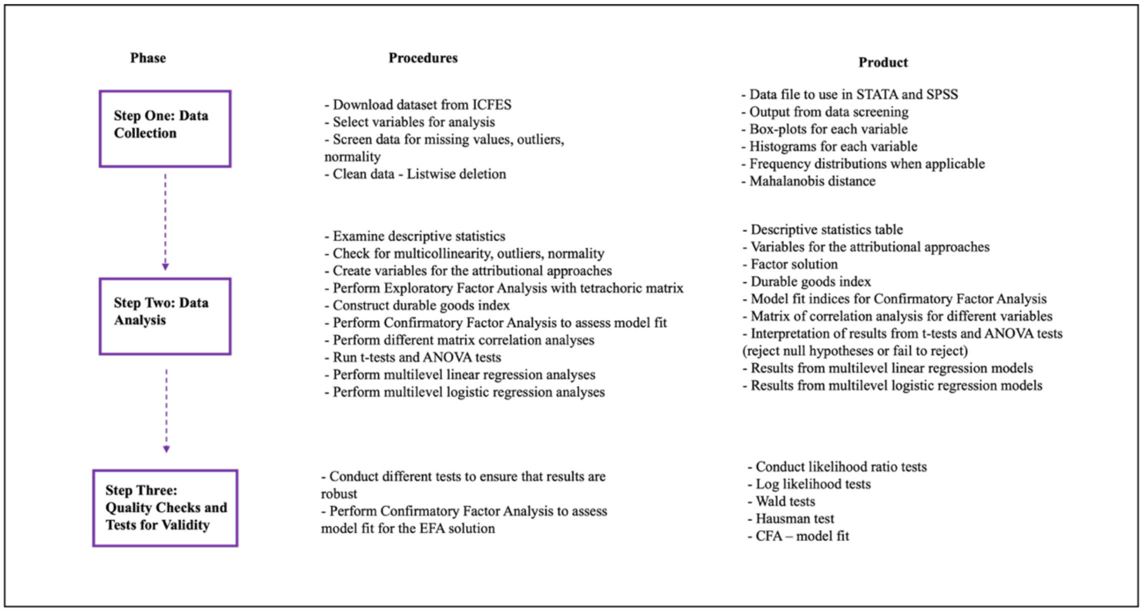
The index approach finds its roots in the fields of psychology and education, where it has been used to operationalize abstract concepts such as depression, anxiety, well-being, and school climate (Hatcher, 1994). Because these concepts are multifaceted, this approach has allowed researchers to include numerous indicators to measure them without having to worry about potential issues of multicollinearity. In econometrics, multicollinearity refers to a situation in which more than two independent variables are highly correlated in a multiple regression model, which could inflate the results and introduce bias in the estimation. To correct for this, researchers have employed statistical techniques such as principal component analysis, factor analysis, and multiple correspondence analysis, which are also the most applied methods for index construction (Vollmer & Alkire, 2018). It is important to stress that the index approach has also contributed to the development of robust data collection tools to capture more information about these constructs, hence improving validity. In the field of development economics, particularly in poverty studies, the index approach has been used to measure concepts such as socioeconomic status, multidimensional poverty, quality of life, or human development (Alkire et al., 2015). In this study, I used the index approach to explore the underlying nature of the relationship between durable goods. Because these variables were expressed in binary terms (e.g., having a durable good vs. not having a durable good), I used a matrix of tetrachoric correlations to perform exploratory factor analysis, the method I considered most appropriate to explore such relationships. Results from this exercise suggested that these seven consumer goods could be expressed, conceptually and in applied terms, by a one-factor solution or one dimension represented as household durable goods. Following this, I used the results from the exploratory factor analysis to construct a durable goods index, a proxy for household wealth. Moreover, it is important to highlight that to assess model fit, I performed a confirmatory factor analysis (CFA). These methods are explained in more detail in the data analysis section.

3.4. Implementation of Research Design

Defining the methodological approaches to model durable goods constituted the first step in the implementation of the research design because it allowed me to develop a strategy for conducting this study. This included, for example, making decisions about handling missing data and outliers, selecting the method for the index creation, choosing a robust statistical software for running the analyses, and defining validation checks. Figure 5 is a procedural diagram which depicts the general structure of my research design.

Figure 5

Procedural Diagram



As observed, each phase of the research design entailed a series of procedures and products. This was the way to operationalize the different inputs that were needed to answer the research questions. For example, step one referred to the data collection process. As shown in the diagram, this step involved completing basic procedures that ranged from obtaining the dataset, selecting the variables for analysis to screening the data for outliers or missing values. To systematize these procedures, I defined specific products for each step. The rationale for this was to implement a monitoring system that could help me track progress towards completing each of the steps. In the case of step one, this included, for instance, saving the datafile in a format that could be used in STATA and SPSS and saving outputs from different data screenings (e.g., frequency distributions, histograms, missing data). As such, Figure 5 serves as a roadmap for the rest of this chapter. In what follows, I describe each stage in detail. Beginning with data collection, I describe the sample, the participants, and the variables that were used in this study. Then, I explain the data analysis process, which includes all the different procedures that were implemented to perform the multilevel analyses. Finally, I describe the different quality checks and validity tests that were performed to ensure that results and model fit are robust.

3.4.1. Data and Data Collection (Step One)

This study used an extensive cross-sectional dataset that contains standardized test score results for the year 2017 from SABER third, fifth, and ninth grades; nationwide standardized exams administered to all students in third, fifth, and ninth grade in Colombia. This is a mandatory test, which entails that it is representative of the population of students on those grades. Between 2002 and 2009, the test was administered only to fifth and ninth graders, and it was conducted every three years. Between 2012 and 2017, the exam was administered every year and included students in third grade. However, in 2018, the government of Colombia announced that SABER third, fifth, and ninth would undergo a methodological adjustment, with a tentative resumption date of 2021. Therefore, the most recent data are from 2017.

The SABER third, fifth, and ninth test assesses students' proficiency in reading and math. Test scores range from 100 at the lowest to 500 at the highest. Depending on the score obtained, students are placed in different proficiency levels. It is important to highlight that the test is adjusted by grade level (see Appendices A, B, and C for detailed information about score cut-offs and proficiency levels for each grade).

In addition to the test results in reading and math, the data provide information about students' sociodemographic and socioeconomic characteristics, except for third graders (ICFES, 2018). This includes information about gender, parental education, and possession of durable goods, among other variables. The data also capture information about schools such as type (public or private), setting (urban or rural), and length of school day (half day or full day). As stressed in Chapter One, Colombia is divided in 32 departments, which in turn are sub-divided in 1,101 municipalities. The data used for this dissertation were nested in four levels: students within schools, schools within municipalities, and municipalities within departments. I used the 2017 SABER test because it is the most recent dataset available. The total number of students in third, fifth, and ninth grade from Colombia who took the SABER test in 2017 was 2,132,611 (ICFES, 2018). It is important to highlight that the data did not contain any private information about the students.

Data were provided by the *Instituto Colombiano para la Evaluación de la Educación* (ICFES)[8], a government agency responsible for assessing quality of education, as part of its Open Data policy. Adhering to local government regulations that protect information privacy, data were de-identified when accessed by the researcher. Therefore, this study posed little to no risk to participants. Sociodemographic and socioeconomic information of the students was used strictly for research purposes. To obtain permission to use data collected by ICFES, I completed an application for review by the University

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[8] Colombian Institute for the Evaluation of Education

of Vermont Institutional Review Board (IRB). The study was classified as "not-human subjects" research, which means that it did not require IRB approval (see Appendix D). Additionally, two data collection procedures were completed. The first one was to register as a researcher in the ICFES database and specify the purpose of my research. The second one entailed converting the files from *.txt* format into Excel. ICFES provided technical assistance to convert the files. Once the data were in Excel format, I proceeded to export them into STATA and SPSS for cleaning and coding.

3.4.1.1. Sample and Participants

In this quantitative study, the units of analysis were students from fifth and ninth grades from Colombia for the 2017 academic year. The study excluded students in third grade because the data did not capture information about the socioeconomic characteristics of their households. Thus, the number of students in fifth and ninth grade who took the SABER test in 2017 was 1,369,887.

This study used a convenience sampling technique because it considered only students in fifth and ninth grade for whom there was complete information about their SABER test scores and the demographic and socioeconomic characteristics of their households. Therefore, the final sample for this study comprised 364,436 students in fifth and ninth grade in Colombia. Age of students ranged from 9 to 15. Mean age was 12.34, with a standard deviation of 1.979. In this sample, 51.44% of students identified as females and 48.56 % as males.

As highlighted earlier in this section, I used the 2017 SABER test dataset because it was the most recent. I focused on two different educational outcomes from the ones used in the Global Multidimensional Poverty Index: 1) academic achievement in reading and math and 2) school attendance (whether students were absent from school during the previous month). The rationale for this is because I wanted to build on previous research about socioeconomic achievement gaps in Colombia, which has mainly used SABER test scores and school attendance as outcomes variables.

3.4.1.2. Variables

The variables that were used in this study capture information about students in fifth and ninth grade in three domains: 1) sociodemographic and socioeconomic characteristics, including possession of durable goods; 2) educational outcomes, and 3) school characteristics. Table 2 shows the variables that were used in this study and how they were be coded in the study.

Table 2

Variables Used and Decisions About Coding

Name of variable (measure)	Original response	Decision about coding	Dependent, independent or control
Reading test score	100 – 500	N/A. Scores will be standardized to compare students in fifth and ninth grade (z-scores)	Dependent
Math test score	100 – 500	N/A. Scores will be standardized to compare students in fifth and ninth grade (z-scores)	Dependent
School attendance (*In the last month, how many times has the student been absent from school?)*	More than 5 days N/A Never Between 3 and 5 days One or two days	Dichotomous variable – dummy variable Yes (1): more than 5 days, between 3 and 5 days, one or two days No (0): never	Dependent
Internet (access to Internet)	Yes No N/A	Dichotomous variable – dummy variable Yes (1) No (0)	Independent
Possession of TV	Yes No N/A	Dichotomous variable – dummy variable Yes (1) No (0)	Independent
Possession of PC or laptop	Yes No N/A	Dichotomous variable – dummy variable Yes (1) No (0)	Independent

Name of variable (measure)	Original response	Decision about coding	Dependent, independent or control
Possession of a washing machine	Yes No N/A	Dichotomous variable – dummy variable Yes (1) No (0)	Independent
Possession of microwave, electric stove, or gas stove	Yes No N/A	Dichotomous variable – dummy variable Yes (1) No (0)	Independent
Possession of a vehicle (car)	Yes No N/A	Dichotomous variable – dummy variable Yes (1) No (0)	Independent
Possession of videogames (e.g., PlayStation, Xbox, Nintendo, etc.)	Yes No N/A	Dichotomous variable – dummy variable Yes (1) No (0)	Independent
Sex	Male Female	Dichotomous variable – dummy variable (0): male (1): female	Control
Grade	Fifth grade Ninth grade	Dichotomous variable – dummy variable (0): Fifth grade (1): Ninth grade	Control
Years of preschool	2 years N/A None Don't remember 3 years 1 year	Dummy variable (0): none, don't remember (1): 1 years, 2 years, 3 years	Control
Father's education	High school N/A Elementary Technical/vocational Grad school College	Four levels/categories: (1): elementary (2): high School (3): college, technical/vocational (4): grad school	Control
Mother's education	High school N/A Elementary Technical/vocational Grad school College	Four levels/categories: (1): elementary (2): high School (3): college, technical/vocational (4): grad school	Control
Father's employment	Farmer CEO or owner of small business Machinery operator Salesman N/A Construction Administrative work Professional work Does not work, studies, or non-paid domestic work Freelance/contractor Pensioner	Six levels/categories (0): non-wage-earning (1): Farmer (2): Service and construction (3): Pensioner (4): Professional work (5): CEO or owner of small business	Control

Name of variable (measure)	Original response	Decision about coding	Dependent, independent or control
Mother's employment	Farmer CEO or owner of small business Machinery operator Salesman N/A Construction Administrative work Professional work Does not work, studies, or non-paid domestic work Freelance/contractor Pensioner	Six levels/categories (0): non-wage-earning (1): Farmer (2): Service and construction (3): Pensioner (4): Professional work (5): CEO or owner of small business	Control
School type (private or public)	Private Public	Dummy variable (0): private (1): public	Control
Length of school day (half day or full day)	Full day (7 am – 12:30 pm + extracurriculars) Morning Night Saturdays/weekend Afternoon Full day (7am – 4pm)	Two levels/categories (0): half day (morning, afternoon) (1): full day Note: Night and Saturday shifts were not considered because they represent young adults who are older than 18	Control
School setting (rural or urban)	Rural Urban	Dummy variable (0): rural (1): urban	Control

Note. This information was obtained from the 2017 SABER test for fifth and ninth grade students.

In the next sections, I explain in more detail the decisions pertaining to coding. This includes providing evidence of studies that have made similar coding decisions for comparable variables as well as describing contextual information related to the variables. Thus, coding decisions were based on previous research and my understanding of the context of the data. I begin with the dependent variables, the independent variables, and the control variables.

3.4.1.2.1. Dependent Variables

This study used two dependent variables: 1) SABER test results for reading and math and 2) school attendance. Academic achievement is measured by the 2017 SABER tests in reading and math for students in fifth and ninth grade. Although there is an ongoing debate about the pertinence of using standardized tests, research has shown that they are good proxies for measuring learning (World Development Report, 2018). Standardized tests such as the Programme for International Student Assessment (PISA)[9], have been used to evaluate education systems around the globe and to measure proficiency levels in reading, math, and natural and social sciences among different groups of students (e.g., girls vs. boys, rural vs. urban settings, low-income vs. high-income) and different groups of schools (e.g., private vs. public) (OECD, 1999). At the local level, most countries have developed their own standardized tests to assess academic achievement, with reading and math as the main target subjects (World Development Report, 2018). Results from these tests are used to measure quality of education and to inform educational policy. As reported in Table 2, SABER test is a continuous variable that ranges from 100 to 500. Because the test is adjusted for grade level, the scores needed to be standardized to compare them. Reading and math scores were normally distributed; roughly 68% of students scored between one standard deviation from the mean. Thus, this variable was not coded differently.

Research on academic achievement suggests that absenteeism is highly associated with low academic performance and school dropout (Battin-Pearson et al., 2000; Ginsburg et al., 2014). In Colombia, school attendance is measured by the number of days in a year that a student goes to school. According to the Ministry of Education of

[9] Developed by the Organization for Economic Cooperation and Development (OECD)

Colombia, an academic school year comprises 200 days (Ministry of Education of Colombia, 2021b). By the same token, absenteeism is defined as the intentional or unjustified absence from school, which is measured by the number of days in an academic year that students are absent from school (Ministry of Education of Colombia, 2021b). This can be calculated weekly, monthly, or yearly. The 2017 SABER dataset captures this information by month (the month prior to taking the test). As reported on Table 2, responses to this question include: never; one or two days; between three and five times; and more than five times. A study conducted by García and Weiss (2018) about student absenteeism in the United States defined chronic absenteeism as missing 10% of the total number of school days in an academic year, and extreme chronic absenteeism as missing more than 10%. According to this study and for the United States context, for example, missing three days or more in a month is considered chronic absenteeism while missing more than ten days in a month constitutes extreme chronic absenteeism (Balfanz & Byrnes, 2012; García & Weiss, 2018; Jacob & Lovett, 2017). On the contrary, missing fewer than two days in a month may be considered a fortuitous event highly associated with illnesses or medical appointments (García & Weiss, 2018). A secondary study about the relationship between nutrition and school absenteeism in Colombia estimated that missing two days or more in a month constitutes chronic absenteeism, which is highly associated to low academic achievement (Rodríguez-Escobar et al., 2015).

Given the ambiguity as to what constitutes chronic absenteeism and that the values reported for this variable overlap with the cut-offs established in the two studies, I decided to code this variable as a dummy variable. This decision was based on two criteria. The first criterion is the frequency distribution of the variable, which indicates that it is negatively skewed. This means that most students are not absent from school. The second criterion is that there is not a clear place to draw a cut line. Thus, this variable takes the values of "0" if the students were not absent from school and "1" if the students were ever absent from school. This entailed combining all the students who were absent in school for at least 1 day a month.

3.4.1.2.2. Independent Variables

In this study, durable goods represented the independent variable. The data captured information for seven durable goods: Internet access; TV; PC or laptop; washing machine; microwave; car; and videogames. Frequency distributions for these variables indicated that 66.33% of students in fifth and ninth grade had access to Internet; 84.74% had a TV at home; 68.21% had a laptop or computer; 83.51% had a washing machine at home; 59.33% had a microwave at home; 34.68% had access to a vehicle (parents own a car); and 36.98% had a videogame console at home. Less than 3% of the students did not respond for each of the variables. Research on durable goods has coded these variables as dummy variables, which makes sense because the nature of the survey questions is dichotomous (YES/NO format). Based on previous research, I decided to code each durable good variable as a dummy variable, where "0" denotes no access to the specific durable good and "1" indicates access to or possession of the specific durable good.

Because I employed different methodological approaches, I used the seven durable goods to create composite variables. For example, in the attributional approach, I created two variables to indicate whether students had access to at least one of the durable goods in the efficiency entertainment category. These variables represented household wealth of low-income families. Similarly, I created two variables to denote whether students had access to *all* the durable goods in the efficiency and entertainment categories. The variables depicted household wealth of high-income families. Because computers and Internet access are complementary durable goods, they were considered as one commodity and measured as a binary. In the index approach, I used exploratory factor analysis to create a durable goods index.

3.4.1.2.3. Control Variables

Control variables were selected based on research about socioeconomic achievement gaps. In what follows, I explain each of the control variables that were used in this dissertation and the decisions pertaining to coding.

Sex. Research on achievement gaps suggests significant differences in elementary school performance between boys and girls. In general, boys perform better in math, while girls perform better in reading and social sciences (Golsteyn & Schils, 2014; OECD, 2012a). Frequency distribution of this variable indicates that 48.56% of students in fifth and ninth grade in Colombia are boys and 51.44% are girls. Therefore, the variable sex (gender) was chosen to control for any potential differences in academic achievement and school attendance. I coded this variable as "0" for male and "1" for female.

Grade Level. This variable was used to test if the relationship among durable goods, academic achievement, and school attendance varied by school grade. Research on achievement gaps indicates that differences in academic performance start at an early age. In a study about racial achievement gaps in grades three to eight in the United States, Clotfelter et al. (2006) found that African American and Hispanic students perform lower in reading and math than their White peers across all grades. Findings also suggest that while the racial achievement gap in math between low-performing students tends to shrink as students are promoted to upper grades, it widens for high-performing students (Clotfelter et al., 2006). In Colombia, the achievement gap among students in fifth and ninth grade is more pronounced in math than in reading. Between 2012 and 2017, for example, close to 32% of students in fifth grade were proficient in math, compared to 27% of students in ninth grade (ICFES, 2018). In reading, and for the same period, close to 42% of students in fifth grade were proficient in reading, compared to 44% of students in ninth grade (ICFES, 2018). Regarding school attendance, it is estimated that the rate of absenteeism in Colombia is higher for middle school and high school students (OECD & Ministry of Education of Colombia, 2016). Potential explanations include child labor, distance to school, domestic violence, teenage pregnancy, lack of interest in school, among others (OECD & Ministry of Education of Colombia, 2016). Research indicates that high levels of absenteeism are associated with lower academic achievement (García & Weiss, 2018). This suggest that examining the relationship among durable goods, school attendance and academic achievement by grade level may provide interesting results. This variable was coded as a categorical variable: fifth and ninth grade. Frequency distribution of this variable shows that 56.24% of students were in fifth grade and 43.73% were in ninth grade.

Years of Preschool. This variable constitutes a reliable measure to assess socioeconomic status because it is directly related to children's education and to quality of life (APA, 2021). Studies on this area suggest that exposure to preschool programs has positive short-term and long-term socioemotional, psychological, and academic benefits (Ansari, 2018; Pianta et al., 2009). Most studies have coded this variable as the amount of time that children attend preschool programs. This has been done either by looking at number of hours per week or years of preschool (Ansari, 2018; Pianta et al., 2009). In Colombia, however, preschool is provided by the state as part of the public education system. Thus, families can choose to send their children to preschool before they enroll in elementary school. This implies that if families do send their children to preschool, children would attend roughly the same number of years regardless of socioeconomic status or ethnic background. Therefore, using number of years of preschool is not an accurate measure to understand the effect of preschool. Frequency distribution of this variable indicates, for example, that 34.8% of children do not remember how many years of preschool they attended, 32.7% attended one year of preschool, and less than 16% attended two years or three years. A different way to account for that effect is to use a dichotomous variable that measures whether the child attends preschool, which can correct for response bias. Hence, preschool was coded as a dichotomous variable, which took the value of "0" if the child did not attend preschool and "1" if the child attended one, two, or three years of preschool.

Parental Education. This variable was used as proxy for socioeconomic status. I used mother's and father's education because empirical evidence suggests that parental education is a consistent and reliable measure to predict infant health, children's academic achievement, and lower levels of poverty (Contreras & Larrañaga, 2001; Currie & Moretti, 2002; World Development Report, 2018). Studies that have used parental education have coded it as a three-level categorical variable. In most surveys in the United States, parental education is distributed among five categories: GED degree; high school; associates degree; college; and grad school. Coding decisions usually involve grouping those responses into three categories—no high school degree; high school; and postsecondary education—to analyze differences by levels of education.

As observed in Table 2, in Colombia this variable is distributed slightly differently. The variable contains five categories: elementary; high school; technical/vocational; college; grad school. The rationale for including elementary school is that more than 20% of the working-age population have completed only elementary school (DANE, 2020e). By contrast, less than 22% of the population have a postsecondary degree (OECD & Ministry of Education of Colombia, 2016). Technical/vocational education refers to a 2-year professional program in fields such as mechanics, electronics, carpentry, masonry, nursing, etc. Frequency distribution for mother's education indicated that 20.43% of mothers completed elementary school; 49.40% completed high school; 10.91% attained a technical/vocational degree; 9.10% completed a college degree; and 10.17% completed a graduate degree. Regarding father's education, 25.61% completed elementary school; 47.53% completed high school; 9.63% attained a technical/vocational degree; 7.60% completed college; and 9.63% completed a graduate degree. To be consistent with previous research and to maintain contextual differences, this variable was coded as an ordinal variable. As such, the variable took the value of "1" for parents who completed elementary school, "2" for parents who completed high school, "3" for parents who have attained a technical/vocational degree or college, and "4" for parents who completed graduate school.

Parental Employment. This variable encompassed father's and mother's employment. Because socioeconomic status entails not only income, but also elements associated with quality of life, there are multiple ways to measure it. However, most studies on this field use income, parental education, access to early childhood education, financial assets, or parental occupation as proxies for socioeconomic status (APA, 2021; Chmielewski, 2019; Currie & Moretti, 2002). In this study, I used father's and mother's employment as proxies of socioeconomic status (Chmielewski, 2019; Currie & Moretti, 2002), which research points to as a consistent and reliable predictor of academic achievement gaps (Chmielewski, 2019; Coleman, 1968). Research about the effect of parental employment in academic achievement suggests mixed findings. On the one hand, there are studies that indicate that parental employment, particularly maternal employment, is positively associated with children's academic achievement (Dunifon et al., 2013; Harvey, 1999; Huff & Schaller, 2009).

In general, these studies suggest that this positive association is attributed to the income effect that is generated when parents work, which is highly related to socioeconomic status. On the other hand, there is research that indicates that mother's employment is negatively related to academic achievement, particularly for young children (Bogenschneider & Steinberg, 1994; Ermisch & Francesconi, 2012). Overall, these studies suggest that the negative association between maternal employment and academic performance among children may be explained as a function of parents having less time to take care of their children. This can be conceptualized as the tradeoff effect between working and childrearing, which disproportionally affects women more than men. Therefore, given that there is a strong, but conflicting, body of research about the impact of parental employment in academic achievement, particularly maternal employment, I considered it important to include these variables in the estimation models. As observed in Table 2, parental employment was originally coded as a categorical variable composed of 11 groups. Many studies about poverty in Latin America have used economic sectors as a reference to categorize parental occupations (Attanasio & Székely, 2001). For example, they have employed categories such as agriculture, industry, construction, transport and communication, public sector, personal services, financial services, and unemployed (Attanasio & Székely, 2001). Based on previous research, parental employment was coded as a categorical variable, comprised of six categories. As such, the variable took the value of "0" to refer to non-wage-earning, which includes people who are unemployed and stay at home parents; "1" farmer; "2" service and construction; "3" pensioner; "4" professional and administrative work; and "5" CEO or owner of a small business.

As to school characteristics, most studies suggest that type of school (private vs. public) (Braun et al, 2006; Duncan & Sandy, 2007; López et al., 2017), length of school day (Alfaro et al, 2015; Dominguez & Ruffini, 2020; Hincapie, 2016; Orkin, 2013; Pires & Urzua, 2011), and school setting (rural vs. urban) (Duarte et al, 2012; Gaviria, 2017) are key indicators of academic achievement gaps. In what follows, I explain each of these variables separately.

School Type. This variable assesses whether schools are public or private. Research suggests that students who attend private schools perform slightly better in academic tests than students who attend public schools. A potential explanation for this is that private schools have more resources, more flexibility in relation to curriculum design and pedagogical practices, and a well-defined leadership structure (Braun et al, 2006; Duncan & Sandy, 2007; López et al., 2017). The frequency distribution of this variable indicated that 79.9% of students in fifth and ninth grade in Colombia attended public schools and 20.1% attended private schools, which is representative of the school population. In most studies, this variable has been coded as a dichotomous/dummy because there are only two response options. Thus, this variable took the value of "0" if the school was private, and "1" if the school was public.

Length of School Day. This measures whether children attend school in a half day format or a full day format. Because of limited infrastructure, schools in Colombia operate in shifts. For example, children can go in the morning (6:30 a.m.-12 p.m.), afternoon (12:30 p.m.-6:30 p.m.), night (7 p.m.-10 p.m.), full day (6:30 a.m.-4 p.m.), and Saturdays (7 a.m.-6 p.m.). The frequency distribution of this variable indicates that 75% of students attended schools which operated during the morning and afternoon shifts; 24% of students attended schools that operated on a full-day format; and 1% attended schools that operated at night or on Saturdays. Colombia is pushing to extend the school day based on research that indicates that lengthening the school day improves academic achievement (Alfaro et al, 2015; Dominguez & Ruffini, 2020; Hincapie, 2016; Orkin, 2013; Pires & Urzua, 2011). Research on this area has coded length of school day as a categorical variable. For most Latin American countries, this variable has been coded into two categories, full day, and half day (Alfaro et al, 2015; Pires & Urzua, 2011). Given the characteristics of the education system specifically in Colombia, however, this variable has been coded into more than three categories (Hincapie, 2016). As observed in Table 2, the variable *length of school day* was originally divided into six categories: 1) full day (7 a.m.-12:30 p.m. + out-of-school enrichment programs); 2) morning; 3) night; 4) Saturdays/weekends; 5) afternoon; 6) full day (7 a.m.-4 p.m.). Based on previous research and the frequency distribution for this variable, I decided to merge "morning" and "afternoon" into one category and name it "half day." Similarly, I decided to merge the two "full day" options into one category and call it "full day". The category "Saturday/weekends" and "night" were removed from the analysis because they served a student population older than 18. Using this category would have inflated the results, yielding biased estimators. Hence, I coded this variable as a dummy variable. The variable took the value of "0" if students attended schools in a half day format, and "1" if students attend schools in a full day format.

School Setting. This measures whether the school is in a rural or an urban setting. Research on socioeconomic achievement gaps in Colombia suggests that students who attend rural schools perform lower on academic tests than students who attend urban schools, even after controlling for socioeconomic status (Duarte et al, 2012; Gaviria, 2017). The frequency distribution of this variable indicated that 77.3% of students in fifth and ninth grade in Colombia attended schools that are in urban settings, while 22.7% attend schools in rural settings, which is representative of the school population. Most studies on education gaps in Colombia have coded this variable as a dichotomous variable because census information classifies people as living in rural or urban areas depending on population density, economic growth, and socioeconomic development (DNP, 2014). As such, sociodemographic survey questions in Colombia have only two response options in relation to geographic residence. Based on previous research, I decided to code this variable as a dummy variable. This variable took the value of "0" if the school is in a rural setting and "1" if it is in an urban setting.

3.4.1.3. Data Screening

The procedure for screening my dataset included a few steps. First, I exported the full dataset from the ICFES website and converted the file from *.txt* format into Excel. Once the data were in Excel format, I exported them into STATA and SPSS. It is important to highlight that I used both statistical packages because I wanted to compare results, particularly regarding the multilevel estimation models. From an applied research perspective, this decision contributed to triangulation and cross-validation, hence yielding rigorous results. I then selected each of the variables listed above and began the process of cleaning and coding. Cleaning the data entailed determining whether data were missing at random, completely at random, or not at random (Howell, 2007). In this study, data were missing at random. As highlighted at the beginning of this chapter, this study used a convenience sampling technique. As such, only cases for which there was complete information about ownership of durable goods, SABER test scores, school attendance, and sociodemographic information were considered. Therefore, to deal with missing data, I employed listwise deletion (Hox et al., 2016; Schumacker & Lomax, 2010).

Furthermore, I screened variables to examine cases of skewness and kurtosis by employing histograms. I also conducted a Mahalanobis distance test to identify outliers. After this, outliers were analyzed on a case-by-case scenario and deleted from the dataset. Decisions about coding were based on previous research and frequency distributions of the variables of interest. As such, I ran frequency distributions for all the variables that were used in this dissertation. Once data were screened and cleaned, I proceeded to conduct data analysis.

3.4.2. Data Analysis (Step Two)

Data analysis was conducted in four stages that ranged from conducting descriptive statistics to running the different multilevel linear and logistics models used to answer the research questions addressed in this study. It is important to stress that this step was conducted on the total sample and on four subsamples (girls, boys, fifth graders, and ninth graders). In what follows, I explain each of the stages and the different procedures.

3.4.2.1. Examine Descriptive Statistics

The first stage consisted of running descriptive statistics for all the variables that were selected for this study. In general, descriptive statistics are used to summarize basic information about a given number of variables in a dataset (Howell, 2007). These analyses were conducted using the *Analyze – Descriptive Statistics – Frequencies* built-in command in SPSS. I used this information to build one table that summarizes all the descriptive statistics for the variables of interest in this study.

3.4.2.2. Operationalization of Durable Goods

The second stage of data analysis encompassed the operationalization or modeling of durable goods. As highlighted in the Research Design section, this study used three different methodological approaches to model durable goods: inventory, attributional, and index approaches. Therefore, in this stage I generated new variables, when applicable, to represent each of the approaches. In what follows, I explain how I created these variables for each approach.

Inventory Approach. Because this approach entailed including all the seven durable goods as independent variables in the estimation models, it did not require creating new variables. Hence, all the durable goods were used in the estimation models.

Attributional Approach. The attributional approach was used to group durable goods by attribute. I grouped the seven durable goods into three categories: information goods; household efficiency goods; and entertainment goods. Information goods included computers and Internet access. Household efficiency goods encompassed washing machines and microwaves. Entertainment goods comprised televisions, videogame consoles, and ownership of a car. Hence, I created three new variables: information goods, efficiency goods, and entertainment goods. As mentioned in the beginning of this chapter, I used two options to model this approach to account for household wealth: unconditional and conditional approaches. In the unconditional approach (UA), which represented low-income households, I modeled durable goods as possession of at least one of the durable goods in the efficiency and entertainment categories. In the conditional approach (CA), which depicted more affluent households, I operationalized durable goods as ownership of all the durable goods in the efficiency and entertainment categories. Because computers and Internet access are complementary commodities, information goods were modeled as ownership of both durable goods.

Index Approach. This approach encompassed constructing a durable goods index using exploratory factor analysis (EFA) for binary variables. Factor analysis is a statistical technique used "to reduce a large number of variables in a dataset to a smaller number of factors, to describe the relationship among observed variables, or to test theory about underlying processes" (Tabachnick & Fidell, 2007 p. 610). The purpose of factor analysis is to estimate a model that explains the variance and covariance of the observed variables by a set of fewer unobserved factors (Hatcher, 1994; Tabachnick & Fidell, 2007).

There are two types of factor analysis: exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). Exploratory factor analysis summarizes the data by grouping correlated variables to generate hypotheses about specific underlying processes (Tabachnick & Fidell, 2007). EFA is usually performed during the early stages of research as a tool to investigate the nature of the factors and how they relate with the variables (Henson & Roberts, 2006). Confirmatory factor analysis is a more advanced technique used to test generalization of factor structure. In CFA, the nature of the factors or constructs is known to the researcher because it has been substantiated by theory. As such, it is used to fully test the hypotheses about the factorial structure of the measure (Henson & Roberts, 2006). In some cases, EFA and CFA can be used as complementary methods. For example, in a one-factor solution model EFA and CFA are the same because all the variables are contained in one factor. This may occur if the factor solution has few variables or if the variables are highly correlated among each other. In this study, I conducted both EFA and CFA because when I performed EFA, I obtained a one-factor solution. It is important to stress that CFA was used to test model fit.

According to Tabachnick and Fidell (2007), several assumptions must be met to perform factor analysis. The first assumption is that there are no outliers in the data. The second assumption is that sample size must be larger than 300, with more than 1,000 considered excellent. The third assumption is that perfect collinearity must be avoided. The fourth assumption is that given that factor analysis is a linear function of the variables that are measured, it does not require homoscedasticity between the variables. The fifth assumption is that factor analysis is based on the linearity assumption, which suggests that the relationship between X and the mean of Y is linear. The sixth assumption is that there must be some degree of normality for the variables that are included in the factor analysis solution. Continuous variables that do not meet this criterion need to be transformed (e.g., logarithm, square root, cube root). For dichotomous/binary variables, factor analysis is performed using a matrix of tetrachoric correlations. For ordinal or categorical variables, this is performed using a matrix of polychoric correlations (Tabachnick & Fidell, 2007).

Once these assumptions are fulfilled, there are six steps to conduct EFA:

1. *Identify* and select the variables that will be used for factor analysis
2. *Screen data*. This step includes identifying outliers, checking that all variables meet the normality requirement, and handling missing data (Tabachnick & Fidell, 2007). For dichotomous or ordinal variables, a matrix of tetrachoric or polychoric correlations must be performed. If the data are missing completely at random or missing at random, it is recommended to perform multiple imputation or to drop the cases if they account for less than 5% of the data (Tabachnick & Fidell, 2007). In the case where the variables are measured in different scales, it is recommended to standardize them (create z scores) to compare them
3. *Factor extraction*. Factor extraction determines the factor solution (number of factors). It is recommended to use three methods for factor extraction: parallel analysis (PA), the Kaiser criterion, and the scree plot. Only factor loadings at or above 0.45 would be retained, as recommended by Finch (2020), Hogarty et al. (2005) and Osborne et al. (2008)
4. *Factor rotation*. This is done to increase interpretability of the factor solution. It is recommended to perform an unrotated factor analysis first to see how the different variables cluster around the factors, and then perform an *oblique rotation* to see the correlation between the different factors and the variables (Schmitt, 2011)
5. *Interpret the factors*. This entails identifying the nature of the factors and how they relate to theory or to the research questions. Once the factors are identified, factor scores may be created. These scores can then be used as predictor variables in further analyses

6. *Validation and reliability of the measures*. Use Cronbach's alpha to test internal consistency and the Kaiser-Meyer-Olkin test to assess sample adequacy (Vollmer & Alkire, 2018)

Because EFA yielded a one-factor solution, confirmatory factor analysis (CFA) was used to test model fit. In general, there are four steps to conduct CFA:

1. *Create a path diagram* depicting the factorial structure underlying the measures (variables), which is based on theoretical or conceptual constructs
2. *Fit the factorial structure to the data*. This entails specifying which variables go into which factors
3. *Examine the goodness of fit index and modification index*. To determine model fit, Finch (2020), Henson and Roberts (2006) and Schmitt (2011) recommend the following four indices: Model Chi-square; square root of the sum of squared correlation residuals for the indicator variables (SRMR); root mean square error approximation (RMSEA); and comparative fit index (CFI). For Chi-square, a *p*-value > .05 was considered a good fit. For SRMR, values less than .08 suggested acceptable fit. In the case of RMSEA, a value of .06 or less indicated good fit. For CFI, a value of .9 or higher suggested that the data fitted well
4. *Consider the types of changes that can be made to fit the data better*. After this, it is recommended to repeat steps two through four

Construction of the Durable Goods Index. Building on previous research and best practices on factor analysis, I performed an EFA using a *matrix of tetrachoric correlations*. Because the variables that were selected were dichotomous, I did not have to check for the normality assumption or for outliers. Regarding sample size, this study used 364,436 observations, an optimal number for conducting factor analysis. In addition, it is important to stress that I used listwise deletion as the method for dealing with missing data, which were missing at random. STATA 17 was used as the main statistical software to perform EFA and CFA. [10]

The first step in the process of conducting EFA was to run a tetrachoric correlation matrix with all the durable goods. Factor extraction was conducted using three approaches: parallel analysis (PA), the Kaiser criterion, and the scree plot. In addition, factor loadings were rotated to facilitate interpretability of the factor solution, and oblique rotation was performed because of the likely correlation between the seven durable goods. Only factor loadings at or above .45 were retained as recommended by Finch (2020), Hogarty et al. (2005) and Osborne et al. (2008). Tetrachoric correlations were adjusted to be positive semidefinite so that all eigenvalues are real and positive (Vollmer & Alkire, 2018). To improve communality estimates, iterated principal-factor (IPF) was selected as the extraction method (StataCorp, 2013).

For the seven durable goods, based on the tetrachoric exploratory factor analysis with oblique rotation, a one-factor solution underlying durable goods emerged. It is important to highlight that parallel analysis suggested a three-factor solution. However, following the Kaiser criterion and the scree plot that resulted from the parallel analysis, it was clear that a one-factor solution was more appropriate. Choosing a three-factor

[10] All the commands and codes used for performing EFA and CFA were saved in a Do-file, which may be accessible upon request.

solution would have entailed that at least two of the factors would have had two variables that were strongly correlated ($r > .7$), a condition that was not satisfied. After this, I proceeded to create factor scores, which embodied the durable goods index. Finally, I obtained the Cronbach's alpha and the Kaiser-Meyer-Olkin measures.

Because this was a one-factor solution, I also conducted CFA on the dataset. To do this, I first created a path diagram to show that the correlation among variables (or covariance) was due to one common factor (Hatcher, 1994). After the path diagram was completed, I performed CFA on the data and obtained the model fit indices recommended by Finch (2020), Henson and Roberts (2006), and Schmitt (2011), which indicated that the structure of the model was adequate.

3.4.2.3. Correlations, T-tests, and Analysis of Variance

The third stage of the data analysis entailed conducting a Pearson's correlation matrix analysis, t-tests, and ANOVA tests. This stage of data analysis was performed using STATA 17.[11] The Pearson's correlation matrix analysis was performed to assess the level of association between variables (Howell, 2007). If variables are highly correlated, a phenomenon known as multicollinearity, they can introduce bias in the results. When performing the correlation matrix, each variable obtains a correlation coefficient that ranges between 0 and 1, with a positive or negative sign indicating the direction of the association (Howell, 2007). In general, coefficients lower than .3 are considered low, meaning that there is a weak correlation between the variables.

[11] All the commands and codes for all the analyses and tests were saved in a Do-file, which may be accessible upon request.

Coefficients below .6 are considered moderate, which entails that there is some correlation between variables. By contrast, coefficients above .7 are considered high, meaning that there is a strong correlation between the variables. It is strongly recommended that variables that have a correlation coefficient above .7 are removed from estimation models because they could introduce bias in the results. For this study, coefficients below .65 were considered moderate and it was assumed that if included in an econometric model, they would not generate collinearity problems.

T-tests and the analysis of variance (ANOVA) constituted a useful exercise for hypothesis testing, in preparation for the multilevel linear and logistic estimations. Independent-samples t-tests were conducted to compare the means of reading and math test scores between two groups for a given variable (StataCorp, 2021). This entailed that t-tests were used only for two-level categorical variables or binary variables. As such, the variables that were used for the t-test analyses were sex, preschool education, ownership of durable goods, school type, school setting, and length of school day. Because hypothesis testing is an important step in the process of conducting t-tests, I developed two general hypotheses for all the variables. It is important to stress that the null hypotheses were rejected if $p < .05$ (95% confidence interval).

Null hypothesis (Ho): there are not statistically significant differences in the mean scores for reading and math between groups for each of the selected variables

Alternative hypothesis (Ha): there are statistically significant differences in the mean scores for reading and math between groups for each of the selected variables

For variables that had more than two categories such as parental education and parental employment, I performed one-way ANOVA tests to identify differences in mean reading and math scores (StataCorp, 2021). Additionally, I used the Tukey post hoc test to examine which groups differed from each other. Summary tables were created to show this information.

3.4.2.4. Multilevel Modeling Analysis

The last stage of the data analysis entailed conducting multilevel modeling analysis. The rationale for this is because data were nested in four levels: students, schools, municipalities, and states. Not accounting for this clustering effect would have yielded biased estimators about the relationship between durable goods and educational outcomes. For example, it is likely that households that live in wealthier or more developed departments and municipalities have more access to durable goods, better schools, and, overall, more opportunities to access different types of assets than people who live in less developed regions.

In general, multilevel models are a type of ordinary least square (OLS) regression method that considers when the predictor variables are structured or nested at varying hierarchical levels (Harring et al., 2016; Raudenbush & Bryk, 2002). In this study, multilevel models were used to examine the decomposition of the variation in the 2017 SABER test results for reading and math as well as school attendance for a sample of fifth and ninth grade students in Colombia and how much of that variation was associated with ownership of durable goods, controlling for other sociodemographic and socioeconomic variables. Because this study used two outcome variables, one continuous and one binary, I utilized two types of multilevel models: multilevel linear models and multilevel logistic or nonlinear models. Multilevel linear estimation was used to explore the relationship between durable goods and academic achievement; and multilevel logistic models were employed to examine the relationship between durable goods and school attendance.

This study used a four-level multilevel model because students were nested within schools, schools were nested within municipalities, and municipalities were nested within departments. Following Harring et al. (2016), Raudenbush and Bryk (2002) and Raudenbush et al. (2019), the four-level model is composed of four submodels, one for each level. In this study, the level-one model represented the relationships among the student-level variables, including ownership of durable goods; the level-two captured the influence of school-level correlates, the level-three included municipality-level effects, and the level-four accounted for the department-level factors (Raudenbush et al., 2019).

Multilevel analyses were performed using STATA 17 and SPSS 28. I used both statistical packages for two reasons. The first was because it took STATA more than 24 hours to run the multilevel logistic models. In contrast, SPSS ran the multilevel logistic models in less than 10 hours, which significantly improved efficiency. The second reason was because I wanted to cross-validate the results to ensure reliability and robustness. It is important to stress that I performed estimations on the total sample ($n = 364,436$), which addressed the first research question of this study; and estimations where I stratified the sample by sex and school grade, which addressed the second research question of this study. Similarly, given that academic achievement encompassed reading and math scores, I had to perform separate estimations for each outcome. Furthermore, because I used three different methodological approaches to model durable goods, I also had to run different estimation models for each approach. Tables 3 and 4 show the number of multilevel estimations that were conducted in this study. The output from each estimation model was used to create summary tables to compare results across approaches and samples, which will be presented in Chapters Four and Five.

Table 3

Summary of Multilevel Modeling Estimations Conducted on Total Sample

Type of Multilevel Modeling	Methodological Approach	Number of Estimations per Outcome
Linear		
Outcomes (continuous)		
(a) Reading scores	a) Inventory (x1)	
	b) Unconditional (x1)	
	c) Conditional (x1)	4
	d) Index (x1)	
(b) Math scores	a) Inventory (x1)	
	b) Unconditional (x1)	4
	c) Conditional (x1)	
	d) Index (x1)	
Nonlinear (logistic)		
Outcome (binary)	a) Inventory (x1)	
Being absent from school	b) Unconditional (x1)	4
	c) Conditional (x1)	
	d) Index (x1)	
Total Number of Multilevel Estimations		12

Note. (x1) denotes the number of estimations conducted per approach, one in this case.

As observed, I conducted a total of 12 multilevel estimations for the total sample: eight for the continuous outcomes (reading and math) and four for the binary outcome.

Table 4

Summary of Multilevel Modeling Estimations Conducted on Stratified Samples

Type of Multilevel Modeling	Methodological Approach by Stratified Sample		Number of Estimations per Outcome
	Sex (Boys and Girls)	Grade (Fifth and Ninth)	
Linear			
Outcomes (continuous)			
(a) Reading scores	a) Inventory (x2) b) Unconditional (x2) c) Conditional (x2) d) Index (x2)	a) Inventory (x2) b) Unconditional (x2) c) Conditional (x2) d) Index (x2)	16
(b) Math scores	a) Inventory (x2) b) Unconditional (x2) c) Conditional (x2) d) Index (x2)	a) Inventory (x2) b) Unconditional (x2) c) Conditional (x2) d) Index (x2)	16
Nonlinear (logistic)			
Outcome (binary) Being absent from school	a) Inventory (x2) b) Unconditional (x2) c) Conditional (x2) d) Index (x2)	a) Inventory (x2) b) Unconditional (x2) c) Conditional (x2) d) Index (x2)	16
Total Number of Estimations			48

Note. (x2) denotes the number of estimations conducted per approach, two in this case.

As highlighted in Table 4, a total of 48 multilevel estimations were conducted for the stratified samples: 32 for the continuous outcomes and 16 for the binary outcome. The rationale for this is that when the total sample was stratified, I had to perform the 12 multilevel estimations shown in Table 3 for four subsamples of the data: boys, girls, fifth graders, and ninth graders. It is important to stress that Table 3 summarizes the estimations that were conducted to answer the first research question of this dissertation. Similarly, Table 4 shows the number of estimations that were performed to answer the second research question of this study.

3.4.3. Quality Checks and Test for Validity (Step Three)

In this study, validity was assessed by conducting different tests to ensure that results were robust and obtained in a transparent and rigorous manner. Thus, validity tests were performed at each stage of the data analysis process. Regarding descriptive statistics, for example, I screened the data for missing values and conducted a Mahalanobis distance test to identify outliers. Similarly, I ran frequency distributions and plotted histograms as well as box-whisker plots to find extreme values.

In relation to the operationalization of durable goods, the only approach that required tests of validity was the index approach. As described before, this study used EFA as the main method for index construction and CFA to assess model fit. The first quality check in this process was to use a tetrachoric correlation matrix to perform EFA given that the variables of interest were binary. To guarantee that factor extraction was robust and that incorporated best practices, I performed parallel analysis as the main extraction method, but I also used the scree plot and the Kaiser criterion. Finally, I used the Cronbach's alpha to test internal consistency and the Kaiser-Meyer-Olkin test to assess whether the data were suited for conducting factor analysis. To assess model fit, I conducted CFA to obtain the following model fit indices: a) Chi-square; b) square root of the sum of squared correlation residuals (SRMR); c) root mean square error approximation (RMSEA); and d) comparative fit index (CFA).

As to the multilevel linear and logistic models, I employed different tests to ensure validity before and after running the models. In preparation for the multilevel analyses, I conducted various validation procedures including correlation analyses, independent t-tests, and analysis of variance.

Performing multilevel estimation entailed building different models. Following Raudenbush and Bryk (2002) and Raudenbush et al. (2019), I first ran a null model with no predictors to examine if the variance for each of the outcome variables varied by level. If the variances were different at each level, this entailed that multilevel modeling was the correct estimation method. Then, I ran different multilevel models with predictors. To assess validity after running the models, I employed different post-estimation tests. For the multilevel linear models, I used the likelihood ratio test, the Chi-square, and significance levels to assess the validity of the estimations. For the multilevel logistic models, I employed the likelihood ratio test, the log likelihood, the Wald test, and significance levels of the coefficients. Additionally, it is important to stress that I ran the multilevel models in different statistical packages to compare results. For example, I conducted the multilevel analyses in STATA and SPSS. Similarly, Dr. Sean Hurley helped me run the models in SAS and R also. Comparisons across statistical software indicated that the results were consistent, which contributed to improve validation and reliability.

CHAPTER FOUR
POWERING UP: THREE APPROACHES TO MODEL THE RELATIONSHIP BETWEEN DURABLE GOODS AND EDUCATIONAL OUTCOMES IN COLOMBIA (ARTICLE #1)

Assessments of wealth have traditionally focused on analyzing the role of income. However, opulence, to borrow Adam Smith's terminology, lies in the types of assets that people have and in how they use them (Smith, 1776/1976). As opposed to income, which is a flow of money, goods, or services used for immediate consumption, assets are stocks of resources that can be invested to generate income, to acquire other assets, or use for future consumption (Hoekstra, 2019; Sherraden, 1991). Examples of assets include physical capital (e.g., land or real estate), financial capital (e.g., savings, bonds, or credit), human capital in the form of education, durable goods, cultural capital, social capital, and political capital (Attanasio and Székely, 2001, Kumaraswamy et al., 2020; Sherraden, 1991; United Nations Environment Programme, 2018; World Bank, 201). Thus, assets can provide a more comprehensive understanding of wealth because they represent all the different forms of capital or resources that people possess.

Scholars such as Sherraden (1991), Moser (1998, 2006, 2008), Shapiro and Wolff (2001), Attanasio and Székely (2001), Kratz (2001), Siegel and Alwang (1999), and Siegel (2005) have pointed out that assets are key factors to foster social and economic welfare because they provide people with opportunities to improve their living conditions, invest in their well-being, and achieve agency. Similarly, the work of organizations such as the United Nations, the World Bank, and the Inter-American Development Bank has gradually pushed for the implementation of policy guidelines and programs that include access to assets and asset accumulation within their poverty reduction strategies (Inter-American Development Bank, 2021; López-Calva & Rodríguez-Castelá, 2016). For example, the United Nations spearheaded the development of the Global Multidimensional Poverty Index (Global-MPI), a policy tool that measures non-income poverty, and the implementation of the Sustainable Development Goals (SDGs), a global agenda devoted to eradicating all forms of poverty (United Nations, 2020, 2021).

Although both initiatives have played a key role in promoting social and economic development, the Global-MPI constitutes one of the most complete tools to measure household wealth beyond income. The Global-MPI is composed of three dimensions of development: health, education, and living standards. The dimension of health assesses if people in the household are undernourished or have experienced the death of children under the age of 18. Education measures if school-age children attend school, and if there is school lag. Living standard assesses the living conditions of the household by considering whether families have access to cooking fuel, electricity, sanitation, potable water, adequate housing materials, and ownership of assets in the form of durable goods (United Nations Development Program & Oxford Poverty and Human Development Initiative, 2020). Although the Global-MPI was initially developed to compare multidimensional poverty across countries, it has served as an input for the formulation of local multidimensional poverty assessments. In 2011, for example, the government of Colombia launched its own version of the Global-MPI, called the Colombian Multidimensional Poverty Index (C-MPI) (Angulo et al., 2011). Of interest to this study was to examine the interlinkage between possession of assets, as defined in the Global-MPI, and educational outcomes among children in Colombia. The rationale for this is that research on this subject is limited and that the C-MPI, does not include assets as an indicator of multidimensional poverty (Angulo, 2016; Angulo et al., 2011; García et al., 2013; Salazar et al., 2013).

Most research on assets can be divided in two categories. The first category encompasses studies that examine the relationship between *assets and poverty*. Such studies have focused on analyzing how financial assets, durable goods, education, and social capital relate to poverty (Attanasio & Székely, 2001; Kratz, 2001; Sherraden & Barr, 2005; Siegel & Alwang, 1999). In this category, financial assets and education are the most salient factors associated with poverty. Findings suggest, for example, that families who own financial assets such as homes or who have access to credit are less likely to fall into poverty (Gray-Molina et al., 2001; Shapiro & Wolff, 2001). Similarly, evidence shows that poverty concentrates among households with low levels of educational attainment and among families with weak group affiliations (Contreras & Larrañaga, 2001). The second category comprises research that explores the relationship between *assets and education*. Studies in this category have mostly investigated the impact of financial assets such as savings or children development accounts (CDAs), a type of investment or saving account which is geared to help low-income children access postsecondary education, on educational outcomes. Findings indicate that children whose families have savings or CDAs perform better academically and attend school more often than children whose parents do not have such financial assets (Elliot et al., 2018; Sherraden, 1991; Zhan & Sherraden, 2003; Zhang, 2006).

Less is known about the relationship between durable goods and educational outcomes. Although not a nascent field, most of the research in this area has focused on exploring how durable goods relate to academic achievement and school attendance in the African region (Chowa et al., 2013; Kafle et al., 2018). Overall, findings indicate that ownership of durable goods improves academic achievement. Evidence of the impact on school attendance, nonetheless, is less clear. Despite advancements in this field, two issues remain. The first is that studies on durable goods have been conducted as part of a larger research agenda on assets (Attanasio & Székely, 2001), which may explain the limited body of research that is available on this subject. The second issue is that most research in this field has modeled durable goods by using two methodological approaches: a binary and an index approach.

In the binary approach, researchers have modeled durable goods as a binary explanatory variable that assesses possession of *any* durable good or possession of *at least one* durable good, regardless of the number or types of durable goods that households may own. For example, in a study about household possessions and school outcomes in Ghana, Chowa et al. (2013) modeled durable goods as a binary variable which took the value of "1" if students had access to *any* durable good at home and "0" if they did not have any durable goods. Using this variable as the independent variable, researchers conducted a propensity score analysis and found that youth from families with household possessions scored close to one point higher on English language than students whose families did not have household possessions (Chowa et al., 2013).

In the index approach, durable goods have been operationalized through the construction of indices, with principal component analysis (PCA) as the main statistical method. For example, Filmer and Pritchett (1999) conducted a study on the effect of household wealth on educational attainment in developing countries. Using principal component analysis (PCA), Filmer and Pritchett (1999) built an asset index, which included possession of different durable goods, to account for household wealth. Findings indicated that across the 35 developing countries that were analyzed in the study, household wealth was positively associated with highest grade completed and school attendance. In a well-documented study about the effect of different types of assets on educational outcomes in Tanzania, Kafle et al. (2018) found that possession of household durable goods and housing quality were positively associated with school completion for elementary and high school children. Using principal component analysis (PCA), the authors built four indices: an agricultural asset index; a household durable index; a housing quality index; and an aggregate asset index, which included all the three indices. The agricultural and housing quality indices were created by assessing factors such as size of land holding, number of agricultural tools, home ownership, and access to electricity and safe drinking water. To build the household durables index, Kafle et al. (2018) arranged the number of durable goods by attribute in three groups: a) information assets, which included TVs, radios, or cellphones; b) transportation assets such as cars, motorbikes, or bicycles; and c) other durable assets such as furniture and kitchen appliances. Findings suggested that ownership of household durable goods and quality of housing were positively associated with increasing children's highest grade completed. By contrast, agricultural assets were negatively associated with educational attainment because such assets may increase the likelihood that children engage in household chores or child labor (Kafle et al., 2018). Estimates for agricultural assets also indicated that the effects were higher for rural children, girls, and children from low-income backgrounds, probably because of the higher opportunity costs associated with schooling.

Although such methodological approaches have yielded useful results, they have provided only a partial picture of the nature of the relationships between durable goods and educational outcomes. For example, one of the assumptions of the binary approach is that all durable goods have the same effect on academic achievement. Hence, it does not differentiate between having a TV, radio, computer, washing machine, or refrigerator. However, it is possible that each commodity has a different effect on education. Not accounting for these differential effects may lead to inaccurate assessments about the impact of durable goods in educational outcomes, which could affect policy formulation. In the case of the index approach, there is a methodological drawback related to using PCA for index construction because this method assumes no measurement error, which can generate overestimated values of the variance that is explained by each of the components (Schmitt, 2011). Research in the field of development economics, particularly in relation to multidimensional poverty, strongly recommends the use of exploratory factor analysis (EFA) as the main method for index construction (Vollmer &

Alkire, 2018) and confirmatory factor analysis (CFA) for addressing issues such as hypothesis testing, and model fit for EFA solutions (Henson & Roberts, 2006).

Such gaps in the literature offered a great opportunity for conducting this study. Using multilevel modeling with data from a standardized test administered to fifth and ninth graders in Colombia for the year 2017, this research explored the relationship among durable goods (an indicator of the Global-MPI), academic achievement, and school attendance in Colombia by employing different methodological approaches to model durable goods. The methods section shows the strategy that was used to address the research question, including the operationalization of durable goods and the econometric models. In the results section, descriptive statistics illustrate important information about possession of durable goods among children in Colombia while the inferential multilevel models demonstrate a significant statistical relationship between the variables of interest. The discussion section positions these results within the literature on this field and underscores the most salient limitations. Finally, the article concludes with research and policy recommendations based on the lessons learned from the three approaches. This paper contributed to the existing literature by expanding the methodological and geographical scope of the relationship between durable goods and educational outcomes.

4.1. Context

According to the most recent population census, Colombia has an estimated population of 49 million people, of which 51.2% are women (DANE, 2020a). In 2020, 18.1% of the population were multidimensionally poor (Multidimensional Poverty Peer

Network, 2021). Geographically, the country is divided in 32 departments (or states) and 1,101 municipalities. According to the 2017 World Bank GINI index, a measure of inequality based on income distribution within a country, Colombia is one of the most unequal countries in the world (World Bank, 2020b). In the Latin American and Caribbean region, Colombia is the second most unequal country, after Brazil (ECLAC, 2019). This is not surprising: Colombia suffered the consequences of an armed conflict that lasted more than 60 years (from 1960 until 2016) and that left millions of people living in extreme poverty, particularly in rural areas (Centro Nacional de Memoria Histórica, 2018).

Education in Colombia is a fundamental human right, and thus, it is universal from early childhood education to high school (Education Act 115, 1994). According to the Education Act 115 of 1994, the education service can be delivered by the government or by private organizations (authorized by the Ministry of Education). If provided by the government, it is free of charge; otherwise, families must pay a fee set by the school. Because of lack of infrastructure (e.g., not enough schools or classrooms), public schools operate in a half day or a full day format. While half day programs run for six hours a day, full day programs operate for eight hours a day (DNP, 2019). More than 80% of public education in Colombia is delivered through half day programs (DNP, 2019).

Academic achievement is measured by a set of national standardized exams at different school grades called *Pruebas SABER (“SABER tests”)*. At the elementary and middle school level, the test assesses proficiency in reading and math for students in third, fifth, and ninth grades. At the high school level, the test assesses proficiency in math, reading, natural sciences, social sciences, and civic engagement (ICFES, 2018). Research on quality of education in Colombia highlights that, in 2019, 50% of children in Colombia of late primary school age were not proficient in reading (World Bank, 2019). Poverty, poor school quality (not enough schools or under-resourced schools), and lack of a support system outside of school are considered the main barriers to student success (OECD & Ministry of Education of Colombia, 2016). In addition, the armed conflict that took place in Colombia exacerbated educational outcomes for rural students. For example, it is estimated that for every 100 students that enroll in first grade in rural areas, only 35 complete elementary education, only 16 continue middle school, and only seven complete high school (Gaviria, 2017). This corroborates the work of Duarte et al., (2012) who found that achievement gaps among Colombian children are highly associated not only with student's socioeconomic status, but also with school type (public vs. private) and school setting (urban vs. rural). For example, their findings suggest that controlling for socioeconomic status, students who attend public schools located in rural areas perform significantly lower than students who attend public schools in urban areas.

Expanding on the work of Duarte et al. (2012), this paper aimed at exploring the relationship between household wealth, as measured by possession of durable goods, and educational outcomes. The rationale for this is that there is empirical evidence which suggests that possession of durable goods is positively associated with academic achievement (Chowa et al., 2013; Kafle et al., 2018). As such, durable goods may constitute key inputs for the formulation of asset-based social policy, particularly in developing countries (Attanasio & Székely, 2001; Kratz, 2001; Moser, 1998, 2006, 2008; Siegel & Alwang, 1999; Siegel, 2005; Shapiro & Wolff, 2001; Sherraden, 1991).

Notwithstanding these developments, two issues remain. On the one hand, most studies in this field have modeled durable goods by using only two methodological approaches: a binary and an index approach. In the binary approach, durable goods are measured as possession of *any* durable good (Chowa et al., 2013). In the index approach, durable goods are represented in an index (Filmer & Pritchett, 1999; Kafle et al., 2018; Vollmer & Alkire, 2018). From a methodological standpoint, this entails that we have only a partial picture of the relationship between durable goods and educational outcomes. For example, neither approach explains whether different durable goods have differential effects on education. Additionally, most research on this topic has been conducted in African and Asian countries, which offered a great opportunity to expand the geographic scope.

Therefore, this research aimed to answer the question: *What is the relationship among durable goods, academic achievement, and school attendance for fifth and ninth grade students in Colombia?* Using durable goods in lieu of income, this study provided useful insights about their role in creating capabilities to enhance educational outcomes. This research added to the existing literature on this field by using different methodological approaches to model durable goods, including the construction of a durable goods index employing exploratory factor analysis (EFA), and by expanding the geographic scope to the Latin American region. By using multilevel linear and nonlinear modeling, this study explored the relationship among durable goods, academic achievement, and school attendance in Colombia.

4.2. Methods

This study employed three different methodological approaches to model durable goods: inventory, attributional, and index approaches. The inventory approach, also known in the econometrics as the full specification model, entailed using all the durable goods in the estimation models (Stock and Watson, 2015). The attributional approach was used to cluster durable goods that shared a similar attribute in three categories: information goods, household efficiency goods, and entertainment goods (Kafle et al., 2018). Information goods encompassed computers and Internet access; household efficiency goods included washing machines and microwaves; and entertainment goods comprised TVs, videogame consoles, and ownership of a car. Because durable goods are a proxy for household wealth, I used two options to model the attributional approach. The first option, called Unconditional Approach (UA), assessed whether students owned at least one of the durable goods in the household efficiency and entertainment categories (Chowa et al., 2013). This approach represented low-income households. The second option, called the Conditional Approach (CA), measured if the students possessed all the durable goods in the household efficiency and entertainment categories. This approach represented more affluent households as it may be expected that wealthier families own more durable goods. Because computers and Internet access are complementary, information goods were modeled as ownership of both durable goods. The index approach consisted of the creation of a durable goods index by using exploratory factor analysis (EFA), which according to the literature on development economics is the most appropriate method for index construction (Vollmer & Alkire, 2018).

For this research, I used a quantitative design, including descriptive statistics, correlation, and multilevel modeling, a type of Ordinary Least Square regression method that takes into account when the predictor variables are structured or nested at varying hierarchical levels (Raudenbush & Bryk, 2002). Two types of multilevel modeling were used in this paper, linear and logistic. This study used a four-level multilevel model because students were nested within schools, schools were nested within municipalities, and municipalities were nested within departments (Raudenbush et al., 2019). Not accounting for this clustering effect would have yielded biased estimators about the relationship between durable goods and educational outcomes. For example, it is likely that children who live in wealthier or more developed departments and municipalities have more access to durable goods, better schools, and, overall, more opportunities to access different types of assets than children who live in less developed regions. Thus, multilevel modeling allowed me to distinguish between the variance in academic performance and likelihood of being absent from school attributable to students' characteristics, including ownership of durable goods, from the variance attributable to characteristics of schools, municipalities, and departments (Raudenbush & Bryk, 2002; Raudenbush et al., 2019).

4.2.1. Data Collection

Data were provided by the *Instituto Colombiano para el Fomento de la Educación Superior* (ICFES) – Colombian Institute for the Evaluation of Education – as part of their Open Data policy. I used the 2017 SABER test because it is the most recent dataset available. The dataset provided information about different school outcomes, including academic achievement and school attendance, as well as students' sociodemographic and socioeconomic information for all the population of children in third, fifth, and ninth grades in Colombia (ICFES, 2019). The data also contained information about school type (public vs. private), setting (urban vs. rural), length of school day (half day vs. full day), and type of curriculum (academic, technical, or vocational). I used a subset of the data that focused exclusively on fifth and ninth grade students because the data did not capture information about durable goods for third graders. Hence, the number of fifth and ninth graders who took the SABER test in 2017 was 1,369,887. This study used a convenience sampling technique because it considered only students in fifth and ninth grade for whom there was complete information about their SABER test scores and the demographic and socioeconomic characteristics of their households. Therefore, the final sample for this study comprised 364,436 students in fifth and ninth grade in Colombia.

4.2.2. Participants

The study totaled 364,436 students selected from a subset of the 2017 SABER test for fifth and ninth grade students in Colombia. Age of students ranged from 9 to 15. Mean age was 12.34, with a standard deviation of 1.979. In this sample, 51.44% of students identified as girls and 48.56 % as boys. Data were de-identified, thus posing little to no risk to participants. Sociodemographic and socioeconomic information of the students was strictly used for research purposes.

4.2.3. Variables

The variables that were used in this study capture information about students in fifth and ninth grade in three domains: 1) sociodemographic and socioeconomic characteristics, including ownership of durable goods; 2) educational outcomes (e.g., SABER test score results and school attendance); and 3) school characteristics. In what follows, I describe the variables that were used to examine the relationship among durable goods, academic achievement, and school attendance in Colombia.

4.2.3.1. Dependent Variables

This study used two dependent variables: 1) SABER test results for reading and math, and 2) school attendance. Academic achievement is measured by the 2017 SABER tests in reading and math for students in fifth and ninth grade. Test scores range from 100-500, with 100 being the lowest and 500 the highest. Depending on the score obtained, and to measure the level of proficiency on each subject, students are placed in one of four categories (see Appendices B and C). To compare results across grades, z-scores were computed.

School attendance is measured by the number of days students were absent from school the month before taking the SABER test. In Colombia, school attendance is measured by the number of days in a year that a student goes to school. According to the Ministry of Education of Colombia, an academic school year comprises 200 days (Ministry of Education of Colombia, 2021b). By the same token, absenteeism is defined as the intentional or unjustified absence from school, which is measured by the number of days in an academic year that students are absent from school (Ministry of Education of

Colombia, 2021b). This can be calculated weekly, monthly, or yearly. The 2017 SABER dataset captures this information by month (the month prior to taking the test). Responses to this question included: never; one or two days; between three and five times; and more than five times. A study conducted by García and Weiss (2018) about student absenteeism in the United States defined chronic absenteeism as missing 10% of the total number of school days in an academic year, and extreme chronic absenteeism as missing more than 10%. According to this study and for the United States context, for example, missing three days or more in a month is considered chronic absenteeism while missing more than ten days in a month constitutes extreme chronic absenteeism (Balfanz & Byrnes, 2012; García & Weiss, 2018; Jacob & Lovett, 2017). On the contrary, missing fewer than two days in a month may be considered a fortuitous event highly associated with illnesses or medical appointments (García & Weiss, 2018). A secondary study about the relationship between nutrition and school absenteeism in Colombia estimated that missing two days or more in a month constitutes chronic absenteeism, which is highly associated to low academic achievement (Rodríguez-Escobar et al., 2015).

Given the ambiguity as to what constitutes chronic absenteeism and that the values reported for this variable overlap with the cut-offs established in the two studies, I decided to code this variable as a dummy variable. Thus, this variable takes the values of “0” if the students were not absent from school and “1” if the students were ever absent from school. This entailed combining all the students who were absent in school for at least 1 day a month.

4.2.3.2. Independent Variables

In this study, durable goods represented the independent variable. The data captured information for seven durable goods: Internet access; TV; PC or laptop; washing machine; microwave; car; and videogames. Because I employed different methodological approaches to model durable goods, I used the seven commodities to create new variables, when applicable, to represent each of the approaches. For example, the inventory approach did not require to create new variables as all the durable goods were used in the estimation models. In the attributional approach, I created six variables to account for two options in which households could own information goods, household efficiency goods, and entertainment goods. In the index approach, I used exploratory factor analysis to create a durable goods index. Table 4.1 shows how I modeled the independent variables across the three approaches.

Table 4.1

Modeling of Independent Variables Across Approaches

Methodological Approach	Number of Variables Used/Created	Modeling Decision
Inventory Approach	Seven	All seven durable goods were used
Attributional Approach		
(a) Unconditional Approach	Three	Information goods: possession of computers and Internet access Efficiency goods: possession of washing machine or microwave Entertainment goods: possession of TV, videogames console, or car
(b) Conditional Approach	Three	Information goods: possession of computers and Internet access Efficiency goods: possession of washing machine and microwave Entertainment goods: possession of TV, videogames console, and car
Index Approach	One	Construction of an index to account for all the seven durable goods

4.2.3.3. Control Variables

Control variables were selected based on research about socioeconomic achievement gaps. In what follows, I explain each of the control variables that were used in this research and the decisions pertaining to coding.

Sex. Research on achievement gaps suggests significant differences in elementary school performance between boys and girls. In general, boys perform better in math, while girls perform better in reading and social sciences (Golsteyn & Schils, 2014; OECD, 2012a). Therefore, the variable sex (gender) was chosen to control for any potential differences in academic achievement and school attendance. I coded this variable as "0" for male and "1" for female.

Grade Level. This variable was used to test if the relationship among durable goods, academic achievement, and school attendance varied by school grade. Research on achievement gaps indicates that differences in academic performance start at an early age (Clotfelter et al., 2006). In Colombia, the achievement gap among students in fifth and ninth grade is more pronounced in math than in reading (ICFES, 2018).

Years of Preschool. This variable constitutes a reliable measure to assess socioeconomic status because it is directly related to children's education and to quality of life (American Psychological Association, 2021). Studies on this area suggest that exposure to preschool programs has positive short-term and long-term socioemotional, psychological, and academic benefits (Ansari, 2018; Pianta et al., 2009). This variable was coded as a dummy variable, which took the value of "0" if the child did not attend preschool and "1" if the child attended one, two, or three years of preschool.

Parental Education. This variable was used as proxy for socioeconomic status. I used mother's and father's education because empirical evidence suggests that parental education is a consistent and reliable measure to predict infant health, children's academic achievement, and lower levels of poverty (Contreras & Larrañaga, 2001; Currie & Moretti, 2002; World Development Report, 2018). This variable was coded as an ordinal variable. As such, the variable took the value of "1" for parents who completed elementary school, "2" for parents who completed high school, "3" for parents who had attained a technical/vocational degree or college, and "4" for parents who completed graduate school.

Parental Employment. This variable encompassed father's and mother's employment. In this study, I used father's and mother's employment as proxies of socioeconomic status (Chmielewski, 2019; Currie & Moretti, 2002), which research points to as a consistent and reliable predictor of academic achievement gaps (Chmielewski, 2019; Coleman, 1968). This variable was coded as a categorical variable, comprised of six categories. As such, the variable took the value of "0" to refer to non-wage-earning, which includes people who are unemployed and stay at home parents; "1" farmer; "2" service and construction; "3" pensioner; "4" professional and administrative work; and "5" CEO or owner of a small business.

School Type. This variable assesses whether schools are public or private. Research suggests that students who attend private schools perform slightly better in academic tests than students who attend public schools (Braun et al, 2006; Duncan & Sandy, 2007; López et al., 2017). This variable was coded as a dummy variable. Thus, this variable took the value of "0" if the school was private, and "1" if the school was public.

Length of School Day. This measures whether children attend school in a half day format or a full day format. Because of limited infrastructure, schools in Colombia operate in shifts. For example, children can go in the morning (6:30 a.m.-12 p.m.), afternoon (12:30 p.m.-6:30 p.m.), and full day (6:30 a.m.-4 p.m.). Research on this topic indicates that lengthening the school day improves academic achievement (Alfaro et al, 2015; Dominguez & Ruffini, 2020; Hincapie, 2016; Orkin, 2013; Pires & Urzua, 2011). This variable was coded as a dummy variable. The variable took the value of "0" if students attended schools in a half day format, and "1" if students attend schools in a full-day format.

School Setting. This measures whether the school is in a rural or an urban setting. Research on socioeconomic achievement gaps in Colombia suggests that students who attend rural schools perform lower on academic tests than students who attend urban schools, even after controlling for socioeconomic status (Duarte et al, 2012; Gaviria, 2017). This variable was coded as a dummy variable. This variable took the value of "0" if the school is in a rural setting and "1" if it is in an urban setting.

4.2.4. Data Analysis and Validation

Data analysis was conducted in four stages, which ranged from conducting descriptive statistics to running multilevel linear and nonlinear modeling to answer the research questions addressed in this study. In what follows, I explain each of the stages and the different procedures that were employed to perform data analysis.

4.2.4.1. Examine Descriptive Statistics

The first stage consisted of running descriptive statistics for all the variables that were selected for this study. In general, descriptive statistics are used to summarize basic information about a given number of variables in a dataset (Howell, 2007). The dataset that was used for this study contained two types of variables: continuous and categorical. Regarding continuous variables, I analyzed three types of descriptive statistics: measures of central tendency, dispersion, and symmetry (Howell, 2007). Measures of central tendency included mean, median, and mode. Measures of dispersion entailed standard deviation and interquartile range. To assess symmetry, I plotted histograms to analyze skewness and kurtosis. In relation to categorical variables, I analyzed frequency distributions. These analyses were conducted in SPSS version 28. I used this information to build one table that summarizes all the descriptive statistics for the variables of interest in this study.

4.2.4.2. Operationalization of Durable Goods

The second stage of data analysis encompassed the operationalization or modeling of durable goods. This study used three different methodological approaches to model durable goods: inventory, attributional, and index approaches. Therefore, in this stage I generated new variables, when applicable, to represent each of the approaches. In what follows, I explain how these variables were created by approach.

Inventory Approach. This approach entailed including all the seven durable goods as independent variables in the estimation models. Thus, it did not require creating new variables.

Attributional Approach. The attributional approach was used to group durable goods by attribute: information, household efficiency, and entertainment. Hence, I created three new variables: information goods, efficiency goods, and entertainment goods. Information goods included computers and Internet access. Household efficiency goods encompassed washing machines and microwaves. Entertainment goods comprised televisions, videogame consoles, and ownership of a car. As mentioned in the beginning of this chapter, I used two options to model this approach to account for household wealth: unconditional and conditional approaches. In the unconditional approach (UA), which represented low-income households, I modeled durable goods as possession of at least one of the durable goods in the efficiency and entertainment categories. As such, each variable took the value of “0” if the household did not have any durable goods in those categories, and a value of “1” if the household owned or had access to at least one of the durable goods in those categories. In the conditional approach (CA), which depicted more affluent households, I operationalized durable goods as ownership of all the durable goods in the efficiency and entertainment categories. Hence, each variable took the value of “0” if the household did not have any durable goods in those categories, and a value of “1” if the household owned or had access to all durable goods in those categories. Because computers and Internet access are complementary commodities, information goods were modeled as ownership of both durable goods.

Index Approach. This approach encompassed constructing a durable goods index. As highlighted before, most studies on the relationship of durable goods and educational outcomes have employed principal component analysis (PCA) as the main method for index construction (Vollmer & Alkire, 2018). Nonetheless, research on index construction suggests that exploratory factor analysis (EFA) is more a robust technique than PCA because it assumes measurement error, which can produce accurate estimates of the values (Schmitt, 2011; Vollmer & Alkire, 2018). Therefore, I used EFA to create a durable goods index variable, which corresponded to the third methodological approach. Because creating this index encompassed a rigorous statistical technique, I provide a general overview of Factor Analysis (FA) and a description of the process for constructing the durable goods index.

Factor Analysis. Factor analysis is a statistical technique widely applied in the fields of education and psychology. It is primarily used "to reduce a large number of variables in a dataset to a smaller number of factors, to describe the relationship among observed variables, or to test theory about underlying processes" (Tabachnick & Fidell, 2007 p. 610). The purpose of factor analysis is to estimate a model that explains the variance and covariance of the observed variables by a set of fewer unobserved factors (Hatcher, 1994; Tabachnick & Fidell, 2007).

Factor analysis assumes that variance can be divided into common variance and unique variance. Common variance refers to the amount of variance that is shared among all variables (Hatcher, 1994). This entails, for example, that variables that are highly correlated among each other will share more variance than variables that are not highly correlated. Unique variance refers to the variance that is not shared with others. As such, each factor contains a certain amount of the overall variance in the observed variables. Factors can then be used for further statistical analyses by creating factor scores, which are values that indicate the ranking or position that an individual occupies on the factor (DiStefano et al., 2009).

There are two types of factor analysis: exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). Exploratory factor analysis summarizes the data by grouping correlated variables to generate hypotheses about specific underlying processes (Tabachnick & Fidell, 2007). EFA is usually performed during the early stages of research as a tool to investigate the nature of the factors and how they relate with the variables (Henson & Roberts, 2006). Confirmatory factor analysis is a more advanced technique used to test generalization of factor structure. In CFA, the nature of the factors or constructs is known to the researcher because it has been substantiated by theory. As such, it is used to fully test the hypotheses about the factorial structure of the measure (Henson & Roberts, 2006). As opposed to EFA, in CFA the researcher specifies the number of factors and determines which variables go into which factors. Unless the investigator has strong theoretical evidence about the underlying nature of the factors, EFA is the most suitable method to conduct factor analysis because it allows the researcher to formulate hypotheses about the nature of the factors. In some cases, EFA and CFA can be used as complementary methods. For example, in a one-factor solution model EFA and CFA are the same because all the variables are contained in one factor. This may occur if the factor solution has few variables or if the variables are highly correlated among each other. In this study, I conducted both EFA and CFA. The rationale for this is because when I performed EFA, I obtained a one-factor solution. Additionally, CFA was used to test model fit.

According to Tabachnick and Fidell (2007), there are several assumptions that must be met before performing factor analysis. The first is that there are no outliers in the data. The second assumption is that sample size must be larger than 300, with more than 1,000 considered excellent. The third assumption is that perfect collinearity must be avoided. The fourth assumption is that given that factor analysis is a linear function of the variables that are measured, it does not require homoscedasticity between the variables. The fifth assumption is that factor analysis is based on the linearity assumption, which suggests that the relationship between X and the mean of Y is linear. The sixth assumption is that there must be some degree of normality for the variables that are included in the factor analysis solution. Continuous variables that do not meet this criterion need to be transformed (e.g., logarithm, square root, cube root). Dichotomous or ordinal variables can be used in factor solutions, but they use a slightly different method to generate correlation matrices. For dichotomous/binary variables, factor analysis is performed using a matrix of tetrachoric correlations. For ordinal or categorical variables, this is performed using a matrix of polychoric correlations (Tabachnick & Fidell, 2007).

Once these assumptions are fulfilled, the researcher must make methodological decisions related to: 1) factor model and estimation methods; 2) optimal number of factors to retain and model fit criteria; and 3) rotation criteria (Finch, 2020; Henson & Roberts, 2006; Schmitt, 2011; Osborne et al., 2008). Regarding factor model and estimation methods, Schmitt (2011) highlighted that there are two models: the component model and the common factor model. The underlying difference between the two is that while the component model assumes that there is no measurement error, the common factor model tries to account for it (Schmitt, 2011). Principal component analysis (PCA) is the most common component model to extract factors from a set of variables when conducting EFA. Because this method assumes no measurement error, it can produce overestimated values of the variance that is explained by each of the components (Schmitt, 2011). Principal axis factoring (PAF) is the most used method under the common factor model for EFA. While this method assumes measurement error, it does not require that the data fulfill the distributional assumption, and therefore, constitutes a non-statistical estimation method (Schmitt, 2011). This, in turn, yields standard errors that are not as accurate to test model fit and model parameters. To correct for this, researchers are increasingly using maximum likelihood (ML) or iterated principal-factor (IPF) as the estimation methods for the common factor model (Schmitt, 2011).

In relation to selecting the optimal number of factors, Finch (2020), Henson and Roberts (2006), Preacher et al. (2013), Osborne et al. (2008), and Schmitt (2011) highlighted that it is better to retain the fewer number of factors, which provide a good statistical explanation of the observed covariance matrix. According to these authors, there are five criteria that can be applied when selecting the number of factors:

1. *Eigenvalues.* They represent the variance explained by a particular factor out of the total variance. Most studies have used the Kaiser criterion which suggests retaining factors if they have an eigenvalue greater than one
2. *Scree test or scree plot.* Visual plot of the eigenvalues to corroborate that only those that meet the Kaiser criterion are retained

3. *Minimum average partial method (MAP).* This method focuses on the common variance in a correlation matrix. It involves a complete principal components analysis followed by the examination of a series of matrices of partial correlations
4. *Chi-square based test or the likelihood ratio test.* It measures the goodness of fit of two competing statistical models based on the ratio of their likelihoods
5. *Parallel analysis (PA).* Involves the generation of artificial data which have the same marginal properties of the original one (means and variances), but without factors. Large numbers of these artificial data are generated, and factor analysis is conducted for each. The eigenvalues that are produced in these analyses are then used to create a distribution of eigenvalues. Factors will be rejected if no underlying factor structure is present. Factors will be retained if the eigenvalues from the observed data are larger than the 95th percentile of the factor eigenvalues that were generated from the artificial data

According to Henson and Roberts (2006) and Schmitt (2011), parallel analysis and the minimum average partial method are the most accurate procedures for selecting the number of factors. On the contrary, the Kaiser criterion is less accurate. The rationale for this is that the Kaiser criterion tends to overestimate the number of factors to retain when dealing with large number of variables. Despite the evidence, most factor solutions in the social sciences use the Kaiser criterion and the scree plot as the main methods for selecting the number of factors. Henson and Roberts (2006) recommended that researchers use multiple criteria when determining the number of factors to retain. Built on previous research and best practices in EFA, this study used parallel analysis (PA), the Kaiser criterion, and the scree plot.

Once the number of factors has been determined, the next step in factor analysis is to interpret the factor loadings. Factor loadings refer to the strength of the relationships between the factors and the variables, hence they represent the variance explained by the variable on a specific factor (Henson & Roberts, 2006). Finch (2020), Hogarty et al. (2005), Osborne et al. (2008) suggested using factor loadings of .45 and above to be considered important. To improve the interpretability of the factor solution, researchers can rotate the factors. Factor rotation is used to increase high correlations between factors and variables and to minimize low correlations (Tabachnick & Fidell, 2007). There are two types of rotation: orthogonal and oblique. Orthogonal rotation is a variance maximizing procedure which assumes that the factors are not correlated. This entails that the variance of factor loadings is maximized because it keeps high loadings higher and low loading lower for each factor (Tabachnick & Fidell, 2007). The most common orthogonal rotation in EFA is *varimax rotation*. According to Schmitt (2011), using orthogonal rotation produces impractical factor structures because most factors in social science are correlated. Moreover, using orthogonal rotation can inflate factor loadings if they happen to be correlated, which can affect interpretability (Schmitt, 2011). Oblique rotation assumes that there is a correlation between the factors that are extracted from a factor solution. By allowing the factors to be correlated, oblique rotation yields more accurate and realistic factor structures (Schmitt, 2011). Therefore, it is highly recommended that researchers use oblique rotation methods such as Promax, Quartimin, or Equamax. In this proposed study, I used Promax and Quartimin as the main oblique rotation solution because it is one of the most effective at reducing the small loadings (Osborne et al., 2008).

In general, factor analysis solutions do not end when factor extraction and factor rotation procedures are completed. Indeed, factors are often used for further analyses (DiStefano et al., 2009). For example, they can be used as predictor variables in estimation models. To do this, the researcher needs to create factor scores. The rationale for this is that a factor is by nature *unobserved*. Hence, creating a measure that represents this latent dimension provides an estimate of what this value would be for each participant in the sample if it was observed (DiStefano et al., 2009). It is important to highlight that factor scores are standardized scores (z scores) with a mean of zero and a standard deviation of one, which makes their interpretation difficult. According to DiStefano et al. (2009), there are two methods to calculate factor scores: 1) non-refined methods and 2) refined methods.

Non-refined methods involve summing or averaging the raw scores corresponding to all items on the factor. There are four non-refined methods to create factor scores:

1. *Sum scores by factor*. This method comprises summing the raw scores related to all items loading on the factor (negative items are subtracted in the score). Advantage: easy to calculate and can be averaged to represent the scale. Disadvantage: gives all items equal weight
2. *Sum scores above a cut-off value*. A cut-off loading value can be used. Then, only items above the cut-off are added. Advantage: if scores are used in further

analyses, the sum scores preserve variation. Disadvantage: defining the adequate cut-off, which may lead to including less variables

3. *Sum scores – standardized variables*. Convert raw scale to z scores before summing. A cut-off can be applied. Advantage: useful when dealing with observed variables that vary a lot regarding standard deviation. Disadvantage: gives all items equal weight
4. *Weighted sum scores*. Multiplies the factor loading to the scale score and then add them. Advantage: considers loading values. Disadvantage: it is possible that differences in factor loading are due to the method of extraction and rotation, in which case it would be akin to the sum scores method

Refined methods seek to increase validity by producing factor scores that are highly correlated with a specific factor and to get unbiased estimates of the factor scores (DiStefano et al., 2009). There are three refined methods to create factor scores:

1. *Regression scores.* Uses a multiple regression estimate to predict factor scores. Advantage: maximizes validity of estimates. Disadvantage: factor scores are not unbiased. It is important to stress that the scores may be correlated when factors are orthogonal
2. *Bartlett.* Akin to regression but produces accurate estimates of the true factor scores. Advantages: produces unbiased estimates and high validity estimates. Disadvantages: scores may be correlated even when factors solution is orthogonal
3. *Anderson-Rubin*. Akin to Bartlett but allows factor scores to be uncorrelated if the factors are orthogonal. Advantage: maximizes validity and correlation accuracy

(when factors are orthogonal, the scores are uncorrelated). Disadvantage: factor scores are not unbiased

DiStefano et al. (2009) suggested using the refined method to create factor scores because it yields more accurate estimates than the non-refined one. Furthermore, the authors underlined using any of the three methods for orthogonal rotations. The Bartlett method yields unbiased estimate factor scores, the regression method increases validity, and the Anderson-Rubin method allows the scores to be uncorrelated with other factor scores (correlation accuracy). For oblique rotations, the authors recommend only using the regression method. Given that this study used an oblique rotation, I employed the regression method to generate factor scores.

Steps to conduct EFA

Generally, there are six steps to conduct exploratory factor analysis:

1. Identify and select the variables that will be used for factor analysis.
2. Screen data to get it ready for conducting a correlation matrix. This step includes identifying outliers, checking that all variables meet the normality requirement, and handling missing data. In relation to outliers, it is recommended to run frequency distributions and obtain histograms, box plots and normal probability plots to identify where they are (Tabachnick & Fidell, 2007). If the number of outliers is few, the researcher may revise each case individually and modify or delete the cases. If dealing with multivariate outliers, the researcher can use the Mahalanobis distance and run a collinearity diagnostic, for which *tolerance values* should be close to one and *variance inflation* (VIF) less than four.

Regarding checking for normality, it is important that the variables that will be used in the factor solution are close to a normal distribution (Tabachnick & Fidell, 2007). In cases where this is not the case, transformations are required. For dichotomous or ordinal variables, a matrix of tetrachoric or polychoric correlations must be performed. If the data are missing completely at random or missing at random, it is recommended to perform multiple imputation or to drop the cases if they account for less than 5% of the data (Tabachnick & Fidell, 2007). In the case where the variables are measured in different scales, it is recommended to standardize them (create z scores) to compare them.

3. Factor extraction. Factor extraction will determine the factor solution (number of factors). As described before, this was done by conducting parallel analysis (PA) as well as by using the Kaiser criterion and the scree plot. Only factor loadings at or above 0.45 were retained, as recommended by Finch (2020), Hogarty et al. (2005) and Osborne et al. (2008).
4. Factor rotation. As explained before, this is done to increase interpretability of the factor solution. It is recommended to perform an unrotated factor analysis first to see how the different variables cluster around the factors, and then perform an *oblique rotation* to see the correlation between the different factors and the variables (Schmitt, 2011).
5. Interpret the factors. This entails identifying the nature of the factors and how they relate to theory or to the research questions. Once the factors are identified,

factor scores may be created. These scores can then be used as predictor variables in further analyses.

6. Validation and reliability of the measures. Use Cronbach's alpha to test internal consistency and the Kaiser-Meyer-Olkin test to assess sample adequacy (Vollmer & Alkire, 2018).

Steps to conduct CFA

In general, there are four steps to conduct confirmatory factor analysis:

5. Create a path diagram depicting the factorial structure underlying the measures (variables). Theoretical evidence supports this process.
6. Fit the factorial structure to the data. This entails specifying which variables go into which factors.
7. Examine the goodness of fit index and modification index. To determine model fit, Finch (2020), Henson and Roberts (2006) and Schmitt (2011) recommended the following four indices:

   Model Chi-square. Measures overall fit and the discrepancy between the sample and the fitted covariance matrices. This index is sensitive to sample size. The cut-off for good fit is p-value > .05.

   SRMR: square root of the sum of squared correlation residuals for the indicator variables. This index measures the standardized difference between the observed correlation and the predicted correlation of the model. Values less than .08 indicate an acceptable fit.

RMSEA: root mean square error approximation. This is an absolute fit index that assesses the extent to which the model's chi-square goodness-of-fit statistic departs from the degrees of freedom. The further the model departs from the degrees of freedom, the less fit it is. A value of .06 or less indicates a good fit.

CFI: comparative fit index. This index compares the fit of a target model to the fit of an independent, or null, model. Larger values of CFI indicate improved fit of the model in relation to the baseline. A value of .9 or higher means that the data fit well.

Construction of the Durable Goods Index. Building on previous research and best practices on factor analysis, I performed an EFA using a *matrix of tetrachoric correlations*. Because the variables that were selected were dichotomous, I did not have to check for the normality assumption or for outliers. Regarding sample size, this study used 364,436 observations, an optimal number for conducting factor analysis. In addition, it is important to stress that I used listwise deletion as the method for dealing with missing data, which were missing at random. STATA 17 was used as the main statistical software to perform EFA and CFA. To guarantee transparency, all the commands and codes may be accessible upon request.

The first step in the process of conducting EFA was to run a tetrachoric correlation matrix with all the durable goods, which entailed specifying significance levels (.05) and eigenvalues. Once I obtained the matrix, I performed factor analysis on the tetrachoric matrix by using Iteration Principal Factors (IPF) as the main method for factor extraction, without specifying the number of factors to retain. The first factor solution indicated that six factors could be retained. However, this solution did not seem plausible because a factor should have at least two variables (Vollmer & Alkire, 2018). Thus, the next step was to conduct Parallel Analysis (PA) to determine the factor solution. Parallel analysis indicated that three factors could be retained. Although this was an improvement in comparison with the six-factor solution, it did not seem reasonable because there were factors with only one variable, which violated the principle related to the minimum number of variables per factor. Hence, I used the scree plot and the Kaiser criterion to compare both factor solutions and it was clear that this was a one-factor solution because most variables were clustered in the first factor. Conceptually, this made sense as all the commodities, regardless of their attribute, form part of a larger construct called *durable goods*.

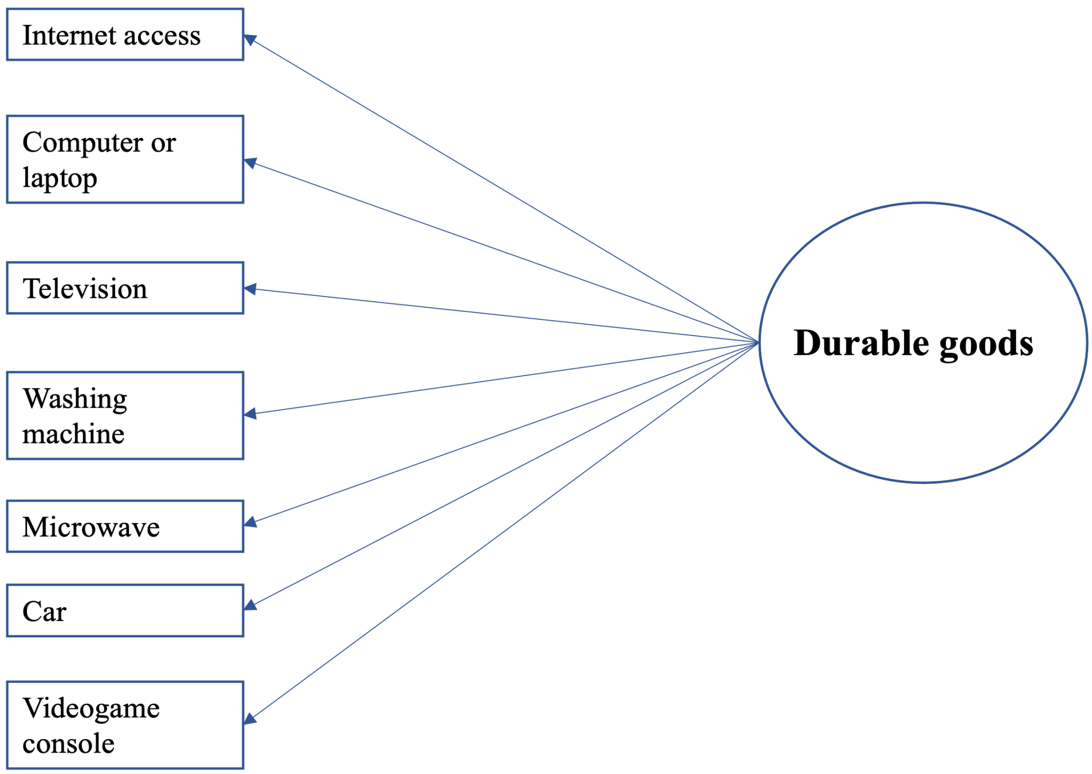
The next step consisted in re-running the factor analysis on the tetrachoric matrix by using Iteration Principal Factors (IPF), but this time specifying that only one factor would be retained. This generated an output with the different eigenvalues, factor loadings, and the unique variance for each variable in the factor solution. It is important to highlight that only factor loadings at or above .45 were retained as recommended by Finch (2020), Hogarty et al. (2005) and Osborne et al. (2008).

After factor analysis was completed, I performed factor rotation. I started with an unrotated factor analysis to observe how the different variables clustered around the factor, and then I performed an *oblique rotation* to examine the correlation between the different factors and the variables. Once factor rotation was finalized, I proceeded to create factor scores using the regression method. Therefore, a new variable called *"Factor 1"* was created in the dataset, which embodied the durable goods index.

Because this was a one-factor solution, I also conducted CFA on the dataset. To do this, I first created a path diagram to show that the correlation among variables (or covariance) was due to one common factor (Hatcher, 1994). Figure 4.1 shows the path diagram for the durable goods one-factor solution. After the path diagram was completed, I proceeded to perform CFA on the data. To obtain the model fit indices recommended by Finch (2020), Henson and Roberts (2006), and Schmitt (2011), I used two post-estimation commands. This generated an output with the values for the following model fit indices: Chi-Square, SRMR, RMSEA, and CFI.

Figure 4.1

Path Diagram for the Durable Goods One-Factor Confirmatory Factor Analysis



4.2.4.3. Correlations, T-tests, and Analysis of Variance

The third stage of the data analysis entailed conducting a Pearson's correlation matrix analysis, t-tests, and ANOVA tests. This stage of data analysis was conducted using STATA.[12] The Pearson's correlation matrix analysis was performed to assess the level of association between variables (Howell, 2007). If variables are highly correlated, a phenomenon known as multicollinearity, they can introduce bias in the results. Therefore, it is important to analyze the level of correlation between variables before

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[12] All the commands and codes for all the analyses and tests were saved in a Do-file, which may be accessible upon request.

conducting any advanced statistical analysis. When performing the correlation matrix, each variable obtains a correlation coefficient that ranges between 0 and 1, with a positive or negative sign indicating the direction of the association (Howell, 2007). In general, coefficients lower than .3 are considered low, meaning that there is a weak correlation between the variables. Coefficients below .6 are considered moderate, which entails that there is some correlation between variables. By contrast, coefficients above .7 are considered high, meaning that there is a strong correlation between the variables. The purpose of the correlation matrix analysis is to identify those variables that have high correlation coefficients so that they can be analyzed, and decisions made about whether to keep them from estimation models. It is strongly recommended that variables that have a correlation coefficient above .7 are removed from estimation models because they could introduce bias in the results. For this study, coefficients below .65 were considered moderate and it was assumed that if included in an econometric model, they would not generate collinearity problems. It is important to stress that the significance level of the correlation coefficients was set at .05.

T-tests and the analysis of variance (ANOVA) constituted a useful exercise for hypothesis testing, in preparation for the multilevel linear and logistic estimations. Independent-samples t-tests were conducted to compare the means of reading and math test scores between two groups for a given variable (StataCorp, 2021). This entailed that t-tests were used only for two-level categorical variables or binary variables. As such, the variables that were used for the t-test analyses were: sex, preschool education, ownership of durable goods, school type, school setting, and length of school day. Because hypothesis testing is an important step in the process of conducting t-tests, I developed two general hypotheses for all the variables. It is important to stress that the null hypotheses were rejected if $p < .05$ (95% confidence interval).

Null hypothesis (Ho): there are not statistically significant differences in the mean scores for reading and math between groups for each of the selected variables

Alternative hypothesis (Ha): there are statistically significant differences in the mean scores for reading and math between groups for each of the selected variables

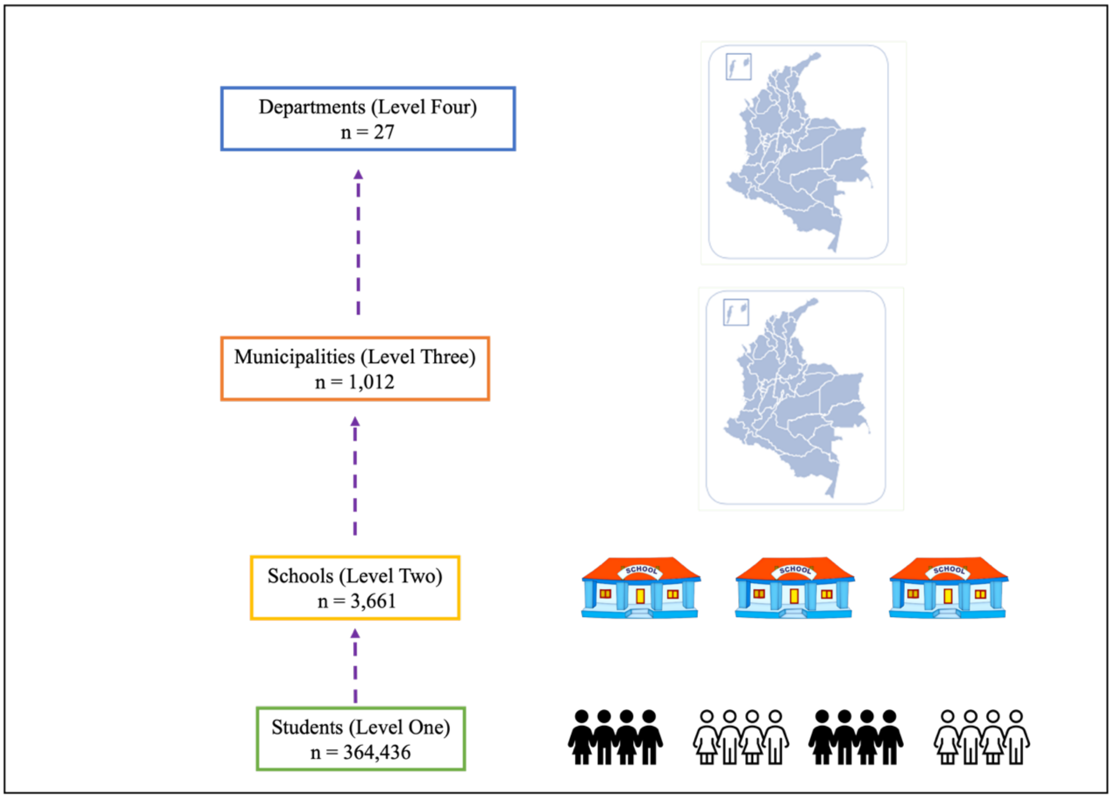
For variables that had more than two categories such as parental education and parental employment, I performed one-way ANOVA tests to identify differences in mean reading and math scores (StataCorp, 2021). Additionally, I used the Tukey post hoc test to examine which groups differed from each other. Summary tables were created to present the information from these tests.

4.2.4.4. Multilevel Modeling Analysis

The last stage of the data analysis entailed conducting multilevel modeling analysis. The rationale for this is because data were nested in four levels: students, schools, municipalities, and departments. Not accounting for this clustering effect would produce biased estimators about how durable goods relate to academic achievement and school attendance because it is likely that children who live in more developed areas (departments and municipalities) have more opportunities to access durable goods, better-equipped schools, or community-assets such as libraries or cultural organizations than children who live in less developed regions. Multilevel modeling accounts for such regional variations in wealth, yielding more accurate estimate. Figure 4.2 provides a visual representation of the nested structure of the data that were used for this study.

Figure 4.2

Nested Structure of the Multilevel Models



In general, multilevel modeling is a type of Ordinary Least Square regression method that takes into account when the predictor variables are structured or nested at varying hierarchical levels (Harring et al., 2016; Raudenbush & Bryk, 2002). Because this study used two outcome variables, one continuous and one binary, I utilized two types of multilevel models: multilevel linear models and multilevel logistic models.

Multilevel linear modeling was used to examine the decomposition of the variation in the 2017 SABER test results in reading and math for a sample of fifth and ninth grade students in Colombia and how much of that variation in results was associated with ownership of durable goods and sociodemographic variables (level one), characteristics of the school (level two), municipality (level three), and department (level four). For this four-level model, I estimated equation (1), which took the basic form of

$$Y_{ijkl} = \beta_0 + \beta_1 X_{ijkl} + (e_{0ijkl} + u_{0jkl} + v_{0kl} + f_{0l})$$

Where Y_{ijkl} is one of the academic outcomes for child i nested in school j, municipality k, and department l. In this model, X_{ijkl} is a vector of covariates, and the random effects e_{0ijkl}, u_{0jkl}, v_{0kl}, and f_{0l} are the residual differentials for children, schools, municipalities, and departments, respectively. It is important to stress that in this four-level model, the residual differentials for children, schools, municipalities, and departments are assumed to be normally distributed with a mean of 0 and a variance of σ^2_{e0}, σ^2_{u0}, σ^2_{v0}, and σ^2_{f0}, respectively. The variances in the four-level models are the parameters of interest and indicate the between-child (σ^2_{e0}), between-school (σ^2_{u0}), between-municipality (σ^2_{v0}), and between-department (σ^2_{f0}) variations in child i experiencing the academic outcomes (reading and math).

Multilevel logistic modeling was used to explore the relationship between ownership of durable goods and the probability of being absent from school. As such, I estimated four level models for the probability of a child i, in school j, in municipality k, in department l experiencing the outcome $Y_{ijkl} = 1$ as equation (2), which took the form of

$$Logit\ (\pi_{ijkl}) = \beta_0 + \beta_1 X_{ijkl} + (u_{0jkl} + v_{0kl} + f_{0l})$$

Where π_{ijkl} is the log odds of the outcome (being absent from school) in child *i* nested in school *j*, municipality *k*, and department *l*. X_{ijkl} is a vector of covariates, and the random effects are the residual differentials for schools (u_{0jkl}), municipalities (v_{0kl}), and departments (f_{0l}). The same assumptions and parameter definitions used for equation (1) were applied to equation (2).

After specifying the equations, I proceeded to perform the multilevel analyses using STATA 17 and SPSS 28. I used both statistical packages for two reasons. The first reason was because it took STATA more than 24 hours to run the multilevel logistic models. In contrast, SPSS ran the multilevel logistic models in less than 10 hours, which significantly improved efficiency. The second reason was because I wanted to cross-validate the results to ensure reliability and robustness.

It is important to stress that I performed different multilevel estimations on the total sample (n = 364,436) to address the main research question of this paper. For example, because I used three different methodological approaches to model durable goods, I had to run different estimation models for each approach. In addition, given that academic achievement encompassed reading and math scores, I had to perform separate estimations for each outcome. Table 4.2 shows the number of multilevel estimations that were conducted in this paper.

Table 4.2

Summary of Multilevel Modeling Estimations Conducted on Total Sample

Type of Multilevel Modeling	Methodological Approach	Number of Estimations per Outcome
Linear		
Outcomes (continuous)	a) Inventory (x1)	
(a) Reading scores	b) Unconditional (x1)	
	c) Conditional (x1)	4
	d) Index (x1)	
	a) Inventory (x1)	
(b) Math scores	b) Unconditional (x1)	4
	c) Conditional (x1)	
	d) Index (x1)	
Nonlinear (logistic)		
Outcome (binary)	a) Inventory (x1)	
Being absent from school	b) Unconditional (x1)	4
	c) Conditional (x1)	
	d) Index (x1)	
Total Number of Multilevel Estimations		12

Note. (x1) denotes the number of estimations conducted per approach, one in this case.

As observed, to perform a multilevel linear model on the entire sample (n = 364,436) for reading, I had to run four models: one for the inventory approach, two for the attributional approaches (unconditional and conditional), and one for the index approach. Another four models were run for math, totaling eight models for academic achievement. Additionally, I conducted four models for the binary outcome. Thus, a total of 12 multilevel estimation models were performed to explore the relationship among durable goods, academic achievement, and school attendance.

4.2.5. Quality Checks and Test for Validity

In this study, validity was assessed by conducting different tests to ensure that results were robust and obtained in a transparent and rigorous manner. Thus, validity tests were performed at each stage of the data analysis process. Regarding descriptive statistics, for example, I screened the data for missing values and conducted a

Mahalanobis distance test to identify outliers. Similarly, I ran frequency distributions and plotted histograms as well as box-whisker plots to find extreme values.

In relation to the operationalization of durable goods, the only approach that required tests of validity was the index approach. As described before, this study used EFA as the main method for index construction and CFA to assess model fit. The first quality check in this process was to use a tetrachoric correlation matrix to perform EFA given that the variables of interest were binary. To guarantee that factor extraction was robust and that incorporated best practices, I performed parallel analysis as the main extraction method, but I also used the scree plot and the Kaiser criterion. In addition, I used an oblique rotation to improve interpretation of the factor solution. To generate factor scores, I employed the regression method, which is highly recommended for oblique rotations. Finally, I used the Cronbach's alpha to test internal consistency and the Kaiser-Meyer-Olkin test to assess whether the data were suited for conducting factor analysis. For the Cronbach's alpha, a coefficient of .70 or higher would be considered acceptable. In relation to the Kaiser-Meyer-Olkin test, values of .80 or higher would be considered meritorious, meaning that the data fit well for factor analysis. To assess model fit, I conducted CFA to obtain the following model fit indices: a) Chi-square; b) square root of the sum of squared correlation residuals (SRMR); c) root mean square error approximation (RMSEA); and d) comparative fit index (CFA). For the Chi-square, a *p*-value > .05 would indicate a good fit. For the SRMR, values less than .08 would suggest an acceptable fit. For the RMSEA, a value of .06 or less would denote a good fit.

As to the multilevel linear and logistic models, I employed different tests to ensure validity before and after running the models. In preparation for the multilevel analyses, I conducted various validation procedures including correlation analyses, independent t-tests, and analysis of variance. I conducted a Pearson's correlation matrix analysis to identify potential collinearity problems. Similarly, I performed several t-tests to assess whether the means of reading and math scores were the same in two unrelated, independent groups. For variables that had more than two categories such as father's and mother's education, I performed one-way ANOVA tests to identify differences in mean reading and math scores.

Performing multilevel estimation entailed building different models. Following Raudenbush and Bryk (2002) and Raudenbush et al. (2019), I first ran a null model with no predictors to examine if the variance for each of the outcome variables varied by level. If the variances were different at each level, this entailed that multilevel modeling was the correct estimation method. Then, I ran different multilevel models with predictors. As highlighted before, running the multilevel logistic models took a long time, perhaps due to model specification (e.g., four-level model with a binary outcome). Therefore, I conducted a Hausman test to determine if I could drop the highest level in the model (e.g., departments) and use it instead as a fixed effect in the model. This test indicated that whether using a four-level model or a three-level model with departments as fixed effects would yield the same results. To assess validity after running the models, I employed different post-estimation tests. For the multilevel linear models, I used the likelihood ratio test, the Chi-square, and significance levels to assess the validity of the estimations. For the multilevel logistic models, I employed the likelihood ratio test, the log likelihood, the Wald test, and significance levels of the coefficients. Additionally, it is important to stress that I ran the multilevel models in different statistical packages to compare results. For example, I conducted the multilevel analyses in STATA and SPSS. Similarly, models were also run in SAS and R. Comparisons across statistical software indicated that the results were consistent, which contributed to improve validation and reliability.

4.3. Results

Results are presented in the order that I conducted data analysis. Hence, I present the descriptive statistics first. Then, I show how I modeled durable goods. Following this, I present the outcomes of the correlation matrix analyses, t-tests, and ANOVA tests. Lastly, I present the results of the multilevel linear and logistic analyses.

4.3.1. Descriptive Statistics

Table 4.3 shows sociodemographic information about the sample of students in this study (n = 364,436) as well as the characteristics of the schools they attended for the year 2017. As observed, 51.44% of the sample identified as girls; 56.24% were fifth grade students; 53.83% attended preschool; and 44.74% were absent from school at least two days in a week during the month before taking the test. Parental education encompassed father's and mother's level of education. In general, most parents completed only high school (47.53% of fathers and 49.40% of mothers). Additionally, as Table 4.3 indicates, mothers had higher levels of educational attainment than fathers.

Parental employment comprised father’s and mother’s occupation. Regarding father's employment, the highest share of occupation was in the service and construction sector (56.66%), which included cleaning and maintenance occupations as well as informal sales, followed by professional jobs (17.64%), which comprised jobs that required postsecondary education (e.g., administrative assistant jobs, accounting, health sciences, teaching, or legal jobs). In relation to mother’s employment, the highest share of occupation was domestic activities or unemployment (39.91%), followed by professional jobs (19.71%). Similarly, and as highlighted in Table 4.3, the percentage of fathers who worked in agriculture and management positions (e.g., owner of a business or CEO of a company) was higher than for mothers. Regarding information about schools, 98.71% of students attended public schools; 87.43% were enrolled in a half day school program; and 98.78% of schools were in urban settings.

Table 4.3

Sociodemographic Characteristics of Students and Information About Schools

Variables	*n*	%
Gender		
Boys	176,975	48.56
Girls	187,461	51.44
School grade		
Fifth grade	204,948	56.24
Ninth grade	159,488	43.76
Preschool education		
Yes	196,162	53.83
No	168,274	46.17
Absent from school		
Yes	163,058	44.74
No	201,378	55.26
Father's education		
Elementary	93,317	25.61
High school	173,202	47.53
College and technical	62,821	17.24
Graduate school	35,096	9.63
Mother's education		
Elementary	74,438	20.43
High school	180,022	49.40
College and technical	72,931	20.01
Graduate school	37,045	10.17

Variables	*n*	%
Father's employment		
Unemployed and/or non-wage-earning	30,476	8.36
Farmer	31,811	8.73
Service and construction	206,477	56.66
Receives pension	10,674	2.93
Professional and administrative work	64,270	17.64
CEO and/or manager	20,725	5.69
Mother's employment		
Unemployed and/or non-wage-earning	145,442	39.91
Farmer	6,813	1.87
Service and construction	124,258	34.10
Receives pension	3,546	0.95
Professional and administrative work	71,831	19.71
CEO and/or manager	12,636	3.47
School type		
Private	4,715	1.29
Public	359,721	98.71
Length of school day		
Half day	318,609	87.43
Full day	45,827	12.57
School setting		
Rural	4,457	1.22
Urban	359,979	98.78

Note. $N = 364{,}436$

4.3.2. Operationalization of Durable Goods

In this study, I used three different methodological approaches to model durable goods: inventory, attributional, and index approaches. Therefore, in this stage I generated new variables, when applicable, to represent each of the approaches. In what follows, I explain how I created these variables for each approach.

4.3.2.1. Inventory Approach

Because this approach entailed including all seven durable goods as independent variables in the estimation models, it did not require creating new variables. Hence, all the durable goods were used in the estimation models. Table 4.4 displays the distribution of durable goods across the sample. As observed, most students had televisions (84.74%) and washing machines (83.51%). Similarly, more than half of students reported ownership of a computer (68.21%), having access to the Internet (66.33%), and possession of a microwave at home (59.33%). In contrast, fewer than 40% of students reported that their families owned a car (34.68%) or a videogame console (36.98%).

Table 4.4

Ownership of Durable Goods

Variables	*n*	%
Internet		
Yes	241,716	66.33
No	122,720	33.67
Computer (PC, laptop, or tablet)		
Yes	248,573	68.21
No	115,863	31.79
Television		
Yes	308,809	84.74
No	55,627	15.26
Washing machine		
Yes	304,348	83.51
No	60,088	16.49
Microwave		
Yes	216,225	59.33
No	148,211	40.67
Car		
Yes	126,386	34.68
No	238,050	65.32
Videogame console		
Yes	134,785	36.98
No	229,651	63.02

Note. $N = 364{,}436$

4.3.2.2. Attributional Approach

The attributional approach was used to cluster durable goods by attribute. I grouped the seven durable goods into three categories: information goods; household efficiency goods; and entertainment goods. Information goods included computers and Internet access. Household efficiency goods encompassed washing machines and microwaves. Entertainment goods comprised televisions, videogame consoles, and ownership of a car. This entailed creating new variables: information goods, efficiency goods, and entertainment goods. As such, computers and Internet were grouped as information durable goods; washing machines and microwaves were categorized as household efficiency durable goods; and TVs, cars, and videogame consoles were classified as entertainment durable goods. To account for household wealth, I operationalized ownership of such consumer goods in two ways: a) by assessing whether households possessed at least one of the durable goods in each category, which represented low-income households, or b) by examining whether households owned all the durable goods in each category, which represented more affluent households.

Tables 4.5 and 4.6 summarize the distribution of durable goods by typology across the sample. Table 4.5 presents information related to whether households possessed at least one of the durable goods in the household efficiency and entertainment categories. Overall, most students had at least one durable good related to household efficiency (89.94%), but less than 60% of students had at least one consumer good in the entertainment category (54.45%).

Table 4.5

Ownership of Durable Goods by Type: Unconditional Approach (At Least One per Category)

Variables	*n*	%
Information durable goods		
Yes	202,393	55.54
No	162,043	44.46
Household efficiency durable goods		
Yes	327,791	89.94
No	36,645	10.06
Entertainment durable goods (others)		
Yes	198,443	54.45
No	165,993	45.55

Note. N = 364,436

Table 4.6 presents the information related to whether households possessed all the durable goods in the household efficiency and entertainment categories. In general, a little over 50% of students possessed all the durable goods in the household efficiency category (52,90%), but fewer than 17% of students possessed all the durable goods included in the entertainment category.

Table 4.6

Ownership of Durable Goods by Type: Conditional Approach (All per Category)

Variables	*n*	%
Information durable goods		
Yes	202,393	55.54
No	162,043	44.46
Household efficiency durable goods		
Yes	192,782	52.90
No	171,654	47.10
Entertainment durable goods (others)		
Yes	58,169	15.96
No	306,267	84.04

Note. N = 364,436

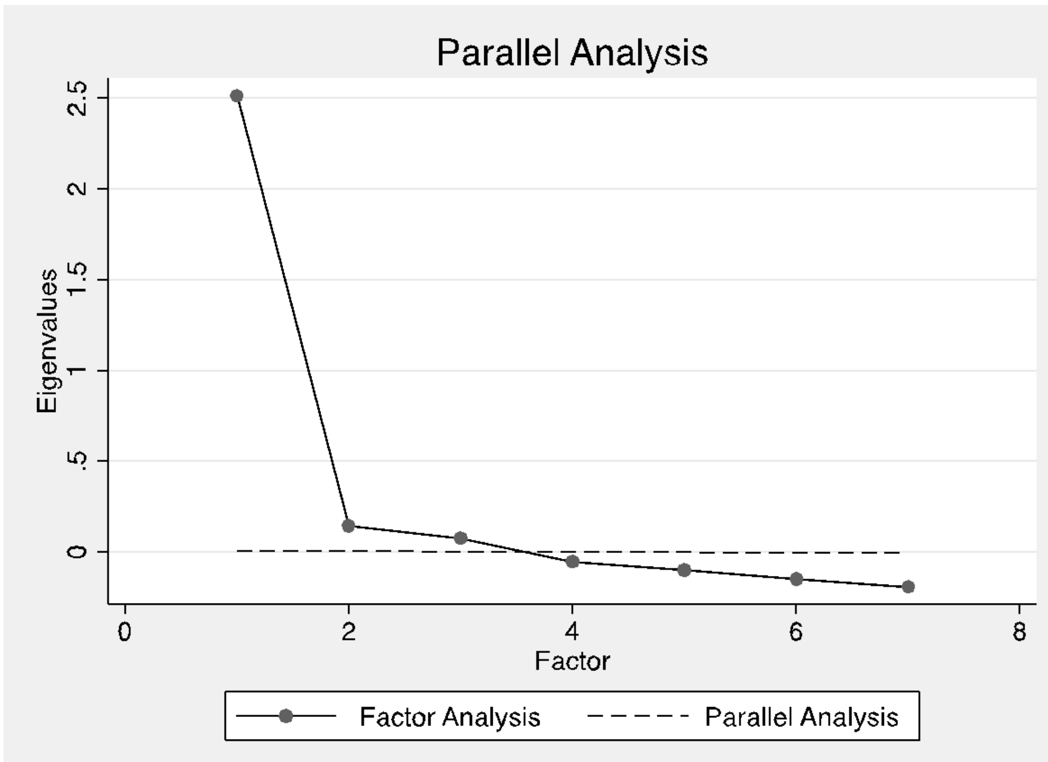
When comparing both approaches, one can observe that while the unconditional approach served as a measure of access, as it showed that most households owned at least one consumer good in the categories of interest, the conditional approach revealed important wealth gaps. For example, only 15.96% of the sample owned a TV, a videogame consoles, and a car. Information goods was the same in both approaches because computers and Internet access are complementary goods, which entail that they go together.

4.3.2.3. Index Approach (Exploratory Factor Analysis)

For the seven variables, based on the tetrachoric exploratory factor analysis with oblique rotation, a one-factor solution underlying durable goods emerged. Figure 4.3 shows the scree plot of eigenvalues for parallel analysis and factor analysis, which suggested a one-factor solution. Because there were only seven durable goods in data, it is not surprising that when performing EFA most of them were clustered around one factor.

Figure 4.3

Durable Goods Index: Scree Plot of Eigenvalues from Parallel Analysis



Seven items were retained using a .45 primary factor loading (see Table 4.7), as recommended by Finch (2020), Hogarty et al. (2005), and Osborne et al. (2008). The model fit for sampling adequacy was meritorious, with the Kaiser-Meyer-Olkin (KMO) test measure amounting to .8216. This indicated that the proportion of the variance was enough to interpret it as common variance. However, it is important to highlight that the unique variances among the variables were also strong (StataCorp, 2013).

Table 4.7

Exploratory Factor Analysis for the Seven Durable Goods

Pooled (1)	Factor 1	Number of observations
Proportion of variance explained	100%	364,436
Rotated Factor Loadings (2)		
Variable	**Factor 1**	**Uniqueness**
Internet	0.7914	0.3737
PC	0.7356	0.4588
TV	0.4775	0.7720
Washing machine	0.5626	0.6834
Microwave	0.5482	0.6994
Car	0.4558	0.7922
Videogame console	0.5492	0.6984
Items retained	**Factor 1**	**All items**
Items retained	7	7
Cronbach's Alpha	0.6362	0.6362
Kaiser-Meyer-Olkin		0.8216

A lack of clustering of interrelated variables and a series of high uniqueness of variables was also observed (e.g., TV and car), which resulted in a moderately internal consistent factor scale (Cronbach's alpha of .6362 for all items). After performing tetrachoric exploratory factor analysis, factor scores were created using the regression method. This method was selected because it is the more appropriate for oblique rotations (DiStefano et al., 2009). It is important to stress that factor scores were used to construct a durable goods index, which corresponded to the third methodological approach used in this study to model durable goods.

Because this was a one-factor solution, I also conducted a one-factor confirmatory factor analysis. Table 4.8 summarizes the fit indices that were obtained after performing a confirmatory factor analysis.

Table 4.8

Fit Indices for Confirmatory Factor Analysis with Tetrachoric Matrix

Fit Indices	Cut-off criteria	Value
Chi-square (X^2)	P-value > 0.05 (not significant)	0.000
Root mean square error approximation (RMSEA)	A value of 0.06 or less indicates a good fit	0.052
Square root of the sum of squared correlation residuals (SRMR)	Values less than 0.08 indicate an acceptable fit	0.030
Comparative fit index (CFI)	A value of 0.9 or higher means that the data fit well	0.944

As observed in Table 4.8, all the fit indices were within the cut-off criteria. These results corroborated that the structure of the model was adequate, suggesting that the factor solution was robust.

4.3.3. Correlation Matrix Analyses, T-tests, and ANOVA Tests

In what follows, I present the results by type of analysis: correlation analyses, independent t-tests, and analysis of variance.

4.3.3.1. Correlation Matrix Analyses

Results from the correlation analyses indicated that most of the variables had negligible or weak correlations, with correlation coefficients below .28 (see Appendices E to H). The only variables that reported correlation coefficients greater than .28 were father's education and the durable goods index (r = .29), mother's education and the durable goods index (r = .30), father's employment and father's education (r = .32), mother's employment and mother's education (r = . 34), computers and Internet (r = .47), mother's education and father's education (r = .56), math and reading scores (r = .65), and students' age and students' school grade (r = .94). Coefficients below .70 were considered moderate and it was assumed that if included in an econometric model, these variables would not generate multicollinearity issues. To test whether these moderate and strong correlations could introduce multicollinearity in the models, I ran a collinearity test with all the durable goods and the control variables (inventory approach), a collinearity test using the variables that were created in the attributional approach, and a collinearity test using the durable goods index. Results indicated that students' age and students' school grade were highly collinear, hence suggesting that one of them could be dropped to improve model accuracy. Because one of the central questions of this study was to examine whether different types of durable goods were differentially related to students by grade, I decided to drop age from the estimation models.

4.3.3.2. Independent t-tests

Results from the t-tests indicated that there were statistically significant differences in the mean scores for reading and math by gender, school grade, access to preschool education, school absenteeism, type of school, length of school day, and school setting ($p < .000$). For example, reading scores were .087 standard deviations above the mean for girls and 0.87 standard deviations below the mean for boys. Similarly, reading scores were .074 standard deviations above the mean for ninth graders and .054 standard deviations below the mean for fifth graders. In contrast, math scores were .046 standard deviations above the mean for boys and .039 standard deviations below the mean for girls. Additionally, math scores were .099 standard deviations above the mean for ninth graders and .073 standard deviations below the mean for fifth graders (see Appendices I through P for details on the different t-tests).

Similarly, results from the t-tests indicated that were statistically significant differences in the mean scores for reading and math by methodological approach ($p < .000$). In the inventory approach, results indicated that there were statistically significant differences in the mean scores for reading and math by possession of durable goods. For example, reading scores were .092 standard deviations above the mean for students who had Internet access but .175 standard deviations below the mean for students who did not have Internet access. Similarly, math scores were .012 standard deviations above the mean for students who had washing machines at home, but .054 standard deviations lower for students who did not have (see Appendices I through P). In the attributional approach, results from the t-tests indicated that there were statistically significant differences in the mean scores for reading and math by type of durable goods ($p < .000$). Regarding the unconditional approach, for example, reading scores were .022 standard deviations above the mean for students who had at least one household efficiency durable good, but .176 for students who did not have any. In relation to the conditional approach, math scores were .017 standard deviations above the mean for students who had at least one household efficiency durable good, but .131 standard deviations below the mean for students who did not own any durables (see Appendices I through P).

4.3.3.3. Analysis of Variance (One-way ANOVA Test)

One-way ANOVA tests were used to assess whether there were statistically significant differences between the means of reading and math for multi-level categorical or ordinal variables (variables with three or more independent groups). The variables that were employed for the ANOVA tests were father's education, mother's education, father's employment, and mother's employment. Results from these tests indicated that there were statistically significant differences in mean reading and math scores between all the groups for the selected variables (see Appendices Q through X for details on the tests). For example, regarding father's education, the test revealed that there was a statistically significance in mean reading scores ($F(3,364432) = 2277.23, p = .000$) and math mean scores ($F(3,364432) = 1492.49, p = .000$) between all groups. In relation to mother's education, the test also showed that there was a statistically significant difference in mean reading scores ($F(3,364432) = 2922.45, p = .000$) and mean math scores ($F(3,364432) = 2118.42, p = .000$) between all the groups (see Appendices Q through X for details on the tests).

4.3.4. Multilevel Modeling

This study used multilevel models because data were nested in four levels: students, schools, municipalities, and states. Not accounting for this nesting effect would have yielded biased estimators, resulting in potential overestimation or underestimation of the strength and direction of the association between durable goods and educational outcomes. Therefore, multilevel linear models were used to examine the relationship between durable goods and academic achievement and multilevel logistic models were employed to investigate the relationship between durable goods and school attendance. Multilevel linear regression models are presented first, followed by the multilevel logistic models. Because this study used different methodological approaches to operationalize durable goods, model estimation tables display the results for all the approaches. It is important to highlight that the approaches are organized in numerical order, as follows: 1) inventory (commodities); 2) unconditional; 3) conditional; and 4) index. The reason to do this was to facilitate comparisons across approaches, thus improving interpretation of results.

4.3.4.1. Multilevel Linear Regression Models

The first step was to run a multilevel linear model with no predictors, known as the null or unconditional model. In this model, the outcome variable is predicted as a function of the clustering variables to assess whether there is significant variation at one or more levels. In this study, the null model was used to examine if the grouping variables at level one, two, three, and four significantly affected the intercept or constant of reading and math scores.

Regarding reading scores, the null model indicated that the intercept varied across levels. Table 4.9 shows the results of the null model for reading. As observed, most of the variance in reading scores was explained at the school and state level (.092295 and .0462255). The intraclass correlation coefficients (ICC) for the null model were .0455259 at the state level, .0699869 at the municipal-within-state level, and .160885 at the schools-within-municipality-within-state level. These results indicated that school, municipality, and region random effects composed approximately 16% of the total residual variance.

Table 4.9

Null Model for Reading Scores

Characteristics of the Model	**Value**
Constant	-0.1563377*** (0.043139)
Random-effects parameters	
Department/region	0.0462255
var (cons)	(0.0135266)
Municipality	0.0248368
var (cons)	(0.0028418)
School	0.092295
var (cons)	(0.0026984)
Var (residual)	0.8520095 (0.0020057)
LR test vs. linear model: Chi2	49732.40***
Observations	364,436

Note. Robust standard errors in parentheses. ****p* < .01, ***p* < .05, **p* < .10

Regarding math scores, the null model also indicated that the intercept varied across levels. Table 4.9.1 shows the results of the null model for math. Like reading scores, most of the variance in math scores was explained at the school and the state level (.092295 and .0462255, respectively). The intraclass correlation coefficients (ICC) for the null model were .0541537 at the state level, .0813011 at the municipal-within-state level, and .1761372 at the schools-within-municipality-within-state level. These results indicated that school, municipality, and region random effects composed approximately 17% of the total residual variance.

Table 4.9.1

Null Model for Math Scores

Characteristics of the Model	**Value**
Constant	-0.0772093 (0.0471499)
Random-effects parameters	
Department/region	0.0556303
var (cons)	(0.0160832)
Municipality	0.0278877
var (cons)	(0.0032964)
School	0.0974221
var (cons)	(0.0028776)
Var (residual)	0.8463282 (0.0019925)
LR test vs. linear model: Chi2	52011.80***
Observations	364,436

Note. Robust standard errors in parentheses. ***$p < .01$, **$p < .05$, *$p < .10$

4.3.4.2. Multilevel Linear Models with Predictors

After running the null models, I conducted several multilevel estimations with predictors. This model was used to explore the extent to which durable goods were associated with academic achievement in Colombia. As such, this model employed all the observations in the sample ($N = 364{,}436$). Table 4.9.2 summarizes all the results for all the multilevel linear estimation models. Results are presented by methodological approach, as follows.

Inventory Approach. Results from this approach revealed that, controlling for sociodemographic and school characteristics, ownership of washing machines, PCs, Internet access, and microwaves was positively associated with reading scores and math scores. For example, students whose parents owned a washing machine scored, on average, .10 standard deviations higher in reading and .09 standard deviations higher in math than students whose families did not own a washing machine. Similarly, students whose families owned PCs scored, on average, .04 standard deviations higher in both reading and math than students who did not have access to PCs. Students whose families had Internet access scored, on average, .04 standard deviations higher in reading and .01 standard deviations higher in math. Overall, after controlling coefficients were larger for reading than for math scores suggesting that these durable goods may be more important for improving reading skills than for developing numeracy skills.

In contrast, durable goods such as cars, TVs, and videogame consoles were negatively associated with reading and math scores. For example, students whose had access to videogame consoles scored, on average, .08 standard deviations lower in reading and .07 standard deviations lower in math than students whose did not have videogames at home.

Unconditional Approach. This approach involved owning at least one consumer good in the household efficiency and entertainment categories. Students who had information goods scored, on average, .07 standard deviations higher in reading and .05 standard deviations higher in math than students who did not have any access to any information goods. In relation to household efficiency goods, students whose parents owned at least one consumer good scored, on average, .06 standard deviations higher in reading and .05 standard deviations higher in math than students who did not have access. Coefficients were larger for reading, suggesting that these types of goods may be more beneficial for improving reading skills. In contrast, students who had access to at least one entertainment good scored, on average, .10 standard deviations lower in reading and .08 standard deviations lower in math. Coefficients were higher for reading, indicating that ownership of these types of goods may be more detrimental for literacy skills.

Conditional Approach. This approach involved owning all the durable goods in the household efficiency and entertainment categories. Students who had information goods scored, on average, .07 standard deviations higher in reading and .04 standard deviations higher in math compared to students who did not have any information goods. Regarding household efficiency goods, students whose families owned washing machines and microwaves scored, on average, .05 standard deviations higher in reading and .04 standard deviations higher in math than students who did not have access to these goods. However, students whose families possessed all the durable goods in the entertainment category scored, on average, .14 standard deviations lower in reading and .12 deviations lower in math in comparison to students who did not have access to any of these goods.

Index Approach. Results indicated a positive relationship between the durable goods index and reading scores, but not for math. As such, students whose families ranked higher on the durable goods index scored, on average .03 standard deviations higher in reading compared with students whose families ranked lower in the index.

Control Variables. Across all approaches, and accounting for the nesting structure of the data, students who completed preschool performed better in reading and math than students who did not complete preschool. Similarly, ninth-grade students had higher scores in both reading and math than fifth graders. In addition, children whose parents had higher levels of education and more skilled jobs, particularly fathers, did better in reading and math. Also, results indicated that while girls performed better than boys in reading, boys performed better in math. It is important to highlight that preschool had the largest positive association with academic achievement. As such, students who attended preschool scored, on average, more than .21 standard deviations in reading and math.

In relation to school characteristics, school setting was positively related to reading scores, but not with math. For example, students who attended urban schools scored, on average, .06 standard deviations higher that students who attended rural schools. Length of school day was positively associated with math scores, but not with reading. As such, students who attended schools that operated on a full-day format scored, on average, .02 standard deviations higher in math than students who attended half day school programs.

In contrast, being absent from school, school type, and mother's employment were negatively associated with reading and math outcomes. For example, students who were absent from school scored on average, .01 standard deviations lower in reading and .04 standard deviations lower in math compared to students who were not absent from school. Similarly, students whose mothers were employed scored, on average, .01 standard deviations lower in both reading and math than students whose mothers did not work. It is important to highlight that school type had the largest negative effect. As such, students who attended public schools scored between .30 and .33 standard deviations lower in reading and math than students who attended private schools.

Table 4.9.2

Multilevel Linear Models for All Students

	Reading				Math			
Variables	(1) Commodities	(2) Unconditional	(3) Conditional	(4) Index	(1) Commodities	(2) Unconditional	(3) Conditional	(4) Index
Internet	0.04***				0.01***			
	(0.004)				(0.004)			
PC	0.04***				0.04***			
	(0.004)				(0.004)			
TV	-0.03***				-0.03***			
	(0.004)				(0.004)			
Washing machine	0.10***				0.09***			
	(0.004)				(0.004)			
Microwave	0.02***				0.01***			
	(0.003)				(0.003)			
Car	-0.10***				-0.08***			
	(0.003)				(0.003)			
Videogame console	-0.08***				-0.07***			
	(0.003)				(0.003)			
Sex	0.12***	0.13***	0.13***	0.14***	-0.14***	-0.14***	-0.14***	-0.13***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
School grade	0.08***	0.09***	0.09***	0.10***	0.15***	0.15***	0.15***	0.16***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Preschool	0.21***	0.22***	0.22***	0.22***	0.23***	0.23***	0.23***	0.24***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Absent	-0.00	-0.00	-0.00	-0.00**	-0.04***	-0.04***	-0.04***	-0.04***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Father's education	0.05***	0.05***	0.05***	0.05***	0.04***	0.04***	0.04***	0.04***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Mother's education	0.08***	0.08***	0.08***	0.08***	0.07***	0.07***	0.07***	0.07***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Father's job	0.02***	0.02***	0.02***	0.02***	0.02***	0.02***	0.02***	0.02***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Mother's job	-0.01***	-0.01***	-0.01***	-0.01***	-0.01***	-0.01***	-0.01***	-0.01***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
School type	-0.33***	-0.33***	-0.33***	-0.33***	-0.31***	-0.30***	-0.30***	-0.30***
	(0.039)	(0.039)	(0.039)	(0.039)	(0.041)	(0.040)	(0.041)	(0.041)
Length of school day	0.01	0.01	0.01	0.01	0.02***	0.02***	0.02***	0.02***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
School setting	0.05**	0.06**	0.05**	0.06**	0.01	0.01	0.01	0.01
	(0.024)	(0.024)	(0.024)	(0.024)	(0.025)	(0.025)	(0.025)	(0.025)
Information goods		0.07***	0.07***			0.05***	0.04***	
		(0.003)	(0.003)			(0.003)	(0.003)	
Efficiency goods		0.06***	0.05***			0.05***	0.04***	
		(0.005)	(0.003)			(0.005)	(0.003)	
Entertainment goods		-0.10***	-0.14***			-0.08***	-0.12***	
		(0.003)	(0.004)			(0.003)	(0.004)	
Durable goods index				0.03***				0.003
				(0.005)				(0.005)
Constant	-0.43***	-0.43***	-0.41***	-0.42***	-0.16**	-0.15**	-0.14**	-0.15**
	(0.062)	(0.062)	(0.061)	(0.062)	(0.066)	(0.066)	(0.066)	(0.066)
Random-effects parameters								
State/region var (cons)	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05
	(0.013)	(0.013)	(0.013)	(0.013)	(0.015)	(0.015)	(0.015)	(0.015)
Municipality var (cons)	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
School var (cons)	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Var (residual)	0.82	0.82	0.82	0.82	0.81	0.82	0.81	0.82
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
LR test vs. linear model: Chi2	37785.66***	37776.33***	37274.65***	37596.95***	43701.40***	43579.76***	43303.96***	43485.84***
Observations	364,436	364,436	364,436	364,436	364,436	364,436	364,436	364,436

Note. Robust standard errors in parentheses. ***$p < .01$, **$p < .05$, *$p < .10$

4.3.4.3. Multilevel Logistic Regression Models

Multilevel logistic models were used to examine the relationship between durable goods and school attendance in Colombia, which was the second educational outcome of interest in this study. The first step was to run a multilevel logistic model with no predictors, known as the null or unconditional model. In this model, the outcome variable is predicted as a function of the clustering variables to assess whether there is significant variation at one or more levels. Because this study used a four-level hierarchical model, the null model was used to examine if the grouping variables at all levels significantly affected the intercept or constant of the outcome variable (being absent from school). Table 4.9.3 shows the results of the null model.

Table 4.9.3

Null Model for Being Absent From School

Characteristics of the model	Value
Constant	-0.3260508***
	(0.0330611)
Random-effects parameters	
State/region	0.0257637
var (cons)	(0.0079433)
Municipality	0.0235645
var (cons)	(0.0030424)
School	0.0331135
var (cons)	(0.0020368)
Var (residual)	1.000
LR test vs. linear model: Chi2	4092.33***
Observations	364,436

Note. Robust standard errors in parentheses. ***$p < .01$, **$p < .05$, *$p < .10$

As observed in Table 4.9.3, the null model indicated that the intercept varied across levels. As such, most of the variance associated with the probability of being absent from school was explained at the school and the state level (.0331135 and .0257637, respectively). The intraclass correlation coefficients (ICC) for the null model were .0076398 at the state level, .0146274 at the municipal-within-state level, and .0244466 at the schools-within-municipality-within-state level. These results indicated that school, municipality, and region random effects composed approximately 2% of the total residual variance.

4.3.4.4. Multilevel Logistic Models with Predictors

After running the null model, I conducted several multilevel logistic estimations with predictors. This model was used to attempt to explore the relationship between durable goods and school attendance in Colombia for all students. Thus, this model employed all the observations in the sample ($N = 364{,}436$). It is important to stress that the total accuracy of the model was 58.4%. This entailed that for the 364,436 observations (students) used in the model, the model predicted whether students were absent from school almost 60% of the time. Table 4.9.4 summarizes all the results for all the multilevel logistic estimation models. Results are shown by methodological approach, as follows.

Inventory Approach. This approach indicated that the odds ratio of being absent from school was lower for students whose families had Internet access (.973) and who owned PCs (.894) and washing machines (.948) compared to students who did not have these commodities, controlling for all the other variables. Results were statistically significant at $p < .01$. In contrast, the odds ratio of being absent from school was higher for students whose families owned videogames (1.136) and microwaves (1.037) than for students who did not have these durable goods. It is important to highlight that the odds of being absent from school were higher for students who owned videogames than for any other durable good. Possession of a car was not statistically significant.

Unconditional Approach. Results from this approach suggested that the odds of being absent from school were higher for children whose parents owned at least one entertainment durable good (1.082) than for children whose parents did not own any entertainment durable goods. Ownership of any information and efficiency goods was not statistically significant.

Conditional Approach. Findings from this approach indicated that the odds of being absent from school were lower for students whose families owned all the durable goods in the information category (.892). On the contrary, the odds of being absent from school were higher for students whose families owned all the durable goods associated with entertainment (1.068). Ownership of efficiency goods was not statistically significant.

Index Approach. This approach suggested that the odds of being absent from school were lower for children whose families scored higher on the durable goods index (.947) than for children whose families scored lower on the index.

Control Variables. Across all approaches, estimates indicated that after controlling for ownership of all the durable goods, preschool, mother's education, school type, and length of school day were associated with a lower probability of being absent from school. For example, the odds of being absent from school were lower if students completed preschool (.966) in comparison with children who did not complete preschool. Similarly, children whose mothers had completed a graduate degree and high school were less likely to be absent from school than children whose mothers completed only elementary education (.914 and .964, respectively). Regarding school type, the odds of being absent from school were lower for children who attended public schools (.892) and for children who were enrolled in full-day school programs (.959) compared to children who attended private schools and children who went to half day school programs.

In contrast, sex, grade, father's education, and parental employment were associated with a higher probability of being absent from school. In relation to sex, the odds of being absent from school were higher for girls than for boys (1.220). Regarding grade, the odds of being absent from school were higher for ninth graders than for fifth graders (1.277). In relation to father's education, the odds of missing classes were higher for students whose fathers completed college or technical education (1.054) and who attained high school (1.030) than for students whose fathers completed only elementary education. Regarding parental employment, the odds of being absent from school were higher for students whose parents worked in the service and construction sector (1.062 for fathers and 1.067 for mothers) than for children whose parents did not work. However, the odds of being absent from school were lower for children whose fathers were farmers or pensioners (.959 and .961, respectively). It is important to stress that the coefficients and odds ratios were larger for girls.

Table 4.9.4

Multilevel Logistic Models for all Students

Dependent Variable = Absent from School (Yes = 1, No = 0)

	(1) Commodities				(2) Unconditioned				(3) Conditioned				(4) Index			
Variables	Coef.	OR	95% Confidence Interval for OR		Coef.	OR	95% Confidence Interval for OR		Coef.	OR	95% Confidence Interval for OR		Coef.	OR	95% Confidence Interval for OR	
			Lower	Upper			Lower	Upper			Lower	Upper			Lower	Upper
Internet	-0.027*** (0.009)	0.973	0.957	0.990												
PC	-0.112*** (0.009)	0.894	0.879	0.909												
TV	-0.010 (0.009)	0.990	0.971	1.010												
Washing machine	-0.054*** (0.009)	0.948	0.93	0.966												
Microwave	0.036*** (0.007)	1.037	1.022	1.052												
Car	0.008 (0.008)	1.008	0.993	1.023												
Videogame console	0.128*** (0.008)	1.136	1.119	1.154												
Sex	0.199*** (0.007)	1.220	1.203	1.237	0.185*** (0.007)	1.203	1.186	1.219	0.178*** (0.007)	1.194	1.178	1.211	0.171*** (0.007)	1.186	1.170	1.202
School grade	0.251*** (0.007)	1.285	1.267	1.303	0.240*** (0.007)	1.272	1.254	1.289	0.245*** (0.0071)	1.277	1.260	1.295	0.238*** (0.007)	1.268	1.251	1.286
Preschool	-0.035*** (0.007)	0.966	0.953	0.979	-0.037*** (0.007)	0.964	0.951	0.977	-0.036*** (0.007)	0.965	0.952	0.978	-0.037*** (0.007)	0.963	0.951	0.977
Father's education																
Graduate school	0.022 (0.016)	1.022	0.991	1.054	0.016 (0.0156)	1.016	0.986	1.048	0.030** (0.016)	1.031	0.999	1.063	0.030* (0.016)	1.030	0.999	1.063
College and technical	0.052*** (0.012)	1.054	1.028	1.080	0.045*** (0.012)	1.046	1.021	1.072	0.059*** (0.012)	1.060	1.035	1.086	0.056*** (0.012)	1.058	1.032	1.084
High school	0.029*** (0.009)	1.030	1.011	1.049	0.026*** (0.009)	1.027	1.008	1.045	0.032*** (0.009)	1.033	1.014	1.052	0.032*** (0.009)	1.032	1.014	1.051
Mother's education																
Graduate school	-0.089*** (0.016)	0.914	0.886	0.944	-0.107*** (0.016)	0.899	0.871	0.927	-0.085*** (0.016)	0.919	0.89	0.948	-0.088*** (0.016)	0.915	0.887	0.945

Variables	(1) Commodities Coef.	OR	95% Confidence Interval for OR Lower	Upper	(2) Unconditioned Coef.	OR	95% Confidence Interval for OR Lower	Upper	(3) Conditioned Coef.	OR	95% Confidence Interval for OR Lower	Upper	(4) Index Coef.	OR	95% Confidence Interval for OR Lower	Upper
College and technical	-0.001 (0.013)	0.999	0.974	1.024	-0.017 (0.013)	0.984	0.959	1.008	0.001 (0.013)	1.001	0.976	1.026	-0.003 (0.013)	0.997	0.973	1.022
High school	-0.037*** (0.009)	0.964	0.945	0.983	-0.044*** (0.009)	0.957	0.938	0.975	-0.036*** (0.009)	0.964	0.946	0.983	-0.038*** (0.009)	0.963	0.945	0.982
Father's employment																
CEO or business owner	0.063*** (0.019)	1.065	1.026	1.106	0.055*** (0.019)	1.057	1.018	1.097	0.070*** (0.019)	1.072	1.033	1.113	0.072*** (0.019)	1.075	1.036	1.116
Professional/admin.	0.023 (0.015)	1.024	0.994	1.054	0.014 (0.015)	1.014	0.985	1.045	0.024 (0.015)	1.025	0.995	1.055	0.022 (0.015)	1.022	0.992	1.053
Pensioner	-0.034 (0.024)	0.967	0.923	1.013	-0.047** (0.024)	0.954	0.911	0.999	-0.034 (0.024)	0.966	0.923	1.012	-0.040* (0.024)	0.961	0.918	1.007
Service and construction	0.060*** (0.013)	1.062	1.035	1.089	0.055*** (0.013)	1.056	1.030	1.083	0.058*** (0.013)	1.060	1.033	1.087	0.058*** (0.013)	1.059	1.033	1.087
Farmer	-0.042** (0.017)	0.959	0.927	0.992	-0.034* (0.017)	0.967	0.935	1.000	-0.044** (0.017)	0.957	0.925	0.990	-0.042** (0.017)	0.959	0.927	0.992
Mother's employment																
CEO or business owner	0.095*** (0.019)	1.100	1.058	1.144	0.093*** (0.019)	1.097	1.055	1.140	0.101*** (0.019)	1.106	1.064	1.150	0.104*** (0.019)	1.109	1.067	1.153
Professional/admin.	0.022** (0.010)	1.022	1.001	1.043	0.016 (0.010)	1.016	0.996	1.037	0.024** (0.010)	1.024	1.004	1.045	0.022** (0.010)	1.022	1.001	1.043
Pensioner	-0.055 (0.036)	0.946	0.882	1.016	-0.056 (0.036)	0.945	0.881	1.015	-0.052 (0.036)	0.949	0.884	1.019	-0.053 (0.036)	0.949	0.884	1.018
Service and construction	0.065*** (0.008)	1.067	1.050	1.084	0.064*** (0.008)	1.066	1.049	1.083	0.065*** (0.008)	1.067	1.050	1.084	0.065*** (0.008)	1.067	1.050	1.084
Farmer	0.039 (0.027)	1.040	0.987	1.095	0.047* (0.027)	1.048	0.995	1.104	0.042 (0.027)	1.042	0.990	1.098	0.043 (0.027)	1.044	0.992	1.100
School type	-0.114*** (0.042)	0.892	0.821	0.969	-0.111*** (0.043)	0.895	0.823	0.973	-0.116*** (0.042)	0.891	0.820	0.968	-0.116*** (0.042)	0.890	0.819	0.967
Length of school day	-0.042*** (0.014)	0.959	0.933	0.985	-0.042*** (0.014)	0.959	0.932	0.985	-0.042*** (0.014)	0.959	0.933	0.986	-0.042*** (0.014)	0.959	0.933	0.986
School setting	0.009 (0.037)	1.009	0.938	1.085	-0.000 (0.037)	1.000	0.929	1.076	0.010 (0.037)	1.010	0.938	1.086	0.005 (0.037)	1.005	0.934	1.081
Information goods					-0.019 (0.015)	0.981	0.952	1.010	-0.115*** (0.008)	0.892	0.878	0.905				
Efficiency goods					-0.014 (0.012)	0.986	0.963	1.009	0.010 (0.007)	1.010	0.996	1.025				
Entertainment goods					0.079*** (0.007)	1.082	1.066	1.097	0.066*** (0.009)	1.068	1.048	1.089				
Durable goods index													-0.055*** (0.011)	0.947	0.926	0.968
Constant	-0.384*** (0.067)	0.681			-0.427*** (0.068)	0.653			-0.410*** (0.067)	0.664			-0.389*** (0.067)	0.678		

	(1) Commodities				(2) Unconditioned				(3) Conditioned				(4) Index			
Variables	Coef.	OR	95% Confidence Interval for OR		Coef.	OR	95% Confidence Interval for OR		Coef.	OR	95% Confidence Interval for OR		Coef.	OR	95% Confidence Interval for OR	
			Lower	Upper			Lower	Upper			Lower	Upper			Lower	Upper
Random effect covariances																
State/region	0.025***				0.025***				0.026***				0.026***			
var(cons)	(0.008)				(0.025)				(0.008)				(0.008)			
Municipality	0.020***				0.020***				0.022***				0.021***			
var(cons)	(0.003)				(0.003)				(0.003)				(0.003)			
School	0.033***				0.035***				0.034***				0.034***			
var(cons)	(0.002)				(0.002)				(0.002)				(0.002)			
Observations		364,436				364,436				364,436				364,436		
LR test vs. logistic		3694.90***				3872.78***				4026.37***				3944.06***		
Log likelihood		-247271.76				-247466.37				-247408.54				-247517.89		
Wald Chi-Square		2521.60***				2138.46***				2252.62***				2037.80***		

Note. Robust standard errors in parentheses. ***$p < .01$, **$p < .05$, *$p < .10$

4.4. Discussion

As stressed in the results section, there is a statistically significant relationship between durable goods and educational outcomes among fifth and ninth grade students in Colombia. The nature of this relationship, however, depends not only on whether families have access to durable goods but also on the types of durable goods that they own. Hence, results from this research can be analyzed from two perspectives: the methodological decision pertaining to the operationalization of durable goods and the estimation models.

From a methodological standpoint, this study showed the utility of using different approaches to model durable goods. Together, these approaches provided a comprehensive understanding of how durable goods related to academic achievement and school attendance in Colombia. In what follows, I explain the lessons learned from each approach. By using the inventory approach, it was possible to identify the individual effect of each commodity in the outcomes of interest, which was something innovative in this field of study. For example, while computers, washing machines, and Internet access were positively associated with academic achievement and school attendance, durable goods such as TVs, cars, and videogame consoles were negatively related. A potential explanation for this finding may be derived from the utility function that each commodity shares with education. For instance, computers and Internet access can be used to enhance learning outcomes, thus having a direct positive effect on education. Washing machines may contribute to improving educational outcomes indirectly by reducing the time devoted to domestic activities. The presence of a washing machine at home may be provide more time for children and parents to engage in schoolwork. On the contrary, durable goods such as TVs, cars, and videogames, which utility function is derived from leisure and entertainment, may have a direct or indirect negative effect on educational outcomes because these commodities enhance leisure opportunities, which may deter students from studying. In the case of TVs, for example, this study corroborated previous research which highlights that heavy television use predicts cumulative loss in literacy skills among 11-year-old children (Mundy et al., 2020). Similarly, findings from this study confirmed previous research about the negative effect of playing videogames on academic achievement among college students (Jackson et al., 2011). In contrast, the result related to car ownership contradicted previous findings about the positive effect of car access on educational outcomes and employment (Ralph, 2018). A potential explanation as to why car ownership was negatively associated with academic achievement and school attendance may be that, in Colombia, some people use their cars to generate income by providing semiformal and informal transportation services. Thus, it is possible that children whose families provide such services may have to participate in these activities, which disproportionally affects their academic performance.

From a policy perspective, the inventory approach may be useful in the formulation of specific asset-based policies to improve educational outcomes and to reduce multidimensional poverty. For example, conditional cash transfer programs, which provide direct financial assistance to low-income families conditioned on investing on their children's education and health, could benefit from this approach by promoting access to durable goods such as computers and washing machines, which this study showed can improve their children's academic achievement. Additionally, this approach may be the most efficient because by using all the durable goods in the estimation methods, it produced more accurate estimates of the relationship between the variables of interest (Kukuk & Baty, 1979). However, one drawback is that putting all the durable goods together will take degrees of freedom.

The attributional approach provided useful insights about how different groups of durable goods related to educational outcomes. Although the estimates for the information and entertainment goods were consistent across approaches, results for the information and efficiency goods were not. For example, results from the unconditional and conditional approaches indicated that possession of information goods was positively associated with academic achievement and school attendance. In the case of entertainment goods, results from the unconditional and conditional approaches indicated that regardless of whether families had access to at least one of the durable goods in this category or all the durable goods, students performed lower academically and were more likely to be absent from school than students whose families did not have those types of durable goods. However, the estimates produced for the household efficiency goods were not consistent. For example, household efficiency goods were positively associated with academic achievement, but not statistically significant in predicting the probability of being absent from school. A potential explanation may be that washing machines and microwaves have opposite effects on school attendance. This may entail that when combined, the net effect is not significant. More research on this area would elucidate this finding.

From a policy perspective, the attributional approach also proved to be beneficial for the formulation of asset-based policies that foster access to consumer goods. For example, this approach showed that information and household efficiency goods need to be included, or at least subject of conversation, in any asset-based policy that aims to improve academic achievement through access to durable goods. However, this approach is not as efficient as the inventory approach because it used a binary method to model ownership of durable goods. The only difference in relation to the traditional binary approach is that in the attributional approach grouped durable goods by attribute or type. As such, the main drawback of this approach is that it assumed that all the commodities in each of the groups had the same effect on education, which as shown by the attributional approach was not true.

The index approach allowed us to assess the combined or net effect of all the durable goods (as a group) in academic achievement and school attendance. Conceptually, this made sense as most of the literature on this topic suggests that creating a durable goods index constitutes a proxy for household wealth. As such, by using the index approach it was possible to identify wealth differences across households and their effect on educational outcomes. As such, this study found that students who scored higher on the durable goods index performed better in reading and math and were less likely to be absent from school compared to children who scored lower in the durable goods index. This approach constituted a great tool for research as it allowed me to model household wealth. However, a drawback from this approach is that it assumed no differential effect by each commodity. Perhaps, this approach may not be as useful for policy formulation, compared to the inventory and attributional approaches, given that it did not offer evidence about which durables goods had a stronger positive effect in education. Nevertheless, it is important to stress that this approach was statistically robust as it used exploratory factor analysis (EFA) as the main method for index construction, which has been recommended in the literature.

In relation to the estimation models, results corroborated existing research about the positive effect of asset ownership, particularly durable goods, on educational outcomes. For example, findings indicated that after controlling for sociodemographic and school characteristics, possession of durable goods was positively related to academic achievement and school attendance. Using the index approach, these results verified what Chowa et al. (2013) and Kafle et al. (2018) found in their studies about ownership of durable goods and academic achievement in Ghana and Tanzania, respectively. However, this study provided useful insights about the relationship between durable goods and school attendance, a research topic that has not been explored as much. Using the inventory and attributional approaches, this study contributed to the exiting literature on durable goods because it showed that different types of durable goods have differential effects on education.

By employing four-level multilevel models, it was possible to get a clearer picture of how durable goods related to academic achievement and school attendance in a country with high levels of inequality. Because Colombia is one of the most unequal countries in the Latin American region, with large social and economic disparities at the local level, the use of multilevel modeling proved to be the correct econometric choice to understand, in a comprehensive manner, how durable goods related to academic achievement and school attendance. For example, the models indicated that after controlling for household socioeconomic characteristics and despite important social and economic disparities among municipalities and departments; computers, washing machines, and Internet access were positively associated with academic achievement and school attendance. This finding suggests that durable goods can play an important role in improving or hindering educational outcomes for children in Colombia.

As highlighted in the introduction, current measures of multidimensional poverty in Colombia do not measure asset ownership. However, results from this study suggest that lack of access to durable goods, which are a type of assets, can negatively affect academic achievement and school attendance. Thus, this research has provided evidence of the interlinkage between two educational outcomes and the assets indicator of the Global-MPI. Similarly, the recent COVID-19 crisis has revealed the importance of durable goods in education. Having a computer and Internet access at home, for example, was crucial for the rollout of remote learning content for children. It is estimated that out of 1.5 billion school-age children affected by school closures globally between 2020 and 2021, 463 million children were not able to attend online classes because they did not have computer nor Internet at home (UNICEF, 2020). In Latin America, for example, more than 13 million children could not access any form of remote learning during the first two months of the pandemic, with rural students bearing a higher share of the problem (United Nations, 2020b). In some countries, educational television and radio programs were produced to offset the impact of not having Internet or computers. A report from the World Bank (2020a) indicated that such disparities could translate into a learning loss that could exceed two years of school learning. As schools start to reopen across the world it would not be surprising to find out that achievement gaps will have been aggravated or that dropout rates will have increased. Thus, research that explores how durable goods relate to multiple educational outcomes in different geographical contexts will be key during the post-COVID era.

4.4.1. Limitations

One of the major limitations of this study was the number of multilevel estimations conducted to explore the relationship between durable goods and educational outcomes. Because this study assessed two different educational outcomes (continuous and binary), separate models were performed for each outcome. Building one model that accounts for both outcomes and the variables of interest could increase efficiency. Structural Equation Modeling (SEM) could correct for this and provide a single estimation model with multiple outcomes. Doing so could yield more robust estimates about the different ways in which the variables of interest relate to each other. For example, we could further understand not only the relationship between durable goods and educational outcomes, but how these outcomes relate to each other given the presence or absence of durable goods.

Another limitation was the decision about how to model the attributional approach. As highlighted in the methods chapter, this approach entailed grouping durable goods by type of attribute. This grouping was done using a binary method. In the unconditional approach, possession of durable goods was modeled as ownership of at least one of the durable goods in the household efficiency and entertainment categories. In the conditional approach, possession of commodities was modeled as ownership of all the durable goods in the household efficiency and entertainment categories. The rationale for this was to account for household wealth by considering the types of durable goods present at home. Similarly, given that the number of durable goods was small, it seemed like an appropriate way to model this approach. However, other methods could have been used to account for this wealth difference such as using a frequency count.

A third limitation of this study was about the decision about coding school attendance. As shown in the methods section, school attendance was coded as a binary variable. The rationale for this was because there was not a clear cut-off value to identify students who were absent from school for minor reasons from students who experienced chronic absenteeism. However, descriptive statistics showed that by using school attendance as a binary variable, close to 45% of the sample were absent from school in the month before taking the SABER test, which constituted a high percentage. As such, using school attendance as a multinomial variable could yield more accurate estimates about how durable goods relate to school attendance.

4.5. Conclusion

In conclusion, the multilevel models used in this paper showed that durable goods can play an important role in improving academic achievement and school attendance. Specifically, this study found that controlling for sociodemographic and school characteristics, students whose families owned durable goods such as washing machines and computers were more likely to go to school and perform better academically. One potential explanation for this is that ownership of durable goods may allow families to increase the efficiency with which household tasks are completed. This may contribute to save time for other activities and to reduce the amount of household responsibilities for school age children. In turn, this may translate into more parental involvement with children's education and more time for children to study. On the contrary, lack of access to durable goods may hinder children's ability to engage in school activities.

Furthermore, this study suggested that using different approaches to model durable goods can enhance our understanding of how durable goods relate to academic achievement and school attendance. Using the three approaches provided useful insights about the interlinkages between durable goods and educational outcomes for school-age children in Colombia. Although the index approach provided a macro-level perspective whereby one can understand how a group of durable goods relates to educational outcomes, the inventory and the attributional approaches added to the existing literature by providing evidence about the differential effects that different commodities or types of commodities can have in academic achievement and school attendance in developing countries. Such underlying difference between the index and other two approaches may be crucial at the policy level where resources are limited, and interventions must be cost-effective. Because the inventory approach yielded more efficient and unbiased estimators than the attributional approach, it is highly recommended for future research in this field. Additionally, the inventory approach may constitute an effective method to identify potential areas for policy development because it provided evidence of which durable goods had a larger positive effect in academic achievement and school attendance.

Results from this study will hopefully contribute to strengthen current assessments of multidimensional poverty in Colombia and provide evidence supporting the formulation of asset-based social policies that include durable goods to improve educational outcomes. For example, a policy recommendation from this study is to strengthen the scope of conditional cash transfer programs, which provide direct financial assistance to low-income families conditioned on investing on their children’s education and health, to increase access to computers, Internet, and washing machines. This could be done through public funding of micro-loan programs or through community-based organizations where instead of owning the durable goods, families share them.

CHAPTER FIVE
RAGE AGAINST THE MACHINES: THE ROLE OF DURABLE GOODS IN GENDER-BASED DEVELOPMENTALLY-SITUATED EDUCATIONAL DISPARITIES IN COLOMBIA (ARTICLE #2)

Wealth accumulation has traditionally been conceived as an issue of income generation. Nonetheless, economic theory indicates that assets are a more comprehensive measure of wealth because they represent all the resources and capital that people possess, not just their income (Brandolini et al., 2010; Carter & Barrett, 2006; Hoekstra, 2019; Narayan & Kapoor, 2008; Sherraden, 1991; Smith 1776/1976). From a macroeconomic standpoint, this conceptualization of wealth refers to the different types of capital and resources that countries possess rather than simply the net value of the goods and services that are exchanged in the market, which are measured by their Gross Domestic Product (GDP). Although many tools have been developed to measure wealth at the macroeconomic level, the *Inclusive Wealth Index* is perhaps one of the most comprehensive because it accounts for all the types of resources and capital that countries possess (Duraiappah & Muñoz, 2012; López-Calva & Rodríguez-Castelá, 2016; Polasky et al., 2015; United Nations Environment Programme, 2018; World Bank, 2006; 2011). For example, it includes manufactural capital, which refers to the inventory of roads, buildings, and machines; physical and natural capital, composed of agricultural land, forests, oceans, and natural resources; human capital, calculated by the return on investment of education; and financial assets such as external debt and foreign direct investment (United Nations Environment Programme, 2018).

From a microeconomic perspective, which is the focus of this paper, scholars such as Sherraden (1991), Moser (1998, 2006, 2008), Attanasio and Székely (2001), and Shapiro and Wolff (2001) have argued that social and economic household welfare depends on the portfolio of assets that families have access to, not solely on income. The rationale for this is that while income is used for immediate consumption, assets can be used for future consumption (Sherraden, 1991). As such, assets can be used as safety nets to protect families from economic shocks or to access other assets. Assets can be divided into six types: physical and natural capital, which refers to properties and land; financial capital; human capital in the form of education; durable goods; social capital; and political capital (Attanasio & Székely, 2001; Kumaraswamy et al., 2020; Moser, 1998, 2006, 2008; Shapiro & Wolff, 2001; Sherraden, 1991).

Although there is not a standard tool to assess household wealth, the Global-Multidimensional Poverty Index (Global-MPI) is perhaps the most comprehensive measure of non-income poverty, which can be used as a proxy for estimating lack of wealth. The Global-MPI measures how people experience deprivations in three dimensions of development: health, education, and living standards. In health, the index assesses two indicators, nutrition and child mortality. In education, it measures whether school-age children attend school, and if there is school lag. Regarding living standards, the index assesses whether families have access to basic services, including electricity and drinking water, and access to assets in the form of durable goods (United Nations Development Program & Oxford Poverty and Human Development Initiative, 2020). According to this index, people are considered multidimensionally poor if they have deprivations in at least one third of the indicators (United Nations Development Program & Oxford Poverty and Human Development Initiative, 2020). The Global-MPI has been used as a policy tool by several countries to map poverty at the local level and to guide social policy formulation. For example, in 2011, Colombia developed an adjusted version of the Global-MPI, called the Colombian Multidimensional Poverty Index (C-MPI) (Angulo et al., 2011). The C-MPI is composed of five dimensions and 15 indicators. However, the assets indicator was excluded in the Colombian index (Angulo et al., 2011; Angulo, 2016), which raises questions because most government data capture information about possession of durable goods.

Assets and Development

Research on assets can be divided in two groups. The first group comprises studies that examine how asset ownership or access to different types of assets relates to poverty (Attanasio & Székely, 2001; Moser, 1998, 2006, 2008). Most research in this group has focused on analyzing the impact of home ownership, education, and social capital in reducing poverty. Findings suggest, for example, that families with higher levels of education or who own homes are less likely to fall into poverty (Attanasio & Székely, 2001; Neri et al., 2001; Poverty and Shared Prosperity, 2018, 2020; Shapiro & Wolff, 2001; World Development Report, 2018). Similarly, studies about the relationship between social capital and poverty indicate that families who have access to social networks and community-based organizations are less likely to fall into poverty (Collier, 2002; Gray-Molina et al., 2001). Similarly, Moser (1998, 2006, 2008) argued that because assets can be used for future consumption, which make them seem more like an investment, they allow people to develop skills such as self-efficacy or self-regulation, which may be important for building capabilities (Drèze & Sen, 1989; Sen, 1983; 1984).

The second category encompasses research that explores the relationship between assets and education. Studies in this category have mostly focused on the effect of financial assets such as savings on improving school outcomes, indicating a positive association (Elliot et al., 2018; Sherraden, 1991; Zhan & Sherraden, 2003; Zhang, 2006). In general, research in this area highlights that one of the reasons financial assets can improve educational outcomes is because they give families and children opportunities to make choices, which creates positive expectations about the future (Sherraden, 1991; Zhan & Sherraden, 2003; Zhang, 2006). High parental expectations about children's education may nudge students to attend school regularly, which in the long-term may positively affect academic achievement (Zhan & Sherraden, 2003; Zhang, 2006). One potential explanation for this may be that once people's basic needs are met, they can devote their time and energy to achieving personal goals, suggesting that assets can contribute to agency development (Arendt, 2018; Meyers, 2014; Mill et al., 1994; Sen, 1983, 1984).

Less is known about the relationship between durable goods and educational outcomes. Although not a new field, most of the research on this area has focused on exploring how durable goods relate to academic achievement and school attendance mainly in African and Asian countries (Chowa et al., 2013; Kafle et al., 2018). Findings indicate that ownership of durable goods improves academic achievement, but evidence on the impact on school attendance is less clear. For the Latin American region, Cabra

(2022a) conducted a four-level multilevel analysis to explore the relationship between durable goods and educational outcomes for school-age children in Colombia. By using different methodological approaches to model durable goods and controlling for key sociodemographic and school characteristics, Cabra (2022a) found that durable goods not only played an important role in education, but also that different types of durable goods had differential effects in academic achievement and school attendance. For example, results from the index approach, a method where durable goods were modeled as an index by using exploratory factor analysis (EFA), suggested that durable goods were positively associated with academic achievement and school attendance (Cabra, 2022a). At the same time, results from the attributional approach, where commodities were grouped by type or attribute, indicated that while information goods were positively associated with academic achievement and school attendance; entertainment goods were negatively related (Cabra, 2022a). Similarly, findings from the inventory approach, which entailed including all the commodities in the estimation models, showed that ownership of computers, washing machines, and Internet access were positively related to academic achievement and school attendance (Cabra, 2022a). Although each approach contributed to the literature on durable goods and education, the inventory approach emerged as a useful tool for policy formulation because it demonstrated which durable goods had the largest positive effects in academic achievement and school attendance. Asset-based policies to improve educational outcomes and reduce poverty, particularly in developing countries, would benefit from this approach.

Findings from this body of research stress that durable goods can contribute to improve living standards in multiple ways. Durable goods such as computers, Internet, washing machines, and refrigerators, for instance, have allowed families to access the knowledge economy and to improve the efficiency of household tasks (Figal et al., 2019; Tewari & Wang, 2021). Computers and the Internet have helped people not only access information, but also enter a market where they can exchange goods and services (Figal et al., 2019). Computers have also supported children's education by enhancing learning (Barrera-Osorio & Linden, 2009; Fairlie & Kalil, 2017). Washers, microwaves, and refrigerators have allowed families, particularly women, to have more time to engage in non-domestic activities (Figal et al., 2019; Rosling, 2011; Tewari & Wang, 2021). This has contributed, to some degree, to reduce gender-based disparities and increase the share of women who enter the labor force (Alfaro et al, 2015; Deere & Dos, 2006; Tewari & Wang, 2021). Similarly, it seems that this time efficiency effect has lessened the time burden imposed upon children, particularly girls, for doing domestic chores, which in turn has freed up additional time for studying or engaging in leisure activities (OECD, 2021b).

Durable Goods and Gender-Based Developmentally-Situated Disparities

Gender-based disparities are rooted in a system of oppression that undervalues the role of women in intrafamily relations (Drèze & Sen, 1989). In such a system, common in many developing countries, women are not perceived as important contributors to the economic well-being of the household vis-à-vis men (Drèze & Sen, 1989). As such, women are excluded from social and economic life and are nudged, coercively or persuasively, to take on childrearing and domestic activities, which may render them more vulnerable than men to experiencing capability deprivations (Drèze & Sen, 1989; Lewis & Lockheed, 2007). This, in turn, may increase the likelihood that women fall into monetary and multidimensional poverty. In the area of education, this may translate into fewer girls attending school or attaining post-secondary education (Drèze & Sen, 1989; Lewis & Lockheed, 2007). For instance, according to the World Development Report (2018) it was estimated that, in 2016, close to 265 million children of primary and secondary school age were not in school, of which more than 60 million were girls (World Development Report, 2018). Poverty, lack of school infrastructure, child labor, and negative family perceptions about the returns to girls' education are some of the most important factors associated with low enrollment levels for girls (Tembon & Fort, 2008; World Development Report, 2018).

Similarly, research on achievement gaps suggests that there are statistically significant differences between girls and boys when it comes to academic performance (Golsteyn & Schils, 2014; OECD, 2012a; Tembon & Fort, 2008). Although girls tend to perform better than boys in reading comprehension and social sciences, boys do better than girls in math and sciences (Golsteyn & Schils, 2014; OECD, 2012a; Tembon & Fort, 2008). Such disparities may disproportionally affect women's college-going decisions and career choices as they may be discouraged to enter STEM-related fields, academic disciplines with the some of the highest returns on investment in education. The recent COVID-19 crisis also exacerbated such disparities because it revealed who could return to school. In a report about the implications of COVID-19 on education in Latin America, García (2020) stressed that low-income students were affected the most during the pandemic because they had limited access to resources to participate in remote learning (e.g., computers and Internet access). Similarly, a report from the World Bank indicated that between March and December 2020 about 1.6 billion children stopped going to schools, which represents an estimated loss of about half a year of school learning (World Bank, 2020). The presence of durable goods at home may offset this trend by reducing the time devoted to completing household chores, which in a system of gender-based oppression, may be more beneficial for girls than for boys.

In addition to gender disparities, school grade, a proxy for age, may also play a key role in understanding the relationship between durable goods and education. Research on socioeconomic achievement gaps highlights that gaps in cognition increase with age, even during preschool (Chmielewski, 2019; World Development Report, 2018). This entails that social and economic deprivations at the household level can have long-lasting effects on children's learning and social relations because they can affect brain development (World Development Report, 2018) and perpetuate systemic oppression for marginalized groups such as women and children (Drèze & Sen, 1989). Lack of access to durable goods, for example, may aggravate intrahousehold relations, which could negatively affect educational outcomes. Hence, it is possible that in the absence of durable goods, older children, and particularly girls, may be forced to take on household responsibilities or care of their younger siblings. This, in turn, may jeopardize the capability of women to achieve similar levels of education of boys, which could further exacerbate exclusion and poverty.

The observation of widespread female disadvantage in education is of direct interest to the analysis of the relationship among durable goods, academic achievement, and school attendance in Colombia, and must be a matter of concern for research in this field. Using four-level multilevel linear and logistic models with data from a standardized test administered to fifth and ninth graders in Colombia for the year 2017, this study explored whether different types of durable goods (an indicator in the original Global-MPI) were differentially related to students' academic achievement and school attendance by sex and school grade, using the inventory approach. This research aimed to answer the following question: *In what way are durable goods, as measured by the inventory approach, differentially related to academic achievement and school attendance by sex and school grade?* This paper contributed to the existing literature by providing useful insights about the role that different types of durable goods have in reducing gender-based developmentally situated disparities. The methods section shows the strategy that was used to address the research question, including the econometric models. In the results section, descriptive statistics illustrate important information about possession of durable goods among children in Colombia while the inferential multilevel models will demonstrate a significant statistical relationship between the variables of interest. The discussion section positions these results within the literature on this field and underscore the most salient limitations. Finally, the article concludes with research and policy recommendations articulating the need for asset-based policies that enhance children's well-being.

5.1. Context

According to the most recent population census, Colombia has an estimated population of 49 million people, of which 51.2% are women (DANE, 2020a). In 2020, 18.1% of the population were multidimensionally poor (Multidimensional Poverty Peer Network, 2021). Geographically, the country is divided in 32 departments (or states) and 1,101 municipalities. According to the 2017 World Bank GINI index, a measure of inequality based on income distribution within a country, Colombia is one of the most unequal countries in the world (World Bank, 2020b). In the Latin American and Caribbean region, Colombia is the second most unequal country, after Brazil (ECLAC, 2019).

Education in Colombia is a fundamental human right, and thus, it is universal from early childhood education to high school (Education Act 115, 1994). According to the Education Act 115 of 1994, the education service can be delivered by the government or by private organizations (authorized by the Ministry of Education). If provided by the government, it is free of charge; otherwise, families must pay a fee set by the school. Because of lack of infrastructure (e.g., not enough schools or classrooms), public schools operate in a half day or a full day format. While half day programs run for six hours a day, full day programs operate for eight hours a day (DNP, 2019). More than 80% of public education in Colombia is delivered through half day programs (DNP, 2019).

Academic achievement is measured by a set of national standardized exams at different school grades called *Pruebas SABER ("SABER tests")*. At the elementary and middle school level, the test assesses proficiency in reading and math for students in third, fifth, and ninth grades. At the high school level, the test assesses proficiency in math, reading, natural sciences, social sciences, and civic engagement (ICFES, 2018). Research on quality of education in Colombia highlights that, in 2019, 50% of children in Colombia of late primary school age were not proficient in reading (World Bank, 2019). Poverty, poor school quality (not enough schools or under-resourced schools), and lack of a support system outside of school are considered the main barriers to student success (OECD & Ministry of Education of Colombia, 2016). This corroborates the work of scholars such as Duarte et al., (2012), Hincapie (2016), Rangel and Lleras (2010), and Rozo (2017) who found that achievement gaps among Colombian children are highly associated not only with student's socioeconomic status, but also with school characteristics, school setting (urban vs. rural), and neighborhood composition. Similarly, Cabra (2002a) found that after controlling for sociodemographic and school characteristics, possession of durable goods, a proxy for household wealth and an indicator of multidimensional poverty, was positively related to academic achievement and school attendance.

Expanding on previous research on socioeconomic achievement gaps in Colombia, particularly the work of Cabra (2022a) on durable goods, this paper aimed at exploring whether different types of durable goods, as measured by the inventory approach, had differential effects on children's academic achievement and school attendance by sex and school grade. The rationale for this is that while there is empirical evidence about the relationship between durable goods and educational outcomes, less is known about the role that different types of durable goods have in reducing or increasing gender-based developmentally situated disparities.

5.2. Methods

This study employed the inventory approach, also known in the econometrics as the full specification model, to model durable goods. This approach entailed using all the durable goods in the estimation models (Stock & Watson, 2015).

This study used a quantitative design, including descriptive statistics, correlation, and multilevel modeling, a type of Ordinary Least Square regression method that takes into account when the predictor variables are structured or nested at varying hierarchical levels (Raudenbush & Bryk, 2002). I used four-level multilevel linear and logistic modeling because data were nested in four levels and because it allowed me to distinguish between the variance in academic performance and probability of being absent from school attributable to students' characteristics (level one), including ownership of durable goods, from the variance attributable to characteristics of schools (level two), municipalities (level three), and departments (level four).

5.2.1. Data Collection

Data for this study come from the 2017 SABER test for third, fifth, and ninth grades, which was administered by the *Instituto Colombiano para el Fomento de la Educación Superior* (ICFES) – Colombian Institute for the Evaluation of Education. The dataset provided information about different school outcomes, students' socioeconomic information, including possession of durable goods, and information about schools for all the population of children in third, fifth, and ninth grades in Colombia (ICFES, 2019). I used a subset of the data that focused exclusively on fifth and ninth grade students because the data did not capture information about durable goods for third graders. Hence, the number of fifth and ninth graders who took the SABER test in 2017 was 1,369,887. Students with complete test scores and durable goods information (N = 364,436) were included as the final analytic sample and did not substantially differ on sociodemographic variables of interest (e.g., sex, grade, preschool, parental education, and parental employment) from the total sample. This study was classified as "not-human subjects" research by the University of Vermont Institutional Review Board (IRB).

5.2.2. Participants

The study included 364,436 students selected from a subset of the 2017 SABER test for fifth and ninth grade students in Colombia. Age of students ranged from nine to 15. Mean age was 12.34, with a standard deviation of 1.979. In this sample, 51.44% of students identified as girls and 48.56 % as boys. Data were de-identified, thus posing little to no risk to participants. Socioeconomic information of the students was strictly used for research purposes.

5.2.3. Variables

The variables that were used in this study captured information about students in fifth and ninth grade in three domains: 1) socioeconomic characteristics, including ownership of durable goods; 2) educational outcomes (e.g., SABER test score results and school attendance); and 3) school characteristics. In what follows, I describe the variables that were used to examine the relationship among durable goods, academic achievement, and school attendance in Colombia.

5.2.3.1. Dependent Variables

This study used two dependent variables: 1) SABER test results for reading and math and 2) school attendance. Academic achievement is measured by the 2017 SABER tests in reading and math for students in fifth and ninth grade. Test scores range from 100-500, with 100 being the lowest and 500 the highest. Depending on the score obtained and to measure the level of proficiency on each subject, students are placed in one of four categories (see Appendices 2 and 3). To compare results across grades, scores were standardized using z-scores. School attendance is measured by the number of days students were absent from school the month before taking the SABER test. For this study, school attendance was coded as a dummy variable that takes the value of "0" if students were not absent in school and "1" if students were absent from school.

5.2.3.2. Independent Variables

In this study, durable goods represented the independent variable. The data captured information for seven durable goods: Internet access; TV; PC or laptop; washing machine; microwave; car; and videogames. Because I employed the inventory approach, all seven durable goods were used as independent variables.

5.2.3.3. Control Variables

Control variables were selected based on research about socioeconomic achievement gaps. In what follows, I explain each of the control variables that were used in this dissertation and the decisions pertaining to coding.

Sex. Research on achievement gaps suggests significant differences in elementary school performance between boys and girls. In general, boys perform better in math, while girls perform better in reading and social sciences (Golsteyn & Schils, 2014; OECD, 2012a). I coded this variable as “0” for male and “1” for female.

Grade Level. This variable was used to test if the relationship among durable goods, academic achievement, and school attendance varied by school grade. Research on achievement gaps indicates that differences in academic performance start at an early age (Clotfelter et al., 2006). In Colombia, the achievement gap among students in fifth and ninth grade is more pronounced in math than in reading (ICFES, 2018).

Years of Preschool. This variable constitutes a reliable measure to assess socioeconomic status because it is directly related to children’s education and to quality of life (American Psychological Association, 2021). Studies of this topic suggest that exposure to preschool programs has positive short-term and long-term socioemotional, psychological, and academic benefits (Ansari, 2018; Pianta et al., 2009). This variable was coded as a dummy variable, which took the value of “0” if the child did not attend preschool and “1” if the child attended one, two, or three years of preschool.

Parental Education. This variable was used as proxy for socioeconomic status. I used mother’s and father’s education because empirical evidence suggests that parental education is a consistent and reliable measure to predict infant health, children’s academic achievement, and lower levels of poverty (Contreras & Larrañaga, 2001; Currie & Moretti, 2002; World Development Report, 2018). This variable was coded as an ordinal variable. As such, the variable took the value of “1” for parents who completed elementary school, “2” for parents who completed high school, “3” for parents who have attained a technical/vocational degree or college, and “4” for parents who completed graduate school.

Parental Employment. In this study, I used father’s and mother’s employment as proxies of socioeconomic status (Chmielewski, 2019; Currie & Moretti, 2002), which research points to as a consistent and reliable predictor of academic achievement gaps (Chmielewski, 2019; Coleman, 1968). This variable was coded as a categorical variable, comprised of six categories. As such, the variable took the value of “0” to refer to non-wage-earning, which includes people who are unemployed and stay at home parents, “1” farmer, “2” service and construction, “3” pensioner, “4” professional and administrative work, and “5” CEO or owner of a small business.

School Type. This variable assesses whether schools are public or private. Research suggests that students who attend private schools perform slightly better in academic tests than students who attend public schools (Braun et al, 2006; Duncan & Sandy, 2007; López et al., 2017). This variable was coded as a dummy variable. Thus, this variable took the value of “0” if the school was private and “1” if the school was public.

Length of School Day. This measures whether children attend school in a half day format or a full day format. Research on this topic indicates that lengthening the school day improves academic achievement (Alfaro et al, 2015; Dominguez & Ruffini, 2020; Hincapie, 2016; Orkin, 2013; Pires & Urzua, 2011). This variable was coded as a dummy variable. The variable took the value of “0” if students attended schools in a half day format and “1” if students attend schools in a full day format.

School Setting. This measures whether the school is in a rural or an urban setting. Research on socioeconomic achievement gaps in Colombia suggests that students who attend rural schools perform lower on academic tests than students who attend urban schools, even after controlling for socioeconomic status (Duarte et al, 2012; Gaviria, 2017). This variable was coded as a dummy variable. This variable took the value of “0” if the school is in a rural setting and “1” if it is in an urban setting.

5.2.4. Data Analysis and Validation

Data analysis was conducted in three stages. The first stage entailed running descriptive statistics for all the variables that were included in this study. Descriptive statistics were computed to understand the distribution of sociodemographic and socioeconomic characteristics of the sample, including ownership of durable goods. The second stage involved performing a correlation matrix analyses, bivariate t-tests, and ANOVA tests to examine the association relating durable goods and control variables to continuous outcomes of interest. In the third stage, I used multilevel modeling to explore whether durable goods were differentially related to academic achievement and school attendance by sex and school grade. To do this, I ran separate multilevel models for four subsamples of the data: girls, boys, fifth, and ninth graders. Conducting the multilevel analyses involved different steps. First, I estimated the null model for each of the outcome variables. The null models were used to examine how much of the variance in the 2017 SABER test and in school attendance were explained by each level of clustering. To do this, I calculated the intraclass correlation coefficient (ICC) for each dependent variable. Then, I ran separate multiple predictor models for each of the dependent variables (full models). Test scores were standardized by using z-scores because I wanted to compare results across grades. Also, it is important to stress that I used listwise deletion as the method for dealing with missing data, which were missing at random. Multilevel analyses were conducted in STATA and SPSS software.

5.3. Results

Results are presented in the order that I conducted data analysis. Hence, I present the descriptive statistics first. Then, I show how I modeled durable goods. Following this, I present the outcomes of the correlation matrix analyses, t-tests, and ANOVA tests. Lastly, I present the results of the multilevel linear and logistic analyses.

5.3.1. Descriptive Statistics

Because this study used subsamples of the data by sex and school grade, descriptive statistics are presented by subsample. Table 5.1 shows sociodemographic information about the students in this study as well as the characteristics of the schools they attended for the year 2017 by sex. Regarding the subsample for boys, 59.2% were fifth grade students; 50.37% attended preschool; and 42.54% were absent from school at least two days in a week during the month before taking the test. Parental education encompassed father’s and mother’s level of education. In general, most parents from the boys’ subsample completed only high school (47.89% of fathers and 49.60% of mothers).

Parental employment comprised father’s and mother’s occupation. Regarding father's employment, the highest share of occupation was in the service and construction sector (56.11%), which included cleaning and maintenance occupations as well as informal sales, followed by professional jobs (17.71%), which comprised jobs that required postsecondary education (e.g., administrative assistant jobs, accounting, health sciences, teaching, or legal jobs). In relation to mother's employment, the highest share of occupation was domestic activities or unemployment (39.16%), followed by service and construction (33.71%). In relation to school characteristics, 98.67% of boys attended public schools; 87.68% were enrolled in a half day school program; and 98.77% of schools were in urban settings.

Regarding the subsample for girls, 53.42% were in fifth grade; 57.09% attended preschool; and 46.82% were absent from school at least two days in a week during the month before taking the test. Like in the subsample for boys, most parents from the girls' subsample completed only high school (47.18% of fathers and 49.20% of mothers). In relation to father's employment, the highest share of occupation was in the service and construction sector (57.18%), followed by professional jobs (17.57%). Regarding mother's employment, the highest share of occupation was domestic activities or unemployment (40.61%), followed by service and construction (34.46%). In relation to school characteristics, 98.74% of girls attended public schools; 87.18% were enrolled in a half day school program; and 98.79% of schools were in urban settings.

Table 5.1

Sociodemographic Characteristics of Students and Information About Schools by Sex

Variables	Boys (n = 176,975)		Girls (n = 187,461)	
	n	**%**	***n***	**%**
School grade				
Fifth grade	104,815	59.23	100,133	53.42
Ninth grade	72,160	40.77	87,328	46.58
Preschool education				
Yes	89,138	50.37	107,024	57.09
No	87,837	49.63	80,437	42.91
Absent from school				
Yes	75,285	42.54	87,773	46.82
No	101,690	57.46	99,688	53.18
Father's education				
Elementary	42,753	24.16	50,564	26.97
High school	84,760	47.89	88,442	47.18
College and technical	30,389	17.17	32,432	17.30
Graduate school	19,073	10.78	16,023	8.55
Mother's education				
Elementary	33,589	18.98	40,849	21.79
High school	87,787	49.60	92,235	49.20
College and technical	35,114	19.84	37,817	20.17
Graduate school	20,485	11.58	16,560	8.83
Father's employment				
Unemployed and/or non-wage-earning	15,506	8.76	14,973	7.99
Farmer	14,377	8.12	17,434	9.30
Service and construction	99,293	56.11	107,184	57.18
Receives pension	5,069	2.86	5,605	2.99

Variables	Boys (n = 176,975)		Girls (n = 187,461)	
	n	%	*n*	%
Professional and administrative work	31,342	17.71	32,928	17.57
CEO and/or manager	11,388	6.43	9,337	4.98
Mother's employment				
Unemployed and/or non-wage-earning	69,307	39.16	76,135	40.61
Farmer	3,556	2.01	3,257	1.74
Service and construction	59,657	33.71	64,601	34.46
Receives pension	1,856	1.05	1,600	0.85
Professional and administrative work	35,398	20.00	36,433	19.43
CEO and/or manager	7,201	4.07	5,435	2.90
School type				
Private	2,347	1.33	2,368	1.26
Public	174,628	98.67	185,093	98.74
Length of school day				
Half day	155,178	87.68	163,431	87.18
Full day	21,797	12.32	24,030	12.82
School setting				
Rural	2,183	1.23	2,274	1.21
Urban	174,792	98.77	185,187	98.79

Note. $N = 364{,}436$

Table 5.2 shows sociodemographic information about the students in this study as well as the characteristics of the schools they attended for the year 2017 by school grade. Regarding the subsample for fifth grade, 51.14% identified as boys; 54.72% attended preschool; and 42.12% were absent from school at least two days in a week during the month before taking the test. In general, most parents from the fifth-grade subsample completed only high school (47.74% of fathers and 48.95% of mothers). Regarding father's employment, the highest share of occupation was in the service and construction sector (53.91%), followed by professional jobs (17.14%). In relation to mother's employment, the highest share of occupation was domestic activities or unemployment (39.14%), followed by service and construction (34.15%). In relation to school characteristics, 98.68% of students in fifth grade attended public schools; 87.59% were enrolled in a half day school program; and 98.77% of schools were in urban settings.

In relation to the subsample for ninth grade, 54.76% identified as girls; 52.67% attended preschool; and 48.11% were absent from school at least two days in a week during the month before taking the test. Like in the subsample for fifth grade, most parents from the ninth-grade subsample completed only high school (48.54% of fathers and 49.98% of mothers). In relation to father's employment, the highest share of occupation was in the service and construction sector (60.19%), followed by professional jobs (18.27%). Regarding mother's employment, the highest share of occupation was domestic activities or unemployment (40.90%), followed by service and construction (34.02%). In relation to school characteristics, 98.74% of students in ninth grade attended public schools, 87.22% were enrolled in a half day school program; and 98.78% of schools were in urban settings.

Table 5.2

Sociodemographic Characteristics of Students and Information About Schools by School Grade

Variables	Fifth Graders (n = 204,948)		Ninth Graders (n = 159,488)	
	n	**%**	***n***	**%**
Sex				
Boys	104,815	51.14	72,160	45.24
Girls	100,133	48.86	87,328	54.76
Preschool education				
Yes	112,154	54.72	84,008	52.67
No	92,794	45.28	75,480	47.33
Absent from school				
Yes	86,334	42.12	76,724	48.11
No	118,614	57.88	82,764	51.89
Father's education				
Elementary	52,997	24.86	40,320	25.28
High school	95,794	47.74	77,408	48.54
College and technical	33,337	16.27	29,484	18.49
Graduate school	22,820	11.13	12,276	7.70
Mother's education				
Elementary	43,227	21.09	31,211	19.57
High school	100,315	48.95	79,707	49.98
College and technical	37,210	18.16	35,721	22.40
Graduate school	24,196	11.81	12,849	8.06
Father's employment				
Unemployed and/or non-wage-earning	23,896	11.66	6,583	4.13
Farmer	15,359	7.49	16,452	10.32
Service and construction	110,481	53.91	95,996	60.19

Variables	Fifth Graders (n = 204,948)		Ninth Graders (n = 159,488)	
	n	**%**	***n***	**%**
Receives pension	5,803	2.83	4,871	3.05
Professional and administrative work	35,131	17.14	29,139	18.27
CEO and/or manager	14,278	6.97	6,447	4.04
Mother's employment				
Unemployed and/or non-wage-earning	80,214	39.14	65,228	40.90
Farmer	4,345	2.12	2,468	1.55
Service and construction	69,997	34.15	54,261	34.02
Receives pension	2,594	1.27	862	0.54
Professional and administrative work	38,086	18.58	33,745	21.16
CEO and/or manager	9,712	4.74	2,924	1.83
School type				
Private	2,702	1.32	2,013	1.26
Public	202,246	98.68	157,475	98.74
Length of school day				
Half day	179,507	87.59	139,102	87.22
Full day	25,441	12.41	20,386	12.78
School setting				
Rural	2,519	1.23	1,938	1.22
Urban	202,429	98.77	157,550	98.78

Note. N = 364,436

Tables 5.3 and 5.4 show the differential distribution of durable goods across gender and school grade. Regarding gender, Table 5.3 shows that the distribution of durable goods was similar across this subsample, except for ownership of videogame consoles where boys outnumbered girls. For example, most children had access to TVs (84.99% for boys and 84.49% for girls), washing machines (84.27% for boys and 82.79%

for girls), computers (69.48% for boys and 67% for girls), and Internet access (67.37% for boys and 65.34% for girls). In contrast, less than 40% had access to a car (36.34% for boys and 33.11% for girls).

Table 5.3

Ownership of Durable Goods by Sex

Variables	**Boys** (n = 176,975)			**Girls** (n = 187,461)		
	n	%	*p* value	*n*	%	*p* value
Internet						
Yes	119,232	67.37	0.000	122,484	65.34	0.000
No	57,743	32.63		64,977	34.66	
Computer (PC, laptop, or tablet)						
Yes	122,968	69.48	0.000	125,605	67.00	0.000
No	54,007	30.52		61,856	33.00	
Television						
Yes	150,414	84.99	0.000	158,395	84.49	0.000
No	26,561	15.01		29,066	15.51	
Washing machine						
Yes	149,141	84.27	0.000	155,207	82.79	0.000
No	27,834	15.73		32,254	17.21	
Microwave						
Yes	110,479	62.43	0.000	105,746	56.41	0.000
No	66,496	37.57		81,715	43.59	
Car						
Yes	64,313	36.34	0.039	62,073	33.11	0.000
No	112,662	63.66		125,388	66.89	
Videogame console						
Yes	85,762	48.46	0.000	49,023	26.15	0.001
No	91,213	51.54		138,438	73.85	

Note. N = 364,436

In relation to school grade, Table 5.4 shows that the distribution of durable goods was similar across this subsample, except for ownership of computers and videogame consoles. In the case of computers, 71.12% of ninth graders had access to a computer at home compared to 65.94% of fifth graders. Regarding videogame consoles, 40.07% of fifth graders had a videogame console at home in comparison to 33.03% of ninth graders.

Overall, most children had access to TVs (84.64% for fifth graders and 84.86% for ninth graders), washing machines (82.15% for fifth graders and 85.26% for ninth graders), and Internet access (67.12% for fifth graders and 67.87% for ninth graders). In contrast, less than 60% had access to a microwave at home and less than 41% reported that their families owned a car.

Table 5.4

Ownership of Durable Goods by School Grade

Variables	**Fifth graders** (n = 204,948)			**Ninth graders** (n = 159,488)		
	n	%	*p* value	*n*	%	*p* value
Internet						
Yes	133,468	65.12	0.000	108,248	67.87	0.000
No	71,480	34.88		51,240	32.13	
Computer (PC, laptop, or tablet)						
Yes	135,148	65.94	0.000	113,425	71.12	0.000
No	69,800	34.06		46,063	28.88	
Television						
Yes	173,461	84.64	0.000	135,348	84.86	0.000
No	31,487	15.36		24,140	15.14	
Washing machine						
Yes	168,373	82.15	0.000	135,975	85.26	0.000
No	36,575	17.85		23,513	14.74	
Microwave						
Yes	119,341	58.23	0.000	96,884	60.75	0.000
No	85,607	41.77		62,604	39.25	
Car						
Yes	73,852	36.03	0.123	52,534	32.94	0.000
No	131,096	63.97		106,954	67.06	
Videogame console						
Yes	82,114	40.07	0.000	52,671	33.03	0.000
No	122,834	59.93		106,817	66.97	

Note. N = 364,436

5.3.2. Correlation Matrix Analyses, T-tests, and ANOVA Tests

In what follows, I present the results by type of analysis: correlation analyses, independent t-tests, and analysis of variance.

5.3.2.1. Correlation Matrix Analyses

Results from the correlation analyses indicated that most of the variables had negligible or weak correlations, with correlation coefficients below .28 (see Appendices E to H). The only variables that reported correlation coefficients greater than .28 were father's education and the durable goods index ($r = .29$), mother's education and the durable goods index ($r = .30$), father's employment and father's education ($r = .32$), mother's employment and mother's education ($r = .34$), computers and Internet ($r = .47$), mother's education and father's education ($r = .56$), math and reading scores ($r = .65$), and students' age and students' school grade ($r = .94$). Coefficients below .70 were considered moderate and it was assumed that if included in an econometric model, these variables would not generate multicollinearity issues. To test whether these moderate and strong correlations could introduce multicollinearity in the models, I ran a collinearity test with all the durable goods and the control variables (inventory approach). Results indicated that students' age and students' school grade were highly collinear, hence suggesting that one of them could be dropped to improve model accuracy. Because one of the central questions of this study was to examine whether different types of durable goods were differentially related to students by grade, age was dropped from the estimation models.

5.3.2.2. Independent t-tests

Results from the t-tests indicated that there were statistically significant differences in the mean scores for reading and math by gender, school grade, access to preschool education, school absenteeism, type of school, length of school day, and school setting ($p < .000$). For example, reading scores were .087 standard deviations above the mean for girls and 0.87 standard deviations below the mean for boys. Similarly, reading scores were .074 standard deviations above the mean for ninth graders and .054 standard deviations below the mean for fifth graders. In contrast, math scores were .046 standard deviations above the mean for boys and .039 standard deviations below the mean for girls. Additionally, math scores were 0.99 standard deviations above the mean for ninth graders and .073 standard deviations below the mean for fifth graders (see Appendices I through P for details on the different t-tests).

Similarly, results indicated that were statistically significant differences in the mean scores for reading and math by possession of durable goods ($p < .000$). For example, reading scores were .092 standard deviations above the mean for students who had Internet access but .175 standard deviations below the mean for students who did not have Internet access. Similarly, math scores were .012 standard deviations above the mean for students who had washing machines at home, but .054 standard deviations lower for students who did not have (see Appendices J and N).

5.3.2.3. Analysis of Variance (One-way ANOVA Test)

One-way ANOVA tests were used to assess whether there were statistically significant differences between the means of reading and math for multi-level categorical or ordinal variables (variables with three or more independent groups). The variables that were employed for the ANOVA tests were: father's education, mother's education, father's employment, and mother's employment. Results from these tests indicated that there were statistically significant differences in mean reading and math scores between all the groups for the selected variables (see Appendices Q through X for details on the tests). For example, regarding father's education, the test revealed that there was a statistically significance in mean reading scores ($F(3,364432) = 2277.23, p = .000$) and math mean scores ($F(3,364432) = 1492.49, p = .000$) between all groups. In relation to mother's education, the test also showed that there was a statistically significant difference in mean reading scores ($F(3,364432) = 2922.45, p = .000$) and mean math scores ($F(3,364432) = 2118.42, p = .000$) between all the groups (see Appendices Q through X for details on the tests).

5.3.3. Multilevel Modelling

This study used multilevel models because data were nested in four levels: students, schools, municipalities, and states. The intraclass correlation coefficient (ICC) indicated that school, municipality, and region random effects composed approximately 16% of the total residual variance for reading, 17% for math, and 2% for being absent from school (Cabra, 2022a). Results are presented by subsample: sex and school grade, respectively. Moreover, for each subsample, multilevel linear regression models are presented first, followed by the multilevel logistic models.

5.3.3.1. Multilevel Linear Modeling for Boys and Girls Only

These models were used to examine whether durable goods were differentially related to students' academic achievement by sex. As such, these models employed a subsample of the data which focused on gender. Tables 5.5 and 5.6 summarize all the results for all the multilevel linear estimation models. Table 5.5 presents the results for reading and Table 5.6 the results for math.

Results suggested that durable goods such as washing machines, Internet access, PCs, and microwaves were positively associated with reading for girls and boys. In general, coefficients were larger for boys, except for ownership of PCs, which was larger for girls. For example, boys whose families owned a washing machine scored, on average, .11 standard deviations in reading while girls scored .09. Similarly, boys who had Internet access scored, on average, .05 standard deviations in reading while girls scored .04. In contrast, girls who had access to PCs scored, on average, .05 standard deviations while boys scored .04. TVs, cars, and videogame consoles were negatively associated with reading scores both for boys and girls. Coefficients were larger for boys regarding ownership of TVs and cars, while larger for girls in relationship to ownership of videogame consoles. For example, boys whose families owned TVs scored, on average, .04 standard deviations lower in reading while girls scored .03 standard deviations lower. Similarly, boys whose families owned a car scored, on average, .12 standard deviations lower compared to girls who scored .08 standard deviations lower.

In relation to math scores, this approach found that PCs, washing machines, microwaves, and Internet access were positively related to math scores. In relation to computers, coefficients were larger for girls (.05) in comparison to boys (.03). Regarding Internet access, coefficients were also larger for girls (.02) than for boys (.01). In contrast, coefficients were larger for boys who had access to washing machines at home (.10) in comparison to girls (.07). TVs, cars, and videogame consoles were negatively associated with math scores. Coefficients were larger for boys regarding ownership of cars and TVs. For example, boys whose families owned a car scored, on average, .10 standard deviations lower in math, while girls scored .05 standard deviations lower.

Control Variables. Results suggested that after controlling for ownership of durable goods, the variables of school grade, preschool education, parental education, and father's employment were positively related with reading for boys and girls. Regarding reading, for example, coefficients were larger for girls (.23) who completed preschool than for boys (.20) who also completed preschool. Similarly, girls whose mothers attained higher levels of education scored, on average, .09 standard deviations higher compared to boys who scored .07 standard deviations. In relation to fathers' employment, both groups scored, on average, .02 standard deviations if the father was employed.

In relation to math outcomes, coefficients were also larger for girls than for boys in relation to preschool education and mother's education. For example, girls scored, on average, .24 standard deviations in math compared to boys, who scored .23 standard deviations. Similarly, girls whose mothers completed higher levels of education scored, on average, .08 standard deviation in comparison to boys, who scored .06 standard deviations. However, coefficients were larger for boys (.02) than for girls (.01) in relation to father's employment. Similarly, coefficients were larger for boys than for girls regarding school grade and father's education. For example, ninth grade boys scored, on average, higher in reading (.12 standard deviations) in comparison to ninth grade girls (.05 standard deviations). Similarly, ninth grade boys scored, on average, higher in math than girls who were in ninth grade (.22 standard deviations vs. .08 standard deviations).

Mother's employment, school absenteeism, and school type were negatively related to reading and math outcomes. In relation to mother's employment, both groups scored, on average, .01 standard deviations lower in reading and math if the mother was employed. Regarding school absenteeism, results indicated that boys who were absent from school scored, on average, .04 standard deviations lower in math while girls who were absent from school scored, on average, .02 standard deviations lower in math. In relation to school type, the models found that boys who attended public schools scored, on average, .37 standard deviations lower in reading and .32 standard deviations lower in math in comparison with girls, who scored, on average .25 standard deviations lower in reading and .30 standard deviations lower in math.

Length of school day was positively associated with reading scores for girls, but not statistically significant for boys. In contrast, length of school day was positively related to math scores for both groups. School setting was positively associated with reading scores for girls, but not significant for boys. In relation to math outcomes, school setting was not significant for any of the groups.

Table 5.5

Multilevel Linear Models for Boys and Girls

(Outcome Variable: Reading)

	Boys	**Girls**
Variables	Inventory Approach (All Durable Goods)	Inventory Approach (All Durable Goods)
Internet	0.05*** (0.006)	0.04*** (0.005)
PC	0.04*** (0.006)	0.05*** (0.005)
TV	-0.04*** (0.006)	-0.03*** (0.006)
Washing machine	0.11*** (0.006)	0.09*** (0.006)
Microwave	0.03*** (0.005)	0.01** (0.005)
Car	-0.12*** (0.005)	-0.08*** (0.005)
Videogame console	-0.06*** (0.005)	-0.10*** (0.005)
School grade	0.12*** (0.005)	0.05*** (0.004)
Preschool	0.20*** (0.004)	0.23*** (0.004)
Absent	-0.01*** (0.004)	0.01* (0.004)
Father's education	0.05*** (0.003)	0.05*** (0.003)
Mother's education	0.07*** (0.003)	0.09*** (0.003)
Father's job	0.02*** (0.002)	0.02*** (0.002)
Mother's job	-0.01*** (0.001)	-0.01*** (0.001)
School type	-0.37*** (0.042)	-0.25*** (0.043)
Length of school day	0.01 (0.012)	0.03*** (0.011)
School setting	0.04 (0.030)	0.08*** (0.030)
Constant	-0.38*** (0.069)	-0.44*** (0.065)
Random-effects parameters		
State/region var (cons)	0.05 (0.015)	0.04 (0.011)
Municipality var (cons)	0.03 (0.003)	0.03 (0.003)
School var (cons)	0.07 (0.002)	0.07 (0.002)
Var (residual)	0.82 (0.003)	0.81 (0.003)
LR test vs. linear model: Chi2	16924.53***	17556.72***
Observations	176,975	187,461

Note. Robust standard errors in parentheses. ***$p < .01$, **$p < .05$, *$p < .10$

Table 5.6

Multilevel Linear Models for Boys and Girls

(Outcome Variable: Math)

	Boys	**Girls**
Variables	Inventory Approach (All Durable Goods)	Inventory Approach (All Durable Goods)
Internet	0.01** (0.006)	0.02*** (0.005)
PC	0.03*** (0.006)	0.05*** (0.005)
TV	-0.03*** (0.007)	-0.02*** (0.006)
Washing machine	0.10*** (0.007)	0.07*** (0.006)
Microwave	0.03*** (0.005)	0.00 (0.004)
Car	-0.10*** (0.005)	-0.05*** (0.005)
Videogame console	-0.06*** (0.005)	-0.08*** (0.005)
School grade	0.23*** (0.005)	0.08*** (0.004)
Preschool	0.23*** (0.005)	0.24*** (0.004)
Absent	-0.04*** (0.005)	-0.02*** (0.004)
Father's education	0.04*** (0.003)	0.04*** (0.003)
Mother's education	0.06*** (0.003)	0.08*** (0.003)
Father's job	0.02*** (0.002)	0.01*** (0.002)
Mother's job	-0.01*** (0.001)	-0.01*** (0.001)
School type	-0.32*** (0.045)	-0.30*** (0.044)
Length of school day	0.05*** (0.011)	0.03*** (0.010)
School setting	0.02 (0.032)	0.01 (0.030)
Constant	-0.21*** (0.075)	-0.34*** (0.067)
Random-effects parameters		
State/region var (cons)	0.06 (0.019)	0.04 (0.012)
Municipality var (cons)	0.03 (0.004)	0.03 (0.003)
School var (cons)	0.08 (0.003)	0.07 (0.003)
Var (residual)	0.90 (0.003)	0.80 (0.002)
LR test vs. linear model: Chi2	19885.03***	20701.88***
Observations	176,975	187,461

Note. Robust standard errors in parentheses. ***$p < .01$, **$p < .05$, *$p < .10$

5.3.3.2. Multilevel Logistic Modeling for Boys and Girls Only

This model was used to explore whether durable goods were differentially related to students' school attendance by sex. The total accuracy of this model was 58.7%. Table 5.7 summarizes all the results for all the multilevel logistic estimation models for boys and girls. Regression parameter estimates, standard errors, and *p* values (<.01, <.05, <.1) are reported.

Results from this model indicated that the odds of being absent from school were lower for students who had Internet access (.972 for boys and .979 for girls), PCs (.913 for boys and .871 for girls) and washing machines (.936 for boys and .961 for girls), than for students who did not have any of those commodities. As observed, odds ratios were higher for boys than for girls, which may suggest that boys benefit more than girls from owning these commodities. In contrast, the odds of missing classes were higher for students who owned a microwave (1.035 for boys and 1.037 for girls) or a videogame console (1.136 for boys and 1.148 for girls). Ownership of cars was not statistically significant.

Control Variables. Results from this model indicated that preschool, mother's education, school type, and length of school day were associated with lower probability of being absent from school. For example, the odds of being absent from school were lower for boys (.967) and for girls (1.536) who completed preschool than for children who did not complete preschool. It is important to highlight that the odds ratios were larger for girls, which corroborated previous research about the importance of educating girls (World Development Report, 2018). Similarly, the odds of missing classes were lower for children whose mothers completed a graduate degree (.912 for boys and .908 for girls) and high school (.953 for boys and .976 for girls) than children whose mothers only completed elementary education. Furthermore, the odds of being absent from school were lower for boys (.887) and girls (.867) who went to public schools and for boys (.968) and girls (.944) who attended a full-day school program in comparison with children who went to private schools and who enrolled in a half day school program.

In contrast, school grade, father's education, and parental employment were associated with a higher probability of being absent from school. Regarding school grade, ninth graders were more likely to be absent from school than fifth graders. Among ninth graders, the odds of being absent from school were higher for girls who were in ninth grade (1.536) than boys who were in ninth grade (1.053). In relation to father's education, boys whose fathers completed college or technical education and who obtained a high school diploma were more likely to be absent from school than boys whose fathers only attained elementary education (1.085 and 1.057, respectively).

In relation to parental employment, results from this model indicated, for example, that the likelihood of missing classes was higher for boys and for girls whose parents worked. For example, the odds of being absent from school were higher for boys whose fathers worked in the service and construction sector (1.037). In contrast, the odds of being absent from school were higher for boys whose mothers were CEOs of a company or small business owners (1.074) and for boys whose mothers worked in the service and construction sector (1.055). Similarly, the odds of being absent from school were higher for girls whose fathers and mothers were CEOs of a company or small business owners (1.106 and 1.115, respectively) and for fathers and mothers who worked in the service and construction sector (1.092 and 1.070). However, the odds of missing classes were lower for boys if mothers were farmers (1.066) and pensioners (.905).

Table 5.7

Multilevel Logistic Models for Boys and Girls

Dependent Variable = Absent from School (Yes = 1, No = 0)

	Boys				Girls			
	Inventory Approach (All Durable Goods)				Inventory Approach (All Durable Goods)			
Variables	Coef.	OR	95% Confidence Interval for OR		Coef.	OR	95% Confidence Interval for OR	
			Lower	Upper			Lower	Upper
Internet	-0.028** (0.013)	0.972	0.948	0.996	-0.022* (0.012)	0.979	0.955	1.002
PC	-0.091*** (0.012)	0.913	0.891	0.935	-0.138*** (0.012)	0.871	0.851	0.892
TV	-0.017 (0.014)	0.983	0.956	1.011	-0.003 (0.014)	0.997	0.97	1.024
Washing machine	-0.066*** (0.014)	0.936	0.910	0.963	-0.039*** (0.014)	0.961	0.936	0.987
Microwave	0.034*** (0.011)	1.035	1.013	1.057	0.036*** (0.010)	1.037	1.016	1.058
Car	0.010 (0.011)	1.010	0.989	1.031	0.002 (0.011)	1.002	0.982	1.024
Videogame console	0.127*** (0.011)	1.136	1.112	1.160	0.138*** (0.011)	1.148	1.122	1.174
School grade	0.052*** (0.010)	1.053	1.032	1.075	0.429*** (0.010)	1.536	1.507	1.566
Preschool	-0.034*** (0.010)	0.967	0.948	0.985	-0.050*** (0.010)	0.951	0.934	0.970
Father's education								
Graduate school	0.007 (0.022)	1.007	0.965	1.051	0.046** (0.023)	1.047	1.002	1.095
College and technical	0.082*** (0.018)	1.085	1.048	1.125	0.027 (0.017)	1.028	0.994	1.063
High school	0.056*** (0.014)	1.057	1.029	1.086	0.016 (0.013)	1.017	0.992	1.042

	Boys				Girls			
	Inventory Approach (All Durable Goods)				Inventory Approach (All Durable Goods)			
Variables	Coef.	OR	95% Confidence Interval for OR		Coef.	OR	95% Confidence Interval for OR	
			Lower	Upper			Lower	Upper
Mother's education								
Graduate school	-0.092*** (0.022)	0.912	0.873	0.953	-0.097*** (0.023)	0.908	0.868	0.95
College and technical	-0.021 (0.019)	0.980	0.945	1.016	0.007 (0.018)	1.007	0.973	1.042
High school	-0.049*** (0.015)	0.953	0.926	0.98	-0.024* (0.013)	0.976	0.951	1.002
Father's employment								
CEO or business owner	0.033 (0.026)	1.033	0.981	1.088	0.101*** (0.028)	1.106	1.047	1.169
Professional/admin.	-0.003 (0.021)	0.997	0.956	1.040	0.054** (0.021)	1.055	1.012	1.101
Pensioner	-0.019 (0.034)	0.981	0.917	1.049	-0.038 (0.033)	0.962	0.902	1.026
Service and construction	0.037** (0.018)	1.037	1.001	1.075	0.088*** (0.019)	1.092	1.053	1.133
Farmer	-0.034 (0.025)	0.967	0.920	1.015	-0.055** (0.024)	0.947	0.903	0.993
Mother's employment								
CEO or business owner	0.072*** (0.026)	1.074	1.020	1.131	0.109*** (0.030)	1.115	1.051	1.182
Professional/admin.	0.018 (0.015)	1.019	0.990	1.048	0.024 (0.015)	1.024	0.995	1.054
Pensioner	-0.099** (0.050)	0.905	0.821	0.998	-0.012 (0.053)	0.988	0.891	1.095
Service and construction	0.054*** (0.012)	1.055	1.031	1.080	0.068*** (0.011)	1.070	1.047	1.094
Farmer	0.064* (0.040)	1.066	0.992	1.146	-0.014 (0.038)	0.986	0.915	1.063
School type	-0.120** (0.052)	0.887	0.801	0.982	-0.143*** (0.054)	0.867	0.781	0.963
Length of school day	-0.032* (0.019)	0.968	0.934	1.004	-0.057*** (0.018)	0.944	0.911	0.979
School setting	0.012 (0.049)	1.012	0.918	1.114	0.002 (0.049)	1.002	0.910	1.103
Constant	-0.258*** (0.081)				-0.256*** (0.083)			

	Boys				Girls			
	Inventory Approach (All Durable Goods)				Inventory Approach (All Durable Goods)			
Variables	Coef.	OR	95% Confidence Interval for OR		Coef.	OR	95% Confidence Interval for OR	
			Lower	Upper			Lower	Upper
Random effect covariances								
State/region	0.024***				0.026***			
var(cons)	(0.008)				(0.008)			
Municipality	0.019***				0.024***			
var(cons)	(0.003)				(0.004)			
School	0.030***				0.035***			
var(cons)	(0.003)				(0.003)			
Observations		176,975				187,461		
LR test vs. logistic		1373.42***				1887.26***		
Log likelihood		-119772.16				-127318.01		
Wald Chi-Square		284.51***				2310.65***		

Note. Robust standard errors in parentheses. ***$p < .01$, **$p < .05$, *$p < .10$

5.3.3.3. Multilevel Linear Modeling for Fifth and Ninth Graders Only

Like the models employed to assess gender-based differences in academic achievement, these models were used to explore whether durable goods were differentially related to students' reading and math scores by school grade. As such, these models employed a subsample of the data which focused on school grade. Tables 5.8 and 5.9 summarize the results for all the multilevel linear estimation models for fifth and ninth grades. Table 5.8 presents the results for reading and Table 5.9 the results for math. Regression parameter estimates, standard errors, and p values (< .01, < .05, < .10) are reported.

Results from the inventory approach indicated that regardless of grade, PCs, Internet access, and washing machines were positively related to reading scores. However, coefficients for Internet access and PCs were higher for ninth than for fifth graders. For example, ninth graders who had Internet access scored, on average, .06 standard deviations higher in reading compared to fifth graders who scored .03 standard deviations. The coefficient for possession of washing machines was larger for fifth graders (.14) than for ninth graders (.04). Possession of microwaves was positively related to reading scores for fifth graders (.03), but not statistically significant for ninth graders.

Ownership of TVs was not statistically significant for fifth graders, but it was negatively associated with reading outcomes for ninth graders. Thus, ninth graders whose families owned a TV scored, on average, .09 standard deviations lower in reading. In contrast, cars and videogames were negatively related to reading outcomes for both groups, with larger coefficients for fifth graders. For example, fifth graders who had access to videogames scored, on average, .09 standard deviations lower in reading compared to ninth graders who scored .06 standard deviations lower. Similarly, fifth graders whose parents owned a car scored, on average, .12 standard deviations lower in reading in comparison to ninth graders, who scored .07 standard deviations lower.

Regarding math outcomes, the models suggested that Internet access was not significant for fifth graders but was positively associated for ninth graders. As such, ninth graders who had Internet access scored, on average, .02 standard deviations higher in math. A possible explanation may be that older students know how to use the Internet and have fewer parental restrictions as to how to use it. PCs were positively associated with math scores for both groups, with larger coefficients for ninth graders (.07) than for fifth graders (.02). Possession of TVs was not significant for fifth graders, but negatively related to math scores for ninth graders (.08), suggesting that older children may spend more time watching TV and less time studying than younger children.

Possession of microwaves was positively associated with math outcomes for fifth graders, but it was not significant for ninth graders. As such, fifth graders who had access to microwaves at home scored, on average, .03 standard deviations higher than fifth graders who did not have access to microwaves at home. In contrast, cars and videogames were negatively associated with math achievement for both grades, with larger coefficients for fifth graders. For example, fifth graders who had access to videogames scored, on average, .08 standard deviations lower in math compared to ninth graders who scored .05 standard deviations lower.

Control Variables. Estimates indicated that after controlling for ownership of durable goods, preschool education, parental education, and father's employment were positively associated with reading and math outcomes for both grades. For example, ninth graders who attended preschool scored, on average, .24 standard deviations higher in reading compared to fifth graders, who scored .19 standard deviations higher. In math, fifth graders scored, on average, .23 standard deviations compared to ninth graders, who scored, on average, .24 standard deviations. Regarding parental education, results indicated that father's education was more salient for ninth graders. For example, ninth graders whose fathers had higher levels of education scored, on average, .06 standard deviations in reading while fifth graders scored .05 standard deviations. Regarding math, results showed that father's education was equally important for both groups, with a similar coefficient (.04).

Mother's education was positively associated with reading and math outcomes, with both groups scoring the same. As such, students whose mothers had higher levels of education scored, on average, .08 standard deviations in reading and .07 standard deviations in math. However, mother's employment was negatively associated with academic achievement in reading and math for fifth graders, but positively related to academic performance for ninth graders. For example, fifth graders whose mothers were employed scored, on average, .02 standard deviations lower in reading and math. In contrast, ninth graders whose mothers were employed scored, on average, .01 standard deviations higher in reading and .004 standard deviations higher in math, which constituted a small coefficient.

Regarding school characteristics, school type was negatively associated with reading and math for both grades, with larger effects for fifth graders. As such, fifth graders who attended public schools scored, on average, .34 standard deviations lower in reading and .30 standard deviations in math compared to ninth graders, who scored, on average, .24 standard deviations lower in reading and .30 standard deviations in math. Length of school day was not statistically significant for fifth graders, but it was positively associated with ninth graders. In addition, school setting was positively associated with reading outcomes for ninth graders only, but not statistically significant for math scores for either group.

Table 5.8

Multilevel Linear Models for Fifth and Ninth Graders

(Outcome Variable: Reading)

	Fifth Graders	Ninth Graders
Variables	Inventory Approach (All Durable Goods)	Inventory Approach (All Durable Goods)
Internet	0.03*** (0.005)	0.06*** (0.006)
PC	0.03*** (0.005)	0.07*** (0.006)
TV	0.00 (0.006)	-0.09*** (0.007)
Washing machine	0.14*** (0.006)	0.04*** (0.007)
Microwave	0.03*** (0.004)	0.000 (0.005)
Car	-0.12*** (0.005)	-0.07*** (0.005)
Videogame console	-0.09*** (0.005)	-0.06*** (0.005)
Sex	0.15*** (0.004)	0.08*** (0.005)
Preschool	0.20*** (0.004)	0.24*** (0.005)
Absent	0.00 (0.004)	-0.01 (0.005)
Father's education	0.05*** (0.003)	0.06*** (0.003)
Mother's education	0.08*** (0.003)	0.08*** (0.003)
Father's job	0.03*** (0.002)	0.01*** (0.002)
Mother's job	-0.02*** (0.001)	0.01*** (0.002)
School type	-0.34*** (0.044)	-0.24*** (0.049)
Length of school day	0.01 (0.011)	0.02* (0.012)
School setting	0.03 (0.031)	0.08** (0.035)
Constant	-0.41*** (0.069)	-0.50*** (0.075)
Random-effects parameters		
State/region var (cons)	0.04 (0.013)	0.05 (0.014)
Municipality var (cons)	0.03 (0.003)	0.03 (0.003)
School var (cons)	0.09 (0.003)	0.07 (0.003)
Var (residual)	0.84 (0.003)	0.80 (0.003)
LR test vs. linear model: Chi2	21356.55***	16990.06***
Observations	204,948	159,488

Note. Robust standard errors in parentheses. ****p* < .01, ***p* < .05, **p* < .10

Table 5.9

Multilevel Linear Models for Fifth and Ninth Graders

(Outcome Variable: Math)

	Fifth Graders	Ninth Graders
Variables	Inventory Approach (All Durable Goods)	Inventory Approach (All Durable Goods)
Internet	0.01 (0.005)	0.02*** (0.006)
PC	0.02*** (0.005)	0.07*** (0.006)
TV	0.01 (0.006)	-0.08*** (0.007)
Washing machine	0.12*** (0.006)	0.03*** (0.007)
Microwave	0.03*** (0.004)	-0.00 (0.005)
Car	-0.10*** (0.004)	-0.05*** (0.005)
Videogame console	-0.08*** (0.005)	-0.05*** (0.005)
Sex	-0.07*** (0.004)	-0.23*** (0.005)
Preschool	0.23*** (0.004)	0.24*** (0.005)
Absent	-0.02*** (0.004)	-0.04*** (0.004)
Father's education	0.03*** (0.003)	0.06*** (0.003)
Mother's education	0.07*** (0.003)	0.07*** (0.003)
Father's job	0.03*** (0.002)	0.0000118*** (0.0021904)
Mother's job	-0.02*** (0.001)	0.004** (0.002)
School type	-0.30*** (0.046)	-0.30*** (0.055)
Length of school day	0.01 (0.011)	0.05*** (0.012)
School setting	0.00 (0.032)	0.04 (0.038)
Constant	-0.24*** (0.072)	-0.01 (0.081)
Random-effects parameters		
State/region var (cons)	0.05 (0.015)	0.05 (0.016)
Municipality var (cons)	0.03 (0.004)	0.03 (0.004)
School var (cons)	0.09 (0.003)	0.10 (0.003)
Var (residual)	0.83 (0.003)	0.75 (0.003)
LR test vs. linear model: Chi2	24579.05***	22422.13***
Observations	204,948	159,488

Note. Robust standard errors in parentheses. ***$p < .01$, **$p < .05$, *$p < .10$

5.3.3.4. Multilevel Logistic Modeling for Fifth and Ninth Graders Only

This model was used to explore the extent to which durable goods were differentially related to students' school attendance by school grade. The total accuracy of the model was 58.9%. Table 5.9.1 summarizes all the results for all the multilevel logistic estimation models. Regression parameter estimates, standard errors, and *p* values (< .01, < .05, < .10) are reported.

Results from this model indicated that the odds of being absent from school were lower for fifth graders whose families had Internet access (.964) and who owned PCs (.914) and washing machines (.909). In contrast, the odds of being absent from school for ninth graders were lower only if students owned PCs (.861). Internet access and washing machines were not statistically significant for ninth graders. An interesting finding from this approach was the role of TVs in predicting school attendance. Ownership of TVs was associated with lower probability of being absent for school for fifth graders (.943), but higher for ninth graders (1.057). In addition, this approach found that odds of being absent from school were higher for fifth and ninth graders whose families owned microwaves (1.024 and 1.046, respectively) and videogame consoles (1.135 and 1.130, respectively) than children whose families did not possess these durable goods. Ownership of cars was not statistically significant for either group.

Control Variables. Estimates indicated that preschool, mother's education, school type, and length of school day were associated with lower probability of being absent from school. For example, the odds of being absent from school were lower for fifth and ninth graders who completed preschool (.941 vs. .989). Regarding mother's education, the odds of being absent from school were lower for fifth graders whose mothers attained a graduate degree (.887), mothers who completed a college degree or technical education (.971), and mothers with high school education (.942) in comparison with students whose mothers only completed elementary school. For ninth graders, only completion of a graduate degree was associated with a lower probability of being absent from school (.957). In relation to school type, the model found that the odds ratio of being absent from school was lower for fifth graders (.885) and ninth graders (.888) who attended public schools compared to students who went to private schools. Similarly, the odds of being absent were lower for students in fifth grade (.949) and students in ninth grade (.982) who were enrolled in full-day school programs than for students who attended half day school programs.

In contrast, sex, father's education, and parental employment were associated with higher probability of being absent from school for both groups. In relation to sex, for example, the odds of being absent from school were higher for girls (1.032 for fifth graders and 1.515 for ninth graders) than for boys. Regarding father's education, the model found that the odds of being absent from school were higher for fifth graders whose fathers attained a college degree or technical education (1.075) and high school (1.046) in comparison to students whose fathers only attained elementary education. Similarly, the odds of being absent from school were higher for ninth graders whose fathers completed graduate school (1.057), college or technical education (1.036), and high school (1.025) in comparison to students whose fathers only attained elementary education.

In relation to parental employment, results suggested that students whose parents were employed were more likely to be absent from school. For example, the odds of being absent from school were higher for fifth graders (1.053) and ninth graders (1.171) whose fathers worked in the service and construction sector compared to students whose parents were unemployed. Similarly, the odds of being absent from school were higher for fifth graders whose mothers were CEOs of a company or small business owner (1.086) and who worked in the service and construction sector (1.046) compared to students whose parents were unemployed. A similar outcome emerged for ninth graders: the odds of being absent from school were higher for ninth graders whose mothers were CEOs of a company or small business owner (1.084) and who worked in the service and construction sector (1.084) compared to students whose parents were unemployed.

A noteworthy finding was that the likelihood of being absent from school was lower for fifth graders whose fathers were farmers (.948) and pensioners (.931), and whose mothers were farmers (1.059). Similarly, the odds of missing classes were lower for ninth graders whose fathers were farmers (1.060) and pensioners (1.086).

Table 5.9.1

Multilevel Logistic Models for Fifth and Ninth Graders

Dependent Variable = Absent from School (Yes = 1, No = 0)

	Fifth Graders				Ninth Graders			
	Inventory Approach (All Durable Goods)				Inventory Approach (All Durable Goods)			
Variables	Coef.	OR	95% Confidence Interval for OR		Coef.	OR	95% Confidence Interval for OR	
			Lower	Upper			Lower	Upper
Internet	-0.037*** (0.011)	0.964	0.943	0.986	-0.012 (0.014)	0.988	0.962	1.016
PC	-0.090*** (0.011)	0.914	0.895	0.934	-0.150*** (0.014)	0.861	0.838	0.884
TV	-0.059*** (0.013)	0.943	0.919	0.967	0.056*** (0.015)	1.057	1.026	1.090
Washing machine	-0.095*** (0.013)	0.909	0.887	0.932	0.024 (0.016)	1.024	0.993	1.057
Microwave	0.024** (0.010)	1.024	1.005	1.044	0.045*** (0.011)	1.046	1.023	1.070
Car	0.003 (0.010)	1.003	0.983	1.022	0.010 (0.012)	1.010	0.987	1.033
Videogame console	0.126*** (0.010)	1.135	1.112	1.158	0.122*** (0.012)	1.130	1.104	1.157
Sex	0.032*** (0.009)	1.032	1.013	1.052	0.415*** (0.011)	1.515	1.483	1.547
Preschool	-0.061*** (0.009)	0.941	0.924	0.958	-0.011 (0.011)	0.989	0.969	1.009
Father's education								
Graduate school	0.013 (0.020)	1.013	0.974	1.053	0.055** (0.026)	1.057	1.005	1.112
College and technical	0.072*** (0.017)	1.075	1.040	1.111	0.035* (0.019)	1.036	0.999	1.075
High school	0.045*** (0.013)	1.046	1.020	1.072	0.025* (0.014)	1.025	0.998	1.054

	Fifth Graders				Ninth Graders			
	Inventory Approach (All Durable Goods)				Inventory Approach (All Durable Goods)			
Variables	Coef.	OR	95% Confidence Interval for OR		Coef.	OR	95% Confidence Interval for OR	
			Lower	Upper			Lower	Upper
Mother's education								
Graduate school	-0.120*** (0.020)	0.887	0.852	0.923	-0.044* (0.027)	0.957	0.909	1.008
College and technical	-0.029* (0.017)	0.971	0.939	1.004	0.023 (0.019)	1.023	0.986	1.062
High school	-0.060*** (0.013)	0.942	0.918	0.967	-0.003 (0.015)	0.997	0.968	1.026
Father's employment								
CEO or business owner	0.030 (0.023)	1.030	0.985	1.077	0.213*** (0.037)	1.237	1.150	1.33
Professional/admin.	0.003 (0.018)	1.004	0.968	1.040	0.129*** (0.029)	1.137	1.074	1.204
Pensioner	-0.072** (0.031)	0.931	0.876	0.990	0.082** (0.039)	1.086	1.006	1.172
Service and construction	0.052*** (0.015)	1.053	1.022	1.085	0.157*** (0.027)	1.171	1.111	1.233
Farmer	-0.053** (0.022)	0.948	0.908	0.991	0.058* (0.031)	1.060	0.997	1.126
Mother's employment								
CEO or business owner	0.082*** (0.023)	1.086	1.038	1.136	0.080** (0.040)	1.084	1.002	1.172
Professional/admin.	-0.003 (0.014)	0.997	0.970	1.025	0.049*** (0.016)	1.050	1.018	1.083
Pensioner	-0.045 (0.043)	0.956	0.880	1.039	-0.094 (0.071)	0.911	0.793	1.046
Service and construction	0.045*** (0.011)	1.046	1.024	1.068	0.081*** (0.012)	1.084	1.059	1.111
Farmer	0.057* (0.033)	1.059	0.992	1.131	-0.020 (0.044)	0.980	0.899	1.069
School type	-0.123** (0.051)	0.885	0.801	0.977	-0.119* (0.063)	0.888	0.785	1.004
Length of school day	-0.052*** (0.018)	0.949	0.917	0.983	-0.018 (0.021)	0.982	0.942	1.024
School setting	-0.011 (0.048)	0.989	0.901	1.086	0.033 (0.057)	1.034	0.924	1.156
Constant	-0.144* (0.078)				-0.528*** (0.098)			

	Fifth Graders				Ninth Graders			
	Inventory Approach (All Durable Goods)				Inventory Approach (All Durable Goods)			
Variables	Coef.	OR	95% Confidence Interval for OR		Coef.	OR	95% Confidence Interval for OR	
			Lower	Upper			Lower	Upper
Random effect covariances								
State/region var(cons)	0.022*** (0.007)				0.036*** (0.012)			
Municipality var(cons)	0.024*** (0.004)				0.033*** (0.005)			
School var(cons)	0.037*** (0.003)				0.051*** (0.004)			
Observations		204,948				159,488		
LR test vs. logistic		1748.54***				2204.15***		
Log likelihood		-138306.7				-108341.54		
Wald Chi-Square		427.06***				1717.14***		

Note. Robust standard errors in parentheses. ***$p < .01$, **$p < .05$, *$p < .10$

5.4. Discussion

The four-level multilevel models used in this study showed that durable goods play an important role in improving or hampering academic achievement and school attendance among children in Colombia. This entails that controlling for sociodemographic characteristics, including stark socioeconomic disparities among schools and regions (e.g., municipalities and departments), durable goods are good predictors of academic achievement and school attendance, which corroborates previous findings on this topic (Cabra, 2022a; Chowa et al., 2013; Kafle et al., 2018). Furthermore, results indicate that ownership of durable goods as well as the types of durable goods that families own or have access to affect children's educational outcomes differentially when considering factors such as sex and school grade, a proxy for age.

In general, results from the multilevel models indicated that regardless of sex and school grade, ownership of a videogame console, a level-one variable, and school type, a level-two variable, were the most important factors predicting academic achievement and school attendance among children in Colombia. Nonetheless, a separate analysis of results by subsample revealed that durable goods were differentially associated with academic achievement and school attendance based on sex and school grade. Regarding sex, the estimation models indicated that, controlling for sociodemographic and school characteristics, reading scores were higher for boys whose families owned or had access to Internet, washing machines, and microwaves in comparison to girls who also had access to those durable goods. In contrast, controlling for sociodemographic and school characteristics, math scores were higher for girls whose families owned computers and had access to Internet compared to boys who also had access those durable goods. However, access to TVs and cars was negatively associated with reading and math scores, with larger effects for boys than for girls, entailing that possession of such durable goods negatively affected boys more than girls. Access to videogame consoles was negatively related to academic achievement, with larger effects for girls. In the case of videogame consoles, this result may be explained as a function of the distribution of this durable in the sample (e.g., few girls owned a videogame console) or as a function of the time spent playing video games (e.g., it could be that girls who owned videogames spent more time playing than boys), but that variable was not captured in the data. Overall, these findings corroborated previous research on gender equity and education which indicates that there are gender differences in reading and math performance among children (Golsteyn & Schils, 2014; OECD, 2012a; Tembon & Fort, 2008; World Development Report, 2018). Similarly, results from this study confirmed previous findings about the positive association between assets, particularly durable goods, and educational outcomes (Chowa et al., 2013; Elliott et al., 2011; Fang et al., 2020; Kafle et al., 2018).

In relation to school grade, results suggested that durable goods may be more beneficial for fifth graders than for ninth graders. For example, results indicated that possession of washing machines had a larger positive effect on educational outcomes for fifth graders than for ninth graders, particularly for boys. One potential explanation for this is that despite having access to durable goods, older children, and particularly older girls, may be required to help with domestic activities. For example, older children may be asked to heat lunch in the microwave or do laundry using the washing machine; whereas young children may not engage in such activities given that it may be too dangerous for them or because they do not know how to operate such durable goods. As such, older children, particularly girls, may be responsible for doing or assisting with domestic activities, which in turn leaves them with less time to study. These results corroborated previous studies on achievement gaps which suggest that academic disparities start at an early age and widen as children continue their education (Alexander et al., 2007; Chmielewski, 2019; Clotfelter et al., 2006; García & Weiss, 2017).

One notable finding from this study is that durable goods have differential effects on reading and math achievement. Overall, Internet access and ownership of PCs were positively related with reading scores while possession of washing machines and microwaves was positively related to math scores. One potential explanation for this is that literacy skills are learned and developed daily as children interact with the world (in and out of school settings). Thus, durable goods such as PCs and Internet access are tools that can be used to improve children's ability to read or write. For example, word processing software or online reading programs can help children familiarize with grammar rules or identify reading comprehension strategies. As such, PCs and Internet access may be perceived as complementary tools for developing literacy skills. Math, on the contrary, may be very difficult to self-teach at a young age using the assistance of a computer or the Internet only because it requires learning abstract reasoning skills, familiarizing with mathematical notation, and developing problem-solving skills. As such, this process may require sketching and performing several calculations, which may be easier to do with paper and pen than on a computer. Additionally, time may play an important role in the process of doing math because it allows children to engage in trial and error, which are key elements for learning. Here is where ownership of washing machines and microwaves becomes noteworthy. As highlighted in the introduction of this paper, durable goods such as washing machines have reduced the time burden related to domestic activities. This, in turn, may allow people, particularly women, to engage in productive activities, hence, gaining leverage in intrahousehold relationships (Deere & Doss, 2006; Tewari & Wang, 2021). This time efficiency effect may have also contributed to improve children's academic performance in math because with the presence of a washing machine at home, children may have more time to study, particularly younger children.

This finding is pivotal for understanding how durable goods can be used to reduce poverty. Scholars such as Amartya Sen (1983; 1984; 1993) Martha Nussbaum (Nussbaum & Sen, 1993), Jean Drèze (Drèze & Sen, 1989), and Caroline Moser (1998, 2006, 2008), among others, argue that poverty is not so much an issue of money or income but rather a problem of capability deprivation. In their view, capabilities give people the opportunity to exercise their freedom so that they can engage in economic activities and partake in political and social life. In education, for example, this entails not only having access to education, but succeeding in school (e.g., achieving specific proficiency levels or attaining certain levels of education). In the case of durable goods, there are commodities that can improve household efficiency tasks so that people have more time to engage in other activities. For example, washing machines have allowed families to reduce the time burden associated with doing laundry. This time efficiency effect may have contributed to increase the number of women who enter the labor market or who pursue post-secondary education.

However, if the benefits of using durable goods such as washing machines or computers are not equally distributed among members of a household, then it is likely that these commodities are not creating or enhancing capabilities. Findings from this study suggested that although durable goods such as washing machines, computers, and Internet access were positively associated with educational outcomes, the benefits were not equally distributed among children. Indeed, this study found that older children (ninth graders), in particularly girls, scored at a lower level than boys despite having access to such durable goods. More research is needed to address this issue so that girls can take full advantage of education opportunities. Educating girls is undoubtedly one of the most effective ways to achieve sustainable development and eradicate all forms for poverty.

5.4.1. Limitations

One of the major limitations of this paper was running multilevel models without an interaction between sex and school grade. This decision entailed assuming that the effect of each of those variables on the outcomes of interest was independent. However, as observed from the different estimation models, this was not the case. Indeed, the effect of durable goods on academic achievement and school attendance varied by sex and school grade. For example, results from this study suggested that the effect of having washing machines on academic achievement and school attendance is larger for fifth graders than for ninth graders. Similarly, findings indicated that gender-based achievement gaps remain despite ownership of durable goods, particularly for children in ninth grade. Including an interaction term in the models would have produced a coefficient that accounted for the relationship between these two variables, instead of separate coefficients for each variable. In turn, this would have reduced the number of estimations that were performed, thus improving efficiency.

A second limitation of this study was the number of multilevel estimations conducted to explore the relationship between durable goods and educational outcomes. Because this study assessed two different educational outcomes (continuous and binary), separate models were performed for each outcome. Building one model that accounts for both outcomes and the variables of interest could increase efficiency. Structural Equation Modeling (SEM) could correct for this and provide a single estimation model with multiple outcomes. Doing so could yield more robust estimates about the different ways in which the variables of interest relate to each other. For example, we could further understand not only the relationship between durable goods and educational outcomes, but how these outcomes relate to each other given the presence or absence of durable goods.

A third limitation of this study was the decision about coding the binary outcome. As shown in the methods section, school attendance was coded as a binary variable. The rationale for this was because there was not a clear cut-off value to identify students who were absent from school for minor reasons from students who experienced chronic absenteeism. However, descriptive statistics showed that by using school attendance as a binary variable, close to 45% of the sample were absent from school in the month before taking the SABER test, which constituted a high percentage. As such, using school attendance as a multinomial variable could yield more accurate estimates about how durable goods relate to different types of school absenteeism.

5.5. Conclusion

In conclusion, results from this study corroborate previous research about the link between possession of durable goods and educational outcomes. The multilevel models used in this paper showed that different types of durable goods were differentially related to academic achievement and school attendance by sex and school grade. Regarding sex, this paper demonstrated that test results were, on average, higher for boys whose parents owned or had access to durable goods than for girls whose parents also had access to durable goods. In relation to school grade, results indicated that younger children whose families had access to durable goods performed better academically and were less likely to be absent from school than older children who also had access to durable goods.

These differences show persisting gender-based disparities in relation to the use of such commodities and the distribution of household responsibilities among children. As such, it seems that despite having access to durable goods such as washing machines or microwaves, which are supposed to reduce the time burden related to household chores, older children, and particularly girls, end up taking on a large share of household responsibilities. As highlighted in the discussion section, a potential explanation for this may be that younger children are not required to help with domestic activities. However, as children get older household responsibilities may shift and they may be asked to partake in domestic chores. A contributing factor to this shift may be that more parents, particularly mothers, enter the labor market and domestic activities are assigned to older children, particularly girls. This, in turn, may leave these children with less time to complete their schoolwork or be at risk for not going to school because the importance of domestic activities outweighs that of schooling. Preliminary results from a randomized control trial on the use of washing machines to change gender-based household roles in Colombia suggested that without a clear division of domestic responsibilities, women and older girls would be expected to complete domestic activities (García-Jimeno & Peña, 2016). In their study, García-Jimeno and Peña (2016) developed a strategy to engage husbands in household chores by holding family meetings to discuss the importance of domestic work in improving intra-household relations.

A research recommendation from this study is the need to include an interaction term between sex and school grade, and to code school attendance as a multinomial variable. Similarly, SEM could improve model efficiency by identifying, in one model, the different pathways in which durable goods relate to academic achievement and school attendance. This, in turn, could enhance our understanding not only of the relationship between durable goods and educational outcomes, but also the interlinkage between the outcomes of interest.

From a policy perspective, these findings are noteworthy as they suggest that policies and programs geared to improve academic achievement and school attendance in Colombia need to consider assets, particularly durable goods, as important components of their portfolios. Similarly, given that this study showed that different types of durable goods have differential effects on educational outcomes by sex and school grade, it is important that these policies and programs foster gender equity and empower children. For example, a potential policy recommendation would be to develop asset-based policies that increase access to durable goods and out-of-school-time programs so that children, particularly girls, are engaged in enrichment activities and not at home where they may be required to complete domestic chores. This could also include access to high-quality childcare services so that women can take full advantage of employment opportunities.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

Throughout this dissertation I have attempted to show that assets, particularly durable goods, play a key role in improving educational outcomes. As described in the literature review and in the conceptual framework, asset ownership creates capacity building opportunities which allow families to prepare for economic hardships, generate income, and improve their quality of life (Yadama & Dauti, 2010). Assets create capacities because they can empower people to develop *agency*, which is the ability to act upon one's freedom. When people achieve agency, they can genuinely choose a way of living that satisfies their needs and aspirations. For example, access to financial assets may allow families to plan for their children's future or start a business.

The idea that assets can foster agency development is rooted in the work of Amartya Sen and Jean Drèze, who wrote extensively about famines and hunger in developing countries, and Martha Nussbaum, whose scholarship was devoted to understanding the concept of quality of life. According to Sen, poverty is not so much a problem of lack of money but an issue of capability deprivation (Drèze & Sen, 1989; Sen, 1983, 1984, 1993). For Sen, capabilities constitute the ability to achieve adequate living conditions so that people can exercise their freedom. In his view, when people do not have capabilities to make genuine choices about how they want to lead their lives, they are deprived of a basic right, the right to freedom (Sen, 1983; 1984; 1993). From Nussbaum's perspective, although quality of life is a subjective concept, it requires that basic needs are met and that individuals feel that they can achieve personal goals (Nussbaum & Sen, 1993). Furthermore, achieving quality of life entails that people can also engage in social and political activities because social relatedness is a crucial element of human well-being (Nussbaum & Sen, 1993; Ratner, 2019; Scott, 2012). According to Nussbaum, people engage with the community because it is a way to put those capabilities to work, which fosters social cohesion (Nussbaum & Sen, 1993).

Throughout Chapters One and Two, I argued that assets can foster economic welfare and reduce poverty because they provide people with opportunities to invest in their well-being (Sherraden, 1991). As such, assets can act as "nudges" to improve decision making, particularly at the household level (Thaler & Sunstein, 2009). As opposed to income, which is used for immediate consumption, assets represent a stock of resources or capital that can be used for consumption, developed into new assets and/or transferred from generation to generation. This suggests that assets have a higher utility function than income because they can provide capacity-building opportunities and strengthen agency by giving people control over resources. The goal of such capacity-building opportunities is to empower individuals and families so that they have the capacity to accumulate wealth, thus improving their social and economic well-being. In the long-term, this may encourage individuals and families to become agents of change in their communities. For instance, social capital can be used to increase opportunities to access employment and to foster civic engagement. Assets can also nudge behavioral change and influence decision-making patterns among families by helping them think differently about how to use their assets. Human capital in the form of education, for example, can be used to acquire skills that prepare children to become critical thinkers, good citizens, and contributors to socioeconomic development. Once families understand the positive effects of education, they may begin to think about education as an instrument to improve quality of life, which can lead to greater investments in their children's education.

Asset deprivation, on the contrary, leave people in a position of vulnerability because they are not capable to attain minimum living conditions. As opposed to income deprivation, which jeopardizes levels of consumption, asset deprivation hinders capacity-building in other areas of social and economic development. For example, lack of political capital may hamper political participation which can lead to lower civic engagement. Similarly, lack of health services and education can lead to increase child mortality, malnutrition, or lower school attainment, which can be detrimental to development. Asset deprivation, therefore, can hinder the ability of individuals to achieve well-being, which puts them at risk of falling into monetary and multidimensional poverty.

Thus, the underlying difference between income and assets is that the latter can be viewed as an investment. Such distinction is crucial because it entails that when people have access to assets, they make informed choices about how they want to use them. This is perhaps the central philosophical assumption of my work because it suggests that asset ownership allows people to make rational choices. It stems from this that when people invest in something, they do it because they have high expectations of the potential return that may be derived from it. Take postsecondary education as an example. Postsecondary education can be viewed as an investment because by achieving a college degree people expect to increase their income-earning potential, improve their social status, or develop new skills.

Durable goods also offer a useful example to explain why assets can be conceptualized as investment. Durable goods are investments because they generate positive externalities beyond their unique utility, which can contribute to improve quality of life. Durable goods such as computers and vehicles, for instance, can be used for income-generating activities, for enhancing learning, for improving mobility, or for leisure. Similarly, durable goods such as washing machines, microwaves, or refrigerators have allowed families to reduce the time burden associated with domestic activities. This, in turn, may provide families, particularly stay-at-home parents, with extra time to look for employment, engage in professional development activities (e.g., finish school or start a career), or spend time with their children. Additionally, this may contribute to reduce the amount of household responsibilities for school age children, which may result in more time devoted to studying.

In the Latin American region, particularly in Colombia, the relationship between durable goods and children's educational outcomes is a new area of research with limited evidence. Hence, the purpose of this study was to examine the relationship among durable goods, academic achievement, and school attendance among children in Colombia. Given that current measures of poverty in Colombia do not include ownership of durable goods, this study provided useful insights for research as well as for policy formulation in this field. As stressed in Chapter Three, by using different methodological approaches to model durable goods, which included the construction of a durable goods index using *exploratory factor analysis*, this study provided evidence of the link between durable goods and education outcomes in Colombia.

6.1. Limitations

One of the major limitations of this study was that by using two separate estimation methods to explain the relationship among durable goods, academic achievement, and school attendance I seemed to have treated the dependent variables as if they were not related to each other (conceptually and empirically). However, research suggests that low school attendance is positively associated to low academic achievement (García & Weiss, 2018; Gottfried, 2012; Rodríguez-Escobar et al., 2015). Failing to account for the network of relationships among durable goods, academic achievement, and school attendance may lead to a less accurate estimation of the *true nature of the relationship* between those variables. A better way to account for this would be to use Structural Equation Modeling (SEM), which is an advanced statistical technique to test hypotheses about relations among observed and latent variables (Mueller & Hancock, 2008). As opposed to traditional estimation methods that only analyze observed variables, SEM is a multivariate technique that incorporates observed and unobserved variables and specifies measurement error. As such, SEM could provide more insights as to how durable goods relate to academic achievement and school attendance.

A second limitation of this study is the number of durable goods that were used in the index approach. As highlighted before, the data captured information for only seven durable goods, which restricted the number of factors that were extracted from the data. In cases where there is a weak correlation between variables or if one of the variables cannot be explained by the underlying factor, this may introduce "noise" in the index. Such noise could, in turn, yield biased estimates of the relationship between the index the outcomes variables.

Furthermore, this study used cross-sectional data and therefore no causation can be inferred. There are two ways to address this issue. The first is to have longitudinal data. The second is to conduct a randomized control trial (RCT) to test for the effect of durable goods on educational outcomes. Thus, collecting longitudinal data on ownership of durable goods and educational outcomes as well as the implementation of a RCT intervention constitute key recommendations for future research. Lastly, it is important to highlight that I used a quantitative method to answer the research questions. Matching the quantitative design with qualitative research methods such as focus groups, semi-structure interviews, or a community-based design thinking activity could produce more participatory and robust findings, particularly in topics related to intrahousehold decision-making, distribution of domestic activities by gender and age, and frequency of use of durable goods. A mixed-methods approach, therefore, is something I would strongly recommend for future research on this field.

6.2. Conclusions

Four principal conclusions can be drawn from this dissertation on the role of durable goods in improving educational outcomes among children in Colombia. First, that durable goods are a good proxy of household wealth. When taken as a group, durable goods were positively related to reading scores and school attendance, which corroborated previous research about the link between socioeconomic status and academic achievement (Coleman, 1968; World Development Report, 2018). Regarding academic achievement, the results from this study suggest that durable goods may be more useful for improving literacy skills than for developing math skills. One potential explanation may be that reading skills can be improved or developed by any activity that stimulates student communication skills. In relation to school attendance, durable goods may reduce the time burden associated with completing household chores, which may give families and children additional time to prepare for school.

Second, *different types of durable goods* affect children's educational outcomes differentially. Results from this study revealed that ownership of washing machines, PCs, Internet access, and microwaves was positively associated with reading scores and math scores. Overall, coefficients were larger for reading than for math scores suggesting that these durable goods may be more important for improving reading skills than for developing numeracy skills. Thus, while PCs and Internet access may offer students more opportunities to develop and practice reading and writing skills, washing machines and microwaves may free up time to engage in activities that can improve math outcomes. In contrast, durable goods such as cars, TVs, and videogame consoles were negatively associated with reading and math scores. One potential explanation may be that these commodities enhance leisure opportunities, which may deter students from studying. For example, students may be faced with a choice between playing videogames and studying. In cases where studying is not perceived as a priority, ownership of entertainment goods such as TVs or videogames may nudge students to choose leisure over schoolwork. Regarding school attendance, this study found that the odds ratio of being absent from school was lower for students who had Internet access and who owned PCs and washing machines compared to students who did not have these commodities, controlling for all the other variables. One potential explanation may be that while PCs and Internet access can improve children's engagement with school activities, washing machines may increase the time available to complete schoolwork because they improve the efficiency of household chores. In contrast, the odds ratio of being absent from school were higher, across gender and school grade, for students who had access to videogames than for students who did not have access to videogames, controlling for other variables.

Third, durable goods have differential effects on children's academic achievement and school attendance based on sex and school grade. Regarding sex, this study found that durable goods such as washing machines, Internet access, PCs, and microwaves were positively associated with reading and math scores, with larger effects for boys than for girls. This may suggest that despite having access to these durable goods, gender-based educational disparities remain. A potential explanation for this may be that despite having access to durable goods such as washing machines or Internet access, girls may be asked/required to help with domestic activities. TVs, cars, and videogame consoles were negatively associated with reading and math scores. In relation to school attendance, this study found that the odds of being absent from school were lower for students who had Internet access, PCs, and washing machines, with larger effects for boys than for girls, which may suggest that boys benefit more than girls from having access to these commodities. It is important to stress that this was a novel finding given that existing research on durable goods and academic achievement does not account for gender-based disparities. In relation to school grade, this study found that regardless of grade, PCs, Internet access, and washing machines were positively related to reading and math scores. However, coefficients for Internet access and PCs were higher for ninth than for fifth graders. This may suggest that older children benefited more from those durables. A potential explanation is that older children may know how to use those commodities and may have fewer parental restrictions than younger children. The coefficient for possession of washing machines and microwaves was larger for fifth graders than for ninth graders. One potential explanation for this finding is that despite having access to washing machines, older children may be asked to help with domestic activities, which may leave them with less time to study. Cars and videogames were negatively related to reading outcomes for both groups, with larger coefficients for younger children. One potential explanation is that younger children may spend more time on leisure activities than older children (e.g., playing videogames), which may distract them from school activities. Regarding school attendance, this study found that the odds of being absent from school were lower for fifth graders whose families had Internet access, who owned PCs and washing machines. These findings may suggest that these durable goods are more important for younger children. One potential explanation is that younger children may not have to engage in domestic chores, which may lessen the time burden associated with getting ready to go to school.

Four, all the methodological approaches to operationalize durable goods provided useful information about the relationship between durable goods and educational outcomes. By using the inventory and the attributional approaches, it was possible to identify how different types of durable goods related to academic achievement and school attendance. For example, while computers, washing machines, and Internet access were positively associated with academic achievement and school attendance; durable goods such as TVs, cars, and videogame consoles were negatively related. By using the index approach, it was possible to estimate that household wealth was positively associated with academic achievement and school attendance, and hence, corroborated previous findings about the positive effect of socioeconomic status and income, proxies for wealth, in improving educational outcomes.

6.3. Recommendations

Throughout this dissertation I have pointed out that social policy formulation needs to shift from an income-based approach to an asset-based approach if significant change is to be made regarding poverty reduction. However, this does not entail that income-based incentives should be removed from social policies or programs. On the contrary, it simply means that income needs to be considered as a component of a larger social policy framework, and not as the one-size-fits-all solution to the poverty puzzle. The rationale for this is that while income-based policies assume that the level of household income is equal to welfare, asset-based welfare theory indicates that assets are a more complete measure of wealth because they represent what families possess, an indicator of present and future social and economic welfare.

The asset-based approach to social policy focuses on the idea that assets can increase investments in key areas of social and economic development, which in turn can improve quality of life and reduce poverty. This approach highlights that assets play a key role in providing families, specifically low-income families, with capabilities to increase their well-being. The work of organizations such as the World Bank, the Inter-American Development Bank, the United Nations, and the Poverty Action Lab (J-PAL) to mention a few, has gradually pushed for the implementation of social policies that include asset accumulation within their poverty reduction strategies (Kratz, 2001; Moser, 1998, 2006, 2008; Siegel, 2005). The rationale for this is that assets can give people opportunities not only to generate income, but also to improve their quality of living. In some developing countries, for example, possession of a vehicle (e.g., car, motorbike, or bicycle) can serve different purposes including transportation, means to generate income (e.g., employment), and leisure. For low-income families, this means not only saving money on public transportation, but also having access to employment opportunities and leisure time. A report on the impact of motorbikes on employment in Colombia, for example, revealed that close to one million jobs were directly or indirectly generated because of motorbike usage (6.5% of the share of employment in Colombia) (ANDI, 2019).

Therefore, the asset-based approach to social policy can be an important policy instrument to reduce poverty because it provides a framework to build capacity (Yadama & Dauti, 2010). Once capacity is built, families are better able to make informed decisions not only about what they consume (e.g., goods and services), but also about how they use and invest their assets. If the goal of social policy is to empower people so that they can achieve social and economic welfare, assets are the means. Access to credit, for example, can help low-income families acquire assets that can be used for immediate consumption (e.g., housing, vehicles, or durable goods) or for future investment (e.g., postsecondary education). Assets such as housing and durable goods can improve the well-being of the family by providing shelter and by increasing the efficiency of household tasks. Investment in education can provide people with skills and qualifications to access specific jobs.

The asset-based approach to welfare and poverty reduction suggests that assets can generate wealth and foster development. But, if that is the case, what are the barriers to asset ownership of asset accumulation? According to Attanasio and Székely (2001), Kratz (2001), Moser (1998, 2006, 2008), Sherraden (1991), and Siegel (2005), the answer lies in the role that has been assigned to low-income families in social policy formulation. For the most part, low-income families have been depicted as *recipients* or *beneficiaries* of “government assistance” or “government subsidies.” Such conceptualization has undermined, or neglected, the opinions and concerns of marginalized communities. This has meant that most social policies and anti-poverty programs have been designed from a top-down approach. This has resulted in the implementation of social policies that rely too much on income transfers. And while some of these policies have certainly contributed to improved quality of life for many low-income families, they have done little to empower them. Promoting access to assets and asset ownership constitute a first step in re-defining the role of families and communities in the conversation about poverty because assets have the potential to build capacity and strengthen agency. As such, the inclusion of assets at the center of social policy formulation can ensure that marginalized communities are regarded as important stakeholders and agents of change in the development of anti-poverty programs.

According to Sherraden (1991), for example, assets are a key factor for social and economic welfare because they provide people with opportunities to invest in their well-being and accumulate more assets. Such a shift from traditional welfare policies that consider income and spending as the main drivers of growth and development contributes to re-defining the role of people in the policy formulation process. For Moser (1998, 2006, 2008), assets foster capacity-building opportunities that can be used for understanding how families can transition out of poverty. Thus, asset accumulation helps us understand the different “pathways” that allow individuals and families to overcome poverty. For Attanasio and Székely (2001) and Kratz (2001) the asset-based approach to poverty reduction entails formulating social policies that 1) enhance the capabilities that people have in order to achieve a better quality of life and 2) create opportunities to put those assets and capabilities to work. This encompasses, therefore, the active participation of families and communities in policy formulation and the creation of a strong support system. Siegel (2005) viewed assets, specifically household assets, as drivers of growth because poverty reduction requires investment in people. For Siegel, the asset-based approach to poverty reduction needs to focus on how people use household assets, specifically productive assets, to generate income, employment, and to increase access to social and political participation.

For organizations such as the World Bank, the Inter-American Development Bank, the United Nations, and the United States Agency for International Development, the purpose of implementing an asset-based approach to welfare and poverty reduction is to reverse social and economic vulnerabilities by empowering people. This approach is based on the notion that the more assets people have, the less vulnerable they are because they have control over what to do with those assets. Under this approach, government programs and policies need to be tailored to support asset accumulation for low-income communities so that they can build socioeconomic capabilities to overcome poverty.

An important component of the assets-based approach is that it conceives social policy as an investment, as opposed to spending, and a vehicle to develop capital, thus making people key stakeholders, particularly people living in poverty. As such, it is founded on the idea that growth, development, and empowerment are essential to poverty alleviation. Examples of programs that would fall under an asset-based approach are children's development accounts, individual retirement accounts, microloans, conditional cash transfer programs, access to shared services (e.g., community co-working spaces, community-based schools, or libraries), and match-funding, among others. As observed, an asset-based approach to social policy and poverty reduction can bring about positive effects in the social and economic well-being of families. Such outcomes will result in the strengthening of individual and collective values so that issues associated with social justice, racial equity, and welfare become the guiding principles of political action and policy formulation.

As described in Chapter One, current assessments of multidimensional poverty in Colombia do not measure ownership of durable goods. However, this study demonstrated that durable goods such as computers, Internet access, and washing machines are important household assets for improving academic achievement and school attendance among children in Colombia. In particular, the finding about the positive association between Internet access and educational outcomes aligns with the development agenda of Colombia, which aims to increase Internet access among public school students and improve proficiency levels in reading and math. As such, my hope is that the results of this study provide evidence supporting the need to include durable goods as key indicators of social and economic well-being in the Colombian context, hence as an input for policy formulation. This entails bringing the topic of durable goods to the policy agenda in Colombia, so that more research can be done to further understand its effects and benefits in other areas of development (e.g., employment, family relations, or poverty). In what follows, I describe five recommendations based on the findings of this research. Some recommendations are methodological, and others are tailored to support the formulation of asset-based social policies to improve educational outcomes and foster capacity-building opportunities for low-income families.

1. *Include the assets indicator of the Global-MPI in measures of multidimensional poverty in Colombia.* As highlighted in Chapter One, the Colombian version of the Global-MPI, called the C-MPI, does not assess ownership of assets in the form of durable goods as an indicator of multidimensional poverty. A potential explanation for this is that research on durable goods and education is a new topic in Colombia, with limited evidence. However, this study demonstrated that durable goods such as computers, washing machines, and Internet access play a key role in improving educational outcomes. Thus, one recommendation from this

study is to include the assets indicator of the Global-MPI, or at least start a conversation about the pertinence of including it, in current assessments of multidimensional poverty in Colombia. This will hopefully contribute to more research on this field, which eventually will provide evidence supporting the formulation of asset-based social policies that promote access to durable goods to improve educational outcomes and mitigate poverty.

2. *Use different methodological approaches to address complex ("wicked") problems.* Understanding the relationship between household wealth, as measured by ownership of durable goods, and education required a multi-faceted approach. By using different methodological approaches, this study showcased multiple ways in which durable goods related, positively and negatively, to academic achievement and school attendance. From an academic perspective, this methodological decision expended our understanding of the nature of the relationship between durable goods and educational outcomes, hence filling gaps found in previous research on this subject. For example, this study found that different types of durable goods had differential effects on education by sex and school grade, suggesting that the benefits of ownership of durable goods are not equally distributed in the household. From a policy viewpoint, this methodological choice helped me gauge the potential benefits and challenges of each approach in policy formulation. For example, the inventory approach seemed to be the most effective because it showed which durable goods has the largest positive effects on educational outcomes. This, in turn, may provide evidence

supporting the formulation of asset-based policies that foster access to durable goods such as computers, washing machines, and Internet access. Hence, a recommendation for future research on this field is to consider different methodological approaches to operationalize concepts such as wealth, poverty, or assets, which are composed of different indicators. Employing multiple approaches to study complex problems can undoubtedly expand our understanding of social phenomena, which can help us identity effective strategies to address them.

3. *Strengthen the scope of conditional cash transfer programs*. For many low-income families in Colombia investing in education is not a choice, but a privilege. Although public education is available at no cost, families are responsible for buying school materials and for accessing good and services that may contribute to improving their children's educational experience. Internet access, computers, and washing machines constitute an example. As highlighted in Chapters One and Two, the share of Colombian households who have Internet access and who own computers and washing machines accounts for less than 60% of the population. As shown in Chapters Four and Five, access to such durable goods is a good predictor of academic achievement and school attendance. Therefore, reducing the barriers to access those durable goods could contribute to close achievement gaps in Colombia.

   Strengthening the scope of programs such as conditional cash transfers, which provide direct financial assistance to low-income families conditioned on investing on their children's education and health, is perhaps the best policy option to foster asset accumulation among low-income families (Armand et al., 2020). There are different options to do this. One option is to offer low-income households access to credit which can be used only to buy certain types of durable goods. Evidence from this study points out to enhancing access to durable goods such as computers, washing machines, and Internet access. Another option is to develop a community-based scheme where instead of owning the durable goods, families share them with other members of the community. An example could be a community development center that is equipped with different types of durable goods such as washing machines and computers. In this option, government action and private investment is needed to build infrastructure and to subsidize the cost of using the durable goods. Families and children could access these durable goods by paying affordable fees. A system of co-pay based on a one-on-one case load could be implemented to make sure that families and children who need it the most are able to access them without jeopardizing consumption of other basic goods and services.

4. *Implement afterschool programs as an alternative to extending the school day.* As shown in Chapters Four and Five, school type and length of school day are key predictors of academic achievement and school attendance. Full-day programs offer students meals and extracurricular activities, which may be an incentive for children to go to school and do well academically. However, the share of students who attend full-day programs is low (12% of total student population). This

policy option would work as a transition strategy to the full-day school policy. Research on afterschool programs highlight that, if well-designed, these programs can have a positive effect in children's social emotional skills, improving behavior in and outside of school, and fostering motivation to engage in learning (Alfaro et al., 2015). These outcomes, most research suggest, are the foundation for active learning; a component that can contribute not only to closing the achievement gap between children (Alexander et al., 2007); but promoting healthy lifestyles. Research also indicates that afterschool programs are more cost-effective than extending the school day because there is no need to build new schools (Alfaro et al., 2015). This policy would start with a pilot project in rural and urban areas for children Pre-k-9. It is suggested that we start with 100 schools throughout the country and then move to a rollout stage to reach 300 and then to scale it up to more schools and more school grades. Priority would be given to schools with highest achievement gaps and highest poverty levels. Enrichment activities would have to combine academic content, arts, physical activity, and social emotional learning.

5. *Increase the availability of affordable high-quality childcare programs.* A noteworthy finding of this research is that parental employment affect children's educational outcomes differentially. Overall, mother's employment seems to negatively affect children's academic performance and school attendance. Given that intrahousehold responsibilities are unequally distributed, with women bearing most of the share of child-rearing and parenting, it is important to increase the

number of high-quality childcare programs that are available to families, particularly low-income families. Government funding and private investment in childcare programs could create capabilities and opportunities for women to improve their standard of living and achieve agency.

This dissertation has argued that durable goods play a key role in academic achievement and school attendance. By using different methodological approaches to model durable goods, this study showed not only that household wealth is an important predictor of school outcomes, but that different types of durable goods have differential effects in education. Moreover, this study found that these differential effects disproportionally affect girls and children in ninth grade, suggesting that the benefits of having durable goods at home are not equally enjoyed among members of the household. Thus, policies that seek to reduce socioeconomic achievement gaps by increasing access to durable goods need to incorporate an equity lens. As an academic exercise, this study provided an opportunity to fill gaps in the literature by showcasing different ways in which durable goods are related to education and expanding the geographic scope to the Latin American region. From a policy standpoint, this research constituted a first step in the consolidation of evidence in support of the formulation of asset-based policies that promote access to durable goods. For example, policies tailored to improve educational outcomes such as academic achievement and school attendance may benefit from increasing access to computers, washing machines, and Internet access, particularly for girls and adolescents from low-income families.

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Appendix A

Proficiency Levels in the 2017 SABER Test for Third Grade Students in Reading and Math

Reading		Math	
Proficiency level	Definition	Proficiency level	Definition
Unsatisfactory 100 - 254	Reads basic short texts	Unsatisfactory 100 – 252	Identifies basic elements of sets and groups. Understands summation
Basic 255 – 307	Draws relationships between characters and the text. Identifies basic grammar	Basic 253 – 305	Solves basic problems using summation. Recognizes different representation of numbers and describes numeric and geometric sequences
Satisfactory 308 – 366	Identifies the structure and communicative goals of the texts. Also, understand grammar and syntactic elements	Satisfactory 306 – 353	Understands and uses properties of summation. Understands that multiplication is a repeated summation of a same quantity. Also, recognizes and classifies characteristics of a basic dataset
Advanced 367 – 500	Understands the text and makes inferences about characters, voices, and the content of the text. In texts that use images, understands the role of images in the process of meaning-making	Advanced 354 – 500	Understands the application of summation to solve numeracy problems. Recognizes fractions. Describes numeric and geometric sequences. Organizes, classifies, and interprets basic statistics by using different forms of data representation

Note. Adapted from 2017 SABER Third Guidelines (SABER 3 Guía de Orientación) (ICFES, 2017a).

Appendix B

Proficiency Levels in the 2017 SABER Test for Fifth Grade Students in Reading and Math

Reading		Math	
Proficiency level	Definition	Proficiency level	Definition
Unsatisfactory 100 - 241	Understands basic information from a text	Unsatisfactory 100 – 279	Understands measurement units
Basic 242 – 318	Recognizes different types of literary texts. Uses basic grammar rules to revise texts. In texts that employ images, understands the role of images the process of meaning-making	Basic 280 – 334	Uses basic operations to problem solving
Satisfactory 319 – 384	Identifies the main ideas of a text and its arguments. Also understands grammar rules and how to use them	Satisfactory 335 – 382	Understands and uses properties of operations to problem solving, understand basic statistics and basic probability
Advanced 385 – 500	Understands the text and makes inferences about the content. Recognizes specific rhetoric styles. Makes inferences about a section of a text or the entire text. Explains the use of connectors in the production of texts	Advanced 383 – 500	Understands and uses division, fractions to solve problems. Understands different elements of data representation and interprets the probability of an event

Note. Adapted from 2017 SABER Fifth Guidelines (SABER 5 Guía de Orientación) (ICFES, 2017b).

Appendix C

Proficiency Levels in the 2017 SABER Test for Ninth Grade Students in Reading and Math

Reading		**Math**	
Proficiency level	Definition	Proficiency level	Definition
Unsatisfactory 100 – 235	Identifies the general purpose of the text. Recognizes the function of a paragraph. Selects pertinent information to complete the content of a text	Unsatisfactory 100 – 252	Interprets information that is presented in graphs and frequency tables. Identifies geometric patterns
Basic 236 – 315	Explains the elements related to the structure of sentences and paragraphs in a text. Establishes the pertinence of a text based on its communicative goals	Basic 253 – 344	Recognizes representation of functions, solves problems in contexts that require summation and multiplication. Identifies relationships dimensions and magnitudes
Satisfactory 316 – 415	Compares different types of texts. Uses grammar to write texts based on their communicative purposes. Evaluates the pertinence of different texts based on purpose/aim, content, and context	Satisfactory 345 – 423	Uses properties of exponentiation, square root, and logarithms. Uses algebraic expressions and graphic representations
Advanced 416 – 500	Identifies how different texts are part of broader historical and social contexts. Revises and corrects texts according to grammatical rules and their communicative purpose	Advanced 424 – 500	Applies algebraic expressions and graphic representations to solve problems. Uses probability and geometry to solve problems. Evaluates different forms to represent data

Note. Adapted from 2017 SABER Ninth Guidelines (SABER 9 Guía de Orientación) (ICFES, 2017c).

Appendix D

"Not-human Subjects" Research Certificate

The University of Vermont

Research Protections Office

To: Hans Walter Cabra Hernandez. PhD candidate - Educational Leadership and Policy Studies
From: Research Protections Office
Date: April 12, 2021
Sponsor: Internal
RE: Understanding the relationship among quality-of-life-enhancing assets, specifically durable goods, school attendance and academic achievement in Colombia

Thank you for completing the Research Not Involving Human Subjects Investigator Self-Determination Tool. The proposed activity is **research that does not involve human subjects** as defined under 45 CFR 46.102(e)

(1) *Human subject* means a living individual about whom an investigator (whether professional or student) conducting research:

(i) Obtains information or biospecimens through intervention or interaction with the individual, and uses, studies, or analyzes the information or biospecimens; or

(ii) Obtains, uses, studies, analyzes, or generates identifiable private information or identifiable biospecimens.

This research **does not require IRB review and approval**. If changes to the project are necessary that may affect this determination, you should complete the self-determination tool again to ensure a continued determination of research not involving human subjects. You may also contact your assigned IRB Research Analyst for assistance.

Note: If this is a sponsored project (projects that are managed through SPA), please be prepared to provide a copy of this document to the SPA Award Acceptance Officer.

Appendix E

Correlation Matrix for the Inventory Approach (all Durable Goods)

Variables	Reading	Math	Internet	PC	TV	Washer	Microwave	Car	Videogame	Sex	Age	School grade	Absent from school	Father's education	Mother's education	Father's employment	Mother's employment	School type	Length of school	School setting
Reading	1.000																			
Math	0.652*	1.000																		
Internet	0.127*	0.088*	1.000																	
PC	0.118*	0.096*	0.468*	1.000																
TV	0.035*	0.024*	0.217*	0.150*	1.000															
Washer	0.086*	0.070*	0.245*	0.212*	0.177*	1.000														
Microwave	0.067*	0.056*	0.239*	0.232*	0.152*	0.184*	1.000													
Car	0.016*	0.022*	0.178*	0.201*	0.087*	0.131*	0.177*	1.000												
Videogame console	0.003	0.013*	0.242*	0.226*	0.134*	0.138*	0.218*	0.191*	1.000											
Sex	0.088*	-0.043*	-0.022*	-0.027*	-0.007*	-0.020*	-0.061*	-0.034*	-0.231*	1.000										
Age	0.021*	0.040*	0.009*	0.027*	-0.007*	0.018*	0.019*	-0.042*	-0.064*	0.023*	1.000									
School grade	0.064*	0.086*	0.029*	0.055*	0.003	0.042*	0.025*	-0.032*	-0.072*	0.059*	0.937*	1.000								
Absent from school	-0.010*	-0.036*	0.006*	-0.012*	0.004*	0.002	0.014*	-0.006*	0.023*	0.043*	0.080*	0.060*	1.000							
Father's education	0.130*	0.105*	0.209*	0.201*	0.100*	0.144*	0.163*	0.139*	0.170*	-0.040*	-0.054*	-0.023*	0.004*	1.000						
Mother's education	0.145*	0.124*	0.217*	0.223*	0.105*	0.157*	0.168*	0.152*	0.168*	-0.045*	-0.053*	-0.010*	-0.004*	0.558*	1.000					
Father's employment	0.101*	0.079*	0.192*	0.172*	0.098*	0.128*	0.133*	0.124*	0.140*	-0.017*	0.004*	0.024*	0.010*	0.320*	0.231*	1.000				
Mothers' employment	0.065*	0.050*	0.164*	0.158*	0.080*	0.109*	0.124*	0.101*	0.125*	-0.023*	-0.033*	-0.022*	0.007*	0.222*	0.345*	0.266*	1.000			
School type	-0.023*	-0.019*	-0.015*	-0.012*	-0.002	-0.013*	-0.010*	-0.015*	-0.014*	0.003	0.008*	0.003	-0.012*	-0.037*	-0.036*	-0.028*	-0.020*	1.000		
Length of school day	0.044*	0.063*	-0.030*	0.001	-0.014*	-0.014*	0.001	0.012*	-0.013*	0.008*	0.000	0.006*	-0.013*	-0.017*	-0.002	-0.016*	-0.002	-0.197*	1.000	
School setting	0.029*	0.022*	0.062*	0.041*	0.030*	0.031*	0.029*	0.014*	0.025*	0.001	-0.001	0.001	0.003	0.033*	0.033*	0.035*	0.028*	0.002	-0.015*	1.000

Appendix F

Correlation Matrix for the Unconditional Approach

Variables	Reading	Math	Info. goods	Household efficiency goods	Entertain. goods	Sex	Age	School grade	Absent from school	Father's education	Mother's education	Father's employment	Mother's employment	School type	Length of school day	School setting
Reading	1.000															
Math	0.652*	1.000														
Information goods	0.044*	0.032*	1.000													
Household efficiency goods	0.060*	0.045*	0.222*	1.000												
Entertainment goods	0.018*	0.027*	0.162*	0.175*	1.000											
Sex	0.088*	-0.043*	-0.018*	-0.032*	-0.156*	1.000										
Age	0.021*	0.040*	-0.022*	0.003	-0.060*	0.023*	1.000									
School grade	0.064*	0.086*	-0.008*	0.021*	-0.058*	0.059*	0.937*	1.000								
Absent from school	-0.010*	-0.036*	0.006*	0.011*	0.013*	0.043*	0.080*	0.060*	1.000							
Father's education	0.130*	0.105*	0.123*	0.137*	0.176*	-0.040*	-0.054*	-0.023*	0.004*	1.000						
Mother's education	0.145*	0.124*	0.131*	0.148*	0.183*	-0.045*	-0.053*	-0.010*	-0.004*	0.558*	1.000					
Father's employment	0.101*	0.079*	0.113*	0.122*	0.151*	-0.017*	0.004*	0.024*	0.010*	0.320*	0.231*	1.000				
Mothers' employment	0.065*	0.050*	0.103*	0.107*	0.131*	-0.023*	-0.033*	-0.022*	0.007*	0.222*	0.345*	0.266*	1.000			
School type	-0.023*	-0.019*	-0.006*	-0.011*	-0.012*	0.003	0.008*	0.003	-0.012*	-0.037*	-0.036*	-0.028*	-0.020*	1.000		
Length of school day	0.044*	0.063*	-0.014*	-0.018*	0.000	0.008*	0.000	0.006*	-0.013*	-0.017*	-0.002	-0.016*	-0.002	-0.197*	1.000	
School setting	0.029*	0.022*	0.040*	0.032*	0.027*	0.001	-0.001	0.001	0.003	0.033*	0.033*	0.035*	0.028*	0.002	-0.015*	1.000

Appendix G

Correlation Matrix for the Conditional Approach

Variables	Reading	Math	Information goods	Household efficiency goods	Entertainment goods	Sex	Age	School grade	Absent from school	Father's education	Mother's education	Father's employment	Mother's employment	School type	Length of school day	School setting
Reading	1.000															
Math	0.652*	1.000														
Information goods	0.141*	0.108*	1.000													
Household efficiency goods	0.093*	0.080*	0.298*	1.000												
Entertainment goods	0.006*	0.013*	0.234*	0.218*	1.000											
Sex	0.088*	-0.043*	-0.023*	-0.056*	-0.124*	1.000										
Age	0.021*	0.040*	0.033*	0.030*	-0.048*	0.023*	1.000									
School grade	0.064*	0.086*	0.059*	0.043*	-0.048*	0.059*	0.937*	1.000								
Absent from school	-0.010*	-0.036*	-0.007*	0.009*	0.004*	0.043*	0.080*	0.060*	1.000							
Father's education	0.130*	0.105*	0.224*	0.185*	0.159*	-0.040*	-0.054*	-0.023*	0.004*	1.000						
Mother's education	0.145*	0.124*	0.239*	0.193*	0.164*	-0.045*	-0.053*	-0.010*	-0.004*	0.558*	1.000					
Father's employment	0.101*	0.079*	0.198*	0.152*	0.137*	-0.017*	0.004*	0.024*	0.010*	0.320*	0.231*	1.000				
Mothers' employment	0.065*	0.050*	0.172*	0.139*	0.114*	-0.023*	-0.033*	-0.022*	0.007*	0.222*	0.345*	0.266*	1.000			
School type	-0.023*	-0.019*	-0.018*	-0.013*	-0.020*	0.003*	0.008*	0.003	-0.012*	-0.037*	-0.036*	-0.028*	-0.020*	1.000		
Length of school day	0.044*	0.063*	-0.017*	0.000	-0.001	0.008*	0.000	0.006*	-0.013*	-0.017*	-0.002	-0.016*	-0.002	-0.197*	1.000	
School setting	0.029*	0.022*	0.053*	0.033*	0.016*	0.001	-0.001	0.001	0.003	0.033*	0.033*	0.035*	0.028*	0.002	-0.015*	1.000

Appendix H

Correlation Matrix for the Index Approach

Variables	Reading	Math	Durable goods index	Sex	Age	School grade	Absent from school	Father's education	Mother's education	Father's employment	Mother's employment	School type	Length of school day	School setting
Reading	1.000													
Math	0.652*	1.000												
Durable goods index	0.133*	0.105*	1.000											
Sex	0.088*	-0.043*	-0.087*	1.000										
Age	0.021*	0.040*	0.000	0.023*	1.000									
School grade	0.064*	0.086*	0.025*	0.059*	0.937*	1.000								
Absent from school	-0.010*	-0.036*	0.007*	0.043*	0.080*	0.060*	1.000							
Father's education	0.130*	0.105*	0.287*	-0.040*	-0.054*	-0.023*	0.004*	1.000						
Mother's education	0.145*	0.124*	0.303*	-0.045*	-0.053*	-0.010*	-0.004*	0.558*	1.000					
Father's employment	0.101*	0.079*	0.252*	-0.017*	0.004*	0.024*	0.010*	0.320*	0.231*	1.000				
Mothers' employment	0.065*	0.050*	0.222*	-0.023*	-0.033*	-0.022*	0.007*	0.222*	0.345*	0.266*	1.000			
School type	-0.023*	-0.019*	-0.020*	0.003	0.008*	0.003	-0.012*	-0.037*	-0.036*	-0.028*	-0.020*	1.000		
Length of school day	0.044*	0.063*	-0.018*	0.008*	0.000	0.006*	-0.013*	-0.017*	-0.002	-0.016*	-0.002	-0.197*	1.000	
School setting	0.029*	0.022*	0.064*	0.001	-0.001	0.001	0.003	0.033*	0.033*	0.035*	0.028*	0.002	-0.015*	1.000

Appendix I

Independent T-tests by Sociodemographic Characteristics

(Outcome Variable: Reading)

Variables	*n*	Mean (SD)	Std. Error	95% CI for Mean Difference	Sig. (2-tailed)
Sex					
Boys	176,975	-0.0876554 (0.9971277)	0.0023703	-0.092301, -0.0830097	0.0000
Girls	187,461	0.0873079 (0.995057)	0.0022982	0.0828034, 0.0918124	
School grade					
Fifth grade	204,948	-0.0541266 (1.012097)	0.0022356	-0.0585084, -0.0497448	0.0000
Ninth grade	159,488	0.0749095 (0.9792218)	0.002452	0.0701036, 0.0797153	
Preschool education					
Yes	196,162	0.1254179 (1.009883)	0.0022802	0.1209489, 0.129887	0.0000
No	168,274	-0.1411282 (0.9685785)	0.0023612	-0.1457561, -0.1365004	
Absent from school					
Yes	163,058	-0.0089441 (0.9922509)	0.0024573	0.1209489, 0.129887	0.0000
No	201,378	0.011483 (1.005948)	0.0022417	-0.1457561, -0.1365004	
School type					
Private	4,715	0.2031648 (1.042152)	0.0151771	0.1734106, 0.2329191	0.0000
Public	359,721	-0.0002889 (0.9990606)	0.0016657	-0.0035537, 0.002976	
Length of school day					
Half day	318,609	-0.0142517 (0.9968297)	0.001766	-0.017713, -0.0107903	0.0000
Full day	45,827	0.1177194 (1.013462)	0.0047342	0.1084403, 0.1269985	
School setting					
Rural	4,457	-0.2600373 (0.9718368)	0.014557	-0.2885762, -0.2314983	0.0000
Urban	359,979	0.005592 (0.9998052)	0.0016664	0.0023259, 0.0088581	

Note. Z-scores for reading scores. $N = 364{,}436$

Appendix J

Independent T-tests by Possession of Durable Goods

(Outcome Variable: Reading)

Variables	*n*	Mean (SD)	Std. Error	95% CI for Mean Difference	Sig. (2-tailed)
Internet					
Yes	241,716	0.0926253 (1.007411)	0.0020491	0.0886092, 0.0966414	0.0000
No	122,720	-0.1754809 (0.9604122)	0.0027416	-0.1808543, -0.1701074	
PC					
Yes	248,573	0.0826588 (1.010827)	0.0020274	0.078685, 0.0866325	0.0000
No	115,863	-0.1699656 (0.953466)	0.0028011	-0.1754558, -0.1644754	
TV					
Yes	308,809	0.0172627 (0.9990797)	0.0017979	0.013739, 0.0207865	0.0000
No	55,627	-0.08048 (1.000366)	0.0042415	-0.0887933, -0.0721667	
Washer					
Yes	304,348	0.0404103 (1.002352)	0.0018169	0.0368491, 0.0439714	0.0000
No	60,088	-0.1904667 (0.9645436)	0.0039348	-0.198179, -0.1827544	
Microwave					
Yes	216,225	0.0575771 (1.010451)	0.002173	0.053318, 0.0618361	0.0000
No	148,211	-.078237 (0.978715)	0.0025422	-0.0832197, -0.0732543	
Car					
Yes	126,386	0.0242562 (1.014208)	0.0028528	0.0186646, 0.0298477	0.0000
No	238,050	-0.0092906 (0.9920139)	0.0020332	-0.0132756, -0.0053055	
Videogame console					
Yes	134,785	0.0062786 (1.009117)	0.0027487	0.0008913, 0.0116659	<0.1
No	229,651	0.0000338 (0.9944343)	0.0020751	-0.0040334, 0.0041009	

Note. Z-scores for reading scores. N = 364,436

Appendix K

Independent T-tests for the Unconditional Approach

(Outcome Variable: Reading)

Variables	*n*	Mean (SD)	Std. Error	95% CI for Mean Difference	Sig. (2-tailed)
Information goods					
Yes	342,981	0.0134118 (1.001377)	0.0017099	0.0100605, 0.0167631	0.0000
No	21,455	-0.1745973 (0.9586928)	0.0065451	-0.1874262, -0.1617685	
Household efficiency goods					
Yes	327,791	0.0223506 (1.002511)	0.001751	0.0189186, 0.0257825	0.0000
No	36,645	-0.1766216 (0.9577573)	0.0050032	-0.1864281, -0.1668152	
Entertainment goods					
Yes	198,443	0.0188044 (1.009173)	0.0022654	0.0143642, 0.0232445	0.0000
No	165,993	-0.0173355 (0.988327)	0.0024258	-0.0220901, -0.012581	

Note. Z-scores for reading scores. $N = 364{,}436$

Appendix L

Independent T-tests for the Conditional Approach

(Outcome Variable: Reading)

Variables	*n*	Mean (SD)	Std. Error	95% CI for Mean Difference	Sig. (2-tailed)
Information goods					
Yes	202,393	0.1284558 (1.011714)	0.0022488	0.1240481, 0.1328635	0.0000
No	162,043	-0.155172 (0.9619846)	0.0023898	-0.1598559, -0.1504882	
Household efficiency goods					
Yes	192,782	0.0903718 (1.009817)	0.0022999	0.0858641, 0.0948796	0.0000
No	171,654	-0.09652 (0.9792422)	0.0023635	-0.1011525, -0.0918875	
Entertainment goods					
Yes	58,169	0.0152972 (1.018105)	0.0042213	0.0070234, 0.023571	0.001
No	306,267	-0.0001169 (0.9963789)	0.0018004	-0.0036457, 0.0034119	

Note. Note. Z-scores for reading scores. $N = 364{,}436$

Appendix M

Independent T-tests by Sociodemographic Characteristics

(Outcome Variable: Math)

Variables	*n*	Mean (SD)	Std. Error	95% CI for Mean Difference	Sig. (2-tailed)
Sex					
Boys	176,975	0.0464454 (1.032829)	0.0024551	0.0416335, 0.0512574	0.0000
Girls	187,461	-0.0392418 (0.9660784)	0.0022313	-0.0436151, -0.0348685	
School grade					
Fifth grade	204,948	-0.0735215 (1.007243)	0.0022249	-0.0778823, -0.0691607	0.0000
Ninth grade	159,488	0.0998912 (0.9819683)	0.0024589	0.0950719, 0.1047105	
Preschool education					
Yes	196,162	0.1333908 (1.022604)	0.0023089	0.1288654, 0.1379161	0.0000
No	168,274	-0.1503669 (0.9503821)	0.0023168	-0.1549077, -0.145826	
Absent from school					
Yes	163,058	-0.0375848 (0.9786321)	0.0024235	-0.0423349, -0.0328347	0.0000
No	201,378	0.0347201 (1.015766)	0.0022635	0.0302837, 0.0391566	
School type					
Private	4,715	0.1694704 (1.079161)	0.0157161	0.1386595, 0.2002813	0.0000
Public	359,721	0.0001788 (0.9987031)	0.0016652	-0.0030849, 0.0034424	
Length of school day					
Half day	318,609	-0.0213326 (0.9920021)	0.0017575	-0.0247771, -0.017888	0.0000
Full day	45,827	0.167153 (1.038846)	0.0048528	0.1576415, 0.1766645	
School setting					
Rural	4,457	-0.1977241 (0.9591265)	0.0143666	-0.2258898, -0.1695584	0.0000
Urban	359,979	0.0048465 (1.000212)	0.0016671	0.0015791, 0.0081139	

Note. Z-scores for math scores. $N = 364{,}436$

Appendix N

Independent T-tests by Possession of Durable Goods

(Outcome Variable: Math)

Variables	*n*	Mean (SD)	Std. Error	95% CI for Mean Difference	Sig. (2-tailed)
Internet					
Yes	241,716	0.0651452 (1.014691)	0.0020639	0.0611001, 0.0691903	0.0000
No	122,720	-0.1212782 (0.9583638)	0.0027357	-0.1266402, -0.1159163	
PC					
Yes	248,573	0.0681808 (1.018282)	0.0020424	0.0641778, 0.0721839	0.0000
No	115,863	-0.1388239 (0.9441457)	0.0027737	-0.1442604, -0.1333874	
TV					
Yes	308,809	0.0126506 (0.9995737)	0.0017987	0.0091251, 0.0161761	0.0000
No	55,627	-0.0547083 (1.000235)	0.0042409	-0.0630205, -0.0463961	
Washer					
Yes	304,348	0.0334959 (1.004364)	0.0018206	0.0299277, 0.0370642	0.0000
No	60,088	-0.1552897 (0.9620524)	0.0039247	-0.1629821, -0.1475973	
Microwave					
Yes	216,225	0.0485626 (1.01462)	0.002182	0.044286, 0.0528393	0.0000
No	148,211	-0.0650228 (0.9742785)	0.0025307	-0.0699829, -0.0600626	
Car					
Yes	126,386	0.0330475 (1.019199)	0.0028669	0.0274285, 0.0386666	0.0000
No	238,050	-0.0139188 (0.9892198)	0.0020275	-0.0178927, -0.009945	
Videogame console					
Yes	134,785	0.0193255 (1.017793)	0.0027723	0.0138919, 0.0247591	0.0000
No	229,651	-0.0075829 (0.9892215)	0.0020642	-0.0116287, -0.003537	

Note. Z-scores for math scores. *N* = 364,436

Appendix O

Independent T-tests for the Unconditional Approach

(Outcome Variable: Math)

Variables	*n*	Mean (SD)	Std. Error	95% CI for Mean Difference	Sig. (2-tailed)
Information goods					
Yes	342,981	0.0102464 (1.002192)	0.0017113	0.0068924, 0.0136004	0.0000
No	21,455	-0.1235583 (0.9549425)	0.0065195	-0.1363369, -0.1107796	
Household efficiency goods					
Yes	327,791	0.0173598 (1.003311)	0.0017524	0.0139251, 0.0207945	0.0000
No	36,645	-0.1317237 (0.9591912)	0.0050107	-0.1415448, -0.1219026	
Entertainment goods					
Yes	198,443	0.0272683 (1.014833)	0.0022781	0.0228032, 0.0317334	0.0000
No	165,993	-0.0273977 (0.9810738)	0.002408	-0.0321174, -0.0226781	

Note. Z-scores for math scores. $N = 364{,}436$

Appendix P

Independent T-tests for the Conditional Approach

(Outcome Variable: Math)

Variables	*n*	Mean (SD)	Std. Error	95% CI for Mean Difference	Sig. (2-tailed)
Internet					
Yes	202,393	0.098689 (1.022879)	0.0022737	0.0942327, 0.1031454	0.0000
No	162,043	-0.1179354 (0.957074)	0.0023776	-0.1225953, -0.1132754	
Household efficiency goods					
Yes	192,782	0.0778314 (1.01657)	0.0023153	0.0732935, 0.0823693	0.0000
No	171,654	-0.0823815 (0.9740432)	0.002351	-0.0869894, -0.0777737	
Entertainment goods					
Yes	58,169	0.0316343 (1.030065)	0.0042709	0.0232633, 0.0400052	0.0000
No	306,267	-0.0031893 (0.9940518)	0.0017962	-0.0067098, 0.0003313	

Note. Z-scores for math scores. $N = 364{,}436$

Appendix Q

One-way ANOVA Tests for Reading – Father's Education

One-way ANOVA for Father's Education

Source of variation	SS	df	MS	*F*	Sig.
Between groups	6704.59489	3	2234.86496		
Within groups	357652.318	364432	0.981396579	2277.23	0.0000
Total	364356.913	364435	3820.42628		

Pairwise Comparisons of Means with Equal Variances for Father's Education

			Tukey		
Levels of education	Contrast	Std. Error	*t*	*P*>value	95% CI
High school vs. elementary	0.1615176	0.0040228	40.15	0.000	0.1511828, 0.1718523
College and technical vs. elementary	0.3725291	0.0051126	72.86	0.000	0.3593946, 0.3856636
Graduate school vs. elementary	0.3722399	0.0062032	60.01	0.000	0.3563036, 0.3881762
College and technical vs. high school	0.2110115	0.0046139	45.73	0.000	0.1991582, 0.2228648
Graduate school vs. high school	0.2107223	0.0057991	36.34	0.000	0.1958243, 0.2256204
Graduate school vs. college and technical	-0.0002892	0.0066019	-0.04	1.000	-0.0172497, 0.0166714

Appendix R

One-way ANOVA Tests for Reading – Mother's Education

One-way ANOVA for Mother's Education

Source of variation	SS	df	MS	*F*	Sig.
Between groups	8559.61974	3	2853.20658		
Within groups	355797.293	364432	0.976306398	2922.45	0.0000
Total	364356.913	364435	0.999785731		

Pairwise Comparisons of Means with Equal Variances for Mother's Education

			Tukey		
Levels of education	Contrast	Std. Error	*t*	*P>value*	95% CI
High school vs. elementary	0.1931008	0.0043057	44.85	0.000	0.1820394, 0.2041623
College and technical vs. elementary	0.4360792	0.005148	84.71	0.000	0.4228537, 0.4493047
Graduate school vs. elementary	0.4165064	0.0062825	66.30	0.000	0.4003663, 0.4326464
College and technical vs. high school	0.2429784	0.004337	56.02	0.000	0.2318364, 0.2541204
Graduate school vs. high school	0.2234056	0.0056372	39.63	0.000	0.2089235, 0.2378877
Graduate school vs. college and technical	-0.0195728	0.0063041	-3.10	0.010	-0.0357682, -0.0033775

Appendix S

One-way ANOVA Tests for Reading – Father's Employment

One-way ANOVA for Father's Employment

Source of variation	SS	df	MS	*F*	Sig.
Between groups	9777.27644	5	1955.45529	2009.78	0.0000
Within groups	354579.636	364430	0.972970492		
Total	364356.913	364435	0.999785731		

Pairwise Comparisons of Means with Equal Variances for Father's Employment

			Tukey		
Levels of education	Contrast	Std. Error	*t*	*P*>value	95% CI
Farmer vs. unemployed and non-wage-earning	0.371182	0.0079062	46.95	0.000	0.3486516, 0.3937125
Service and construction vs. unemployed and non-wage-earning	0.532628	0.0060527	88	0.000	0.5153797, 0.5498764
Receives pension vs. unemployed and non-wage-earning	0.4996097	0.011094	45.03	0.000	0.4679952, 0.5312242
Professional and administrative work vs. unemployed and non-wage-earning	0.6363251	0.0068601	92.76	0.000	0.6167758, 0.6558745
CEO and director vs. unemployed and non-wage-earning	0.373847	0.0088808	42.1	0.000	0.3485392, 0.3991548
Service and construction vs. farmer	0.161446	0.0059412	27.17	0.000	0.1445152, 0.1783767
Receives pension vs. farmer	0.1284277	0.0110336	11.64	0.000	0.0969853, 0.1598701
Professional and administrative work vs. farmer	0.2651431	0.006762	39.21	0.000	0.2458733, 0.2844128
CEO and director vs. farmer	0.0026649	0.0088053	0.3	1.000	-0.0224275, 0.0277573
Receives pension vs. service and construction	-0.0330183	0.0097911	-3.37	0.010	-0.06092, -0.0051166
Professional and administrative work vs. service and construction	0.1036971	0.0044555	23.27	0.000	0.0910004, 0.1163938
CEO and director vs. service and construction	-0.1587811	0.0071874	-22.09	0.000	-0.1792631, -0.138299
Professional and administrative work vs. receives pension	0.1367154	0.0103098	13.26	0.000	0.1073355, 0.1660953
CEO and director vs. receives pension	-0.1257628	0.0117516	-10.7	0.000	-0.1592513, -0.0922742
CEO and director vs. professional and administrative work	-0.2624782	0.0078794	-33.31	0.000	-0.2849322, -0.2400241

Appendix T

One-way ANOVA Tests for Reading – Mother's Employment

One-way ANOVA for Mother's Employment

Source of variation	SS	df	MS	*F*	Sig.
Between groups	5359.63048	5	1071.9261		
Within groups	358997.282	364430	0.985092562	1088.15	0.0000
Total	364356.913	364435	0.999785731		

Pairwise Comparisons of Means with Equal Variances for Mother's Employment

			Tukey		
Levels of education	Contrast	Std. Error	*t*	*P*>value	95% CI
Farmer vs. unemployed and non-wage-earning	-0.2218074	0.012303	-18.03	0.000	-0.2568672, -0.1867475
Service and construction vs. unemployed and non-wage-earning	0.0711534	0.0038342	18.56	0.000	0.0602271, 0.0820797
Receives pension vs. unemployed and non-wage-earning	-0.2470304	0.017	-14.46	0.000	-0.2957105, -0.1983504
Professional and administrative work vs. unemployed and non-wage-earning	0.2670322	0.005	59	0.000	0.2541337, 0.2799308
CEO and director vs. unemployed and non-wage-earning	-0.2037415	0.009	-22.13	0.000	-0.2299731, -0.1775099
Service and construction vs. farmer	0.2929608	0.012	23.72	0.000	0.2577674, 0.3281541
Receives pension vs. farmer	-0.025223	0.021	-1.22	0.829	-0.0842903, 0.0338442
Professional and administrative work vs. farmer	0.4888396	0.013	38.85	0.000	0.4529849, 0.5246943
CEO and director vs. farmer	0.0180659	0.015	1.21	0.832	-0.0244463, 0.060578
Receives pension vs. service and construction	-0.3181838	0.017	-18.59	0.000	-0.3669601, -0.2694075
Professional and administrative work vs. service and construction	0.1958788	0.005	42.11	0.000	0.1826218, 0.2091359
CEO and director vs. service and construction	-0.2748949	0.009	-29.66	0.000	-0.3013046, -0.2484852
Professional and administrative work vs. receives pension	0.5140626	0.017	29.74	0.000	0.464807, 0.5633183
CEO and director vs. receives pension	0.0432889	0.019	2.27	0.206	-0.0110051, 0.0975829
CEO and director vs. professional and administrative work	-0.4707737	0.010	-49.17	0.000	-0.4980585, -0.4434889

Appendix U

One-way ANOVA Tests for Math – Father's Education

One-way ANOVA for Father's Education

Source of variation	SS	df	MS	*F*	Sig.
Between groups	4422.85635	3	1474.28545		
Within groups	359987.97	364432	0.9878056	1492.49	0.0000
Total	364410.827	364435	0.999933669		

Pairwise Comparisons of Means with Equal Variances for Father's Education

			Tukey		
Levels of education	Contrast	Std. Error	*t*	*P*>value	95% CI
High school vs. elementary	0.1174801	0.0040359	29.11	0.000	0.1071117, 0.1278485
College and technical vs. elementary	0.3019809	0.0051293	58.87	0.000	0.2888036, 0.3151582
Graduate school vs. elementary	0.2967447	0.0062234	47.68	0.000	0.2807565, 0.3127329
College and technical vs. high school	0.1845008	0.004629	39.86	0.000	0.1726089, 0.1963928
Graduate school vs. high school	0.1792646	0.005818	30.81	0.000	0.164318, 0.1942112
Graduate school vs. college and technical	-0.0052362	0.0066234	-0.79	0.859	-0.0222521, 0.0117796

Appendix V

One-way ANOVA Tests for Math – Mother's Education

One-way ANOVA for Mother's Education

Source of variation	SS	df	MS	*F*	Sig.
Between groups	6245.96607	3	2081.98869		
Within groups	358164.861	364432	0.982802994	2118.42	0.0000
Total	364410.827	364435	0.999933669		

Pairwise Comparisons of Means with Equal Variances for Mother's Education

			Tukey		
Levels of education	Contrast	Std. Error	*t*	*P*>value	95% CI
High school vs. elementary	0.1579249	0.00432	36.56	0.000	0.1468267, 0.169023
College and technical vs. elementary	0.3680414	0.0051651	71.25	0.000	0.354772, 0.3813108
Graduate school vs. elementary	0.3593884	0.0063034	57.01	0.000	0.3431948, 0.3755821
College and technical vs. high school	0.2101165	0.0043515	48.29	0.000	0.1989375, 0.2212956
Graduate school vs. high school	0.2014636	0.0056559	35.62	0.000	0.1869333, 0.2159938
Graduate school vs. college and technical	-0.008653	0.006325	-1.37	0.519	-0.0249021, 0.0075962

Appendix W

One-way ANOVA Tests for Math – Father's Employment

One-way ANOVA for Father's Employment

Source of variation	SS	df	MS	*F*	Sig.
Between groups	7595.67768	5	1519.13554	1551.56	0.0000
Within groups	356815.149	364430	0.979104764		
Total	364410.827	364435	0.999933669		

Pairwise Comparisons of Means with Equal Variances for Father's Employment

			Tukey		
Levels of education	Contrast	Std. Error	*t*	*P*>value	95% CI
Farmer vs. unemployed and non-wage-earning	0.4131626	0.0079311	52.09	0.000	0.3905612, 0.4357639
Service and construction vs. unemployed and non-wage-earning	0.4888229	0.0060717	80.51	0.000	0.4715202, 0.5061255
Receives pension vs. unemployed and non-wage-earning	0.4336788	0.0111289	38.97	0.000	0.4019647, 0.4653928
Professional and administrative work vs. unemployed and non-wage-earning	0.5613292	0.0068817	81.57	0.000	0.5417183, 0.5809401
CEO and director vs. unemployed and non-wage-earning	0.3328051	0.0089088	37.36	0.000	0.3074177, 0.3581926
Service and construction vs. farmer	0.0756603	0.0059599	12.69	0.000	0.0586763, 0.0926444
Receives pension vs. farmer	0.0205162	0.0110683	1.85	0.431	-0.0110251, 0.0520576
Professional and administrative work vs. farmer	0.1481666	0.0067833	21.84	0.000	0.1288362, 0.167497
CEO and director vs. farmer	-0.0803574	0.008833	-9.1	0.000	-0.1055288, -0.055186
Receives pension vs. service and construction	-0.0551441	0.0098219	-5.61	0.000	-0.0831336, -0.0271545
Professional and administrative work vs. service and construction	0.0725063	0.0044695	16.22	0.000	0.0597696, 0.085243
CEO and director vs. service and construction	-0.1560177	0.00721	-21.64	0.000	-0.1765642, -0.1354712
Professional and administrative work vs. receives pension	0.1276504	0.0103423	12.34	0.000	0.098178, 0.1571228
CEO and director vs. receives pension	-0.1008736	0.0117886	-8.56	0.000	-0.1344676, -0.0672796
CEO and director vs. professional and administrative work	-0.228524	0.0079042	-28.91	0.000	-0.2510488, -0.2059993

Appendix X

One-way ANOVA Tests for Math – Mother's Employment

One-way ANOVA for Mother's Employment

Source of variation	SS	df	MS	*F*	Sig.
Between groups	3622.47345	5	724.49469		
Within groups	360788.353	364430	0.990007281	731.81	0.0000
Total	364410.827	364435	0.999933669		

Pairwise Comparisons of Means with Equal Variances for Mother's Employment

			Tukey		
Levels of education	Contrast	Std. Error	*t*	*P*>value	95% CI
Farmer vs. unemployed and non-wage-earning	-0.1131018	0.0123336	-9.17	0.000	-0.148249, -0.0779546
Service and construction vs. unemployed and non-wage-earning	0.0565073	0.0038437	14.7	0.000	0.0455538, 0.0674607
Receives pension vs. unemployed and non-wage-earning	-0.2477685	0.017125	-14.47	0.000	-0.2965698, -0.1989671
Professional and administrative work vs. unemployed and non-wage-earning	0.2166058	0.0045375	47.74	0.000	0.2036751, 0.2295365
CEO and director vs. unemployed and non-wage-earning	-0.1972139	0.0092279	-21.37	0.000	-0.2235108, -0.1709169
Service and construction vs. farmer	0.169609	0.0123806	13.7	0.000	0.134328, 0.20489
Receives pension vs. farmer	-0.1346667	0.0207791	-6.48	0.000	-0.1938811, -0.0754523
Professional and administrative work vs. farmer	0.3297076	0.0126132	26.14	0.000	0.2937635, 0.3656516
CEO and director vs. farmer	-0.0841121	0.0149553	-5.62	0.000	-0.1267302, -0.041494
Receives pension vs. service and construction	-0.3042758	0.0171589	-17.73	0.000	-0.3531736, -0.2553779
Professional and administrative work vs. service and construction	0.1600986	0.0046637	34.33	0.000	0.1468085, 0.1733886
CEO and director vs. service and construction	-0.2537211	0.0092906	-27.31	0.000	-0.2801966, -0.2272456
Professional and administrative work vs. receives pension	0.4643743	0.0173275	26.8	0.000	0.414996, 0.5137526
CEO and director vs. receives pension	0.0505546	0.0191	2.65	0.086	-0.0038747, 0.1049839
CEO and director vs. professional and administrative work	-0.4138197	0.0095985	-43.11	0.000	-0.4411725, -0.3864669