Economic Development and Reproduction:

Understanding the Role of Market Opportunities

in Shaping Fertility Variation.

By

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ABSTRACT

Evolutionary and economic theories of fertility variation argue that novel subsistence opportunities associated with market economies shape reproduction in ways that both increase parental investment per child and lower overall fertility. I use demographic and ethnographic data from Guatemala as a case study to illustrate how ethnic inequalities in accessing market opportunities have shaped demographic variation and the perceptions of parental investments. I then discuss two projects that use secondary data sets to address issues of conceptualizing and operationalizing market opportunities in national and cross-population comparative work. The first argues that social relationships are critical means of accessing market opportunities, and uses Guatemala household stocks of certain forms of relational wealth are associated with greater parental investments in education. The second focuses on a methodological issue in how common measures of wealth in comparative demographic studies conflate economic capacity with market opportunities, and how this conceptual confusion biases our interpretations of the observed links between wealth and fertility over the course of the demographic transition.

DEDICATION

To my family. This achievement is as much yours as it is mine.

ACKNOWLEDGMENTS

You know who you are. I would like to thank Stephen Crowley, John Ziker, and Mark Plew. You all saw a spark and worked hard to fan it. To Jonathan Maupin, who knows better than most the road it took to get here. Thank you for your patience, understanding and friendship. A special thanks to Dan. You are an exceptional scholar, and an even better mentor. I would not be here if not for stumbling into your lab all those years ago. To the folks in Guatemala who patiently suffered through my Spanish and so graciously shared your stories. Your warmth and spirit have changed me in ways I cannot describe.

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CHAPTER 1

INTRODUCTION

The recent transition from high mortality and high fertility to low mortality and low fertility is a defining feature of contemporary humans. Low fertility is a central puzzle in evolutionary approaches human behavior because of the problem of reconciling a reduction in fertility with a framework centered on maximizing reproductive success (Mulder 1998; Vining 1986). A simple prediction from evolutionary life-history theory would posit that increasing access to resources and material security that accompanies economic development should be converted into greater reproductive output. However, a key feature of modern low fertility is the negative association between socioeconomic status and fertility (Goodman, et al. 2012; Mulder 1998).

A complete evolutionary account of low fertility among industrial populations must be consistent with reproductive patterns observed in traditional societies (Hill and Hurtado 1996; Kaplan, et al. 2002; Winterhalder and Smith 2000). Early evolutionary theorists proposed cultural success should increase the likelihood of reproductive success (Alexander 1979; Irons 1979), with the ethnographic literature rife with examples of wealth, status, and prestige improving reproductive outcomes in traditional societies (Betzig and Turke 1986; Cronk 1991; Mealey 1985; Mulder 1987).

Modelled as a quality-quantity trade-off, the negative association is the result of changing patterns of parental investments in response to new social and economic

opportunities (Becker 1992; Kaplan 1996; Mace 2014). This shift has altered the costs and benefits of extended parental investment and the availability of helpers to subsidize the costs of childbearing (Hrdy 2009; Turke 1989). The importance of education for economic and social achievements in these new environments has increased the cost of rearing successful children. While models suggest low fertility can maximize fitness under specific conditions (Hill and Reeve 2005; Low, et al. 2002), empirically the benefits of recent low fertility do not appear to translate to increased fitness even after several generations (Goodman, et al. 2012).

Models that focus on the role of parental investments in education in rearing successful children are perhaps the most prominent and accepted frameworks in the evolutionary social sciences. Empirically, limiting fertility has been shown to increase both offspring educational attainment and adult income in a number of contexts (Goodman, Koupil, & Lawson, 2012; Kaplan, Lancaster, Johnson, & Bock, 1995). The proposed link between these two outcomes is that educational attainment is the primary means by which parents increase the quality of their offspring, and the primary means by which offspring access high-income employment. The models based on this quality quantity trade-off dynamic have proposed that parents have a psychology which attempts to maximize the summed income (i.e. resources) across all offspring (Snopkowski & Kaplan, 2014).

Recently, these economic models that focus on maximizing income across offspring have been criticized for a narrow focus on a single proposed life history trade-off (D. W. Lawson & Mulder, 2016a; Shenk, Hooper, & Kaplan, 2016). Indeed recent analysis have suggested that the quality-quantity trade-off does not account for variation in fertility in pre-transition populations and that the trade-off observed in modern economies reflects a much more fundamental shift in reproductive decision making that previously thought (D. W.

Lawson & Mulder, 2016b). Reproductive decisions are made in concert with other life history trade-offs, particularly those trade-offs parents make between investment in reproduction vs. investments in themselves. Just as investments in child quality trade-off with fertility in modern market economies, investments in parental status may also trade-off with fertility.

Status competition plays an important role in human reproduction (Boone & Kessler, 1999; Turke & Betzig, 1985). Status hierarchies are pervasive across human societies, including the relatively egalitarian hunting and gathering groups. Furthermore, status differentials show a broadly positive association with reproductive success across nonindustrial populations (von Rueden, 2014). The reproductive returns to status in foraging and horticultural groups can include access to mating opportunities, cooperative sharing and coalition partners, and the ability to marshal greater aid when sick or injured (reviewed in (von Rueden, 2014)). These returns can lead to greater overall fertility, or increased offspring survival. These broadly positive associations suggest a universal concern for status may be a basic human motivation subject to positive selection in our evolutionary history. (Cheng, Tracy, Foulsham, Kingstone, & Henrich, 2013; Shenk et al., 2016; von Rueden, 2014).

Status competition has played a key part in evolutionary theorizing about causes of low fertility. Similar to wealth, Irons argued that cultural success, or relative social status, is translated into reproductive success in traditional societies(Irons, 1983; Vining, 1986). That is, we have evolved to pursue status because in the ancestral past status was fitness enhancing. However, in modern market economies, the links between status and reproductive success have been severed (Borgerhoff Mulder, 1998c; Pérusse, 1993), and we

are stuck with the evolved mechanisms that motivate status competition. More recently, evolutionary demographers have emphasized the role of status competition in shaping fertility patterns. Low modelled the conditions under which status competition could result in lower fertility could result in longer term reproductive success (Low, Simon, & Anderson, 2002). Furthermore, population studies in industrial societies have found that the association between wealth and reproductive outcomes can vary across socioeconomic status and subgroups within populations (R. L. Hopcroft, 2006; Mace, 1998; Stulp, Sear, Schaffnit, Mills, & Barrett, 2016a). Finally, Shenk et al argue that the robust effects of status in small scale societies and the potential for status to trade-off with fertility in conditions of heritable wealth and market economies means that purely economic models of fertility decline are incomplete.

> "We argue that economic and risk-based models are necessary yet insufficient to explain modern levels of fertility decline and suggest that failure to consider stats competition is a key reason why (Shenk et al., 2016, pg 2)".

This dissertation aims to extend this work by outlining the various proposed mechanisms linking parental investments in education to greater offspring socioeconomic success. The dissertation proposes that education is not the sole determinant of offspring socioeconomic success. Rather the effects of education on socioeconomic success are shaped by the channels, or the suite of market opportunities, that individuals and households have to turn education into income in their socio-economic contexts. It explores how access (or lack of access) to these market opportunities shape parental decisions about educating their children and about how many children to have. It examines this at a range of scales,

including in-depth study of these dynamics in rural and urban Guatemala as well as broad comparative analysis of fertility across 56 low- and middle-income countries worldwide.

This work extends economic models of fertility by adding one form of status differentials in the calculus. Anthropologists have recently clarified the distinction between wealth and status, where wealth broadly represents resources, while status broadly represents access or opportunities to access resources (Borgerhoff Mulder & Beheim, 2011; Colleran, Jasienska, Nenko, Galbarczyk, & Mace, 2015). The focus on market opportunities captures the idea that the income returns to parental investments in education depend in part on the status of the household, proxied by opportunities available to turn education into income.

Chapter 1 presents a descriptive account of ethnic differences in fertility and parental investments in Guatemala. The fertility decline in Guatemala is characterized by large ethnic differences in the rate of the decline over the last 50 years, with the large indigenous Mayan population showing higher fertility and slower declines than the non-indigenous Ladino population. Most of the literature on these ethnic differences in fertility in Guatemala has focused on access and uptake of family planning, with little explicit focus on the social and structural barriers Mayans face in accessing market opportunities (Metz, 2001; Santiso-Gálvez, Ward, & Bertrand, 2015; Seiber & Bertrand, 2002). This chapter focuses on how social and economic exclusion face by Mayans has limited the economic benefits of reduced fertility and increased investments in education. This descriptive account outlines how variation in accessing novel economic opportunities associated with economic development has shaped ethnicity-related differences in parents' reproductive decisions.

Chapter 2 and Chapter 3 address issues of conceptualizing and operationalizing market opportunities in empirical research on parental investment and fertility behaviors in national and cross-national research. Chapter 2 builds upon the descriptive account outlined in Chapter 1 to test predictions about the effects of market opportunities on parental investment decisions. The study focuses on one pathway by which Mayan households can increase access to market opportunities – social networks. A large body of work over the last 30 years has emphasized the importance of social capital in today's modern world (Bourdieu 1986; Knack and Keefer 1997; Lin 2002; Torsvik 2000), particularly as a determinant of economic outcomes for both individuals (Coleman 1988) and households (Narayan and Pritchett 1999; Narayan and Pritchett 2000). The resources embedded in social networks shapes access and effectiveness of investments in education (Horvat, et al. 2003; Lai, et al. 2015), and economic outcomes in competitive wage labor economies (Burt 2000; Granovetter 1973; Marsden and Hurlbert 1988). Drawing on this body of research, this study tests the prediction that Mayan households with key forms of social capital will be more willing to invest in offspring education as they have the social capital to leverage that education into higher paying jobs in the future. Using nationally representative data from over 11,000 school-aged children, the study finds that 1) household stocks of social capital do positively associate with parental investments in offspring education, and 2) the effects of social capital are significantly stronger for Mayan households. Importantly, all else equal, ethnic disparities in school-enrollment of indigenous girls disappears when indigenous households have the right types of social connections.

Chapter 3 focuses on a methodological issue in how common measures of wealth in comparative demographic studies conflate economic capacity with market opportunities, and

how this conceptual confusion biases our interpretations of the observed links between wealth and fertility over the course of the demographic transition. A key piece to the puzzle of low fertility has been the mixed associations between measures of wealth and fertility across populations at different stages of the transition. This chapter explores one potential reason for these perplexing findings. The study suggests that many common measures of wealth do not simply capture economic capacity, but also reflect the history of access to market opportunities. These two concepts, economic capacity and market opportunities, are suggested to have opposing effects on fertility in many contexts. Studies that rely on wealth measures that conflate these two concepts may mistakenly attribute the negative impact of market opportunities on fertility to economic capacity. In this way, the multi-faceted meaning of many wealth measures obscures researchers' ability to draw inferences about the causal mechanisms underlying the relationship between wealth and fertility.

The study proposes a method of disentangling economic capacity and market opportunities using multiple measures of wealth developed from household-level assets commonly found in demographic and health monitoring surveys. These alternative measures of wealth (e.g. agricultural wealth) do not carry the same market-oriented biases as standard asset-based measures, and thus do not conflate economic capacity and market opportunities. Using these multiple measures of wealth from 472,812 households, across 90,425 sampling clusters, across 114 surveys in 56 countries, the study employs a multi-group latent variable structural equation model to estimate 1) latent variables capturing economic capacity and market opportunity and 2) their effects on completed family size. Market opportunities had a consistent negative effect on fertility, while economic capacity had a weaker but generally positive effect on fertility. The results show that the confusion

between measures of wealth and the concepts of economic capacity can impede our understanding of how material resources shape reproductive decision making.

These studies reflect a solid contribution to growing body of work in evolutionary demography, which focuses on the causes of within-population variation in fertility (Sear, Lawson, Kaplan, & Shenk, 2016). By outlining potential pathways by which households access the novel economic opportunities provided by the spread of market economies, this work helps refine to refine evolutionary theories regarding human fertility. Additionally, this works aids in clarifying the factors that shape parents' reproductive decision-making, particularly in contexts characterized by both declining fertility and rising inequality. In doing so, these studies point to new directions in understanding the reproductive trade-offs faced by parents in a wide-range of contexts, and contribute new evidence to the debates regarding the evolutionary dynamics underlying the puzzle of contemporary low fertility.

CHAPTER 2

INEQUALITY IN MARKET INTEGRATION AND ETHNIC DISPARITIES IN FERTILITY IN GUATEMALA

Abstract

The transition to low fertility in Guatemala is characterized by ethnic differences between the indigenous Mayan population and the non-indigenous Ladino population. Consistent with economic theories of fertility, these ethnic differences in fertility reflect unequal access to market opportunities, with Mayan households having fewer economic incentives to limit fertility and invest in education. Using case studies from a community in the central highlands, this paper explores one explanation for these ethnic differences in market opportunities, investments in education, and fertility – Mayan households have fewer social resources needed to convert education into income. First, I use qualitative data to show how reproductive norms reflect concerns for market access, primarily through investments in education. Second, I explore the importance of social relationships in turning education into income, and how certain types of social relationships can also shape parental investment decisions. Finally, given the importance of certain forms of social relationships, I review evidence that Mayan households have fewer social resources needed for turning education into income. These observations highlight the importance of social relationships for leveraging education to succeed in the Guatemalan wage-labor economy, and their potential for shaping parental investment decisions. This work presents an unexplored

explanation for ethnic disparities in fertility in Guatemala, as well as provides a novel extension to economic theories of fertility that argue low fertility is a result of parental investment decisions in wage-labor economies.

Introduction

In 2015, the national newspaper in Guatemala, *The Prensa Libre*, published an article on the population projection in Guatemala. Summarizing data from the national census institute and drawing on a number of published reports regarding current fertility patterns, the article estimated the current population of 15 m would double to 30m in the next 15 years. A cursory examination of the social media reactions to the online article shows how many people in Guatemala feel about these population projections. Many people commented that discussions regarding sex would become less taboo making it easier to implement better sexual education in the school system and rural areas. Others felt imposing policies to limit the size of families, like policies in China during the last 30 years would be appropriate, with consequences for breaking the limit.

Most telling were the comments regarding who were having the most children. The comments made clear that Guatemalans see the rural poor, particularly indigenous populations as the largest contributor to population growth. Historically they are right. Current demographic estimates show rural indigenous Mayan populations having 3.6 children on average, with nearly a 1 child difference compared to their non-indigenous or Ladino counterparts (Ministerio de Salud Pública y Asistencia Social, Instituto Nacional de Estadística, & ICF International, 2017). While the fertility rate declined from 5.6 to 3.1

births per woman in the last 30 years, the rate of decline was much slower than other Latin American Countries (De Broe & Hinde, 2006; Grace, 2008). It took Guatemala close to 44 years to see an overall decline in 2 children since 1960. By contrast, Bolivia took 34 years, whereas Honduras, el Salvador and Nicaragua saw a 2 child decline in approximately 25 years (Guzmán, Rodríguez, Martínez, Contreras, & González, 2006) . In Guatemala, this stalled decline is characterized by large disparities across ethnic groups, rural and urban residence, as well as education and economic gradients (Grace, 2008; Grace & Sweeney, 2016). Indeed, the mean completed family size of urban residents in Guatemala City is 3.2. By contrast, the average completed family size is well over 6 children in rural areas in many parts of the country.

Ethnic Disparities in Fertility and Unequal Market Opportunities

So why do Guatemala's poor rural indigenous have some of the highest fertility rates in the western hemisphere? The current state of the empirical literature on ethnic differences in fertility in Guatemala is relatively narrow in scope, focusing primarily on the supply and demand of family planning services (Grace, 2009), particularly the disparities in access and uptake of modern family planning among the large indigenous populations (Santiso-Gálvez et al., 2015; Seiber & Bertrand, 2002; Ward, Bertrand, Puac, & Ward, 2013). Spanish language fluency predicts greater uptake of family planning and reproductive health services (Grace, 2009; Ishida, Stupp, Turcios-Ruiz, William, & Espinoza, 2012). Other research has suggested that strong ethnic and linguistic boundaries create barriers to the spread of modern fertility norms including attitudes towards contraception (De Broe & Hinde, 2006; Pebley & Stupp, 1987). These language barriers have been argued to shape contraception uptake in Guatemala (Ward et al., 2013). Economic arguments tout marginalization,

isolation, and poverty from preventing accessing and utilizing family planning and educational services (Ishida et al., 2012).

Economic theories of the fertility decline argue that access to novel market opportunities drives down fertility as parents begin to perceive increasing benefits for high investments in education for themselves and their offspring (G. Becker, Murphy, & Tamura, 1990; Handwerker, 1986; Kaplan, 1996; Kaplan, Hill, Lancaster, & Hurtado, 2000; Snopkowski & Kaplan, 2014). According to this view, the fertility decline reflects a demographic response to increasing access to market opportunities, with a demand for family planning emerging as a result of the social and economic benefits of lowering fertility. However, in heterogeneous populations, access to market opportunities is often unevenly distributed. In the Guatemalan case, economic discrimination and exclusion along ethnic and linguistic lines plays a strong role in maintaining the social and economic disparities between indigenous and ladino populations (Hale, 2002; Mitchell, 2014; Mulongoy, 2012; Patrinos, Skoufias, & Lunde, 2007). In such cases, populations with fewer access to market opportunities have less economic incentives to lower fertility and may have slower fertility declines than groups with better access to market opportunities.

Consistent with this explanation, historical demographic analyses found the ethnic differences in fertility emerged during a period of increasing engagement in the market economy. Early argued that in response to increasing land scarcity among the large, mixed-ethnicity peasant population, Ladinos had the social and cultural capital to transition to wage-labor employment (Early, 1982). This resulted in the divergence of fertility patterns, particularly among the rural populations in the late 1980s and early 1990s. The resulting fertility patterns showed a steeper decline among Ladino populations, with relatively little

change in fertility rates among indigenous populations. However, by the end of the civil war in the mid 1990s, access to market opportunities increased for Mayan households. Demographic analysis by Grace and Sweeney found a sharp decline in fertility among the indigenous population during the years after the end of the civil war. They argued that the social and cultural changes associated with the peace accords opened both educational and market opportunities to Mayan households (Grace & Sweeney, 2016). The increased rate of decline among Mayan households was attributed to a reduction in barriers in market opportunities as the government expanded funding and commitment to educational and health services including efforts to recognize the indigenous populations (ibid). Neoliberal economic reforms opened avenues for pursuing market opportunities

Despite these changes in the late 90s and early 2000s, the socioeconomic benefits of low fertility high investment strategies are still less for Mayan households compared to Ladinos. In addition to historically having fewer opportunities to access market opportunities, when Mayan families did invest in education in order to improve access, they saw less economic benefit compared to their ladino counterparts. Analysis of wage differentials of the late 1980s through early 2000s show that on average, Mayan households were getting less for the same level of education as their Ladino counterparts (Patrinos, 2000; Psacharopoulos, 2005; Shapiro, 2006). Interpretations reflect discrimination and exclusion on the job market.

This exclusion from employment opportunities in the wage-labor economy are reflected in the sources of income for Mayan households. Isolation and fragmentation have restricted the types of market opportunities available to indigenous people to diversify their income. Recent economic analyses found most of indigenous peoples' income in both rural and urban areas was generated by self-employment, while Ladinos had higher proportions of

income coming from salaries or formal jobs(Patrinos & Skoufias, 2007). Additionally, income from non-labor sources showed Ladinos had higher proportion of income from capital sources, such as interest, investments, rents, retirement pension, and private and public transfers. This higher proportion of income from non-labor sources was observed in both rural and urban contexts. Even when self-employed, Mayans tend to make less than their Ladino counterparts do. In his ethnographic research on the Chor'ti Maya, Metz describes how Mayan households supplement subsistence agriculture by selling crafts and agricultural products (Metz, 2001). However, the profits tended to average less than $2 per week, as they were subjected to exploitation by Ladino intermediaries who were able to earn 2 to 5 times the original price.

Given these contexts, economic theories of fertility predict that Mayan households see fewer benefits from limiting fertility and investing in education compared to Ladinos. Empirical patterns of both reproduction and parental investment in education are consistent with these theories. First, Mayans still have higher overall fertility and earlier transition to parenthood than Ladinos.

Second, national patterns show large ethnic disparities in school enrollment, with Mayan children spending less overall time in formal education. Importantly, schooling creates economic trade-offs in the household, as child labor can make significant contributions to the household through paid wage-labor or unpaid domestic or childcare work . National patterns of child labor show that indigenous children are more likely to contribute economically to the household than Ladinos. Furthermore, indigenous children are more likely to quit school to contribute labor to the household. Finally, differences ethnicity related achievement gaps reflect opportunity structures in communities. Recent analysis

regarding ethnicity-related achievement gaps found community characteristics had larger and more prominent effects than school or classroom characteristics (Marshall, 2009). These authors argue that these community effects may reflect the local opportunity structures that motivate investment and persistence in education.

> "Indigenous students and their families may be less sanguine about the future payoffs to schooling, perhaps because cultural and /or physical isolation reduces access to urban labor markets. (Marshall, 2009)"

In summary, employment and school enrollment patterns suggest that Mayan households have less opportunities to turn education into income, compared to Ladino households. As such, the relatively higher fertility of the Mayan population reflects the lower economic incentives to reduce fertility and increase parental investments in education. One explanation for the differences in the returns to education and the investment in education by Mayan households is that they lack the types of social and cultural resources necessary for success in market economies. Indeed, Early argued that language barriers restricted Mayan populations ability to respond to increasing land-pressure the same way Ladinos did.

In addition to cultural resources like language fluency, social networks are important resources for accessing market opportunities. A large body of literature in sociology has documented the economic relevance of social networks in market economies, particularly for accessing the types of high-income jobs that require high levels of formal education (Burt, 2001; Glaeser, Laibson, & Sacerdote, 2002; Granovetter, 1973; Van Der Gaag & Snijders, 2005). In competitive market economies, social relationships can be leveraged to access high

income, skills-based employment opportunities. Households with these social resources face greater economic incentive to pursue education. Indeed the ability to turn education into high-income employment often requires knowing the right people. Furthermore, these economic effects of social capital are likely stronger among populations where inequality and structural barriers limit opportunities for capitalizing on the long-term investments in education and other forms of embodied capital (Patrinos 1997).

Social connections do have an impact on access to employment in Guatemala. A recent analysis from the World found that the use of references from social contacts was the most common strategy for acquiring employment in Guatemala with about 37% of surveyed workers having found their occupation through word-of-mouth (Fazio, 2007).

These insights from sociology provide a novel extension to economic theories of fertility decline, and a relatively unexplored mechanism underlying ethnic differences in fertility in Guatemala. If Mayan households lack the appropriate social connections, relative to Ladino households, this may account for the lower income returns to investments in education, resulting in less incentives for reduced fertility and increased investments in education.

The Current Study

The current study offers a first step toward assessing the hypothesis that social relationships can shape parental investment decisions, resulting in downstream effects on fertility. Using ethnographic data from a town center of a municipality in the central highlands, I present cases that illustrate how social access to market opportunities shape parental investment decisions. I first outline how reproductive norms reflect the concern for

accessing market opportunities primarily by emphasizing the role of education in shaping reproductive decisions. Using case studies, I then outline how social connections are a key channel by which households convert education into income, and how social connections can motivate investments in education. These case studies highlight how the interaction of both education and social connections are required to gain access to good jobs. In some cases, those with proper education but lack the social connections cannot get access to the jobs they are qualified for. Finally, having the right kinds of social connections can shape parents' decisions about investing in education for their children. Finally, I review national data and previous research that suggests Mayan households have fewer social resources needed for successfully converting education into success in the wage-labor economy.

The data comes from household surveys and ethnographic interviews conducted by the author and students in the Community Health and Medical Anthropology Field school associated with Arizona State University. The field school offers global health and other undergraduates hands-on experience in the research process. Each field season, 8-15 undergraduate students conduct household surveys with 100-200 households in the town center and surrounding neighborhoods (Table 1.). The primary case studies are taken from ethnographic field notes and semi-structured interviews conducted over the summer field seasons (June-Aug) from 2012 up through 2017.

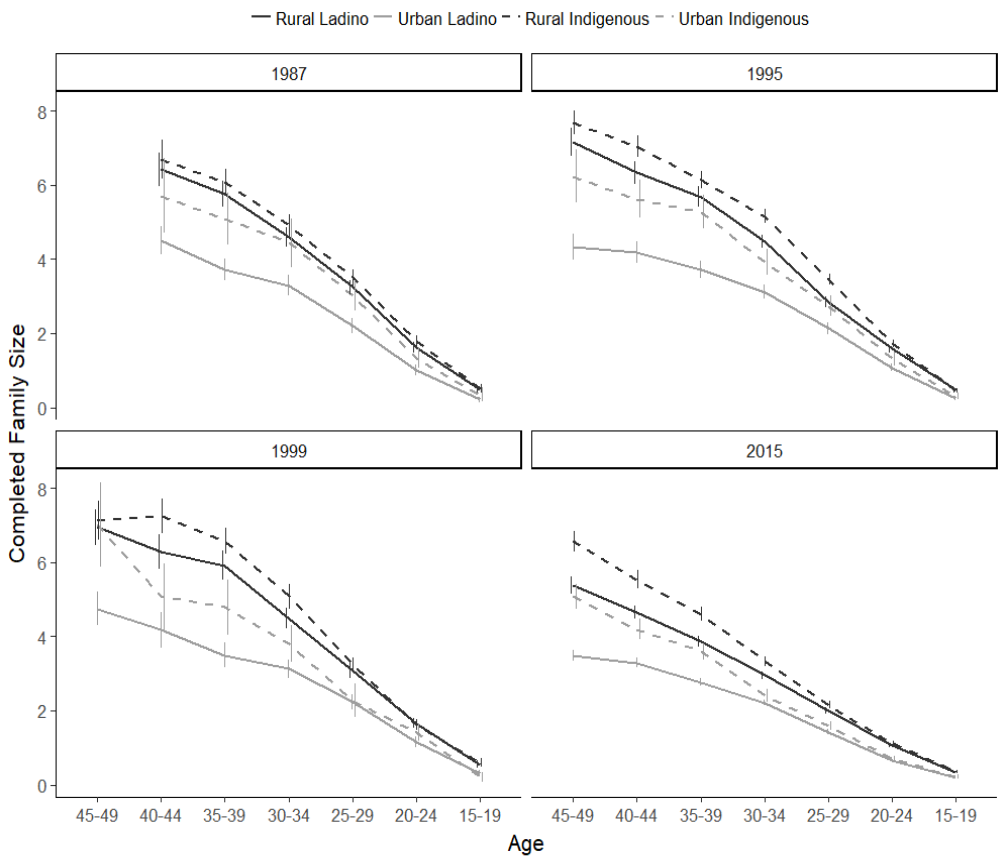

Figure 1. Age-Specific Fertility by Ethnicity and Residence. The age-specific fertility estimates by ethnicity and residence from the Demographic and Health Monitoring Surveys (DHS). Rural fertility (black lines) showed little differences in 1987. However, by the mid-1990s Ladinos (solid lines) were having fewer children, primarily at later ages. By 2015 the gap was clearly observable at nearly all ages. In urban contexts (gray lines) Ladinos have consistently shown lower fertility at nearly all ages. However, in the most recent estimates, ethnic differences in fertility have decreased for women 35 and younger.

Additional data were collected over the 5 years in small supplemental projects. In 2014 I conducted semi-structured interviews of 20 adults using convenience sampling in town, with questions focusing on perceived problems of different reproductive patterns. In 2015

we conducted 25 in-person follow-up interviews which focused on ideas around what made a good or bad parent and the appropriate timing of transitioning to parenthood. Finally, in 2016 I used convenience sampling to conduct 20 interviews on perceived employment opportunities in the town. The semi-structured questionnaire focused on the types of employment opportunities that were available for residence who completed different levels of education.

	2012		2015		2017	
	Maya n	Ladino	Maya n	Ladino	Maya n	Ladino
N	92	106	44	60	56	70
Median Income	450Q	560Q	-	-	600Q	790Q
Age	36 (12)	42 (15)	39 (12)	40 (14)	35 (11)	41 (15)
Household Size	5.4	4.9	5.4	4.7	-	-

Table 1. Selected descriptives of the household-level surveys.

Field Site

The field site is a semirural municipality in the southern part of the department of Chimaltenango in the central highlands of Guatemala, with a population of around 23,000 with roughly 9,000 living in the town center. The peri-urban town center, located in the center of the municipality in the valley of the Cocoyá River, is surrounded by six aldeas or smaller rural communities, and over 40 different fincas or coffee plantations (Matas Oria Francisco, Archila Serrano, Benítez, & Vega Solórzano, 2006). The municipality is roughly 80 km from Guatemala City, and 35 km from the department capital of Chimaltenango.

The surrounding aldeas and fincas are predominantly indigenous, in the town center, the population is closely split between indigenous Kaqchikel Mayan and non-indigenous

Ladino populations. The Kaqchikel represent one of the more dominant Mayan language groups, with a large, economically diverse population located in the central highlands. It is the second largest Mayan language group with roughly 500,000 speakers (Metz and Webb). This mixed community in the town center is different from the more predominantly Kaqchikel communities in the department of Chimaltenango in the central highlands. While a number of households still speak Kaqchikel, nearly all households speak Spanish as their primary language. As is the case for most other indigenous populations in Guatemala, ethnic identity is prominently displayed for women through their clothing, while men have given up traditional clothing decades ago.

Coffee production is the primary economic base and source of income for the area. This results in seasonal ebb and flow of employment. The plantation context has resulted in wealthy landowners and a handful of households working as managers. Data from the most recent census (2002) in Guatemala show that an estimated 70% of agricultural workers are day laborers while only 30% are producers or owners of their own plots. Outside of these opportunities, there are limited manufacturing and service industry jobs in the town center. Municipal government, local schools and health clinics, and a handful of NGO's offer few of the only sources of formal employment in the town. The local economy in the town center is dominated by informal jobs, particularly household-level business such as running tiendas, restaurants, shops and internet cafes out of the house. Additionally, all members of the household have opportunities to work in the fields during coffee harvests, and as day-laborers for agricultural operations in other central highland communities. Women also find work in childcare and domestic chores for some of the few wealthy households in town,

with house cleaning and laundry seen as primary employment opportunities for many women.

There are accessible educational opportunities in the town center, with three primary schools. One primary school is the free national school, which enrolls approximately 600 students. The other two primary schools are private religious school with approximately 100-125 students each. Both private schools require roughly a 4.50 monthly enrollment fee with required uniforms. Additionally, there are middle schools and vocational schools in town, although opportunities for education beyond high school require one to two hour trips outside of the community. Coffee harvest during the months of November through February results in high rates of school absence as the majority of the population between 8 and 17 are engaged in agricultural work to contribute to the household (Matas Oria Francisco et al., 2006).

There is a range of employment opportunities outside of the town, but most can be classified into low- and high-income work. Low-income work is manual labor in the fields in other central highland towns that produce non-traditional exports. Many individuals work as day laborers in the fields surrounding Patzicia, a larger neighboring urban center. This work typically yields 40-70Q (~$3-10 US) for a day's labor and typically involves harvesting non-traditional exports, such as carrots, cabbage, and broccoli. For men, albeñils are day laborers who perform menial labor such as construction both in town and in other highland communities. High-income employment is found outside of the town, primarily in Chimaltenango, the department capital. These are typically both blue and white-collar occupations. Opportunities for these services in the town center are limited. Few individuals commute daily to the capital, Guatemala City, for school and work. And while

local diversificado training programs are offered in town for nurses, mechanics, accountants, and computer science technicians, these programs are preparing students for jobs that almost certainly require seeking employment outside of town.

Data from all years of the household survey show a wide range of material wealth reflected in the diversity of occupations, estimates of 2-week income, and asset ownership (Table 1). Median household 2-week income were typically between 500-700 Quetzals ($65 to $91 dollars per two-week) which equates to roughly $130-$182 US dollars per month. Similar to national patterns, Mayan households in Acatenango have lower socioeconomic standing. In the 2012 data, only 39% of surveyed Mayan households fell above the community median income, whereas 57% of Ladino households did. Furthermore, surveyed Mayan households had significantly lower two-week incomes during the time of the interviews (Mayan Mean=436Q, N=92, SD=453, Ladino Mean 874, N=106, SD=1352). Using the same 2012 dataset, we estimated household wealth quintiles from household construction and assets. Collapsing the wealth index into quintiles showed Mayan households are more likely represented in the lower economic quintiles. Finally, greater levels of food insecurity are observed among Mayan households. These ethnic differences in two-week income were also observed in the later 2017 survey data. The 2017 data showed large ethnic differences in reported bi-weekly income with Ladino households reporting 1440Q (~185$ US) every two weeks, compared to 885Q (114$ US) for Mayan households.

Similar to national patterns, adults and adolescents in the community endorsed low-fertility norms. The 2015 household survey asked female heads of the household about reproductive preferences and ideals for both boys and girls. The ideal age at marriage for boys was on average 24 years old with slightly younger ideals for girls (23.6 years old). The

ideal age to start a family was 25 for boys and 24.3 for girls. The short time between marriage and starting a family suggest that residents in town see marriage and starting a family as more of a single transition that two milestones in life. The pilot study in 2013 found similar results with a convenience sample of 24 adults in town. In this study, the ideal age at marriage was 24.3 for young people today, and the ideal age for starting a family was 24.8 years. This ideal age at marriage and first birth is well above reported actual ages for Guatemala as a whole (21.3 urban and 20.0 rural), and the department of Chimaltenango (21.2). (Ministerio de Salud Pública y Asistencia Social et al., 2017). In the 2015 household survey, the mean ideal number of children a young couple should desire to have is 2.5 kids. The 2013 sample found a mean ideal of 2.6. These ideal numbers of children are consistent with responses in nationally representative surveys, particularly in urban settings where (2.8 for women 15-49, ENSMI 2015). Ideal number of children in the community was lower than the overall department average of an ideal of 3.4 children.

The ideal family size and timing of the transition to parenthood in the community fit with low fertility high-investment reproductive strategies. Adolescent and young people desire small families, want to start the transition to marriage and parenthood later than their parents, and hope that their own offspring will be able to focus on schooling and development without having to make economic contributions to the household (CITE Maupin paper). Discussion about the timing and number of children during these interviews centered around the ability of parents to use education to find work to support their children, and for parents to ensure their children are able to pursue education. In this context, education is seen as the primary means by which individuals access better employment opportunities.

Qualitative Data

Social relationships as channels for accessing market opportunities

The importance placed on education, and its links with ideals around timing and number of children highlight how households' concerns for accessing market opportunities influences reproductive norms. Here, education is seen as the central determinant of opening employment opportunities. However, in this community other pathways are important for accessing market opportunities. Social relationships are a key channel through which individuals access employment opportunities. Informal discussions with participants revealed that most participants who did not work for themselves gained access to their jobs through some form of social connections.

During the 2016 interviews about employment opportunities in town, respondents often mentioned that people with little education would only have opportunities for work that required a patron. For women with little education, options were limited to childcare, domestic work like laundry or house cleaning, or self-employment through selling food or handicrafts. For men with little education, job opportunities were solely found int the agricultural sector, either in the coffee fincas or as day-laborers on farms in nearby highland communities. Most if not all of these opportunities require social relationships to wealthy land and homeowners, or to middlemen who find workers. Alternatively, family relationships are often relied upon for finding work, particularly when family members start or own a business. The story of a local shop-owner highlights the role of social connections in finding work. Their family story was shared with research assistants and the field school director who was fluent in Kaqchikel.

[CASE STUDY – *One Mayan family owns three of the most successful tiendas in town. The family had moved to town years ago and purchased a home with a storefront which had been converted into a tienda. The home front convenience stores are common in Latin America, and are a key form of informal self-employment in Guatemala. While the work is not as physically demanding as agricultural work, tienda owners in towns and aldeas work long hours in their stores and need to make frequent trips to the department capital or Guatemala City to buy wholesale. Running stores out of the house is one of the few business opportunities households have in town to start a business. These stores are ubiquitous in Guatemalan communities, such that every neighborhood has multiple tiendas.*

The man's first tienda was purchased near the town entrance. This favorable location attracted enough business that the family was able to save enough money to purchase two more stores in other neighborhoods in town. In order to find workers in their new stores, the family hired cousins and in-laws who lived in other highland communities. These extended family members moved from their home communities, brought their families, and found housing in town. The move represented a significant uprooting for the incoming workers. These family members were Kaqchikel speakers and came from a predominantly Kaqchikel aldea outside of an urban center in the neighboring department. The women's traditional traje or clothing clearly marked them as outsiders to the community. While these family members had their own small plot of land in their home community, to make ends meat they needed to work in other people's fields as day-laborers. The work in the tiendas represents a modest increase in the wages earned by these extended family members.

This entrepreneurial family ended up providing employment for many of their extended family members. This dynamic of relying on extended kin ties to find work, or offering employment opportunities to extended kin is typical of Guatemalans. Furthermore, having connections in town

who could give work was the primary motivation for these extended family members to relocate their families to the community.]

The dynamic of relying on social connections to find work is well documented in Guatemala (Patrinos et al., 2007). In this context, the job opportunity provided by family members was enough to motivate rural to urban migration for a number of extended and in-law family members. Importantly, relying on social connections to find work is not just a strategy for those working in the informal sector. Individuals can also access high-paying professional work through social connections. For example, analyses of national employment data showed that 64% of salaried workers in the private sector obtained their positions through the use of social contacts (Fazio, 2007). For some, investments in education may not turn out when individuals are lacking the connections necessary to find high-income employment. During a pilot project with interviews focused on employment opportunities in town a participant shared the story of how her college educated husband was unable to find suitable work.

[CASE STUDY – *One interview with a Mayan woman highlights the importance of social connections for finding high-income work for those who complete post-secondary education. She lived in a poor neighborhood in town. During the interview, she mentioned her husband had completed his equivalent to a bachelor's degree in computer science in the department capital. This level of education was unusual for residents in town, and even more rare for residents in her neighborhood. She described how he looked for work as an IT professional for months both in the department capital and in Guatemala City. However, after months of not being able to find work as an IT professional, he was able to find a job in the city working for an industrial chicken processing plant. His father-in-law worked at the plant and was able to find him a position. It was an entry-level*

position but it still paid more than alternatives in town. She explained how difficult a decision it was for her husband to take the position, but even as an entry -level position it still paid more than the alternatives available in town. He had committed to continue to look for work as an IT professional, but he had been at the chicken processing for five years at the time of the interview.]

This is a clear example of how, in many cases, education is not sufficient for accessing good jobs. While the husband had completed his post-secondary education, without social connections he was unable to find work through formal means using his skillset. However, he was able to secure a well-paying job in the city through social connections. By contrast, when education is paired with good social connections, individuals can have much better outcomes. During the same pilot project, I interviewed the local minister who shared his story of how he and his wife came to Acatenango.

[CASE STUDY - *The minister of the evangelical church, whose salary is an order of magnitude greater than the town median not only found out about the job opening through his father's social connections, but was hired because of it. The minister was a ladino man in his mid-40s who lived in the town center close to the town entrance in a relatively wealthier neighborhood. While interviewing him regarding his opinions on employment opportunities in town he recalled how he first came to the community. His father had been a long-time pastor in another highland community. Much of social life in the Guatemalan highlands revolves around the church, and his fathers' position as a church leader offered privileged access to a broad network of social connections. His father had learned that the church in the community was going to be in need of a minister. His father had known some of the members of the church and was able to put in a good word with the church leadership. His father was able to secure a position for him as the new minister precisely*

because he had early access to information about the job opening, and because he had connections to the church]

Positions of power within the church are one highly valuable relationship, not only for developing broad networks but for leveraging connections into opportunities for individuals and their children. Another highly valuable relationship is having a connection to the local municipal elected officials. In the community, employment at the school or health center, often requires having favorable connections in the local municipality government. As an example, those who are qualified for a position but lack the appropriate connections may not get the job. The school director shared this story one afternoon while the field school was conducting a project with students in the public primary school.

[CASE STUDY – *A women who had worked for the local public elementary school decided to get more education in order to apply for a job as a teacher. Because her mother was the school director, and her father was a teacher that had been employed the longest in the school, she was certain she would be able to get a job there. She had worked for the school previously doing receptionist and office administrative work. She had enrolled in a training program in order to become qualified to be a teacher. When she finished her training and was eligible to apply for a teaching position, both parents told her the school had a position open. However, when she applied for the position at the local municipality office, she was turned down and was told that there were no available positions at the school at the time. She was certain there was a position available since her mother was the director. Both her and her mother claim that she didn't get the job because they were not friends of the head of the municipal government. During the most recent local election, both her and her mother had voted for the opponent of the current mayor.*]

These two case studies highlight the importance of the right kinds of social connections in obtaining valuable employment opportunities, and that education in the absence of such social connections may bear little fruit. The former case highlights the importance of connections that facilitate the exposure to novel sources of information. Sociologists call these ties bridging relationships and have focused on how information flows across these relationships can be leveraged into new opportunities in market economies (Burt, 2001; N. Lin & Erickson, 2008; Michael Woolcock & Narayan, 2000). The latter case highlights the importance of what sociologists call "linking connections" or those bridging connections that connect to positions above individuals in social hierarchies (Szreter & Woolcock, 2004). In summary, education is necessary but not sufficient for accessing high-income jobs in the central highlands, or elsewhere. However, having the right mix of education and social connections can improve ability to turn education into income. Positions that bridge groups or those in positions of power within the church or local governments are key relationships here.

Having the right connections can influence parental investment decisions

The existence of such relationships can also influence parents' decisions to invest in higher-education for their children. Households that have these forms of social connections may see more certain outcomes for their long-term investments in education. As these social relationships can be leveraged into better, higher paying jobs, those households that have them may also see higher potential benefits to costly investments in education, particularly those in above primary schooling. During my first field season in town, a family I was staying with shared their story about choosing to send their teenage son to college in the

next town over, describing how social connections played a role in their willingness to pay for expensive schooling.

> [CASE STUDY – *Attending community college: One Ladino family who lived in a nice home in a nice neighborhood close to the entrance of the town had a son who was attending a local community college in the next town over. The family was small, just a mother and her two sons, but there home was part of a larger compound that connected with households of extended family members. The household had a small plot of land that stretched out behind the house as well as plots in the hills. In addition to producing their own small amounts of coffee on the land, the family had connections to coffee fincas in the hills surrounding the town as well as connections to farms growing produce in other central highland communities. Both sons were enrolled in school. The eldest was attending the Universidad Rural de Guatemala, pursuing the equivalent to an associate's degree in agricultural engineering. He was planning on taking a management position in one of the farms or fincas that his family had connections to. These management positions in farms and fincas offer greater job security as they are year-round work, whereas most work on the farms and fincas revolve around seasonal harvests. Tuition at the university was expensive. These connections frequently made their way into discussions regarding the households' decisions to send their child to community college. The son was explicit when talking about pursuing higher-education was motivated by the connections that he could leverage to find a management position in nearby farms. He wasn't interested in moving to the city to find good paying work, rather he liked the rural environment.]*

In this case the family chose to pursue post-secondary primarily because the family had connections that could be leveraged into a job opportunity for their son. Specialization in secondary and post-secondary education often requires families to have clear connections to the field

Ethnicity and social connections

Ethnographic case studies from the field site highlights the importance of social connections in turning education into income in Guatemala, and how social connections may influence parental investment decisions in ways that are consistent with low-fertility strategies. Here I review evidence from recent analyses that show there are clear ethnic differences in the role of social connections in accessing employment opportunities (Fazio, 2007; Lunde, Skoufias, & Patrinos, 2007). These analyses show Mayan households have fewer social resources necessary for success in competitive wage-labor economies compared to their Ladino counterparts.

Using data collected from La Encuesta Nacional de Empleo e Ingresos -ENEI- (National Survey of Employment and Income), Fazio analyzed job-seeking behaviors, and the reliance on social contacts to find employment across ethnic lines and across contexts in Guatemala (Fazio, 2007). The results showed Mayans are more likely to rely on social connections to find work in rural areas, in low-education contexts, and in the informal or agricultural sectors relative to Ladinos. On the other hand, Ladinos are more likely to use social contacts to obtain employment in urban settings, in high education categories, and in the formal sector (firms with more than 6 employees and contribute to social security system).

Moreover, the ENEI dataset distinguished between receiving help from family members and receiving help from politicians or friends. These two categories can be considered proxies for social relationships that have different strengths. Indigenous workers tended to use help from relative more than Ladinos, while Ladinos were more likely to draw

on friends or politicians in obtaining employment (Fazio, 2007). These differences suggest that the contacts available to Mayan households do not provide access to high income jobs in urban settings that require high levels of education. In these settings Mayans have to rely more on formal methods of obtaining jobs.

In summary, analyses of job seeking behaviors at the national level reveal ethnic differences in the role and value of social connections across rural and urban contexts and across varying levels of education. Consistent with the framework being explored here, the evidence suggests that Mayan households have fewer stocks of social resources that promote social mobility in competitive wage-labor economies relative to their Ladino counterparts. Furthermore, their reliance on social contacts to find employment in the informal sector with low paid, unskilled jobs, may lead to the fewer and fewer opportunities for social mobility as these reinforce homogenous social relationships among unskilled workers (Fazio, 2007).

Discussion

The ethnographic data and case studies presented here highlight the importance of social connections in household's abilities to turn education into income. Furthermore, they highlight the importance of specific types of social connections, and the difficulties of investing in education without social opportunities for finding work. These social connections can influence parent's decisions to invest in higher levels of education, as employment and income outcomes are more certain among those with the right types of connections. Finally, national-level analysis reveals clear ethnic differences in the role of social networks in finding work. Relative to Ladinos, Mayan households, who have fewer

social resources to access market opportunities have lower economic incentives to reduce fertility and increase investments in education.

These data support prominent theories of fertility decline which emphasize the reproductive costs associated with market opportunities as a primary driver of fertility declines (G. Becker et al., 1990; Kaplan & Lancaster, 2000; Robinson, 1997). According to these theories, the high costs of education necessary for success in market economies drives down fertility. However, in Guatemala, education is not the sole determinant of success in the job market. The perspective outlined here suggests that differences in social connections may account for ethnic differences in parental investment in education and fertility between Mayan and Ladino populations.

Anthropologists and demographers have explored the importance of social relationships in shaping the fertility decline (Bereczkei, 1998; Mathews & Sear, 2013; Newson, Postmes, Lea, & Webley, 2005; Sear & Dickins, 2010). However, these studies tend to focus on the direct benefits to the costs of rearing children, rather than the long-term economic benefits of certain types of social relationships. The current study offers an outline for examining how social relationships shifts the long-term economic considerations households make regarding reproduction.

Future work should focus on how social relationships influence household's economic calculations surrounding reproductive decisions, with an emphasis on future returns of education rather than on current costs of children. Additionally, data regarding the structure and content of household and individual-level social networks will be necessary in order to

test the importance of different types of social connections on parental investment and reproductive behaviors.

This work presents an unexplored explanation for ethnic disparities in fertility in Guatemala, as well as provides a novel extension to economic theories of fertility that argue low fertility is a result of parental investment decisions in wage-labor economies. By outlining pathways by which households access employment opportunities created by market economies, this work helps refine economic theories of fertility declines. Additionally, this works aids in clarifying the factors that shape parents' reproductive decision-making, particularly in contexts characterized by both declining fertility and rising inequality. In doing so, this study points to new directions in understanding the reproductive trade-offs faced by parents and how differences in these trade-offs can structure population differences in fertility and educational outcomes.

CHAPTER 3

EDUCATION AND ACCESSING OPPORTUNITIES: HOUSEHOLD SOCIAL CAPITAL EFFECTS ON SCHOOL ENROLLMENT IN GUATEMALA

Abstract

Theories of parental investment predict that parents will invest in their children's education when it is likely to contribute to future economic success. Accordingly, parental decisions should depend on the future opportunities they expect their children will have to leverage education into better-paying jobs. Here, we examine how one proxy of future opportunities—a household's social connections to outside individuals and entities—is associated with parental investment in their children's schooling—as proxied by school enrollment. We use nationally representative data from 11,680 school-aged children (7-18) from Guatemala to assess the effects of household social connections—through membership in voluntary associations and engagement in collective activities—on school enrollment. Findings indicate that household stocks of social capital are positively associated with school enrollment. However, these effects are strongest for those children with the fewest opportunities - indigenous girls. Notably, all else equal, any disparities in enrollment between indigenous and Ladino children disappear when indigenous households have social connections fostered through group-membership and participation in collective activities. These results highlight a relatively unexplored pathway by which social connections shape parental investment decisions, particularly in the contexts characterized by inequality in employment opportunities.

Introduction

Among animals, humans have a uniquely long period of juvenile dependence coupled with extensive care from parents and allo-parents. This extended period provides unique opportunities for learning the skills and knowledge necessary to adapt to novel social and ecological contexts (Flinn & Ward, 2005; K. Hill & Kaplan, 1999; Kaplan et al., 2000). However, it also presents parents with novel trade-offs as they must make tough choices about how to invest in their children's learning and development. Optimal parental investments in offspring are ecologically contingent (Quinlan, 2007), and are hypothesized to rely on evolved psychological mechanisms to navigate these trade-offs (Del Giudice, Kaplan, & Gangestad, 2004; Snopkowski & Kaplan, 2014). While such choices have always existed, modern educational systems and market economies have created a new set of trade-offs that parents must negotiate as they decide whether to bear the direct and indirect costs of sending a child to school. These trade-offs involve balancing the short and long-term costs and benefits of formal education.

Broadly, the benefits to increased formal schooling are well-known. Competitive wage-labor economies can increase the importance of skills acquired through formal education and training (G. S. Becker & Tomes, 1994; Chi & Qian, 2016; Kaplan, 1996). Education is positively associated with income, and is a primary means for social and economic mobility in market economies (Colclough, Kingdon, & Patrinos, 2010; Vila, 2000). In addition to gains in the job market, formal education is important for a number of other things including health (Cutler & Lleras-Muney, 2006) and reproduction (Bongaarts, 2003; Martin, 1995; Snopkowski, Towner, Shenk, & Colleran, 2016), child growth and development (McCrary & Royer, 2011).

While education can confer benefits, investments in schooling carry direct and indirect costs that can present heavy economic burdens for parents and households (Admassie, 2003; Ananga, 2011). Parents typically pay for school fees, supplies, uniforms, transportations, and suffer indirect costs such as limiting the ability of offspring to contribute to the household production. Children can make economic and labor contributions to the household through paid employment, unpaid agricultural and domestic labor (Bock, 2002). Offspring can be an important source of allocare, helping parents cover the costs of increasing fertility (Kramer, 2005; Kramer & Ellison, 2010). Furthermore, these immediate opportunity costs may vary according to the types of livelihood opportunities available (Hedges, Borgerhoff Mulder, James, & Lawson, 2016).

Another consideration when choosing to invest in schooling is that the long-term returns to schooling can be uncertain and variable, depending on access and distribution of opportunities to use education for social and economic mobility. A key assumption in evolutionary and economic theories of human capital is that in competitive skill-intensive market economies, education is the primary determinant of success. However, a number of factors unrelated to education, such as local demand for educated workforce, social and economic discrimination, and social opportunities to find jobs, can shape the distribution of employment and market opportunities in ways that determine the costs and benefits of educational investments (Neill, 2010; Patrinos, 2000; Verhaeghe, Van der Bracht, & Van de Putte, 2015).

For example, the importance of skills attained through formal education are more directly tied to wage-income in urban environments where the demand for skilled-labor is higher than in rural environments. Subsistence strategies in urban environments are based on

income and wages, which often rely on skills learned through formal education. This results in overall higher opportunity costs for non-educational activities, and lower net-gains for childhood labor contributions in urban settings. Case studies in Fiji show that parents who invest in their children's education are more motivated to migrate to urban locations as a means of increasing access to employment opportunities (Neill, 2010). Furthermore, self-reported data among the same population found higher non-school workloads for rural children, suggesting that urban children face steeper opportunity costs for labor contributions to the household (Mattison & Neill, 2013; Neill, 2011).

Ethnic and racial discrimination in both formal state institutions and labor markets can also lower the long-term payouts to education in marginalized groups. Indeed, early work in economics on race and gender discrimination in labor markets defined discrimination as the differential returns to investments in human capital (G. S. Becker, 1957). These early models described how discrimination among employees, employers, or consumers could push marginalized groups into a more limited number of jobs with lower pay and fewer opportunities to negotiate for higher wages (Carnoy, 1996). As a result, families from disadvantaged backgrounds may expect less overall returns to investments in education, and therefore be less willing to invest in the education of their offspring (Hill and Kaplan 1999).

Discrimination in the job market can reflect broader disenfranchisement from formal state institutions accompanying market economies. Groups who face structural barriers to access of formal state institutions and market opportunities often rely on informal social relationships for . These relationships can shape parental investment decisions in several ways, including the ways in which parents mobilize resources for parental investments. For

example, Shenk found class-based differences in how parents financed offspring weddings in south India. Professional-class parents preferred the use of formal institutions, such as bank loans and savings, while working-class parents relied more on credit from family and friends (Shenk, 2005). Informal social relationships can provide reliable sources of social insurance and support when groups face structural barriers or discrimination in accessing formal institutions like public services, markets, and social safety nets.

Social Relationships Shaping Long-Term Returns to Education

Residential ecology and ethnic discrimination are only two of the better known factors that shapes access to skill-dependent employment opportunities. Social relationships can also alter the long-term payouts to parental investment in education in other ways. One explanation for the wage-gap of different population sub-groups is variation in the distribution of certain types of social relationships that offer access to economic opportunities. Differences in parental networks may explain differences in lifetime earnings of college graduates who were raised in different economic classes in the US (Hershbein, 2016a, 2016b). Broader, more heterogeneous social networks can also provide an economic advantage in market economies (Burt, 2001; Granovetter, 1973).

Indeed sociologists have long linked the formation of human capital and social capital as reciprocal, with social capital necessary for the cultivation of human capital (Coleman, 1988; Glaeser et al., 2002; S. Lin & Huang, 2005), and conversely, human capital improving employment outcomes precisely through producing greater social capital (Friedman & Krackhardt, 1997). These authors suggest that it is the process of producing social capital from human capital that creates group-level differences in returns to education.

Social and cultural differences can limit income gains from education on the job market as those who are more socially and culturally different from the dominant group are less able to parlay education into greater social capital.

Households rich in the right types of social resources may then perceive higher, more certain returns to investments in education. Furthermore, as marginalized groups rely more on tight-knit social relationships for insurance and economic buffering, they may lose opportunities to cultivate more diverse relationships in a broader social network (Portes, 1998).

The idea that social relationships promote and constrain access to resources and opportunities is not new to evolutionary anthropology. Status and relational wealth have been key concepts in recent anthropological studies of fitness, with several studies focusing on how certain types of relationships can alter the costs of heavy parental investments (Bereczkei, 1998; Mathews & Sear, 2013; Sear & Coall, 2011). However, these studies emphasize how kin-ties affect the number and timing of having children, rather than the amounts of investments parents put into each child. Furthermore, these studies focus on the role of kin in providing direct childcare in offspring, which lower the costs of childrearing for parents.

Evolutionary frameworks prioritize kinship because of the strong evidence supporting predictions derived from inclusive fitness theory; however, relational wealth is conceptually broader than simply kin-based ties. Relational wealth is defined as the social ties derived from social position, trust, reputation, kinship and symbolic systems which individuals can draw upon (Bliege Bird & Smith, 2005; Borgerhoff Mulder & Beheim, 2011).

In small scale societies this is often operationalized in terms of network membership or position or status within social group hierarchies (Shenk et al., 2016; von Rueden, 2014). However, the importance of certain types of relationships change over the course of market-integration and economic development. Relational wealth, conceived as something more similar to status in small-scale studies, is often operationalized as socioeconomic status in analysis of parental reproductive behaviors. However, this coarse grain measures of relational wealth overlaps conceptually with embodied capital, such as occupation or education status, or with material wealth (R. L. Hopcroft, 2006; Stulp & Barrett, 2016; Stulp, Sear, Schaffnit, et al., 2016a).

To better specify and measure relational wealth in transitioning and industrial societies, evolutionary demographers can draw on broader social science literature. Indeed, social capital theory has a long history of exploring how relational wealth is cultivated, maintained, and spent in industrial and developing contexts, particularly in ways that shape parental investment decisions (Bühler & Philipov, 2005). A large body of work over the last 30 years has documented how social capital embedded in communities and personal networks shapes education and economic outcomes for both individuals and households (Coleman, 1988; Narayan, Pritchett, & Adserà, 1999; M Woolcock & Narayan, 2000). Studies have consistently shown the importance of household, school, and community-level measures of social capital in educational outcomes(Dika & Singh, 2002; Dufur, Parcel, & McKune, 2013; Parcel & Dufur, 2001) as well as opportunities for realizing economic returns to early life investments in embodied capital (Friedman & Krackhardt, 1997; S. Lin & Huang, 2005). Households with more diverse ties may have more accurate information about employment opportunities, expected income returns for different levels of education,

or the better assessments of the economic value of women's contribution to the households beyond the domestic sphere (N. Lin, 1999, 2017). Parental social network size and composition had positive impacts on parental involvement in education at school and at home (Sheldon, 2002). Additionally, parental tocks of social capital can alter the trade-offs between continued investments in education and age of entry in the labor market (Verhaeghe et al., 2015). A number of studies have also focused on the context specific effects of social networks on household outcomes, assessing how urbanization and access to educational services interact with household level predictors such as household composition, household wealth, and parent's employment status to determine educational outcomes (Matthews, Pendakur, & Young, 2009) (Huisman & Smits, 2009).

We propose that households that that have access to social connections necessary for leveraging education into better employment opportunities, will invest more heavily in their children's education. This study tests the hypothesis that these types of social resources will have a positive effect on school enrollment. We expect that households with social network ties that provide opportunities or access to employment will be more willing to forgo the immediate economic contributions of child labor with the expectation that long-term payouts to education investments are more certain. In addition to the positive effects of social resources on school enrollment, thus we expect that the effects of social resources will be stronger for disadvantaged households. Social network ties that provide access to employment opportunities may carry greater importance for households who face discrimination on the job market where formal mechanisms create barriers to access.

The Current Study

To test these hypotheses, we use a nationally representative data from Guatemala. Guatemala is an ethnically diverse population with nearly 50% of the population being indigenous Maya, while the other 50% is Ladino, or Spanish-speaking people with mixed indigenous and Spanish descent. The high proportion of indigenous combined with extreme social, political and economic inequality has resulted in the characterization of Guatemala as "the most segregated country in Latin America"(Metz, 2001). This divide is a result of the colonial history of exploitation of indigenous populations, the elitist character of Latin America and the slow integration of marginalized populations into the market economy (Ferreira, 2008). For Mayans in Guatemala in particular, the result is pervasive structural barriers that limit integration, engagement, and social mobility in a skill-intensive labor market.

The experiences of discrimination Mayans face in the labor market are well documented in the anthropological and economics literature (Metz, 2001; Patrinos, 2000; Thorp, Caumartin, & Gray-Molina, 2006). Discrimination in the labor market means that Mayans are be less able to negotiate for higher wages than their ladino counterparts, resulting in lower overall levels of income for the same levels of education. The large wage-differentials found among a nationally representative sample of indigenous and non-indigenous workers found that ethnic discrimination could explain as much as one third of the wage differentials observed between Mayan and Ladino males (Vásquez, 2010). Furthermore, the wage-differentials were found to be the result of lower returns for education for Mayans than Ladinos. With lower long-term benefits of completing higher levels of schooling, many Mayan parents face greater incentives to reap the immediate economic gains of children's labor contributions. Indeed, Mayan adults of all ages are more

likely to have worked as children, compared to their ladino counterparts, and recent cohorts of Mayan children are more likely to combine work and schooling or exclusively work than Ladino children (Patrinos & Shafiq, 2008).

Because of this discrimination and barriers to employment, we expect that Mayan households with the social resources that facilitate access to employment opportunities be more willing to invest in costly education than those Mayan household without key social ties. While we expect these forms of social connections to increase schooling investments for both Indigenous and Ladino households, we expect that social resources will a stronger effect on education investments for indigenous households than for non-indigenous households. First, Mayan households may rely more on informal access to opportunities as formal mechanisms for accessing employment provide a disadvantage. Social ties can be used by the poor to overcome exclusionary rules or practices (Michael Woolcock, Woolcock, & Mill, 2001). Second, indigenous households are disproportionately poor and rural, and the effects of social capital on well-being outcomes are typically larger for poorest households. Analysis of multiple forms of social capital in Burkina Faso found that the effects of social capital on economic well-being were strongest among poorer households, and households without land (Grootaert, 2002). Research in Bolivia also found that as an asset, social capital had a greater effect on household welfare among poorer households (Grootaert & Narayan, 2004). Finally, households with more crosscutting ties that link to more diverse social groups are more likely to be exposed to norms that challenge traditional norms of Mayan households. One argument in the literature for low education achievement for Mayan girls is because of stricter traditional gender norms (Hallman, Peracca, Catino, & Ruiz, 2007; Wehr & Tum, 2013). Early marriage and pregnancy, as well as son preference and domestic

division of labor within the household can work to prevent girl's education (Hunt 2008). There is pressure to marry early and bear children, resulting in nearly 40% of Maya girls entering a consensual or formal union before 18, nearly double that of their ladino counterparts (Hallman et al., 2007). As a result, a young girl's contribution to household-well-being is often primarily in the domestic sphere, resulting in low education achievement, as poor Maya households are less likely to educate girls as they will leave the household, and not gain formal employment that requires education.

Measuring Social Connections

To assess the associations between measures of household access to opportunities and schooling outcomes, and the moderating effects of ethnicity, we use household stocks of social capital as a proxy for access to opportunities. We employed two common approaches to measuring social capital. The first uses membership in formal and informal institutions as a measure of social capital. Participation in voluntary organizations is a clear indicator of social capital, as it facilitated trust, mutual expectations and norms, and increases strength and density of network ties(Putnam, 1995). Group membership promotes strong affective ties connecting group members to each other, and is often centered on reinforcing exclusive identifies and promoting a homogenous in-group in ways that cultivate and preserve access to shared resources (Agnitsch, Flora, & Ryan, 2006; N. Lin, 1999; Putnam, 1995). These ties are important for risk-management and economic support, work to smooth household consumption, and serve as informal credit and insurance systems (Saracostti, 2007; M Woolcock & Narayan, 2000).

In addition to promoting group solidarity and cohesion, voluntary membership in civic organizations also provides context for the formation of more heterogeneous social ties. Social capital theorists have argued that a primary benefit of social capital is found in diversity of ties that connect dissimilar groups(Burt, 1997, 2001, 2004). The social relationships that tend to be outward-looking and heterogeneous, connecting people across social groups provide access to a wider variety of resources and information that can be leveraged by households (Agnitsch et al., 2006). Diversity in social ties is an important asset in market economies, with several writers pointing to the importance of ties outside of a primary network, including accessing private agencies and public services as an avenue for accessing resources and power (Narayan & Pritchett, 1999). Indeed, Granovetter argued that social and economic mobility involved the cultivation of ties beyond the immediate network to more expansive and loosely knit networks with greater access to information and resources (Granovetter, 1973, 1983).

The second approach measures informal connectedness through participation in collective activities. Unlike membership in organizations, community activities often do not require structured organizations or the potentially costly process of creating new organizations. Furthermore, they often do not entail a permanent commitment or investments of time or money. These activities may necessitate one-time efforts or coordination between small groups of people and can be less costly that participating in formal or informal organizations. However, participation in collective action outside of formal group membership also provides opportunities for developing weak but goal directed ties. These can also connect individuals to locally salient forms of social or political power, effectively creating ties that bridge power differences (M Woolcock & Narayan, 2000). For

example, in Guatemala public displays of political loyalty can carry material benefits, particularly during election years. Participating in campaign rallies and activities can have lucrative effects on household's well-being. Constituents have cited local politicians emphasizing infrastructure projects that directly benefit loyal supporters, like road and water maintenance, house repairs, and accessing employment opportunities in the municipality.

Data and Methods

The data for this study come from the Encuesta Nacional de Condiciones de Vida (ENCOVI) for the year 2000, which is the Guatemalan version of the World Bank Living Standards and Measurement Survey (LSMS). The ENCOVI is a nationally representative survey, with a total of 7,276 households and 37,926 individuals participating. The households were sampled in eight broad regions, cut across both urban and rural areas, and includes 25 different ethnic and language groups. The survey collected detailed information about household assets, as well as household income and expenditure data. Furthermore, the Guatemalan ENCOVI was the first of the World Bank's LSMS to include questions relating to social capital, including questions about household participation in organizations and collective actions.

Parental Investment in Education.

School Enrollment. For all members of the household the ENCOVI collected enrollment status. The majority of Guatemalans finish their schooling by the age of 24; however, by age 16 young people begin leaving familial homes and becoming heads of household. We limit our analysis to those 18 years of age or younger and exclude those children who are considered heads of household. The analytic sample contains N=11,680

children, age 7 to 18 who were not identified as the head of household. In Guatemala, compulsory enrollment begins at age 7. For children age, 7 through 18 we treat enrollment as a binary variable where 1 indicates that they were enrolled in some form of schooling for the survey year (2000).

Measures of Social Opportunities

Social capital. We measured social capital in terms of membership in formal and informal institutions, as well as participation or involvement in certain forms of collective action. The ENCOVI contained a series of questions regarding participation in a number of different types of organizations as well as household participation in collective action. For measures based on group membership, individuals older than seven years old identified three main institutions in which they participated as members. The types of groups listed contained a number of organization types including religious groups, income-generating groups, community groups, school-oriented groups, groups dedicated to the provisioning of public goods, recreation groups, and social groups (Table 2).

In the full sample, 21.9% of individuals and 46.6% of households having membership in any organization (SM Table 1). The most prominent form of group membership was participation in religious organizations with 16.1% of all individuals and 32.3% of households participating in a religious group. Excluding religious organizations, 6.3% of individuals and 23.3% of households were members of an organization. Given the prominence of religious organizations in membership rates, we created two dichotomous variables for group membership at the household level. The first indicated whether any household member participated in a religious organization. The second indicated whether at

least one member of the household has at least one tie to at least one non-religious organization. We chose to analyze religious and non-religious groups separately as membership rates in religious organizations are comparable to all other organizations combined.

For non-religious group membership, we also excluded membership in groups directly relating to school (school committees, parent teacher associations), or directed at children (boy scouts, girl scouts, youth groups), as these are direct indicators of parental investment in offspring and are conflated with our primary outcome variable. Furthermore, school enrollment may increase the likelihood that households participate in organizations like these. Table 1. shows the frequencies of membership in all groups in the subset sample containing only those households with school-aged children

For the second measure based on collective action, the ENCOVI asked whether any member of the household had participated in several kinds of collective action during the previous 12 months. Activities included collection of funds, community workshops, labor agreements, donations in cash or kind, community childcare, and the construction of community infrastructure, contacting government officials, information campaigns, and electoral campaigns, contacting local politicians, notifying judicial authorities. We chose not to include voting as an indication of participation in collective action. While it is not mandatory in Guatemala, during the civil war, citizens who did not vote were regarded as guerilla sympathizers and could face retaliations. Given the survey data were collected just 4 years after the peace accords were signed, a number of respondents in sampled communities mentioned that they voted out of fear of retaliation (Ibáñez, Lindert, & Woolcock, 2002).

	Ladino (N=6866)		Indigenous (N=4814)		
	N	%	N	%	p-Value
Urban	3211	46.8	1402	29.1	p<0.000
Female	3299	48	2409	50	p=.04
No Parent	643	9%	390	8%	
Mother Only	1240	18%	670	14%	
Father Only	145	2%	112	2%	
Both Parents	4838	71%	3642	76%	p<0.000
At least one parent employed	5704	83%	4080	85%	p=.02
Child Employed for Wages	1718	25%	1761	37%	p<0.000
Household Membership (Religious)	2385	35%	1861	39%	p<0.000
Household Membership (Non-Religious)	3495	51%	2536	53%	p=0.06
Households Collective Action	4516	66%	3251	68%	p=0.05
Less than Primary	2976	43%	2728	57%	
At Least Primary	2616	38%	1800	37%	
At Least Secondary	1274	19%	286	6%	p<0.000
Read or write in Spanish	5431	79%	2845	59%	p<0.000
Does not speak Spanish	653	10%	1293	27%	
Secondary Language	87	1%	2876	60%	
Native Language	6126	89%	645	13%	p<0.000
	Mean	SD	Mean	SD	
Child Age	12.23	3.48	12.09	3.43	p=.024
Number of Children in Household	4.15	2.02	4.97	2.11	p<0.000
Absolute Household Wealth	8.8	1.3	7.8	0.9	p<0.000
Agricultural Wealth	0	1	0.4	0.9	p<0.000
Log Income	8.2	1.1	7.5	1.1	p<0.000

Table 1. Descriptive statistics for all variables split by ethnicity. For categorical variables, Chi-square test to determine if the differences were significant. For continuous variables, we used independent samples t-tests.

In the full sample, 63% of households engaged in some form of collective action. The most common forms were the construction of community infrastructure (34.4%), donations (39.7%), and labor exchange agreements (20.7%) (SM Table 2). The number and

percentage of households with school-aged children participating in specific collective action activities is presented in Table 3. We created a single binary variable indicating whether the household had engaged in any form of collective action in the past 12 months.

Ethnicity. was self-identified in the survey and included in our analysis as a dummy variable indicating whether the head of the household was self-identified as either Ladino=0 or Indigenous=1. While most indigenous groups come from the one of the 23 different Mayan groups, a small percentage from the sample are also non-Mayan indigenous Xinca and Garifuna (0.4%). Like the Mayan groups, Xinca and Garifuna experience discrimination (Mulongoy, 2012).

Covariates

Household economic capacity. As households become richer they can better cover the direct costs of formal schooling and are less likely to rely on child labor contributions. This suggests a generally positive association between material wealth and schooling outcomes. Two distinct forms of economic resources were assessed – Material Wealth and Income. To assess material wealth, an asset based approached was employed. Asset based approaches are often preferred by social scientists working in low- and middle-income settings as a better means to assess the long-run economic capacity of households (Filmer & Pritchett, 2001; Kaiser, Hruschka, & Hadley, 2017) . We use multiple correspondence analysis to estimate two reliable dimensions of wealth (Cronbach's alpha; Dimension1= 0.95 and Dimension2=0.86). The first dimension corresponds to typical asset-based dimension reduction measures, and is dominated by ownership of consumer goods, services and construction materials that indicate success in the market-economy. We

transform this first wealth dimension ranking into an estimate of absolute household wealth (2011 constant international dollars PPP). The second dimension is associated with success in the agricultural sector and has been shown to be associated with a number of health outcomes (Hruschka, Hadley, & Hackman, 2017). Currently, we are ambivalent about how material wealth associated with success in the agricultural domain would affect parental investments in education. Larger land-holdings and agricultural wealth may signal the need for increased labor contributions of children. This would increase the opportunity costs for offspring education. However, greater success in the agricultural domain may buffer households from economic shocks that would prompt parents to pull children from school in order to make economic contributions to the household (Carletto, Kirk, Winters, & Davis, 2010).

Finally, we also use total per capital household income. The ENCOVI collects detailed information on income from all household members including formal wage-labor, income, agricultural production, and informal employment. This aggregate household income was log-transformed.

Urban residence. Urban residence has been shown to be an important predictor of schooling in developing contexts, and in Latin America in particular (Andersen, 2001). Urban parents may be more likely to incur the short-term costs of reduced offspring labor contributions in anticipation of long-term gains of increasing educational investments. Additionally, parents who invest in education may be more likely to migrate to urban centers in order to take advantage of more employment opportunities. Households were dummy coded based upon rural or urban residence. Rural residence was coded as 0 and urban residence was coded as 1.

Parents education and language fluency. In the current study, parental embodied capital was measured in a number of ways. First, in order to capture parental education across households with different compositions, we coded education into two dummy variables. The first indicates whether the child has a parent in the household who achieved at least completed primary level of education. The second was a similar dichotomous variable indicating if the child had at least one parent in the household who had achieved some form of secondary education.

Second, we code Spanish language fluency of parents in the household. Languages are important forms of embodied capital. Again, to control for differences in household composition we use a two dichotomous variable approach. First, we code if the child has at least one parent who speaks Spanish as a second language. Then, we code if the child has at least one parent who speaks Spanish as a native language. Furthermore, we also use parent's literacy status, and whether the child has at least one parent who can read or write in Spanish.

Additionally, we examine how the effects of parental education vary across ethnic lines. Nationally, Mayan households have significantly lower mean levels of education than their Ladino counterparts do. Guatemalans are still recovering from a 36-year civil war, which left few resources for important social services including health care and education. The civil war has documented effects on embodied capital accumulation (in the form of education), particularly among the indigenous population as the war had a disproportionate impact on the indigenous population, at the height escalating to genocide (Chamarbagwala and Morán 2011). Given the lower levels of education in Mayan households, we expect

parental education to have a smaller effect on enrollment for indigenous households than for Ladinos.

Household composition. We use two measures of household composition. The first is a 4-category factor variable that indicates whether the child's mother, father, or both are present in the household. 0=no parents, 1= Father only, 2= mother only, 3= both parents present in the household. Parents present in the household have been shown to shape parental investment outcomes, particularly schooling (Shenk & Scelza, 2012). Our second measure is an ordinal measure of total number of children in the household. While a number of studies have identified birth-order effects on parental investments (Borgerhoff Mulder, 1998a; Gibson & Lawson, 2011; Hertwig, Davis, & Sulloway, 2002), the ENCOVI data do not permit identifying birth order of a given child. We adopt a similar, but more general resource-dilution argument whereby a given share of the finite resources of a household shrink as household size increases. Thus, we expect that education investment for a given child will decrease as the number of school-aged children increase in the household.

Employment status. We include employment status as a binary variable indicating if at least one parent is employed for wages. As child labor presents a primary opportunity cost to household decisions to invest in education, we include a binary variable indicating if the child is employed or engaged in work. A child is considered employed if, in the last week, the child worked for wages, as self-employed, to have performed paid work for other people, to have helped in a family business, or if they declared to have a job but were absent for leave, illness, vacation, maternity leave or some other reason (D.Vuri, 2008).

Gender. Despite an overall increase in education levels, there still exist prominent gender and ethnic gaps in education achievement (Figure 1). While persistent, global gender gaps in schooling have been declining (Grant & Behrman, 2010) and most of Latin America has shown improvements in the gender gap in schooling over the last four decades. Guatemala is one of a handful of countries that have not closed the gap, with girls having significantly lower levels of educational attainment (Andersen, 2001; Duryea, Galiani, Nopo, & Piras, 2007). Employment and income benefits are higher for sons, and families have more opportunity to realize these benefits for sons as daughters tend to marry out into other families. Thus, the opportunity costs of losing girls' labor contributions to the households are greater given the lower chances of families receiving the long-term benefits of increased education. To account for gender differences in the effects of opportunities, we stratify the analyses by gender.

Child Age. We include age as a categorical variable to account for nonlinear effects on enrollment. From the ages of 7 to 12 there is a slight positive effect on the probability of enrollment. After age 12 there is a steep decline in the effects of age on enrollment (Figure 2).

Analysis

We first present the differences in economic capacity and household characteristics using bivariate descriptive statistics for all variables used in the analysis, split by ethnicity and gender. We then construct a logistic model with the outcomes of school enrollment for both boys and girls that includes all the main predictors and covariates. We expect a significant effect of ethnicity to remain after controlling for differences in household

economic capacity, child and parent characteristics, and opportunities. Second, we expect that measures of social capital based on group membership and participation in collective action to be positively associated with school enrollments and that the interaction with ethnicity and social capital will be positive and significant. Finally, we include an ethnicity by parental education interaction to assess whether parental education has a stronger impact on enrollment for ladino households than for Mayan.

Results

Distribution of child and household characteristics by ethnicity. Tables 1 shows the distribution of child and household characteristics by ethnicity. Consistent with national demographic patterns, Indigenous households were more likely to be rural, had slightly younger children, and slightly higher number of school aged children in the household. Furthermore, Indigenous children are more likely to have dual parent households compared to Ladino children and were more likely to have at least one parent involved in wage-labor.

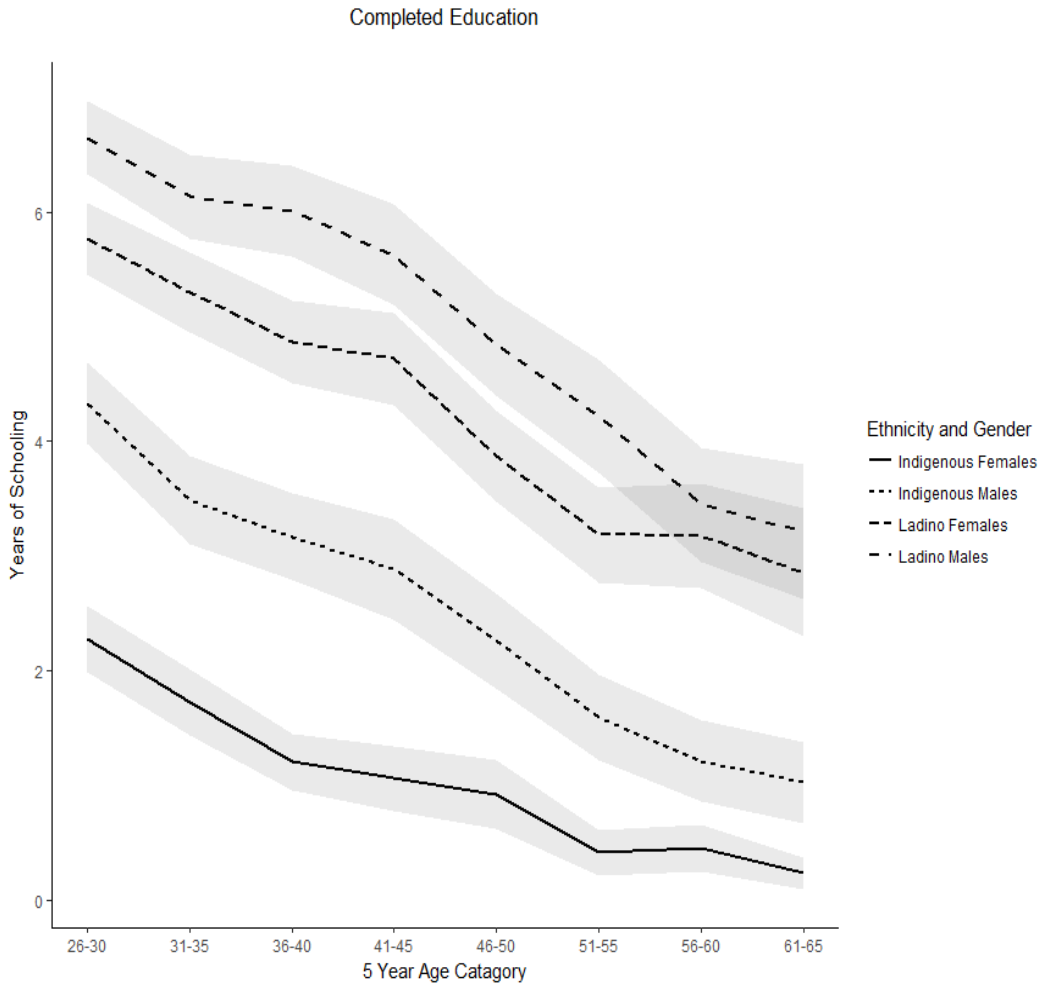

Figure 1. Average years of completed schooling for adults by 5-year age groupings.

Distributions of economic capacity and opportunities by ethnicity. Ladino households have significantly higher levels of household wealth and household income compared to indigenous households. However, indigenous households have higher rankings in agricultural wealth dimensions. Results also show significant differences in reported social capital across ethnic lines, with indigenous household more likely having bonding and linking ties. Bridging social capital was similar across both indigenous and ladino households.

	Ladino	Indigenous

	N	%	N	%	p-value
Income Group	**287**	**4%**	**176**	**4%**	**0.17**
Farmer Coops	64	1%	50	1%	0.63
Business Associations	28	0%	28	1%	0.23
Cooperatives	77	1%	69	1%	0.16
Credit Groups	34	1%	12	0%	0.05
Professional Associations	64	1%	5	0%	0.00
Workers Unions	41	1%	17	0%	0.09
Community Group	**107**	**2%**	**79**	**2%**	**0.78**
Civic Group	6	0%	7	0%	0.52
NGO	76	1%	64	1%	0.32
Charity Organizations	25	0%	8	0%	0.07
School Group	**261**	**4%**	**223**	**5%**	**0.03**
Family Groups	57	1%	34	1%	0.52
School Committees	214	3%	189	4%	0.02
Public Goods Group	**99**	**1%**	**154**	**3%**	**0.00**
Political Groups	22	0%	14	0%	0.91
Boards of Water and Garbage	69	1%	111	2%	0.00
Board of Roads	8	0%	31	1%	0.00
Housing Committee	9	0%	7	0%	1.00
Recreation Group	**990**	**14%**	**359**	**8%**	**0.00**
Sports Groups	955	14%	359	8%	0.00
Boy Scouts	45	1%	4	0%	0.00
Girl Scouts	2	0%	0	0%	0.64
Social Group	**688**	**10%**	**716**	**15%**	**0.00**
Women's groups	81	1%	165	3%	0.00
Youth Groups	89	1%	57	1%	0.65
Cultural Groups	121	2%	51	1%	0.00
Indigenous Groups	168	2%	177	4%	0.00
Neighborhood Committees	270	4%	355	7%	0.00

Table 2. Distribution of household-level membership rates.

Finally, indigenous households had significantly lower levels of parental embodied capital within the household. Among Ladinos, 43% of households had parents who had not completed primary school, compared to 57% among indigenous households. Furthermore, 19% of ladino households had one parent who had at least some secondary education,

compared to 6% of indigenous households. Unsurprisingly, indigenous household had lower levels of Spanish literacy, and fewer children had at least one parent who was a native Spanish speaker.

Multivariate Logistic Regressions School Enrollment. Table 4 presents the results from the multivariate logistic regression. As expected, school enrollments for both males and females were significantly higher in urban households compared to rural households, and increased with all measures of household economic capacity. Parental education, literacy, and employment status also had strong positive effects on probability of enrollment. Age showed the expected curvilinear effect on enrollment, increasing probabilities of enrollment from the age of 7 until age 10, and showing a marked decline by age 12 (SM Table 2). In addition, as expected, enrollment probabilities decreased with household size.

	Ladino		Indigenous	
	N	Percent	N	Percent
Collection of funds	1221	18%	677	14%
Community Workshops	168	2%	186	4%
Contact government officials to access programs	609	9%	634	13%
Information campaigns	494	7%	469	10%
Electoral campaigns	758	11%	484	10%
Contacting local politicians	427	6%	248	5%
Notifying judicial authorities when problems arise	656	10%	324	7%
Giving monetary or in-kind donations	2278	33%	1084	23%
Providing unpaid labor to charity institutions	1213	18%	955	20%
Labor exchange agreements	1370	20%	1401	29%
Community childcare	188	3%	129	3%
Construction of community infrastructure	2252	33%	2561	53%
Voting in elections[1]	5423	79%	3800	79%
Other collective action	76	1%	44	1%
Any Collective Action	451	66 %	325	68 %

Table 3. Number of Households Engaged in Collective Action in the Past 12 Months. Voting in elections was not included in the social capital measure based on collective action.

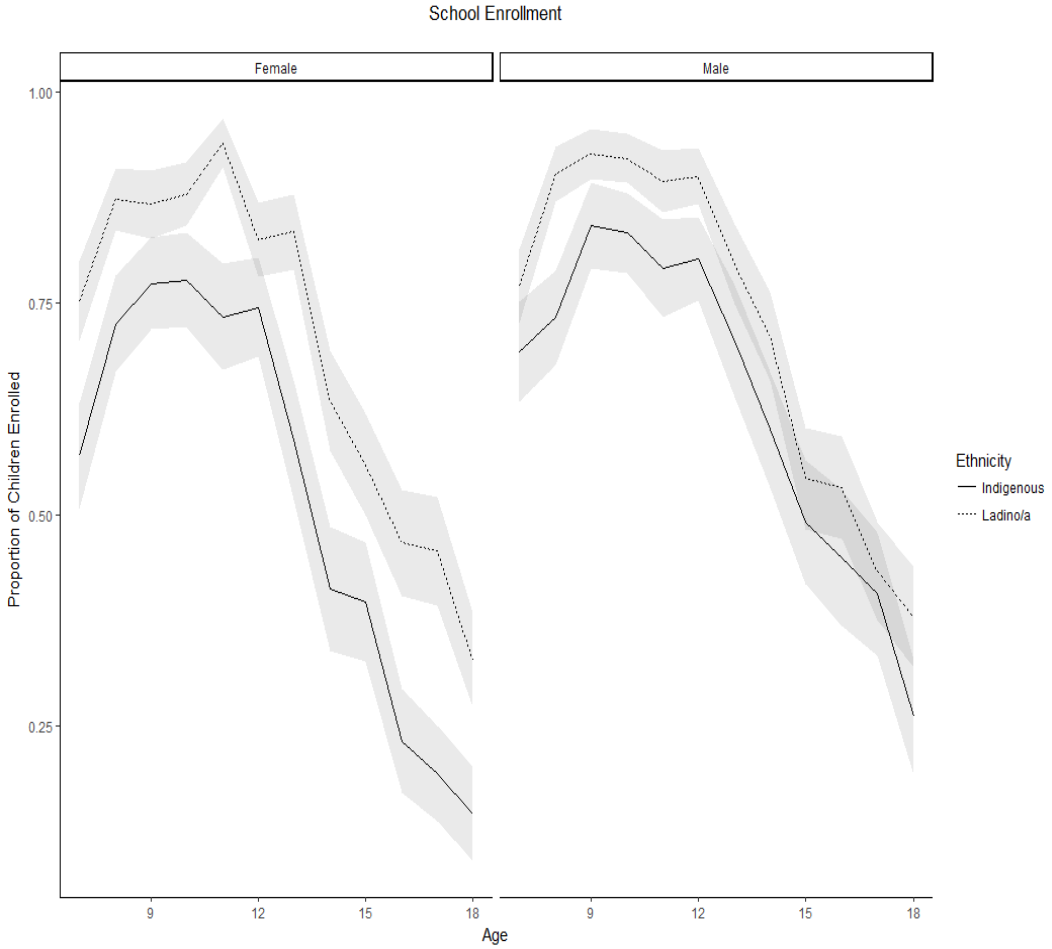

Figure 2. Proportion of children and adolescents currently enrolled in school.

	Males		Females	
	Baseline Model	Full Model	Baseline Model	Full Model
Urban	1.38*** (1.15, 1.66)	1.40*** (1.17, 1.69)	1.64*** (1.37, 1.97)	1.66*** (1.39, 1.99)
N Children in Household	0.92*** (0.89, 0.96)	0.92*** (0.89, 0.96)	0.97* (0.94, 1.01)	0.97 (0.94, 1.01)
Mother Only Household	0.73 (0.47, 1.14)	0.78 (0.50, 1.22)	1.96*** (1.30, 2.96)	2.09*** (1.38, 3.17)
Father Only Household	0.59* (0.32, 1.10)	0.62 (0.33, 1.16)	0.78 (0.41, 1.45)	0.83 (0.44, 1.56)
Both Parent Household	0.72 (0.44, 1.17)	0.77 (0.47, 1.27)	1.07 (0.68, 1.69)	1.16 (0.73, 1.84)
Absolute Wealth Estimate	1.54*** (1.39, 1.71)	1.56*** (1.41, 1.73)	1.65*** (1.49, 1.82)	1.65*** (1.49, 1.83)

Agricultural Wealth Estimate	1.63*** (1.49, 1.78)	1.65*** (1.50, 1.80)	1.63*** (1.49, 1.78)	1.64*** (1.50, 1.80)
Log Income	1.07* (1.00, 1.15)	1.07* (1.00, 1.15)	1.20*** (1.12, 1.29)	1.20*** (1.12, 1.29)
At least one parent employed	1.27 (0.95, 1.70)	1.26 (0.94, 1.69)	1.31* (0.97, 1.76)	1.30* (0.97, 1.75)
Child employed for wages	0.28*** (0.23, 0.32)	0.28*** (0.23, 0.33)	0.51*** (0.43, 0.60)	0.51*** (0.43, 0.60)
Spanish primary language	0.98 (0.74, 1.29)	0.96 (0.72, 1.27)	1.05 (0.81, 1.36)	1.09 (0.84, 1.42)
Spanish secondary language	0.86 (0.66, 1.12)	0.84 (0.64, 1.10)	0.89 (0.68, 1.16)	0.85 (0.64, 1.11)
Literate	2.03*** (1.64, 2.51)	1.97*** (1.59, 2.44)	1.93*** (1.56, 2.38)	1.87*** (1.51, 2.31)
At least some primary school	0.98 (0.79, 1.20)	0.95 (0.74, 1.22)	1.21* (0.98, 1.49)	1.04 (0.81, 1.34)
At least some secondary school	3.13*** (2.17, 4.51)	2.49*** (1.66, 3.72)	1.88*** (1.37, 2.59)	2.08*** (1.40, 3.09)
Indigenous	1.05 (0.81, 1.37)	0.71† (0.50, 1.01)	0.69*** (0.54, 0.87)	0.44*** (0.31, 0.60)
Membership Tie	1.44*** (1.21, 1.71)	1.27** (1.01, 1.60)	1.26*** (1.06, 1.49)	1.06 (0.84, 1.34)
Religious Membership Tie	1.31*** (1.13, 1.52)	1.30*** (1.12, 1.51)	1.30*** (1.13, 1.50)	1.29*** (1.12, 1.49)
Collective Action Tie	1.23*** (1.06, 1.43)	1.03 (0.84, 1.25)	1.37*** (1.18, 1.58)	1.14 (0.93, 1.39)
Indigenous: Membership Tie		1.27 (0.90, 1.79)		1.42** (1.01, 1.99)
Indigenous: Collective Action Tie		1.49*** (1.10, 2.00)		1.48*** (1.10, 1.98)
Indigenous : At least some primary		1.08 (0.80, 1.46)		1.41** (1.05, 1.89)
Indigenous : At least some secondary		3.08** (1.13, 8.37)		0.72 (0.37, 1.39)
Intercept	0.05*** (0.02, 0.11)	0.06*** (0.03, 0.12)	0.003*** (0.001, 0.01)	0.003*** (0.001, 0.01)
Observations	5,972	5,972	5,706	5,706
Log Likelihood	-2,528.19	-2,520.15	-2,571.62	-2,562.21
Akaike Inf. Crit.	5,116.38	5,108.30	5,203.23	5,192.42

Table 4. Logistic Regression Models. †p<0.1, *p<0.05, **p<0.01, ***p<0.001

Finally, in the baseline model ethnic identity showed gender differences in the effects on enrollments. After controlling for all covariates, indigenous boys were no less likely to be enrolled in school than Ladino children were (OR= 1.05, 95% CI= 0.81, 1.37). However, indigenous girls were significantly less likely to be enrolled in school compared to their Ladina counterparts (OR= 0.69, 95% CI= 0.54, 0.87).

	Males		Females	
Households with…	Odds Ratio	95% CI	Odds Ratio	95% CI
No Social Capital	0.71†	(0.50, 1.01)	0.44***	(0.31, 0.60)
Membership Ties Only	0.9	(0.56, 1.43)	0.62**	(0.40, 0.96)
Collective Action Ties Only	1.05	(0.76, 1.45)	0.64***	(0.48, 0.87)
Both	1.33	(0.89, 1.99)	0.91	(0.63, 1.33)

Table 5. Odds Ratios of Enrollment for Indigenous Children Compared to Ladino Children. Compared to Ladino children in households with the same levels of social capital. †p<0.1, *p<0.05, **p<0.01, ***p<0.001.

In the baseline model assuming similar effects across ethnicity, all three measures of social capital showed positive associations on enrollment. Compared to households with no social capital, households with secular membership ties were 1.44 (95% CI=1.21, 1.71) times more likely have a boy enrolled and 1.26 (95% CI=1.06, 1.49) times more likely to have a girl enrolled. Religious group membership had a similar effect for boys (OR= 1.31, 95% CI= 1.13, 1.52), and for girls (OR= 1.30, 95% CI= 1.13, 1.50). Finally, households who engage in collective activities had children who were more likely to be enrolled than household who have not been involved in collective action activities (Boys: OR= 1.23, 95% CI= 1.06, 1.43; Girls: OR= 1.37, 95% CI= 1.18, 1.58).

Effects of Engagement in Collective Activities. The main test of our hypothesis concerns the interaction between ethnicity and the three measures of social capital. The effects of collective activities showed a significant interaction with ethnicity for both boys and girls, with the effect of household collective activities strongest in indigenous households (Indigenous: Collective Activities Boys p=0.009, Girls p=0.008). For Ladinos, households engaging in collective activities are no more likely to have children enrolled than Ladino houses that have no collective activities (Boys: OR= 1.03, 95% CI= 0.84, 1.25; Girls: OR= 1.14, 95% CI= 0.93, 1.39). By contrast, among Indigenous households, those with collective activities were 1.52 (95% CI =1.22, 1.91) times more likely to be enrolled in school while girls are 1.68 (95% CI= 1.35, 2.09) times more likely (compared to those Indigenous households not engaged in collective activities).

Effects of Secular Group Membership. Secular group membership had gender specific interactions with ethnicity. For boys, Ladino households engaged in secular group membership were 1.27 (95% CI=1.01, 1.60) times more likely to have children enrolled compared to Ladino households not engaged in secular group membership. Similarly, Indigenous households engaged in secular group membership were 1.61 (95% CI= 1.24, 2.09) times more likely to have children enrolled compared to Indigenous households with no secular group membership ties. While the effects are larger for indigenous households, the differences in effects of secular group membership did not differ significantly across ethnic lines (Indigenous: Membership Tie p=0.18).

For girls, the effects of secular group membership was only significant among indigenous households (Indigenous: Membership Tie p=0.04). Ladino households who engaged in secular group membership were no more likely to have a child enrolled than

those ladino households with no secular group membership ties (OR=1.06, 95% CI=0.84, 1.34). However, for indigenous households, those with secular group membership ties were 1.51 (95% CI=1.17, 1.94) times more likely.

Effects of Religious Group Membership. There were no significant interactions of religious membership with ethnicity, for boys (Indigenous: Religious Membership Tie p=0.54) or for girls (p=0.27), indicating that religious membership has similar effects on enrollment among regardless of ethnicity. Thus, the interaction term was excluded from the full model. For Ladinos, households with religious group membership ties were more likely to have children enrolled in school than ladino households without religious group membership ties (Boys OR=1.30, 95% CI= 1.12, 1.51; Girls OR= 1.29, 95% CI=1.12, 1.49). Similarly, Indigenous households with religious group membership ties were also more likely to have children enrolled than indigenous households without religious group membership ties (Boys OR=1.30, 95% CI=1.12, 1.51; Girls OR= 1.29, 95% CI=1.12, 1.49).

Cumulative Effects of Social Capital. Table 5 reports the odds ratios of enrollment for indigenous children, compared to Ladinos, by sex for different levels of social capital. Among households with no membership ties or collective activities, indigenous males were less likely to be enrolled compared similar ladino households (OR=0.71, 95% CI= 0.50, 1.01), though this was only marginally significant. However, the gap shrunk among households with just group membership ties. (OR= 0.90, 95% CI= 0.56, 1.43), with just a collective activity (OR= 1.05, 95% CI= 0.76, 1.45), and among households with both (OR= 1.33, 95% CI= 0.89, 1.99).

Among girls, households with no social capital showed indigenous girls were significantly less likely to be enrolled in school compared to similar Ladina girls (OR= 0.44, 95% CI= 0.31, 0.60). The odds ratios of households with one type of membership or collective activity showed the indigenous girls were still significantly less likely to be enrolled, however the ethnic gap was much smaller (Membership (OR= 0.62, 95% CI=0.40, 0.96), households with linking only ties (OR= 0.64, 95% CI= 0.48, 0.87). However, among households with both bridging and linking ties, there were no significant differences in enrollment rates for indigenous and Ladina girls (OR= 0.91, 95% CI= 0.63, 1.33).

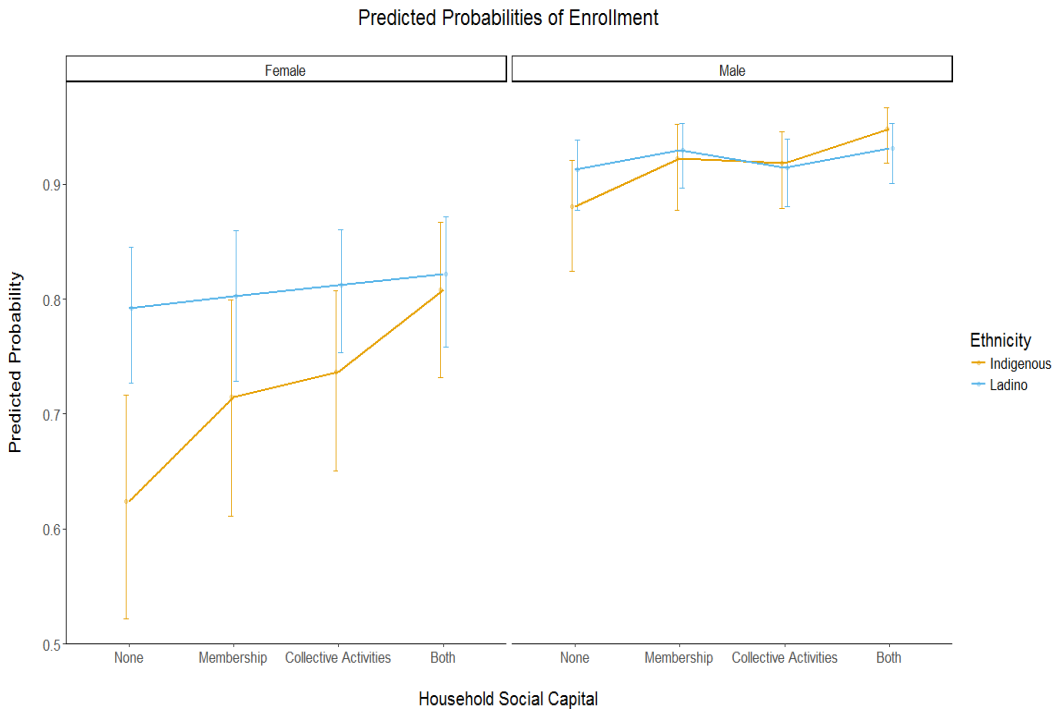

Figure 3. Predicted probability of enrollment by household social capital. Predicted probabilities are estimated using the mean and modal values for all model parameters.

While indigenous households have lower probabilities for enrollment than Ladino households, particularly for households with girls, indigenous households can compensate

for the disparity through social capital effects. Figure 3 plots the predicted probability of enrollment for children in households as a function of social capital, highlighting the strong effects of secular group membership and collective activities social ties on indigenous enrollment probabilities. The probability of enrollment for Ladino households differs little across households with or without bridging and linking ties. However, for indigenous households, those with both bridging and linking ties have much higher rates of enrollment than those households without.

Finally, we also assessed interaction of parental education and ethnicity on enrollment. For girls, the effect of having at least one parent complete primary school is associated with higher enrollment for indigenous girls only. Both indigenous and ladino households showed strong positive effects of having a parent with some secondary. However, for boys, having at least one parent with some secondary has a much stronger effect for indigenous boys.

Discussion

The current study found evidence that indigenous households invest less in offspring education, particularly for girls, independent of residential ecology, household economic capacity, household composition and parental education level. These results are consistent with the expectation that discrimination in the job-market lowers the opportunity costs of child labor by decreasing the long-term payouts to education. Importantly, we found strong effects of specific types of relational wealth on school enrollments, particularly for indigenous households. For indigenous households, the effects of household social ties that

link households to more heterogeneous social groups, as well as those ties that help access local power structures increase parental investments in education.

The types of social investments households make are associated with decisions regarding investments in the education of their offspring. The idea that social networks change over the course of economic development and have impacts on how household navigate reproductive behaviors is nothing new. In the initial articulation of classic Demographic Transition Theory, Notestein noted that important functional roles of the family will be replaced by formal institutions, as residential mobility associated with industrialization and urbanization reduces strong ties among kin. Anthropologists have assessed how support networks alter the direct costs of childcare and the reproductive-related norms individuals are exposed to (Bereczkei, 1998; Newson et al., 2005; Sear, Moya, & Mathew, 2013). The current study offers evidence that certain types of social-connections may also increase offspring investments through a different mechanism. We propose that social connections provide critical access to economic and social opportunities that can increase the long-term payouts to investments in offspring education.

These findings are consistent with an extensive body of research on social capital effects on education and social mobility in industrial populations (Huang, van den Brink, & Groot, 2009; Matthews et al., 2009; Portes, 1998). For anthropologists who study the fitness effects of wealth (Borgerhoff Mulder & Beheim, 2011; Colleran et al., 2015), and the emergence and maintenance of wealth inequalities over the course of market-integration (Mattison, Smith, Shenk, & Cochrane, 2016), the social capital literature can provide insight into what types of relationships provide access to opportunities in a given context, as well as how households cultivate and maintain new forms of relational wealth.

Two other points emerged from the analysis that warrant discussion. First, contrary to our expectations, the effects of parental education were stronger for indigenous households than for ladinos. The embodied capital theory predicts that the effects of parental education would be less for marginalized ethnic groups with lower mean levels of education (Kaplan, 1996). This argument is based on the assumption that parental education increase the efficiency of investments in offspring education. However, parental education also serves as a proxy for increased access to social and economic opportunities. In this way, parental education may increase the payouts to investments in offspring education more strongly among indigenous households by providing a means of accessing opportunities for upward social or economic mobility.

Second, the largely positive association of agricultural wealth on both enrollment and progression suggests that increasing agricultural holdings does not create larger opportunity costs that with increasing child labor demands. These results suggest that, in the Guatemalan context, success in the agricultural dimension can be used to enhance education in offspring. It is likely that households rich in agricultural wealth are less likely to experience economic shocks that require children to trade-off long-term benefits of education, with immediate benefits of economic contributions they can make through employment.

Limitations

A number of limitations are worth noting. First, we used cross-sectional observational data with self-reported school enrollment. The nature of observational data does not permit establishing clear causal pathways. Rather than social resources shaping

parental decisions to invest in offspring, households with children enrolled in schools may be more likely to seek out groups to participate in or engage in collective action. Second, the current study employed relatively coarse-grained measures of social capital at an aggregate level. We propose that membership and participation in collective activities promotes the formation of heterogeneous social ties that households can leverage to access opportunities that can increase the value of investments in offspring education. However, these groups may also strengthen within group bonds and facilitate social insurance norms. These types of bonds can increase a household's ability to continue to address the opportunity costs associated with sending children to school. More direct measures of the diversity of household ties and the nature and strength of supportive relationships could better distinguish the causal mechanisms underlying the association between household social networks and parental investment decisions.

Third, it may be the case that communities differ in their distribution and quality of voluntary organizations and opportunities for membership are limited. Additionally, local avenues for participation in collective actions can differ dramatically across communities. How the strength and access to formal and informal associations as well as opportunities for more fluid forms of collective participation will shape how households navigate trade-offs involved with investment in these forms of social resources, as well as their potential downstream effects on human capital investments.

Similarly, the outcome measures of school enrollment are based on measures of self-report. that the presence of household ties to a wide variety of types of formal and informal civic organizations may signal community effects on education. Communities with these opportunities available may have other infrastructure in place that may make it easier for

households to invest in education. Here we assume that schools available to indigenous and non-indigenous are roughly equivalent and the lower wage returns for indigenous are due to market discrimination. This motivates lower levels of investment as the opportunity costs for long-term investment decrease. However, if there are stark differences in the quality of education available to Ladinos and indigenous households, the wage-returns may not reflect discrimination. While there is some evidence that differences in school attributes can account for some of the achievement gap between indigenous and non-indigenous households (McEwan & Trowbridge, 2007), the results are not conclusive. For example, other research has shown little effects of school quality using an extensive list of school attributes (Marshall, 2009). However, these researchers found evidence that community-effects relating to institutions and labor-markets provide a more compelling explanation for the achievement gaps between indigenous and non-indigenous households.

Conclusion

Evolutionary and economic models of parental investment often cite education as the primary determinant of success in wage-labor economies. However, accessing opportunities for skill-intensive employment may vary according to factors unrelated to education investments. Here we found evidence that discrimination on the job-market may lower parental investments in education, and that households who face economic discrimination may invest more in education when they have the social connections to realize economic returns to investments in education. These results highlight a relatively unexplored pathway by which social connections shape parental investment decisions, particularly in the contexts of market economies characterized by inequality in employment opportunities. In market economies where education is important for economic and social

mobility, households face opportunities to cultivate new types of social connections. Rather than offsetting the direct costs of childcare or providing channels for the spread of high-investment norms, the right types of social connections can modify the expected returns to investments in education.

CHAPTER 4

ECONOMIC CAPACITY OR MARKET OPPORTUNITIES? DISENTAGLING WEALTH EFFECTS ON COMPLETED FERTILITY IN 56 LOW-AND MIDDLE-INCOME COUNTRIES

Abstract

Numerous studies have shown mixed associations of wealth with fertility, a finding that has posed ongoing puzzles for evolutionary theories of human reproduction. One potential reason for these mixed results is that measures of wealth do not simply assess economic resources, which are expected to increase fertility. Certain forms of wealth can also serve as a proxy for market opportunities available to a household, which some theories propose should reduce fertility. In this way, the multi-faceted meaning of many wealth measures obscures our ability to draw inferences about the causal mechanisms underlying the relationship between wealth and fertility. We propose a means of disentangling economic capacity and market opportunities by estimating the effects of alternative measures of wealth (e.g. agricultural wealth) that do not carry the same market-oriented biases as standard asset-based measures. Using multi-level models, we assess the effects of measures of agricultural and wage-labor market-based forms of wealth on completed fertility in 472,812 households, across 90,425 sampling clusters, across 114 surveys in 56 countries. Consistent with expectations, market-based wealth and education showed consistent negative associations with completed fertility. By contrast, agricultural wealth was usually associated with increased fertility. Using these multiple measures of wealth, we also employ

a multi-group latent variable structural equation model to estimate 1) latent variables capturing economic capacity and market opportunity and 2) their effects on completed family size. Market opportunities had a consistent negative effect on fertility, while economic capacity had a weaker but generally positive effect on fertility. The results show that the confusion between measures of wealth and the concepts of economic capacity can impede our understanding of how material resources shape reproductive decision making.

Introduction:

The associations between socioeconomic status and fertility are a biological puzzle. The global transition to low fertility in the midst of modernization has been a biological puzzle for decades (Handwerker, 1986; Kaplan, 1996; Vining, 1986). A central feature of this puzzle is the inconsistent relationship between socioeconomic status and fertility across human contexts. A long history of studies in anthropology have often documented positive effects of wealth and status on reproduction and fertility across a range of traditional and subsistence populations (Cronk, 1991; Flinn, 1986; Turke & Betzig, 1985). For example, when wealth is measured as food energy, researchers have often found a strong positive association between wealth and reproductive success (Borgerhoff Mulder & Beheim, 2011; Kaplan, Lancaster, Tucker, & Anderson, 2002). When wealth comes in the form of material assets in these contexts, there is also a positive association with reproductive output, particularly for men (Borgerhoff Mulder & Beheim, 2011; Cronk, 1991; Flinn, 1986; Nettle & Pollet, 2008). However, positive effects of wealth and status on fertility are far from universal, and numerous studies have also shown negative or null associations, especially among market-integrated populations (Retherford, 1986; Vining, 1986). Over the course of

the fertility transition, wealthier families reduce their fertility earlier and more dramatically than the rest of the population (Borgerhoff Mulder, 1998b; Cummins, 2013; Livi-Bacci, 1986; Skirbekk, 2008). Furthermore, within contemporary western populations, wealthier, higher status men tend to have lower fertility (Kaplan et al., 2002; Lam, 1986; Pérusse, 1993). In low and middle income countries where populations are at different stages of this transition, there is a negative association between household wealth and women's fertility (Hruschka & Burger, 2016). At the population level, there seems to be a clear negative relationship between population wealth and fertility rates, where people in wealthier populations tend to have lower fertility (Hruschka, Sear, Hackman, & Drake, 2018; Lutz & KC, 2011; Myrskylä, Kohler, & Billari, 2009; Pérusse, 1993). Finally, studies using historical samples have identified a switch in the relationship between socioeconomic status and fertility, whereby high status individuals move to low fertility strategies while low-status individuals move to having relatively higher fertility (Skirbekk, 2008).

The current paper tackles the puzzling and inconsistent associations between socioeconomic status and fertility by exploring the possibility that measures of socioeconomic status (e.g. wealth & education) confound two factors—differential economic capacity and differential market opportunities—that should have opposing effects on fertility. We first review recent studies and theoretical explanations of the wealth-fertility association. We focus on investment models, common in economics and evolutionary social sciences, which argue market economies drive down fertility as parents focus on generating access to novel forms of social and economic opportunities (Shenk, 2009). Next, we argue that commonly used measures of wealth tend to conflate economic capacity with market opportunities, making it difficult to test theories about the independent effects of economic

capacity and market opportunities. Finally, we attempt to disentangle the effects of market opportunities and economic capacity on fertility using multiple forms of wealth to parse out the effects of economic capacity from those of market opportunities.

Prominent models suggest market economies change quality-quantity trade-offs, resulting in null or negative relationships between socioeconomic status and fertility. The demographic transition and associated changes in the wealth and fertility relationship has been discussed in great detail in evolutionary social sciences (Borgerhoff Mulder, 1998c; Irons, 1983; Sear et al., 2016; Vining, 1986). The causes of the fertility decline and changing relationships between socioeconomic status and fertility have been attributed to increasing costs and benefits of status competition (Boone & Kessler, 1999; Borgerhoff Mulder, 1998b; S. E. Hill & Reeve, 2005; Low et al., 2002), the increasing costs and benefits of parental investments in novel market economies (G. Becker et al., 1990; Kaplan, 1996) women's education (Low et al., 2002; Robinson, 1997), changing payoffs to human capital investments (Kaplan et al., 2000) the breakdown of kinship networks (Turke, 1989), and cultural evolution (Boyd & Richerson, 1985; Richerson & Boyd, 2005) or the costs and benefits of fertility reduction as a social mobility strategy in a stratified society social stratification (Rogers, 1990).

Perhaps the most prominent evolutionary and economic explanations have been those that focus on how market economies shape the quality-quantity trade-off that parents face. These models focus on quality-quantity trade-offs derived from life history frameworks where parents balance investment in producing offspring with investment in the

quality of existing offspring to promote survival and future success (D. Lawson, Alvergne, & Gibson, 2012; D. W. Lawson & Mulder, 2016b).

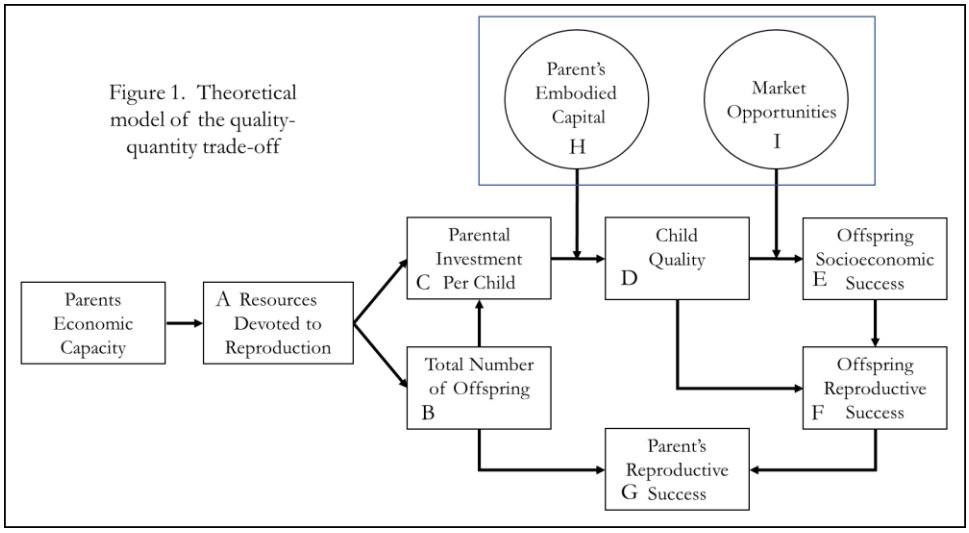

Figure 1. Theoretical model of the quality quantity trade-off.

Figure 1 outlines the key points of the quality-quantity models. Resources that are devoted to reproduction (A) are split between the total number of offspring (B) and the investment in each offspring (C) in order to maximize their own reproductive success (G). Kaplan and colleagues developed an extensive theory of human reproduction that specified many of the links in the full model (Kaplan, 1996; Kaplan et al., 2002; Snopkowski & Kaplan, 2014). By combining economic and evolutionary theory, they outlined a theory of reproduction and the physiological and psychological mechanisms that underpinned reproductive behavior. According to their model, among hunter-gatherers, fertility is coordinated through systems of behavioral and physiological responses, with psychological adaptations which evolved to track the links between parental investment and the reproductive success of their offspring. The skill-dependent foraging niche of humans

required extended parental support, which placed constraints on the fitness returns to both parental investments in existing offspring, and the production of additional offspring.

A key premise in many of these models is that navigating trade-offs in order to maximize reproductive success (G) is a complex task. Thus, parents try to optimize some combination of proximate currencies like total offspring (B) and offspring socioeconomic success (E). To do this, they pay attention to how efficiently their investments in child quality (C) translate to child quality (E) and how efficiently child quality translates into socioeconomic success (E). For example, what is the cost of ensuring a child reaches a certain level of education? And how much can a child leverage a given level of education to achieve a certain income or status? While the efficiency of moving from (C) to (E) can be quite variable, the costs of bearing and feeding a child are roughly fixed by the physiological costs of reproduction, lactation and post-weaning feeding.

According to this model, increasing socioeconomic payoffs to investment in child quality can tip the balance of quality-quantity trade-offs, leading parents to reduce fertility in favor of investing in fewer high-quality children. The model here outlines two ways that returns on investment can be increased.

The first is increasing the efficiency with which investments (C) translate into child quality (D)(e.g. investments in education leading to a more educated and skilled child). The second is how well a person can use their education and skills to unlock opportunities for increase income or socioeconomic success. Kaplan's model touches on both of these. First, it proposes that parents with experience in the education system are better equipped to help their children navigate the educational system. Thus, their investments in education can

more efficiently lead to an educated child (Kaplan, 1996; Kaplan et al., 2002). This can result in a positive association between parents embodied capital (H) and the optimal parental investments (C), to produce higher quality offspring (D). When parental wealth is associated with parental education, this can also lead to negative associations between measures of wealth and overall fertility.

Second, Kaplan's model also considers how changing market opportunities can increase the socioeconomic returns to education (e.g. the efficiency by which D translates to E). For example, they argue that competitive wage-labor economies increase opportunities to translate current quality into future SES. They also argue that changing balances of supply and demand for skilled labor can affect returns on investment in child quality (Kaplan & Lancaster, 2000). While broad social changes can shape overall quality-quantity tradeoffs, not all children in a society will have the same opportunities to translate education (or other investments in quality) into greater later life success. Changing economic conditions may affect women differentially because of lower expected socioeconomic gains from education and differences in available employment opportunities (Snopkowski & Kaplan, 2014). A family's social connections may provide more opportunities for translating a child's education into income-producing jobs (Hackman in prep(Coleman, 1988; Granovetter, 1973; Matthews et al., 2009; Portes, 1998). The wage returns to schooling may be lower for certain ethnic groups that suffer from exclusion from certain sectors of the labor market (Patrinos, 2000; Patrinos & Psacharopoulos, 1997). Even physical proximity to market opportunities may shape returns to investment (McAllister, Gurven, Kaplan, & Stieglitz, 2012). Market opportunities are often more concentrated in urban centers, providing more opportunities to translate education into income-producing employment (Mattison & Neill, 2013; Neill,

2010). Additionally, a family's experience with labor markets and market economies may provide valuable skills and connections necessary to translate education into future income and socioeconomic status. Even in the presence of educational opportunities, family livelihoods may shape the expected returns to investments in child quality. For example, Hedges and colleagues found parental investments in schooling to vary across distinct livelihoods in Tanzania, with market integrated household facing lower opportunity costs and greater perceived returns to investments in education (Hedges et al., 2016). In contrast, pastoralist households were least likely to send offspring to school, given the increased ability of children to contribute economically to the household and the lower perceived need and payout for cultivating school-based skills.

In each of these cases, individual and household variation in *market opportunities*—or opportunities to translate education into future socioeconomic status—may substantially shape the returns on investment in child quality and quality-quantity tradeoffs more generally. Analysis of populations without accounting for this variation in accessing market opportunities may further obscure how parents are decisions about the trade-offs (Stulp, Sear, & Barrett, 2016).

In heterogeneous populations, where different groups of people face different suites of employment opportunities, investment options, or different costs of raising children, groups with greater market opportunities might follow decision rules that lead to smaller families overall compared to groups with less market opportunities (Mace, 1998; Stulp & Barrett, 2016). In those cases where family status (however measured) is associated with greater market opportunities for their children, this can lead to a negative correlation

between family status and fertility at the population level. However, within those high and low status groups we may see those with greater economic capacity still having higher relative fertility (Mace, 1998) (An example of Simpson's paradox). In an early empirical example, one study among highly educated women in Britain's top universities found wealth was positively associated with reproductive success (Hubback, 1957). Here, similarities in education were assumed to reflect similarities in market opportunities. In another example, across subgroups in urban and rural Mongolia, researchers found a negative association between resources and fertility, however within each group fertility correlated positively with measures of material resources (Alvergne & Lummaa, 2014). More recently, Colleran found that within communities in rural Poland, associations of non-farming and farming wealth with fertility were generally positive after controlling for market integration and education (Colleran et al., 2015).

Assessing empirical support for the model is difficult due to data and measurement issues. Researchers have argued that data limitations have inhibited clear tests of the model, particularly in comparative contexts (Colleran et al., 2015; R. L. Hopcroft, 2006; Stulp, Sear, Schaffnit, Mills, & Barrett, 2016b). A key component of this critique is disentangling key concepts, such as economic capacity and market opportunity, from standard measures of parental socioeconomic status. Disentangling economic capacity and market opportunities is important because they are argued to have distinct, interactive, or even opposing effects on fertility (Colleran et al., 2015; Shenk et al., 2016). However, historical and cross-sectional datasets often use measures that conflate market opportunities with economic capacity.

Different measures of parental socioeconomic status may differentially confound parental economic status and market opportunities available to their children. For example, parental education may more strongly reflect market opportunities than economic capacity. Consistent with this expectation, parental education is robustly associated with investing more in each of fewer children (Skirbekk, 2008).

Even something as apparently simple as parental wealth may reflect both parental economic capacity and market opportunities available to their children. For example, asset-based wealth measures commonly used in large demographic datasets most commonly reflect the kinds of assets that can be accumulated with cash and engagement in market economies (e.g. TVs, cell phones, concrete walls, tin roofs) (Bingenheimer, 2007; Hruschka et al., 2017)(Rutstein & Johnson, 2004). As such, these measures reflect the outcome of a history of engagement in specific types of economic production, and exposure to distinct suites of opportunities to accumulate different sorts of material assets and manage reproduction. For this reason, these measures of material wealth not only reflect the economic capacity of a household, but also the extent to which households are exposed to, and can capitalize on, market opportunities.

Many measures of wealth conflate these two concepts because they reflect both accumulation of resources and engagement with specific economies. Here we propose an additional means of disentangling economic capacity and market opportunities by estimating alternative measures of wealth that do not carry the same biases as standard asset-based measures. In contrast to a one-dimensional model of material wealth, a multidimensional model of wealth suggests that different asset-based indicators of wealth

reflect not only the economic capacity of a household, but also a proxy for engagement in different types of economic production. Engagement in these distinct dimensions may create suites of opportunities and constraints for households that are not captured in one-dimensional approaches to estimating material wealth. These opportunities and constraints are particularly important for understanding the nature of the reversals between wealth and fertility. For example, success in the agricultural economy requires that parents make very different decisions regarding investments in human capital compared to households engaged in the livelihoods grounded in the cash economy. The returns to investments in education and to reduced fertility may vary widely when households are predominantly engaged in professional wage-labor versus households engaged in predominantly agricultural production (Hedges et al., 2016).

To address this concern, recent studies have focused on agricultural measures of material wealth and the effects on fertility, particularly in mixed economies where traditional livelihoods exist alongside market opportunities (Colleran et al., 2015; Garenne, 2015). In previous work, Colleran has pointed to the need to include multiple forms of wealth, particularly traditional and market-based, as a means of disentangling economic capacity and engagement in the market economy. Indeed, in here study of farming communities in rural Poland she includes measures of both farming and non-farming wealth, based on ownership of different suites of assets. Furthermore, she used independent indicators of market integration using employment status and occupation categories. The ability to capture more direct measures of "traditional" and "modern" wealth is a strength of using primary data in small-scale or regional studies. However, these studies tell us little about the effects across a broader range of global contexts. To better understand the process of demographic

change in the contexts of market integration, the changes in the importance of different types of material wealth, and the suites of opportunities that accompany economic development, we need comparative data. Colleran states the problem clearly:

> Many studies focus on either pre-DT or post-DT populations, where measures of wealth and status- and the cultural and economic contexts in which they matter- differ dramatically. This heterogeneity makes it difficult to compare the magnitude and variation of effects across study sites, or to identify points on a continuum of change. More detailed comparative studies are needed in transitioning populations where both 'traditional' and 'modern' forms of wealth and status influence fertility. (Heidi Colleran, Jasienska, Nenko, Galbarczyk, & Mace, 2015, pg.35)

Disentangling agricultural and market-based wealth in worldwide sample. We address this need for more detailed cross-population studies of diverse wealth effects on fertility by assessing effects of measures of "agricultural" and "market-based" forms of wealth on fertility in 472,812 households, across 90,425 sampling clusters, across 114 surveys in 56. Data come from the Demographic and Health Surveys, which collects detailed information on household assets, construction, and access to services, alongside demographic data. The DHS surveys are conducted in low and middle income countries and countries that receive US foreign aid, with a number of countries containing multiple waves. In the last two decades, the DHS have also begun collecting data on livestock ownership and land-ownership, which have been used to estimate indices of traditional or agricultural wealth (Garenne, 2015; Hruschka et al., 2017).

Researchers have applied data reduction techniques to use these data to generate multiple orthogonal dimensions of material wealth (Hruschka et al., 2017). Using an MCA approach, researchers are able to identify multiple dimensions of wealth that reflect engagement in the market economy and agricultural economy. The MCA approach has deep commonalities with the data reduction techniques used to estimate typical wealth indices from asset data. Households are represented in a multidimensional livelihood space, where distances between data points are determined by shared ownership in suites of assets and access to services. The MCA then successively identifies the dimensions that capture the most variation in the cloud of households. These dimensions represent composite measures of material wealth along different dimensions, with distinct suites of assets and services carrying different weight along each dimension. Households are then assigned values along each dimension of wealth, permitting researchers to identify individual households and mean household position in the multi-dimensional livelihood space based on similarities in asset ownership.

We use this technique on a large database of demographic and health monitoring surveys from low- and middle-income countries worldwide to assess the effects of multiple forms of material wealth on total fertility. We use these multiple measures of wealth to assess the links between economic capacity and market opportunities with completed fertility. First, we assess the associations between agricultural and market wealth on fertility and the extent to which these effects vary across populations. We expect market-based wealth to be generally negatively associated with fertility, as it also reflects a family's access to market opportunities as much as their economic capacity. By contrast, we expect agricultural

wealth to be positively associated with total fertility as it is a more direct measure of economic capacity with little reflection of market-based opportunities.

Second, we assess the overall effect of economic capacity and market opportunities on fertility by exploring the association between the market wealth and agricultural wealth across populations. Using both measures of wealth in a latent variable structural equation model, we estimate how agricultural and market based wealth reflect economic capacity, and how education and market wealth reflect market opportunities. The modelling approach permits 1) estimating economic capacity and market opportunities as independent latent variables and 2) their overall effect on fertility outcomes across a broad range of populations currently undergoing transitions to low fertility.

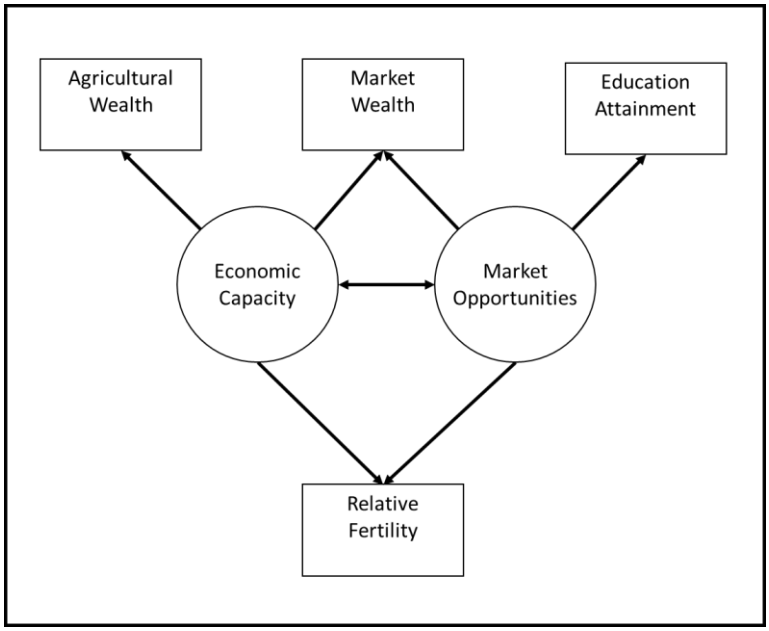

Figure 2. Latent variable model estimating economic capacity and market opportunities.

Current Study

Starting from a database of 307 harmonized DHS datasets ranging from 1989 to 2016 we estimate multiple dimensions of wealth independently for each survey. These dimensions reflect engagement and success in the market-based economy and the agricultural sectors. We limit the analysis to those countries that we can reliably estimate market and agricultural dimensions of wealth, 2) had data on completed fertility for women aged 40-50. We split the analysis between urban and rural samples, given the nature and meaning of wealth may vary across contexts with different suites of social and economic opportunities for pursuing different livelihoods.

This resulted in 114 surveys across 56 countries. Sample sizes varied across the 114 surveys, ranging from the low of n=322 for Malawi 2012 to the high of n=49,295 for India 2015. Figure 3 maps the countries used in the analysis, where reliable measures of both wealth dimensions were estimated.

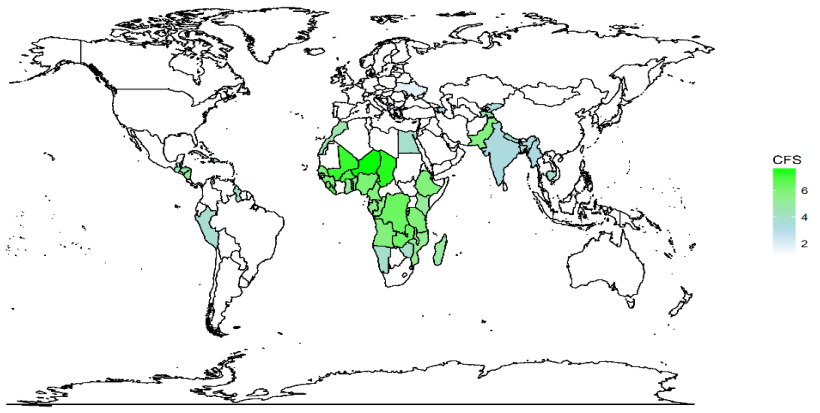

Figure 3. Countries included in the analyses. Color codes indicate mean completed family size of women 45-49.

As described below, we then center all variables at the community level in order to capture local dynamics and focus on how wealth is associated with increased or decreased fertility relative to the community mean. Such an approach captures anthropologist's sentiments about the primacy of local-level resource and status competition (Colleran, Jasienska, Nenko, Galbarczyk, & Mace, 2014a; Colleran & Snopkowski, 2018). Using community centered measures of material wealth and fertility we use mixed effects models to assess the effects of market-based wealth, agricultural based wealth, and education on relative fertility. The mixed effects models permit estimating unique slopes for each of the surveys in the dataset, and estimating the variation in the effects across all countries.

Next, we assess the relationship between the effects of multiple forms of material wealth on fertility. To do this we employ a multi-group structural equation model (see Figure 2). This allows us to estimate the economic capacity and market opportunities as independent latent variables and assess their effects on fertility across the populations in the sample. Again, we expect market opportunities to negatively impact fertility, while economic capacity is predated to be positively associated with fertility.

Methods and Measures

Relative Wealth Indices. We follow the procedure outlined in Hruschka et al 2017, where household-level wealth dimensions were computed for each country individually. Variables used to estimate the dimensions included source of drinking water, electricity, wall, roof and floor construction material, sanitation, cooking fuels and material asset ownership like bikes, radios, televisions, and cellular phones. Household holdings of cattle, cows, sheep, chickens, horses, goats, and country-specific animals were also included. Finally,

household land holdings were included. All household assets and services were coded as present/absent, while nominal variables, such as flooring and wall construction materials were harmonized across all surveys and then dichotomized. Continues variables, such as cattle holdings were binned into categories and then dichotomized. The total number of dichotomized / discretized variables used for each country ranged from 11 to 204. (Mean=93, SD=56)

The multiple correspondence analysis was applied separately to each survey, using a household by variable matrix. The MCA procedure produced 4 orthogonal dimensions of wealth, however we only retained 2 wealth dimensions that had acceptable internal reliability and clear interpretations of reflecting either the market-economy or the agricultural sector. Reliability was assessed using Cronbach's alpha of <0.7. We conduct a sensitivity analysis in the supplemental materials using both a stricter reliability threshold (alpha >0.79), and a more relaxed threshold (alpha >0.60).

To identify clear interpretations of the dimensions, we anchored them using a suite of anchoring variables (see supplemental materials for detailed description of the anchoring procedure.). For each country, we assign households a score along each dimension, and examine the relationships between these scores and household characteristics, ownership of specific assets, and access to specific services. For the market wealth dimension, we examined the relationship between dimension scores and ownership of a television, refrigerator, electricity, and rural or urban residence. We also compared the DHS wealth index against the market wealth dimension produced from the MCA procedure. For

anchoring the agricultural dimension, we examine the relationship between land and livestock ownership, and rural or urban residence.

The MCA procedure produces a ranking of households along each dimensions for the all households included in that survey. In other words, the indices produce a population-level relative ranking of households along each dimension. To assess the local, relative effects of both measures of wealth, we center each household's measures of wealth, fertility and education relative to the cluster mean. The sampling cluster is the lowest level of geographic scale in the DHS sampling strategy. Clusters reflect sampling units within subdistricts (akin to states in the US), and usually represent about 20-50 households that are in relatively close proximity to each other. 95% of the PSU's have between 1 and 80 individuals represented in the dataset, despite the range realistically going as high as 800 (Supplemental Materials figure of psu size).

This centering permits estimating a household economic position relative to the community mean rather than the country. This is the level in which we would expect to see wealth effects on fertility. It is precisely in these local contexts, where the distributions of opportunities and resources shape what economic pathways are feasible. Furthermore, local social contexts provide the suite of behavioral strategies deemed acceptable behavior (Bachrach & Morgan, 2013; Colleran, Jasienska, Nenko, Galbarczyk, & Mace, 2014b; Johnson-Hanks, Bachrach, Morgan, & Kohler, 2011; Kertzer, 2013). Centering all measures at the cluster level permits estimating the relative effects of wealth and education on fertility while holding community-level differences constant.

Relative Education. Similar to wealth, the effects of education on fertility may be context specific. There are several reasons that parental education can be associated with lower fertility. First, parents may delay reproduction in order to continue pursuing higher education, and secure higher paying jobs. Second, parental education can increase the returns to their children's education in several ways as described above. We use number of years of education which ranged from 0 to 15 across all surveys. As with wealth we center on the community-level mean at the level of the sampling cluster.

Relative Total Fertility. We used total children ever born for all women age 40-50 yrs old. Survey average completed family size ranged from the low of 1.8 in Ukraine 2007 and 2.3 in Modlova 2005 to the high of 7.6 in Niger 2012 and 7.5 in Chad 2015. Across all surveys the mean total fertility was 5.2 (SD=1.3). As with the wealth and education measures, we center fertility on the community mean total fertility of surveyed women 40-50 yrs old.

Analysis

We first present the descriptive and bivariate statistics for all variables included in the models. We then report the results of the MCA in generating reliable wealth estimates. We give a brief review of the associations with the anchoring variables used to interpret the market wealth index and the agricultural wealth index.

To assess the associations between both measures of wealth on fertility, we fit a multi-level linear model with the outcome completed fertility relative to the community mean. The multi-level modelling approach permits explicit modelling of the cross-

population structure of the data and can assess how the relationship between wealth, education, and fertility varies across different populations. Since variables are centered at the community level, we do not include random intercepts, however we permit the slopes for the effects of market wealth, agricultural wealth, and education to vary across surveys. To estimate survey-specific effects of market wealth, agricultural wealth, and education, we use the conditional modes of the random effects (using restricted maximum likelihood REML), which are similar to the Empirical Best Unbiased Linear Predictions (EBLUPs) from linear mixed effects models (Bates, 2010; Bates et al., 2017; Zuur, Ieno, Walker, Saveliev, & Smith, 2009). Finally, because the meanings and effects of wealth and educations can vary across rural and urban contexts in different ways both within and between countries, we chose to split the analysis by urban and rural residence.

The multi-level model provides estimates of the effects of the wealth and education measures on fertility. To test whether market-based wealth measures conflate economic capacity and market opportunities, we employ a multi-group latent variable structural regression model (Kline, 2015). In the model, we use market wealth, agricultural wealth, and education to estimate two latent factors – economic capacity and market opportunities – which are then regressed on relative fertility (See Figure 2). This model represents a first attempt at partialling the effects of market opportunities from economic capacity in standard asset-based wealth measures. Furthermore, it provides a first approximation of the relative magnitude of the positive effects of economic capacity on fertility relative to the negative effects of market opportunities.

The full latent variable structural regression model can be seen as two separate models that are estimated simultaneously. The first model, called the measurement sub-model, estimates the latent variables from the indicators. The second part of the model, called the structural sub-model, uses the estimated latent variables as predictors in a linear regression with fertility as the outcome for each population.

In the model, the latent variable economic capacity captures the covariance between effects of agricultural wealth and market wealth on fertility. As both measures reflect the economic capacity of the household, the shared variance reflects this. The latent variable for market opportunities captures the covariance between market wealth and education. We estimate two latent variables with three correlated indicators. In SEM models, estimating a latent variable with only two indicators requires special conditions. Since we are estimating two latent variables with three indicators, a key requirement is the residual variances of the indicators cannot be correlated with each other (Kenny, n.d.; Kline, 2015). Correlated residual variance, or errors, reflect the indicators have something in common that is not captured by the latent variables. We assess the correlated residual variance of the indicator variables in SM.

Additionally, to set the scale of the latent variables, the factor loading of one of the indicators needs to be fixed. This sets the scale of the latent variable to the same scale as the indicator variable. This marker-indicator approach to setting the scale of the latent variable is commonly used. We use the marker-indicator approach to scaling the latent variables, using agricultural wealth as the indicator for economic capacity, and education as the indicator for market opportunities. Our model was sensitive to setting the values of the

indicator variables, and convergence issues occurred when setting values to 1. Running a multi-group sem across 114 different surveys, particularly with a measurement model that has relatively few indicators, can often result in convergence issues (Kenny, n.d.). Most prominently are Heywood cases, where estimated variances are negative. All of the Heywood cases were resolved when re-scaling the latent variables by setting the reference indicators between 0.4-0.7, rather than the standard 1. All reference scales are included in the SM. Here we report the standardized estimates for the measurement model, where standardization is based on the variance of the latent variables. We report the completely standardized coefficients, where standardization is based on the variance of latent variables and observed variables, however this does not allow for computing standard errors (Kenny, n.d.; Kline, 2015).

As with the multi-level model, we estimate the sem by urban and rural samples independently. We first estimate the models on the full sample, without accounting for population differences. We then assess the same models for each population in the sample using multi-group specification. We examine the sign and magnitude of the parameters in the structural model for each population, as well as the distribution of these parameters across all populations, to assess whether economic capacity and market opportunities are associated with relative fertility in the predicted directions. Assessing the mean and standard deviation of the model parameters across allows for a simple description of the between country variation in the effects of the estimated latent variables on fertility.

For each of the SEM models, we assess model fit using a number of standard model fit indices. The standard chi-square test assess discrepancies between the model and the

observed data in the covariance structures. However, this test becomes less reliable with large samples, and very small discrepancies can result in failing this model test. While we report this statistic, we focus more on relative, or incremental fit indices, which reflect how well the model fits the data relative to a null model. We use the CLI and the TLI for these, which have standard threshold cutoffs of greater than 0.95 as indicating good fit (Kline, 2015). We also report the RMSEA which is a widely used measure of model fit that unlike the Chi-square the RMSEA is relatively invariant to large increases in sample sizes (https://www.rasch.org/rmt/rmt254d.htm). The RMSEA has standard thresholds of less than 0.05 for a good fit (Kline, 2015).

Results

Multiple dimensions of household wealth. Out of the 307 total available DHS surveys, the MCA procedure identified at least two reliable wealth dimensions (Cronbach's alpha >0.70) with clear interpretations for 114 surveys from 56 countries (Figure 1). The first dimension of wealth identified for each country reflected success within the market economy. As with Hruschka et al 2017, we compared the first dimension identified by the MCA with the original DHS wealth factor score. This first dimension was strongly associated with the DHS wealth index factor score, with correlations ranging from a low of 0.67 to a high of 1.0 (mean r=0.95, SD=0.045). Only nine of the 114 had a correlations coefficient below a 0.90, and only two were below 0.80. This dimension clearly captures the same variance in household asset ownership and access to services as the original DHS wealth index.

For the Agricultural wealth measure, we used land and livestock ownership in order to anchor the dimension. The average association between the agricultural wealth measure and ownership of livestock ranged from a low of r=0.16 to a high of r=0.84 (mean r=0.47, SD=0.14). The average association between the agricultural wealth measure and ownership of land ranged from a low of 0.06 to a high of 0.61 with a mean of r=0.34 (SD=0.13).

Urban

	Fertility	Market Wealth	Agricultural Wealth	Education
Fertility	1.00			
Market Wealth	-0.16	1.00		
Agricultural Wealth	-0.04	0.39	1.00	
Education	-0.23	0.37	0.21	1.00

Rural

	Fertility	Market Wealth	Agricultural Wealth	Education
Fertility	1.00			
Market Wealth	-0.12	1.00		
Agricultural Wealth	0.03	0.13	1.00	
Education	-0.12	0.32	0.12	1.00

Table 1. Correlations of Model Predictors. The correlation between all model predictors and the outcome variable split by urban and rural samples.

The agricultural and market-based wealth dimensions were not highly correlated across surveys, with the average correlation of (r=0.04). This was expected given the MCA estimates orthogonal dimensions. However, once anchored the wealth measures were centered at the cluster level. These centered measures showed more variation in their association with each other than the raw, un-centered wealth scores. Table 1 presents the correlations for the full dataset. As expected, market wealth and education have a negative association with fertility. Furthermore, education and market wealth are positively associated in both urban and rural settings. Notably, in urban settings agricultural wealth is positively associated with both market wealth and education. Examining the same set of correlations by survey show similar results.

Multi-level Model Results

Effects of Market wealth, agricultural wealth and education on fertility.

Results of the multilevel models are presented in Table 3 and Figures 3 and 4. The association between market-based wealth and fertility was consistently null or negative. The average model coefficient for market-based wealth effects on completed fertility was b=-0.63 (-0.72,-0.55) for rural and b=-0.54 (-0.61,-0.47) for urban populations.

	Urban		Rural	
	Coef	95% CI	Coef	95% CI
Fixed Effects				
Intercept	0.00	(-0.01, 0.01)	0.00	(-0.01, 0.01)
Market Wealth	-0.54	(-0.61, -0.47)	-0.63	(-0.72, -0.55)
Agricultural Wealth	0.19	(0.15, 0.24)	0.15	(0.1, 0.19)
Education	-0.69	(-0.75, -0.64)	-0.49	(-0.56, -0.41)
N	157,852		267,187	
ngroups	114		114	
Variance Components				
Market Wealth	0.11		0.16	
Agricultural Wealth	0.04		0.05	
Education	0.07		0.12	
Residuals	4.11		5.66	

Table 2. Multi-level Model Results.

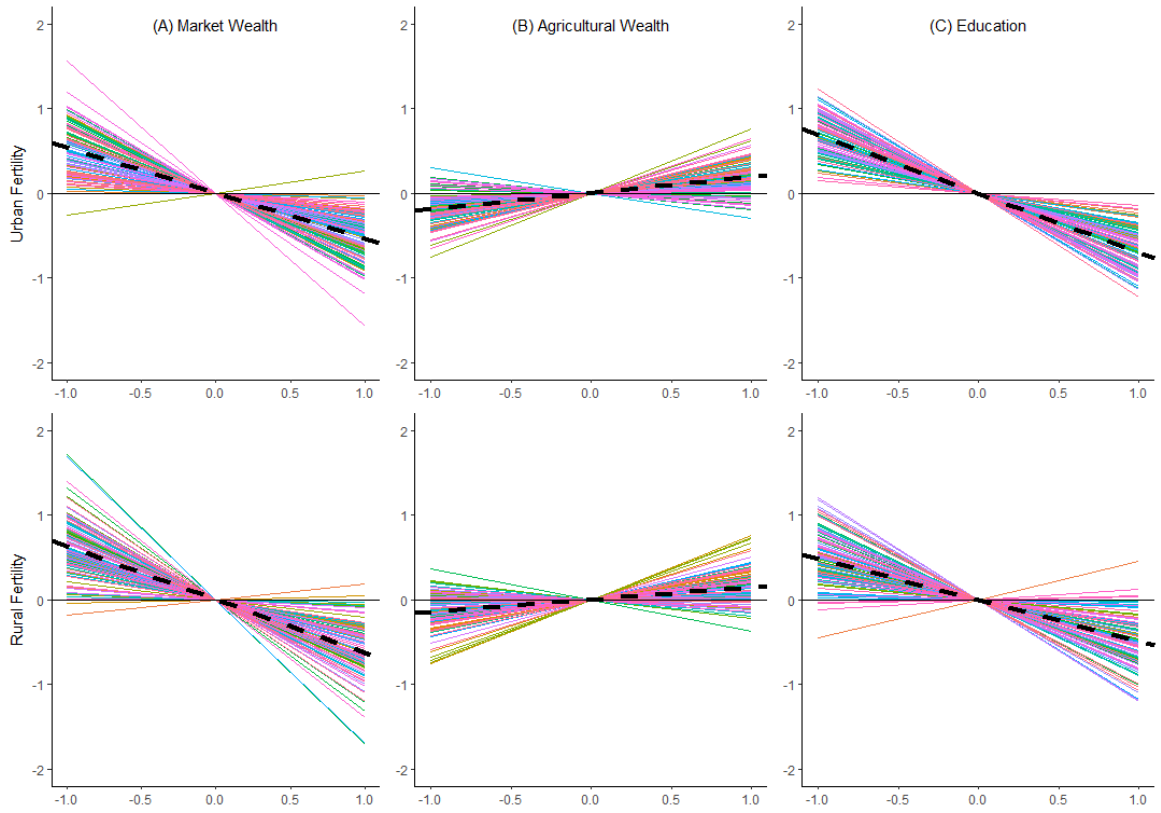

Figure 4. Survey specific slopes for the effects of Market Wealth, Agricultural Wealth, and Education across surveys. Top panel reflects urban samples and the bottom is rural.

These results show that on average a 1 SD increase in market-based wealth above the community mean is associated with more than a half child reduction in total children born for both rural and urban populations. We found similar results for the effects of relative education on completed fertility. The model average coefficient was negative for both rural (b=-0.49, [-0.56,-0.41]) and urban samples (b=-0.69, [-0.75,-0.64]). Thus, on average, a year increase in education relative to the community mean is associated with approximately a half child decrease in total offspring. The model average coefficient for agricultural wealth was positive in both urban (b=0.15, [0.10, 0.19]), and rural contexts (b=0.19, [0.15, 0.24]). Thus,

a standard deviation increase in agricultural wealth relative to the community mean is associated with a small but significant increase in number of offspring.

Latent Variable Model Results

Assessing Model Fit. We first ran the latent variable structural regression model on the full sample split by urban and rural residence. Overall, the two models showed acceptable fit using three of the four metrics (Table 3). The chi-square test indicated the models did not adequately predict the data, however, this is typical of large-sample studies (Kline, 2015). An examination of the residual correlations, or the difference between the observed and model predicted correlations showed the model did not over or under-estimate the correlations by any significant margin (typically greater than 0.1(Kline, 2015). Both models exceeded acceptable thresholds (>0.95) for model fit for the CFI and the TLI, as well as the RMSEA (<0.05). For urban samples, the multi-group SEM had acceptable fits for the TLI, CFI and the RMSEA. For rural samples in the multi-group SEM, the model fit statistics passed acceptable thresholds for the CFI and the RMSEA.

	Urban	Rural	Multi-Group Urban	Multi-Group Rural
	Value	Value	Value	Value
Chi Square Test	**677.9**	**1292.1**	**2660.5**	**3229.5**
CFI	0.99	0.97	0.97	0.95
TLI	0.98	0.95	0.95	0.93
RMSEA	**0.03**	**0.04**	**0.05**	0.05
Groups	1	1	113	113
Df	4	4	452	452
N	157,232	264,282	157,232	264,282

Table 3. Fit statistics for the SR Models.

The Measurement Sub-Model: Estimating the Latent Variables. The results of the SEM models are presented in Table 4 and Figure 5. The results of the measurement sub-model – the part of the model estimating the latent variables from the measures of wealth and education – are presented as the fully standardized solution. This allows for a interpreting the coefficients as standardized regression coefficients, and permits comparisons within and between models on a similar metric. The measurement sub-model shows both agricultural wealth and market-based wealth are association with economic capacity but the association with agricultural wealth is twice as strong as market wealth. The association of economic capacity with both wealth measures were strongest in urban settings, both in the full model and multiple group model. In rural settings, economic capacity had a strong association with agricultural wealth, but a much weaker and more variable association with market wealth. Second, The latent variable market opportunities is positively associated with market wealth and education in all models, though the associations between the indicators and latent were weaker in the multigroup sample. Across all the models, the estimates of economic capacity and market opportunities are positively associated with a correlation ranging from r=0.2 in the multigroup rural to a r=0.47 in the urban full model. Finally, education is positively associated with market opportunities.

The Structural Sub-Model: Latent Variable Regression. For the structural model, the coefficients are presented as the unstandardized coefficients. In contrast to the measurement portion of the model, the unstandardized coefficients have a meaningful interpretation. In the full sample models, a 1 sd increase in economic capacity was associated with 0.37 and 0.23 increase in fertility in urban and rural samples. In the multi-group models, the average coefficients were also positive. In urban samples the effects were

0.4 increase in relative fertility for every 1 sd increase in economic capacity. Additionally, 42% of the models found significant positive effects of economic capacity on fertility. However in the multi-group rural model, the average effect of economic capacity was much lower, only 0.17 increase in fertility for a 1 sd increase in economic capacity.

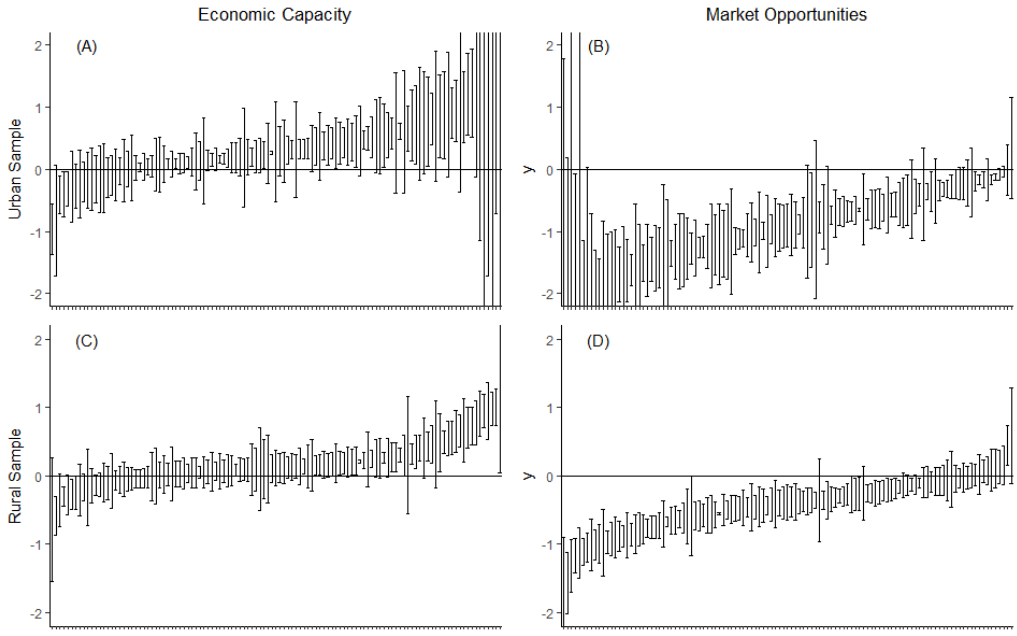

Figure 5. The results of the latent variable regression model by urban and rural samples. The effects of economic capacity in urban (A) and rural (C) are significantly positive in 42% cases in the urban model and 35% of cases in the rural model. The effects of market opportunities in urban (B) and rural (C) samples were largely negative with 82% and 75% of cases reporting significant negative associations in urban and rural samples.

While 35% of the samples found a significant positive effect in the multi-group rural samples. The effects of market opportunity on fertility were negative across all models. Additionally, the effects of market opportunities were much stronger than those of economic capacity. In the full sample models, the effects of market opportunities were close to an average reduction of a full child for every standard deviation increase in market

opportunities. In the rural sample the average reduction of a full child was observed for every two standard deviation increases in market opportunities. In the multi-group models, the results for urban samples were qualitatively similar to the full sample model. That is for an average increase of 1 sd in market opportunities, women had over a one child reduction in fertility, with 82% of the sample having a significant negative effect on fertility. In the rural sample, the average effects of market opportunities on fertility were -0.44, where a 1 child reduction in fertility is associated with over a 2 sd difference. However, the small effect is somewhat robust as a significant negative effect was found in 75% of the samples.

Discussion

The results show that the effect of wealth on fertility depends critically on how wealth is measured and interpreted. Our two wealth measures showed both positive and negative associations with fertility across a broad range of populations. Consistent with our expectations, market wealth showed negative associations with fertility, while agricultural wealth tended to show more positive associations. Additionally, using these two measures we estimated latent variables to disentangle the effects of economic capacity and market opportunities from standard asset-based wealth measures. Again, consistent with our expectations market opportunities had a strong negative association with fertility, while economic capacity had positive impacts on fertility, though generally much weaker. These results suggest a new interpretation for the puzzling associations between wealth and fertility found in populations undergoing fertility transitions. Rather than capturing fertility differences between households with different levels of economic resources, these

associations are capturing households that vary across the types of livelihoods they are engaged in and the market opportunities available to their children.

Furthermore, when accounting for variation in market opportunities, households with greater economic capacity still tend to have relatively higher fertility than households with less economic capacity. This suggests that much of the puzzling associations between wealth and fertility may reflect the inability of current approaches to properly disentangle market opportunities and economic capacity. Indeed, the majority of economic and evolutionary theories of low fertility point to the influence of modern competitive wage labor economies as the primary driver of fertility declines. However, as market economies develop and take hold in a population, households vary in their ability to access and take advantage of novel economic opportunities offered by expanding markets. Households with greater opportunities to turn costly investments in education into greater socioeconomic success are more likely to engage in a low-fertility, high-investment strategy.

Clearly there is a need to better capture variation in market opportunities both populations undergoing economic development and industrial low fertility populations. Studies that use education as a proxy for market opportunities are increasingly finding null or positive associations between economic capacity and fertility in both populations undergoing fertility transitions (Colleran et al., 2015), and in low-fertility industrial populations (R. Hopcroft, 2017; Stulp, Sear, Schaffnit, et al., 2016a). However, measuring market opportunities outside of populations undergoing market integration have been difficult, resulting in the reliance on education, and rural or urban residence for rough proxies(Mattison & Neill, 2013; Neill, 2010; Skirbekk, 2008).

	Urban Sample		Rural Sample		Multi-Group Urban Sample			Multi-Group Rural Sample		
Measurement Sub-Model	Std β	SE	Std β	SE	Mean Std β	Std of Coef	Prop Sig.	Mean Std β	Std of Coef	Prop Sig.
Latent Factor Loadings										
Market Wealth *Economic Capacity	0.39	0.01	0.09	0.00	0.25	0.25	0.81	-0.03	0.42	0.86
Agricultural Wealth * Economic Capacity	0.70	0.00	0.58	0.00	0.55	0.14	1.00	0.98	0.17	1.00
Market Wealth* Market Opportunities	0.34	0.00	0.42	0.00	0.22	0.22	0.74	0.26	0.17	0.88
Education * Market Opportunities	0.57	0.00	0.69	0.00	0.39	0.25	1.00	0.78	0.14	1.00
Latent Covariance										
Market Opportunities *Economic Capacity	0.47	0.01	0.29	0.01	0.39	0.25	0.82	0.20	0.18	0.65
Structural Regression Sub-Model	B	SE	B	SE	Mean B	Std of B	Prop Sig.	Mean B	Std of B	Prop Sig.
Intercept	0.00	-0.05	0.00	0.00	-0.01	0.03	1.00	0.00	0.01	1.00
Economic Capacity	0.37	0.01	0.23	0.00	0.40	0.65	0.42	0.17	0.32	0.35
Market Opportunities	-0.95	0.01	-0.53	0.00	-1.05	0.84	0.82	-0.44	0.40	0.75
Groups	1		1		113			113		
N	157,232		264,282		157,232			264,282		

Table 4. Results of the SEM and Multi-group SEM Models.

The findings from the multi-level model differ in a number of substantial ways from a recent cross-population analysis using the same DHS datasets. Using the same set of surveys, Colleran and Snopkowski found more variation in the effects of market-based wealth on fertility, with a number of surveys showing positive associations between market

wealth measures and fertility (Colleran & Snopkowski, 2018). However a number of reasons could account for the differences. First, we focused solely on completed fertility, for women 40-50 years of age, while Colleran and Snopkowski analyze age-specific fertility. The effects of economic capacity on fertility can vary across different stages of the reproductive period, as wealth can speed up or slow down progression through multiple offspring. Second, the differences could be a result of how we center at the community level. We focused our attention on how household wealth, relative to the community mean, was associated with increased or decreased total fertility relative to the community mean. Colleran and Snopkowski included a measure of community level fertility to account for within community dynamics but left the wealth indices scaled to population level rankings.

There are a number of important limitations and caveats to interpreting the structural regression models. First, we clearly need more indicators for the latent variables in order to fully assess the constructs in the measurement model. Our ability to estimate the latent variables rests on the covariance structures in the indicator variables. Using only two indicator variables for each latent construct resulted in a relatively unstable model. For example the SEM model faired worse in rural settings, with relatively poorer scores on model fit indices. One reason for this could be the low covariance between the indicator variables in rural settings. Without a significant amount of shared variance it is difficult to estimate reliable latent variables. One possibility is that this is the results of poor measurement. Another is that these are truly orthogonal, and reflect that in many contexts success along one dimension carries steep trade-offs with success along another dimension. To assess these two possibilities we need more indicators of market opportunities and economic capacity. Two important candidates to include in future work are occupation

types and employment status of individuals and heads-of-households. Similar to stocks of assets, these directly reflect a household's engagement with wage-labor employment and also proxy success in competitive labor economies. While the DHS surveys do collect data on occupation and employment, the types of occupations available and their meaning across contexts can vary significantly.

Despite these limitations, the SR model provides a first attempt at disentangling key features of the quality-quantity trade-off model in developing contexts and market economies. Estimating these effects in a multilevel model would be ideal but given the data limitations we would not be able to identify the model. Adding random slopes and intercepts to either the measurement model or the latent variable structural model would increase the number of parameters estimated beyond the amount feasible given the number of observed variables included in the model.

Conclusion

Commonly used measures of wealth tend to capture both economic capacities, as well as a history of engagement in specific suites of livelihoods. For standard asset-based wealth measures used in demographic and health surveys, the bias towards market-oriented goods and services means the measure tracks not only household economic capacity but also serves as a proxy for market opportunities. When these wealth measures are treated uncritically as simply reflecting economic capacity they can limit our ability to draw inferences about how economic disparities shape health and reproductive outcomes. Our results highlight the need to estimate multiple, varying forms of wealth and status in order to disentangle the effects of market opportunities from economic capacity. While

anthropologists have focused on estimating multiple forms of wealth and status in community studies, this is difficult in large secondary datasets often used in evolutionary demography. Our method draws on recent changes to demographic and health monitoring surveys where data on livestock, land, and other agricultural assets are used to estimate measures of wealth that track success independent of market opportunities. Using multiple measures of wealth, we were able to estimate the independent effects of economic capacity and market opportunities on relative fertility. We showed that across a broad range of contexts, economic capacity typically has a positive association with fertility. However, this positive association is often masked by a strong, negative association between fertility and a household's engagement in the market economy. Accounting for household-level variation in market opportunities and relying on multiple measures of household economic capacity are key steps to refining theories about how households make reproductive and parental investment decisions both within and between populations.

CHAPTER 5

DISCUSSION

The combined research illustrates the importance of market opportunities in shaping fertility and fertility declines. In the Guatemalan case, exclusion from social and economic opportunities that accompany economic development has resulted in ethnic differences in both fertility patterns over the past 30 years as well as differences in parental investments in education. However, the extent to which social and structural barriers to accessing market opportunities can be overcome through reliance on social connections seems to have a positive impact on Mayan families' decisions to invest in education, particularly for girls. In the case of the cross-national comparison, controlling for market opportunities provided evidence that households with more economic resources are still able and willing to convert those extra resources into greater reproductive output across a wide range of contexts.

Both of the empirical studies add to a growing body of work in evolutionary demography that is focused on within-population variation in fertility, particularly those undergoing fertility transitions (Sear et al., 2016). This so-called second wave of evolutionary demography is characterized by a greater attention to mechanisms that drive within and between population variation in fertility (pg 7). Both of the empirical studies presented in Chapter 2 and Chapter 3 focus explicitly on capturing intra-household variation in access to market opportunities as a primary means of explaining within population variation in fertility and parental investment decisions.

These studies contribute to a deeper evolutionary understanding of low fertility by expanding economic frameworks through explicitly disentangling wealth and status. Recently, economic models have been painted as necessary yet insufficient in explaining transitions to low fertility (Shenk et al., 2016), and are increasingly incorporating both cultural evolutionary dynamics and modelling alternative status as an alternative currency to fitness and resources (Colleran et al., 2015; Low et al., 2002; Snopkowski & Kaplan, 2014). Our explicit focus on market opportunities provides a novel approach to measuring status in market economies, as anthropologists have recently begun characterizing status as access to resources. Our results focus on how variation in access to competitive wage labor jobs can shape parental investment and fertility decisions both within and across populations.

Future Directions 1 – Social capital and fertility in an evolutionary framework

The focus on social relationships in Chapter 2 provides a new perspective to economically-oriented models of fertility in evolutionary demography, and a potential pathway for resolving debates regarding social and economic drivers of fertility declines. Demographic theories of fertility change have focused on changing social relationships as a causal determinant of declining fertility in a number of ways. Indeed, early architects of the classic demographic transition theory suggested the role of extended kin ties changed as people took advantage of the opportunities provided by economic development, urbanization, and industrialization (Davis 1945; Notestein 1945; Notestein 1953). In modern low fertility environments, people rely more on resources embedded in formal social institutions and success in skill-intensive labor markets rather than social relationships for important things (Handwerker 1986). In order to achieve cultural and economic success in new modern environments, social networks widen and non-kin interactions become

increasingly important (Handwerker 1986; Newson, et al. 2005). Effective and efficient formal social institutions allowed for less of a reliance on extended kin ties for important resources (Hruschka, et al. 2014).

An alternative to the quality-quantity trade-off hypothesis is that it is precisely this changing composition of networks that lowers fertility by shaping the social transmission of reproductive norms (Bühler and Philipov 2005; Colleran, et al. 2014; Colleran and Mace 2015; Newson, et al. 2007). Social networks are the channels in which ideas spread and norms are enforced, and network attributes appear to influence reproduction (Bernardi and Klärner 2014), including contraception (Lindstrom and Muñoz-Franco 2005; Montgomery and Casterline 1996). Fewer kin in social networks means less pressure to reproduce or pro-natal social influence (Newson, et al. 2007). The independent effects of kin influence and child-care support has yet to be tested empirically (Mathews and Sear 2008).

The rising costs of child-rearing and changing social networks offer two explanations for modern low fertility, though these might be linked through a common process. Both social influence and economic motivations play a role in declining fertility. Recent work has begun to draw these approaches together (Colleran, et al. 2014; Shenk 2009; Shenk, et al. 2016; Shenk, et al. 2013). One notable example is (Snopkowski and Kaplan 2014) where the authors predict that with differential gains from education, fertility strategies will cluster in social networks which then shape the flow of reproductive norms within the network. People rely on stocks of cultural knowledge to understand investment outcomes, and social learning is particularly important when environments are rapidly changing and long term outcomes are difficult to predict (Henrich and McElreath 2003; Richerson and Boyd 2008). Kaplan and Snopkowski's model is an important step in integrating the effects of social

influence and economic effects on fertility; however, what is missing is how social networks themselves directly shape the differential gains from education and market involvement.

A large body of work over the last 30 years has emphasized the importance of social capital in today's modern world(Bourdieu 1986; Knack and Keefer 1997; Lin 2002; Torsvik 2000). The social resources embedded in personal networks is a determinant of economic outcomes for both individuals (Coleman 1988) and households (Narayan and Pritchett 1999; Narayan and Pritchett 2000). Despite broad variation in theoretical definitions and empirical applications, the concept of social capital has been used extensively to understand the material benefits of sociality (Lin 2002; Portes 2000). The resources embedded in social networks shapes access and effectiveness of investments in education (Horvat, et al. 2003; Lai, et al. 2015), and economic outcomes in competitive wage labor economies (Burt 2000; Granovetter 1973; Marsden and Hurlbert 1988). This literature suggests an alternative process by which social relationships can lower fertility. Rather than through declining kin influence and child support, social relationships influence fertility by facilitating access to education and economic opportunities. However, the economic effects of these social relationships are not limited to kin support for childrearing; they also shape opportunities for education, employment, and marriage.

In a broader sense, there is an opportunity here for evolutionary social sciences to expand its theoretical and methodological tool-kit to understand how social relationships shape life-history trade-offs over the course of economic development. Anthropologists have been increasingly focused on relational wealth in understanding fitness differences, however the use of relational wealth in evolutionary demography is limited in two ways. First, population studies often rely on coarse-grain measures that can conflate other forms of

wealth, like education, income, or socioeconomic status. Second, relational wealth is itself diverse, and the ways in which relational capital can be accrued and utilized changes over the course of market integration and industrialization. The social capital literature in sociology has a long history of studying the material benefits of social relations (i.e. relational capital) in developing and industrial societies. The theoretical and analytic tools taken from social capital literature can be employed to address both problems in evolutionary approaches to low fertility. These tools offer means to take steps toward a systematic comparative study of the fitness effects of wealth by better understanding the different kinds of relational wealth that can be accrued within and between populations and the mechanisms by which they impact fitness.

Future Directions 2 – Estimating impact of market opportunities

Transitions in economic systems showed that different types of wealth increase importance in different economic systems (Colleran et al., 2015). In hunter-gather societies, wealth is food resources and linked directly to fertility through the impact of energetic resources on physiology. In addition, embodied capital, in the form of size, hunting and fighting skill, knowledge of local ecology are key determinants to access mates and fertility (CITE). As hunter-gatherers transition to agriculture, new forms of wealth become central determinants of reproduction. Particularly, extra-somatic wealth, typically in the form of land, livestock, and other material assets are increasingly associated with higher fertility (Borgerhoff Mulder & Beheim, 2011; Irons, 1983; Pérusse, 1993). However, through market integration, where systems of traditional subsistence economies are replaced by competitive wage-labor markets, the importance of embodied capital re-emerges in the form of education, employable skills, and occupational achievement.

In addition to the changes in the importance of different types of wealth, there is a shift in the kinds of material wealth that individuals pursue, and their relevance to different pathways to prosperity. For example, the positive associations between material wealth and fertility in pre-transition societies are often assessed using locally salient forms of wealth related to agricultural or subsistence economies, such as land, livestock, and other related forms of assets (Borgerhoff Mulder & Beheim, 2011; Cronk, 1991; Mace, 1998). However, the negative association between wealth and fertility observed in post-transition societies are often measured using either indicators of socioeconomic status (R. L. Hopcroft, 2006; Stulp, Sear, Schaffnit, et al., 2016a), or a suite of assets that indicate success in the market economy, such as consumer goods and services (Colleran & Snopkowski, 2018). Thus, over the course of the transition, and the changing associations between wealth and fertility, there is an associated change in the types of asset ownership that reflects different pathways to prosperity. The study presented in Chapter 3 explicitly addresses these by drawing on a broad range of assets in estimating multiple dimensions of wealth that reflect economic capacity and engagement in different livelihoods.

Increasingly, studies have focused more on this multifaceted nature of material wealth and the effects on fertility, particularly in mixed economies where traditional livelihoods exist alongside market opportunities (Colleran et al., 2015; Garenne, 2015). However, these studies tell us little about the effects across a broader context. As such, in order to better understand the process of this reversal, the changes in the importance of different types of material wealth, and the suites of opportunities that accompany economic development, we need comparative data. However, comparative data is hard to come by. Studies of wealth and fertility conducted in small-scale and less market-integrated societies

are able to collect wealth measures that capture the diversity of livelihoods and pathways to prosperity that are salient in the local socio-ecology. In contrast, broad national and cross-population studies often rely on large cross-sectional datasets that may lack the sufficient resolution to capture salient aspects of the local contexts and the multi-facetted nature of wealth in these contexts.

Treating market opportunities as a proxy for a certain form of status also permits studying the effects of status on fertility across a wide-range of populations undergoing the fertility transition. Consistent with anthropological conceptions of status, market opportunities reflect a certain form of access to resources through providing channels for turning education into income. Our ability to assess market opportunities across a wide-range of populations permits estimating the variable effects on fertility, and how the effects of wealth on fertility may vary as a function of market opportunities. In addition to the estimating the general range and interaction effects of wealth and status on fertility, a focus on market opportunities will help on-the-ground ethnographers identify how parental investments in reproduction might trade-off with investments in their own social status. In a given context, what types of investments do parents make that enhance their own market opportunities, and how do these investments shape other reproductive trade-offs? Understanding these intergenerational effects of parental investments in their own social standings should help reconcile low fertility high-investment strategies with an evolutionary framework based on the assumptions of fitness maximization.

Conclusion

The work presented in this dissertation directly contributes to a number of the aims of the second-wave' movement of evolutionary demography, and more broadly to expanding evolutionary approaches to understanding human fertility. First, this dissertation adds to a prominent evolutionary model of fertility by incorporating social relationships as a means by which parental investments in education translate into offspring socioeconomic success. Second, the work takes steps toward integrating evolutionary demography with neighboring social science disciplines, particularly sociology, through incorporating the social capital concept in the embodied capital theory. Finally, the work here adds methodological innovation by providing a novel approach to estimating the impact of market opportunities using large, cross-national data.

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APPENDIX I

CHAPTER 1

Experimental Vignette Study

Despite what appears to be a commonly stated set of norms reflecting low fertility and emphasizing the importance of education, the residents of Acatenango also frequently state that Mayan households are seen as less likely to be able to achieve these aims. We collected data from a vignette study to examine how people perceive individual and structural barriers to finishing education, having appropriate numbers of children, and the need to rely on child labor to overcome economic hardships. Data were collected from 110 households. We gave the following hypothetical description of a family, varying key characteristics. We were interested in whether participants saw individual characteristics like couple age and ethnicity would affect estimates of ideal and appropriate numbers of children, as well as the likelihood of investing in education, particularly in the face of economic hardships.

The sample size was too small to assess the full factorial design and interactions of all factors but we were able to assess the main effects of each of the factors. Controlling for participant, participant ethnicity, and vignette group and other factors, results showed that there are perceptions that Mayans are more likely to have larger family sizes and less likely to finish school and find a good job.

There is a couple who are **[18-20/early 30s].** They are **[mayan / ladino].** They live in a nearby **[aldea / town]** and have **[many / few]** children. The couple works **[in the fields / in town]**.

Based on you observation of other couples in the same or similar situation:

1. What do you think **[many / few]** children means for this couple?_____
2. How many children do you think would be best for this couple? _____
3. How likely is it that this couple will [**want?]** have another child?
4. How likely is it that this couple uses contraception to no longer have children?
5. How likely is it that all of the couple's children finish primary school?
    a. Secondary school?
    b. Get a good job in town or in the city?
6. If the couple is struggling to provide basic food goods for their family, or suffers from money problems, how likely will they be to have one of their children to quit school to start working to help the family?

In this hypothetical scenario, respondents perceived Mayan families as less likely to use family planning. Focusing on education and employment, Mayan families were perceived less likely to finish primary or secondary school relative to Ladinos, less likely to find a good job in urban settings. Finally, Mayan households were perceived as more likely to pull children from school to help contribute to the household during times of economic hardships. Figure S1 plots the odds ratios for the ethnicity factor for each of the response questions. The logistic regressions control for all the other factors, as well as participant ethnicity.

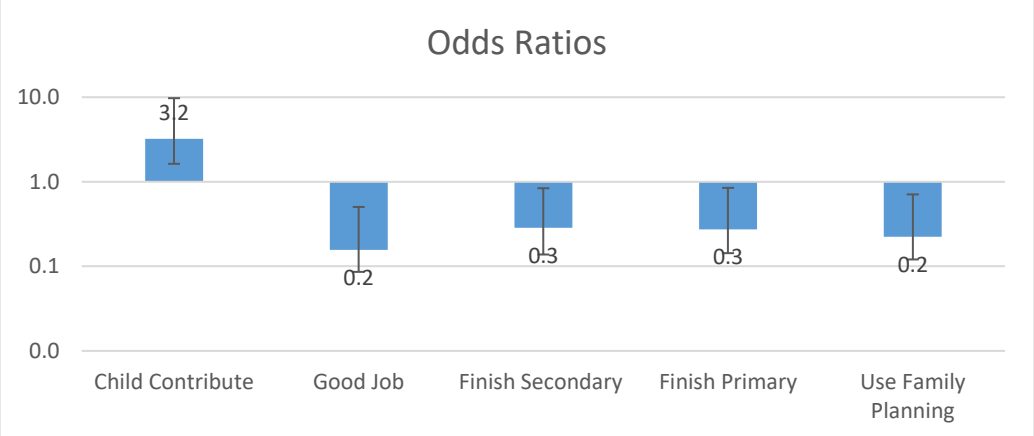

Figure S1. Odds ratios of agreement with the statements.

A key finding of this preliminary work was that Mayans saw themselves as less likely than Ladinos to be able to achieve these aims. These sentiments of Mayans perceiving less opportunities reflect sentiments about Mayan households perceived social standing in the community and in the country as a whole. In 2012, data from the community ladder question showed Ladinos are more likely to rate their social standing in both the community and the country as higher compared to Mayan respondents.

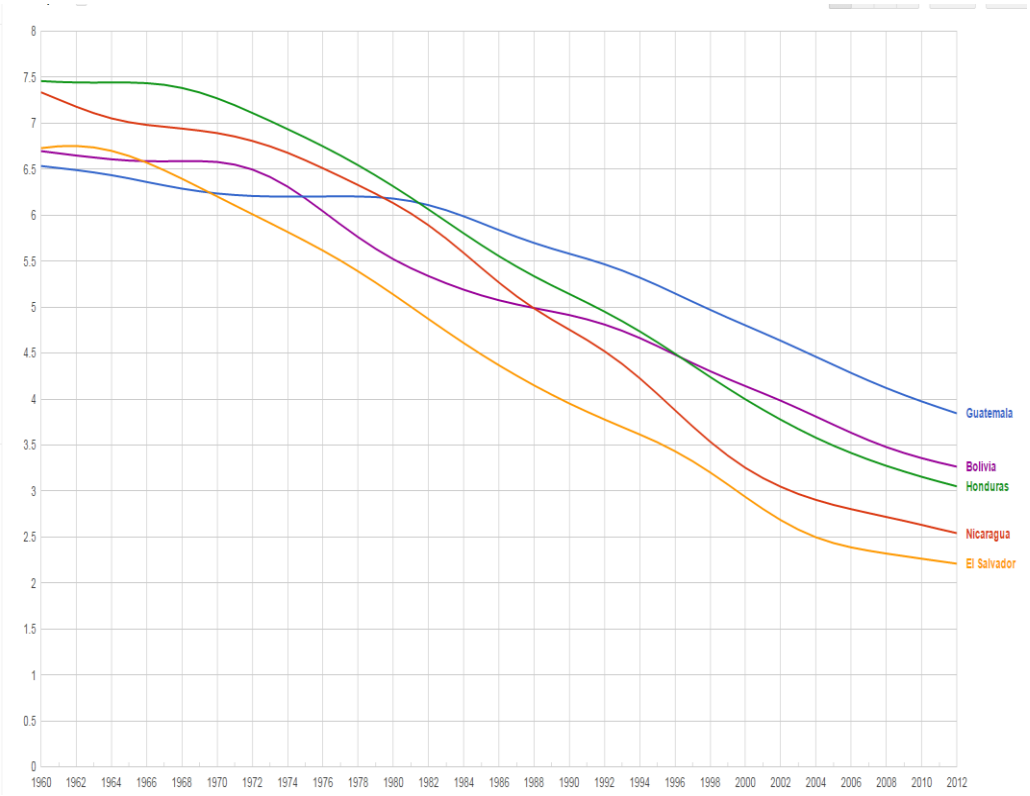

Figure S2. Mean Completed Fertility for Selected Latin American Countries. The slope of Guatemala's fertility decline is shallower than other Latin American Countries. (Source: WorldBank)

APENDIX II

CHAPTER 2

	Individual (37,926)		Households (7,276)	
	N	%	N	%
Religious Group	6097	16.1%	2350	32.3%
Income Group	306	0.8%	259	3.6%
School Group	231	0.6%	210	2.9%
Public Goods Group	135	0.4%	117	1.6%
Recreation Group	983	2.6%	733	10.1%
Community Group	116	0.3%	99	1.4%
School Group	795	2.1%	669	9.2%
Any group	8045	21.2%	3393	46.6%
Any group excluding religious groups	2373	6.3%	1692	23.3%

Table 1S. Frequency of voluntary associations.

	Households (7,276)	
	N	%
Collection of funds	1,077	14.8%
Community Workshops	204	2.8%
Contacting government officials to access social programs	649	8.9%
Information campaigns	530	7.3%
Electoral campaigns	671	9.2%
Contacting local politicians	370	5.1%
Notifying judicial authorities when problems arise	607	8.3%
Giving monetary or in-kind donations	2,160	29.7%
Providing unpaid labor to charity institutions	1,265	17.4%
Labor exchange agreements	1,507	20.7%
Community childcare	189	2.6%
Construction of community infrastructure	2,504	34.4%
Voting in elections	5,419	74.5%
Other collective action	79	1.1%
Any Collective Action	6,277	86.3%
Any Collective Action excluding Voting	4,583	63.0%

Table 2S. Frequency of households engaging in collective action activities

Full Models with Age

	Boys Baseline Model	Boys Full Model	Girls Baseline Model	Girls Full Model
AGE7	4.01*** (2.85, 5.65)	4.09*** (2.90, 5.76)	9.09*** (6.44, 12.82)	9.13*** (6.46, 12.90)
AGE8	7.57*** (5.26, 10.90)	7.75*** (5.38, 11.17)	20.01*** (13.88, 28.87)	20.09*** (13.92, 29.00)
AGE9	17.01*** (11.34, 25.52)	17.22*** (11.47, 25.85)	24.40*** (16.73, 35.57)	25.00*** (17.11, 36.52)
AGE10	17.56*** (11.98, 25.73)	17.90*** (12.20, 26.26)	26.87*** (18.39, 39.27)	27.20*** (18.59, 39.81)
AGE11	13.22*** (9.00, 19.41)	13.46*** (9.15, 19.79)	31.54*** (21.21, 46.92)	32.19*** (21.62, 47.93)
AGE12	15.70*** (10.91, 22.61)	16.10*** (11.17, 23.20)	18.96*** (13.18, 27.27)	19.11*** (13.27, 27.53)
AGE13	9.07*** (6.37, 12.91)	9.20*** (6.46, 13.12)	12.73*** (8.89, 18.22)	12.59*** (8.79, 18.03)
AGE14	5.54*** (3.97, 7.74)	5.64*** (4.03, 7.88)	4.72*** (3.34, 6.68)	4.75*** (3.36, 6.73)
AGE15	2.89*** (2.07, 4.02)	2.90*** (2.08, 4.05)	3.84*** (2.73, 5.41)	3.83*** (2.72, 5.39)
AGE16	2.31*** (1.65, 3.25)	2.33*** (1.66, 3.27)	1.74*** (1.22, 2.47)	1.74*** (1.23, 2.48)
AGE17	1.62*** (1.16, 2.26)	1.63*** (1.16, 2.28)	1.84*** (1.29, 2.63)	1.83*** (1.28, 2.60)
URBAN	1.38*** (1.15, 1.66)	1.40*** (1.17, 1.69)	1.64*** (1.37, 1.97)	1.66*** (1.39, 1.99)
HH_N_KIDS	0.92*** (0.89, 0.96)	0.92*** (0.89, 0.96)	0.97* (0.94, 1.01)	0.97 (0.94, 1.01)
PARENT1	0.73 (0.47, 1.14)	0.78 (0.50, 1.22)	1.96*** (1.30, 2.96)	2.09*** (1.38, 3.17)
PARENT2	0.59* (0.32, 1.10)	0.62 (0.33, 1.16)	0.78 (0.41, 1.45)	0.83 (0.44, 1.56)
PARENT3	0.72 (0.44, 1.17)	0.77 (0.47, 1.27)	1.07 (0.68, 1.69)	1.16 (0.73, 1.84)
INDIGENA1	1.05 (0.81, 1.37)	0.71* (0.50, 1.01)	0.69*** (0.54, 0.87)	0.44*** (0.31, 0.60)
JOB21	1.27 (0.95, 1.70)	1.26 (0.94, 1.69)	1.31* (0.97, 1.76)	1.30* (0.97, 1.75)
AWE_CENT	1.54*** (1.39, 1.71)	1.56*** (1.41, 1.73)	1.65*** (1.49, 1.82)	1.65*** (1.49, 1.83)
MDIM2	1.63*** (1.49, 1.78)	1.65*** (1.50, 1.80)	1.63*** (1.49, 1.78)	1.64*** (1.50, 1.80)

LOG_INCOME	1.07* (1.00, 1.15)	1.07* (1.00, 1.15)	1.20*** (1.12, 1.29)	1.20*** (1.12, 1.29)
MEMBER21	1.44*** (1.21, 1.71)	1.27** (1.01, 1.60)	1.26*** (1.06, 1.49)	1.06 (0.84, 1.34)
MEMBER_REL1	1.31*** (1.13, 1.52)	1.30*** (1.12, 1.51)	1.30*** (1.13, 1.50)	1.29*** (1.12, 1.49)
LINKING	1.23*** (1.06, 1.43)	1.03 (0.84, 1.25)	1.37*** (1.18, 1.58)	1.14 (0.93, 1.39)
NATIVE21	0.98 (0.74, 1.29)	0.96 (0.72, 1.27)	1.05 (0.81, 1.36)	1.09 (0.84, 1.42)
SECOND21	0.86 (0.66, 1.12)	0.84 (0.64, 1.10)	0.89 (0.68, 1.16)	0.85 (0.64, 1.11)
LITERATE21	2.03*** (1.64, 2.51)	1.97*** (1.59, 2.44)	1.93*** (1.56, 2.38)	1.87*** (1.51, 2.31)
PRIMARY21	0.98 (0.79, 1.20)	0.95 (0.74, 1.22)	1.21* (0.98, 1.49)	1.04 (0.81, 1.34)
SECONDARY21	3.13*** (2.17, 4.51)	2.49*** (1.66, 3.72)	1.88*** (1.37, 2.59)	2.08*** (1.40, 3.09)
HAS_JOB1	0.28*** (0.23, 0.32)	0.28*** (0.23, 0.33)	0.51*** (0.43, 0.60)	0.51*** (0.43, 0.60)
INDIGENA1 * MEMBER21		1.27 (0.90, 1.79)		1.42** (1.01, 1.99)
INDIGENA1: LINKING		1.49*** (1.10, 2.00)		1.48*** (1.10, 1.98)
INDIGENA1: PRIMARY21		1.08 (0.80, 1.46)		1.41** (1.05, 1.89)
INDIGENA1: SECONDARY21		3.08** (1.13, 8.37)		0.72 (0.37, 1.39)
Constant	0.05*** (0.02, 0.11)	0.06*** (0.03, 0.12)	0.003*** (0.001, 0.01)	0.003*** (0.001, 0.01)
Observations	5,972	5,972	5,706	5,706
Log Likelihood	-2,527.46	-2,518.53	-2,572.64	-2,563.11
Akaike Inf. Crit.	5,116.93	5,107.07	5,207.28	5,196.22
Note:				*p**p***p<0.01

Table 3S. Full logistic regression model including age.

APENDIX III

CHAPTER 3

Anchoring the wealth dimensions.

The results of the MCA produce dimensions along which households are ranked. Household are assigned values along each of the estimated dimensions, creating a position in multidimensional space. Importantly, positive values on these dimensions do not have inherent meaning, where increasing values do not mean increasing wealth. To assign a direction to these dimensions, and a clear interpretation, we assessed the correlation between the estimated dimensions and key anchoring variables. Based on these associations with anchoring variables, we assign a direction to the dimension where increasing values represent increasing wealth.

Anchoring the market wealth dimension

1) Assessed the direction, significance, and consistency of correlations between dimension scores and ownership of assets linked to market success. We also included correlations with the DHS wealth index that was calculated by DHS using similar data-reduction techniques.
    a. Television
    b. Refridgerators
    c. Electricity
    d. Rural
    e. Wealth Index from DHS

2) If the associations between dimension scores and the four indicators were all in the same direction we labeled the dimension as consistent. We also tracked the number of indicators that returned a significant correlation with the dimension.
3) If the dimension was not consistent, i.e. one of the associations of the indicator variable with the dimension was in the opposite direction as the others, we used the association with the DHS wealth index to anchor and interpret the dimension.

Anchoring the agricultural dimension

Anchoring the agricultural dimension proceeded in a similar fashion however, we first needed to identify whether dimension 2 or dimension 3 from the MCA was most consistent with proxies for success in the agricultural sector. As described in Hruschka et al, the MCA was permitted to estimate up to 4 dimensions. Most surveys were only able to identify 3. In the small number of surveys used in the Hruschka et al paper, dimension 3 was interpreted as capturing regional or livelihood variation in the agricultural sector. However, in the full dataset, a small number of cases, showed that a reliable third dimension captured general success in the agricultural sector better than the second estimated dimension. The procedure for determining which dimension reflected agricultural wealth and anchoring the dimension was as follows:

1) Assess correlations between dimension 2 and dimensions 3 with anchoring variables
    a. Own livestock
    b. Own Land
2) Assess their consistency, i.e. are they both in the same direction.

3) We default dimension 2 as agricultural dimension if dimension 3 was inconsistent (meaning opposing directions for the correlations
4) If dim 2 is not consistent and dim 3 is we default the agricultural dimension to the dimension 3.
5) If neither is consistent, or if both are consistent, then we assign the agricultural dimension based on the absolute magnitude of the associations with the anchoring variables.