# Human Capital Acquisition and Occupational Choice: Implications for Growth and Inequality*

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**Abstract**

This paper investigates the role of human capital acquisition for growth and inequality. We construct an overlapping generations model of occupational choice in the presence of borrowing constraints that allows for *(i)* investment in human capital during youth (schooling) and *(ii)* entrepreneurial entry, exit, and investment decisions. The focus of our analysis is on the role of borrowing constraints in determining human capital and entrepreneurship. We analyze how different levels of financial development jointly determine human capital investments and the productive structure of the economy. Our model is consistent with observable correlations at the microeconomic level between wealth, education, talent and occupational choices. We find that economies that undergo financial reforms experience very protracted transitional dynamics.

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# 1 Introduction

This paper investigates the role of human capital acquisition for growth and inequality. We build on the work emphasizing the role of credit constraints in shaping the process of development through selection into entrepreneurship and the allocation of capital across firms.[1] We incorporate to these type of models an additional margin of decision for households: endogenous human capital acquisition. As a result, the process of development in this model comes from the household's joint accumulation of human and physical capital. In our framework, credit constraints affect simultaneously the human capital investment and occupational choice/entrepreneurship margins. Distortions or "misallocation" along these two investment margins reinforce each other, which amplifies the distortions created by credit constraints in any of these two dimensions when considered in isolation.

Our main goal is to present a rich quantitative framework to analyze simultaneously how human capital investment and entrepreneurship affect economic development. While these two channels have been recognized as important factors affecting the process of development and they have been extensively studied separately, there is little work that studies them simultaneously in general equilibrium. Yet, prima facie, these two margins appear complementary to each other. For example, operating successfully a business may require human capital –and more so, if an entrepreneur operates a modern technology that requires, for example, the use of computers. Moreover, many empirical studies (e.g., (Pawasutipaisit and Townsend, 2011 and Midrigan and Xu, 2014) have found that firm or entrepreneurial productivity is highly persistent. Thus, to the extent that education can affect entrepreneurs' productivity, it may rise aggregate productivity and increase firms' demand for labor. This, in turn, can increase the aggregate demand for labor and the incentives to accumulate human capital among workers.

We develop a general equilibrium model to systematically address these mechanisms. Our model features two sectors (modern and subsistence) and endogenous human capital acquisition. Firms in the modern and subsistence sectors need to be run by entrepreneurs. The subsistence sector technology can operate at any level of capital investment. The modern sector requires a setting up cost, but it has a higher level of productivity.[2] Human capital is produced using final output, previous human capital and time of students.

Our focus is on the role of borrowing constraints in shaping the equilibrium allocations in the

[1] See Buera et al. (2015) and the references therein.

[2] Banerjee and Duflo (2005) stress the important of these non-convexities to give rise to realistic investment dynamics and dispersion in the returns to capital.

economy and generating many empirical regularities in economic development such as low income per capita, low aggregate TFP and low intergenerational mobility. We also investigate how changes in the financial environment that reduce borrowing constraints affect the process of development, which is framed as the transition of the economy to a (new) invariant distribution. In our economy, as the economy evolves over time, it transforms its structure of production because the technology by which final output is produced changes from the subsistence to the modern technology. This is due to capital accumulation, human capital accumulation and technological progress of the formal sector. Along with the evolution of the macroeconomic/aggregate variables, our model has implications for the cross section of individual outcomes that conform the aggregate measures (e.g., wealth and income distributions).

We aim at providing a model that has clear microeconomics underpinnings and, at the same time, offers implications for the evolution of aggregate macro measures. To fulfill this purpose we lay out a theoretical framework which rests on household decisions as the fundamental unit of analysis, rather than aggregate production functions. This allows us to map our model to household survey data. Thus, we can use these data to guide our quantitative exercise and and to contrast the results of our simulations to those observed in the household data (in addition to the more standard aggregate variables).

Our quantitative exercise in Section 3 uses data from the U.S. and Mexico. We calibrate the technological parameters from our model using US data. Then, we let the parameters governing financial frictions in the model change to match the financial development of Mexico. This allows us to isolate the role of financial constraints from other distortions. We find that borrowing constraints alone generate sizable differences in the aggregate level of output, TFP and average years of education. Finally, in Section 3.5 we analyze the dynamic effects of relaxing borrowing constraints in the economy.

*Related Literature (Incomplete)* There are different strands of the literature that this work relates to. First, it relates to the estimation of models of human capital accumulation in dynamic general equilibrium models, such as Heckman et al. (1998). We share with this work the interest on the analysis on the evolution of labor earnings and skill formation. A key aspect of our theory is the existence of borrowing constraints in education. Caucutt et al. (2015), Caucutt and Lochner (2012), Lochner and Monge-Naranjo (2011) among others have provided evidence on the importance of credit constraints in education in the United States. Our premise is that these ought to be even more prevalent in developing countries. Our formulation of credit constraints that generates distortions in human capital investment (and physical capital investment) is very simple. Even though Lochner and Monge-Naranjo (2014) and Lochner and Monge-Naranjo (2012) have argued on the need of more elaborate formulations of credit constraints for education, we view our exercise as a first step towards building a more comprehensive theory.

Second, the paper relates to the diverse and rich literature that enquires how human capital accumulation contributes to the process of development. Erosa et al. (2010) pursue a similar endeavour as ours, but their focus is more in explaining cross country differences rather than the process of development. It is also related to Seshadri and Manuelli (2005), who argue that adding human capital to the standard one sector growth model does a good job explaining economic miracles. Oded Galor and Omer Moav (2004) model how human capital has played different roles in the last two centuries for economic growth. Munshi (2010) analyzes the transition into a new occupation/sector, but he emphasizes the role of community-based networks for families to bootstrap their way out of poverty rather than investment in human capital and wealth accumulation, as we do.

Third, the model builds on the work on occupational choice and wealth distribution in heterogeneous agent models as developed in DeNardi (2004) and Cagetti and DeNardi (2006) in quantitative models for the US. These models of entrepreneurship have been subsequently applied to quantitative analysis in development economics as in Buera and Shin (2013), Shin et al. (2011a), Buera et al. (2011) and Shin et al. (2011b) among others. Relative to this literature, our contribution is to add the endogenous human capital accumulation margin and quantify its role in the process of development.

Huggett et al. (2011) analyze sources of lifetime inequality in the US and conclude that initial differences at age 23 account for most of the variation in lifetime inequality. Relative to this paper ...

## 2 Model

**Overview of the model** We consider an economy populated by households that are heterogeneous in terms of their wealth, schooling levels and talent. Talent and schooling affect the productivity of agents in the two possible occupations in the economy: entrepreneurs and workers. Entrepreneurs run firms in this economy. Firms produce a homogeneous good that is used both for consumption and investment. A household consists of one parent and one child. Each household chooses the education of the child (or whether she joins the labor force) and whether the parent becomes a worker or an entrepreneur. Conditional on becoming an entrepreneur, a parent can operate a subsistence or a modern technology.

## 2.1 Preferences, Endowments and Demographics

**Demographics** The unit of decision in our model is a household. A household is composed by two agents: a parent and a kid. Agents' lives are divided in two broad stages: youth and adulthood. During the youth stage, agents (which we refer to as kids) live in the same household as their parents. In the second stage of their lives, agents form their own household and become parents.

In our economy, when a kid becomes an adult, she immediately gives birth to one kid, forming a new household. Her former household disappears, and her parent dies. Thus, we assume that both youth and adulthood stages last the same periods of time, which we denote by $\mathcal{T}$. Note that at each point in time all households consist of a parent and a kid. Population is constant and normalized to one, i.e., there is a continuum of measure one of parents and a continuum of measure one of kids at every point in time $t$.

**Talent** Each agent is endowed with innate talent upon being born. The talent $\theta$ of an individual is constant over time, unidimensional and observable. The cumulative distribution of talent in the population is $F(\theta)$.

For a given household, talent evolves over time through the talent draws of new generations. Once a kid is born, she inherits the talent of her parent with probability $\phi$, while with probability $1-\phi$ she draws a new talent draw from $F(\theta)$.

**Household Utility** The individual instantaneous utility from consumption $u(\cdot)$ is

$$u(c) = \frac{c^{1-\sigma}}{1-\sigma}, \tag{1}$$

where $\sigma$ is the coefficient of relative risk aversion. We denote the consumption at time $t$ of a parent $p$ born at time $\tau$ by $c_t^{p,\tau}$. Analogously, the consumption of a kid is denoted by $c_t^{k,\tau}$. Note that the time subscript on consumption refers to the time in which an agent is consuming, whereas the superscript denotes the generation.[3] The instantaneous utility of a household $U$ at time $t$ is defined as

$$U_t\left(c_t^{p,\tau}, c_t^{k,\tau+\mathcal{T}}\right) = \lambda u\left(c_t^{p,\tau}\right) + (1-\lambda) u\left(c_t^{k,\tau+\mathcal{T}}\right), \tag{2}$$

where $\lambda \in (0,1)$ denotes the Pareto weight on the consumption of the parent. Given the constant relative risk aversion utility function (1), we note that there exists an aggregate representation of the instantaneous household utility.

**Remark.** *(Aggregate Representation of Household Preferences) Let* $c_t = c_t^{p,\tau} + c_t^{k,\tau+\mathcal{T}}$ *denote the total consumption of a household at time* $t$*. Then, total household utility is*

$$U(c_t) = \frac{c_t^{1-\sigma}}{1-\sigma}\left(\lambda^{\frac{1}{\sigma}} + (1-\lambda)^{\frac{1}{\sigma}}\right)^{\sigma}. \tag{3}$$

This result follows from the optimal allocation of consumption between parents and kids, given that total consumption is $c_t$. This implies that the only relevant state variable for household welfare is total consumption.

The utility of a household at time 0 is the discounted present value of the instantaneous utilities of all her dynasty

$$V_0^{HH} \equiv U_0^{HH} + \mathbf{E}_0\left[\sum_{t=1}^{\infty} \beta^t U_t^{HH}\right], \tag{4}$$

with $\beta \in (0,1)$. There is an expectation operator in future utilities because at time zero the types of future generations have not been realized.

**Endowments** Each household is endowed with initial wealth $a_0$ at time 0. Each agent is endowed with one unit of time per period. As we discuss below, agents can use their time to go to school, work for a wage or work as entrepreneurs.

## 2.2 Technologies

[3]Note that the year gap between parents and kids is constant across generations in our model. Thus, knowing the time in which a generation is born and the current time period completely determines whether an agent is a parent or a kid.

### 2.2.1 Human Capital Production

Kids can accumulate human capital by going to school.[4] Kids can go to school for at most $\bar{s}$ periods. $\bar{s}$ can be interpreted as the total number of years necessary for going through primary, secondary and tertiary schooling.

We model human capital as increasing the effective units of labor an agent can supply to the market. Moreover, we allow that the increase in effective units be contingent on the occupational choice. In particular, we assume that if a kid goes to school for $s \in [0, \bar{s}]$ units of time, she increases the effective units by $\psi_w s^\zeta$ if she chooses to become a worker, where $\zeta \in (0, 1)$ and $\psi_w > 0$. If she becomes an entrepreneur they increase by $\psi_e s^\zeta$ with $\psi_e > 0$. Also note that there is a time cost for kids to attend school as the maximum amount of school they can obtain is given by the length of a period (e.g., if periods are measured in the same time units as schooling units of time, it takes $s$ periods to attain a level of education $s$).

We make the assumption that kids cannot go back to school after they have dropped out. That is, kids start going to school once they are born and households can choose the length of time they attend school. However, once they enter the labor market, they cannot go back to school. Moreover, we assume that payments to education are done upfront within the period.

**Assumption 1.** *(Irreversibility of Schooling) Once a kid drops out of school, she cannot go back to school. Payments for schooling are done upfront within the period.*

**Effective Human Capital** Human capital and innate talent are combined to generate the *effective* human capital that is used in production. We denote by the vector $(\theta_w, \theta_e)$ the effective levels of human capital an agent can supply to the market when choosing to become a worker or an entrepreneur, respectively. We make the following functional assumptions,

$$\theta_w = (1 + \psi_w s^\zeta)\theta^{\kappa_w}, \tag{5}$$

$$\theta_e = (1 + \psi_e s^\zeta)\theta^{\kappa_e}. \tag{6}$$

with $\kappa_e > 0$ and $\kappa_w > 0$, which allow for the affect of innate talent to be different across occupations. We allow for the education being relatively more important as a worker or entrepreneur with $\psi_e > 0$ and $\psi_w > 0$. Also, the gains from education are concave, $0 < \zeta < 1$ (and log-linear). Note that if

[4] We rule out on-the-job training. Erosa et al. (2010) and the references therein argue that there is no systematic correlation between on-the-job training and income per capita.

a kid chooses no schooling ($s = 0$), then the only relevant margin is her innate ability.

**Experience** In our quantitative model, we allow for agents to accumulate experience over time and improve their effective human capital. We do so in a parsimonious way. We let effective human capital of an agent that has been out of school for $t$ periods to be $\vartheta_t \theta_i$ with $\vartheta_t > 1$ and $\theta_i$, $i = \{w, e\}$ as defined in equations (5) and (6). In what follows, we abstract from experience in our theoretical derivations to make the discussion more agile.

Thus, the model generates differences in the intensive margin of education (time spent at school), but conditional on time spent in school $s$ and innate talent, it does not allow for heterogeneous quality levels depending on the amount spent, nor changes in schooling quality over time.

**Schooling Production Function** Schooling services $S$ are produced using final good $M$ (which can be thought of as providing school infrastructure and materials), and teaching input $T$, which is produced using human capital. The production function is assumed to be of Cobb-Douglas form,

$$S = A_s T^{\alpha_s} M^{1-\alpha_s}, \qquad 0 < \alpha_s < 1, \quad A_s > 0. \tag{7}$$

### 2.2.2 Final Good Production Technologies

Final good is produced by firms. Each firm is run by one entrepreneur. Entrepreneurs employ labor and use capital to produce final good. Recall that agents can choose to become entrepreneurs or working for a wage at any point in time. We make the following assumption on entrepreneurship and occupational choice.

**Assumption 2.** *Firms need to be set-up and run by adults. Kids and adults can work for a wage. Occupations are mutually exclusive.*

The fact that occupations are mutually exclusive imply that an entrepreneur cannot be a worker at the same time.

There are two possible technologies to produce final good, which we label as *modern* and *subsistence* technologies. Subsistence technologies do not have any set-up cost, while a fixed cost needs to be incurred to operate a modern technologies. The advantage of modern technologies is that they have a higher level of productivity. We describe them in detail below.

Table 1: Occupational choices for parents and kids.

| Occupation | Parent | Kid |
|---|---|---|
| Student | ✗ | ✓ |
| Entrepreneur | ✓ | ✗ |
| Worker | ✓ | ✓ |

**Subsistence Technology** The subsistence technology can operate at any (positive) level of capital. This technology produces final output combining capital, labor and entrepreneurial skills.

$$y = \theta_e k^\alpha l^\gamma, \quad \alpha + \gamma < 1, \tag{8}$$

where $l$ is the mass of workers hired and $k$ the amount of capital used in production.[5]

**Formal Technology** This technology requires a per-period fixed cost to operate, $\underline{k}$. This is, in addition to the working capital, $k$, an additional sunk investment $\underline{k}$ has to be made. The formal technology production function is

$$y = \theta_e A k^\alpha l^\gamma, \quad \alpha + \gamma < 1, \; A > 1, \tag{9}$$

where $l$ denotes labor used in production and $k$ denotes the operating capital. Thus, the total capital required to produce is is $k + \bar{k}$.

Figure 1 summarizes the occupational choices in the economy.

## 2.3 Markets

**Incomplete Financial Markets** Given our interest in the process of development, we allow for severe imperfections in financial markets. First, as in Buera et al. (2011), we assume that debt cannot be rolled over across periods. Financial wealth has to remain positive, $a \geq 0$. In other words, payments have to be honored within the the period. In particular, this implies that the debt of an adult agent has to be paid off before she passes away. Thus, parents cannot bequeath a loan to their offspring.

[5] We have also used a formulation that allows for self-employment, $y = \theta_e k^\alpha (l+1)^\gamma$, obtaining similar results in the quantitative exercise for the US.

Second, the amount of credit available to agents at any point in time is restricted. We assume that the amount of borrowing available to a household is proportional to her financial wealth at the beginning of the period, $a_t$. We denote this factor of proportionality by $\xi \in [0, \infty)$. That is, the amount borrowed, $l_t$, cannot exceed $\xi a_t$. Buera and Shin (2013) show that this collateral constraint can be derived from a limited enforcement problem.

Finally, all financial wealth is rented as capital to firms at the competitive rate of $r_t + \delta$ through an intermediary using a within-period capital rental or credit contract. As we have discussed, this contract is subject to a quantity limit. Indeed, this is the same set-up as in Buera et al. (2011) and Buera and Shin (2013), among others.

**Competitive Non-financial Markets** All other markets operate under perfect competition.

## 2.4 Recursive Formulation of The Household Problem

Households maximize the present value of household utility, (2), by choosing sequences of consumption, financial wealth, occupations, capital/labor inputs if they choose to be entrepreneurs and education of kids, subject to a sequence of period budget constraints and rental limits.

Consider a household at the beginning of period $t$. The household's state is summarized by its wealth and a vector of effective human capital and talent. This vector is composed by the parent's effective human capital $(\theta_e^p, \theta_w^p)$ and the kid's initial talent $(\theta^k)$. The household jointly decides the level of education provided to the kid and the occupational choice of the parent: worker or entrepreneur in the modern or subsistence sector. Recall that the time not spent at school by the kid is spent in the labor market as a worker.

Denote the vector of effective human capital and talent by $z = \left(\theta_e^p, \theta_w^p, \theta^k\right)$. Then, the problem of a household is to select the occupation and education of the kid that maximizes the value function of the household, $V(a, z)$ defined in (2) across all possible occupations,

$$V(a, z) = \max \left\{ V^{\text{Worker}}(a, z), V^{\text{Modern}}(a, z), V^{\text{Subsistence}}(a, z) \right\} \tag{10}$$

Next we describe the household problem of a household conditional on each of the possible occupational choices to a parent.

Consider an agent that has been a parent for $\tau$ periods and decides to become a worker in the current period. Conditional on this occupational choice, the household problem is to decide total household consumption today, $c$, the fraction of time the kid attends school within the period, $\eta$

and next period's assets, $a'$, to maximize continuation utility,

$$V^{\text{Worker}}(a,z) = \max_{c,\eta\in[0,1],a'\geq 0} U(c) + \beta \mathbf{E}_{z'} V'(a',z') \qquad \text{subject to} \tag{11}$$

$$a' = (1+r)(a - p_s\eta) + (\theta^p_w + (1-\eta)\theta^k_w)w - c, \tag{12}$$

$$p_s\eta \leq (1+\xi)a, \tag{13}$$

$$s' = s+\eta, \qquad s+\eta \leq \bar{s}, \qquad \text{and} \qquad \eta = 0, \quad \text{if} \quad s<\tau \tag{14}$$

where $U(c)$ is the per-period household utility, (3), and $z = (\theta^p_w, \theta^p_e, \theta^k, s)$ is a state vector denoting the effective human capital of the parent $(\theta^p_w, \theta^p_e)$, the talent of the kid, $\theta^k$, and its education level coming into the period, $s$. Note that there is an expectation operator because $z'$ contains the random draws of talent of the next generations. The within period budget constraint is stated in the second line, (12). We have normalized the price of consumption/investment good to one. Agents enter the period with wealth $a$. They can use this wealth to invest in kids education $p_s\eta$. Whatever is left, $a - p_s\eta$ earns an interest $r$ at the end of the period (note that this can be negative if $p_s\eta > a$). Labor income comes from the parent working (and supplying $\theta^p_w$ units of effective human capital) and the time the kid does not spend in school $(1-\eta)\theta^k_w$. The wage per unit of human capital is $w$. As it is customary, we assume that a period of time has a unit of time.[6] Line (13) states the collateral constraint. Households, cannot invest more than $(1+\xi)a$ in the education of kids. Also, note that in the choice set we are restricting $a' \geq 0$, so that assets next period are non-negative. Finally, line (14) denotes the updating rule of schooling next period $s'$ as a function of the schooling level coming into the period $s$ and the school attendance during the period, $\eta$. There is also a constraint on the total amount of schooling an agent can obtain. Assumption 1 on irreversibility of schooling is stated in the last condition.

Consider now the case of an agent that has been a parent for $\tau$ periods and decides to become a subsistence entrepreneur in the current period. In this case, the household problem conditional

[6] This is not the case in our quantitative exercise.

on the occupational choice is

$$V^{\text{Subsistence}}(a,z) = \max_{c,\eta\in[0,1],a',l,k\geq 0,} U(c) + \beta \mathbf{E}_{z'} V'(a',z') \qquad \text{subject to} \tag{15}$$

$$a' = (1+r)(a - p_s\eta) + (1-\eta)\theta_w^k w + \theta_e^p k^\alpha (1+l)^\gamma - wl - Rk - c, \tag{16}$$

$$p_s\eta + k \leq (1+\xi)a, \tag{17}$$

$$s' = s + \eta, \qquad s + \eta \leq \bar{s}, \qquad \text{and} \qquad \eta = 0, \quad \text{if} \quad s < \tau. \tag{18}$$

In this case, the budget constraint (16) shows that the parent's source of income are the profits from operating the subsistence technology, $\theta_e^p k^\alpha(1+l)^\gamma - wl - Rk$, where $R$ is the price of capital charged by financial intermediaries. Equation (17) shows that in this case, the collateral constraint potentially affects both investment in human capital and the capital level of operation. The human capital formation technology (18) remains unchanged.

Finally, consider the case in which a parent decides to operate a modern technology. In this case, the problem reads

$$V^{\text{Modern}}(a,z) = \max_{c,\eta\in[0,1],a',l,k\geq 0,} U(c) + \beta \mathbf{E}_{z'} V'(a',z') \qquad \text{subject to} \tag{19}$$

$$a' = (1+r)(a - p_s\eta) + (1-\eta)\theta_w^k w + \theta_e^p A k^\alpha (1+l)^\gamma - wl - R(k+\bar{k}) - c, \tag{20}$$

$$p_s\eta + k + \bar{k} \leq (1+\xi)a, \tag{21}$$

$$s' = s + \eta, \qquad s + \eta \leq \bar{s}, \qquad \text{and} \qquad \eta = 0, \quad \text{if} \quad s < \tau. \tag{22}$$

In this case, the profit from the entrepreneurial activity has to be net of the fixed capital cost, $\theta_e^p A k^\alpha (1+l)^\gamma - wl - R(k+\bar{k})$. Also, the collateral constraint (21) applies to all investments that have to be made at the beginning of the period.

## 2.5 Competitive Equilibrium

Given an initial distribution of state variables $\mathcal{F}_0(a,z)$ and a sequence of wages, interest rates and schooling prices $\{w_t, r_t, p_{s,t}\}_{t=0}^\infty$, a competitive equilibrium is given by a sequence of allocations $\{c_t(a_t,z_t), s_t(a_t,z_t), a_{t+1}(a_t,z_t), k_t(a_t,z_t), l_t(a_t,z_t)\}_{t=0}^\infty$ such that *(i)* households maximize utility by solving (10), *(ii)* the schooling sector maximizes profits, $\max_{M_t,T_t} p_{s,t} T^{\alpha_s} M^{1-\alpha_s} - w_t T_t - m_t$, *(iii)* the intermediary sector makes zero profits, $R_t = r_t + \delta$ and *(iv)* there is market clearing in final good, schooling, capital and labor markets.[7]

From the solution of the household problem, we obtain policy functions that inform us on the occupational choices of parents $o_t(a, z) = \{\text{Worker, Subsistence, Modern}\}$, educational choices and consumption/savings decisions. If a parent becomes an entrepreneur, we can also derive the capital and labor demands. A key disctinction comes from whether a household operates at the unconstrained optimal capital level, in which case the factor demands are

$$k = \left(A^i\theta_e\right)^{\frac{1}{1-\alpha-\gamma}} \left(\frac{\gamma}{w}\right)^{\frac{1-\gamma}{1-\alpha-\gamma}} \left(\frac{\alpha}{R}\right)^{\frac{\gamma}{1-\alpha-\gamma}} + \mathbf{1}_{i=\text{Modern}}\bar{k}, \tag{24}$$

$$l = \left(A^i\theta_e\right)^{\frac{1}{1-\alpha-\gamma}} \left(\frac{\gamma}{w}\right)^{\frac{1-\alpha}{1-\alpha-\gamma}} \left(\frac{\alpha}{R}\right)^{\frac{\alpha}{1-\alpha-\gamma}}, \tag{25}$$

with $A^i = 1$ for subsistence entrepreneurs and $A^i = A$ for modern entrepreneurs. For the modern entrepreneurs capital demand includes the fixed cost, as captured by the indicator function $1_{i=\text{Modern}}$. [8] Next consider the case in which households are borrowing constrained and can only borrow up to $\mathcal{K}$. Note that this amount is endogenously determined in the household decision problem. This results of balancing the returns of investment on business versus the alternative options of investing wealth in education or saving wealth and earning an interest. In this case factor demands are

$$k = \mathcal{K}, \tag{26}$$

$$l = \left(A^i\theta_e\right)^{\frac{1}{1-\gamma}} \mathcal{K}^{\frac{\alpha}{1-\alpha}} \left(\frac{\gamma}{w}\right)^{\frac{1}{1-\gamma}}. \tag{27}$$

Note that the conditions on the right column of the previous equation are a short-hand for choosing the allocation that maximizes profits taking into account the constraints.

[7] We also impose the standard transversality condition, $\lim_{t\to\infty} \beta^t \frac{\partial U(c_t)}{\partial c_t} c_t = 0$. Also, note that our description of the environment imposes a law of motion for the joint distribution of assets and talent such that the distribution at $\mathcal{T}+1$ incorporates the fact that when a new generation is born, with probability $\phi$ the household retains the same talent and with the complementary probability it is re-drawn from $F(\theta)$. Let $\mathcal{G}_{\mathcal{T}+1}(a|\theta)$ denote the marginal probability of households with type $\theta$ to have assets $a$, then

$$\mathcal{G}_{\mathcal{T}+1}(a|\theta) = \phi\mathcal{G}_{\mathcal{T}}(a|\theta) + (1-\phi)\int dF(\tilde{\theta})\mathcal{G}_{\mathcal{T}}(a|\tilde{\theta}). \tag{23}$$

[8] The corresponding profit is

$$(1-\alpha-\gamma)\theta_e^{\frac{1}{1-\alpha-\gamma}} \left(\left[\frac{\gamma}{w}\right]^{\gamma} \left[\frac{\alpha}{R}\right]^{\alpha}\right)^{\frac{1}{1-\alpha-\gamma}}.$$

Next, we discuss the problem of the schooling sector,

$$\max_{T,M} \quad p_s T^\gamma M^{1-\gamma} - M - wT,$$

where we are using the fact that the price of final good (that enters as materials $M$) has a price normalized to one. The schooling sector can supply as much schooling as demanded at the cost-minimizing price

$$p_S = \left(\frac{1}{1-\gamma}\right)^{1-\gamma}\left(\frac{w}{\gamma}\right)^{\gamma}. \tag{28}$$

The demand of factors for an output level $S$ is given by $T = S\left(\frac{\gamma}{(1-\gamma)w}\right)^{1-\gamma}$ and $M = S\left(\frac{(1-\gamma)w}{\gamma}\right)^{\gamma}$. Note that market imperfections do not alter the production function of schooling per se.

Thus, given a distribution of skills and wealth and the prices for labor, human capital and capital, we can compute the aggregate demands for this economy by integrating over household demands. Recall that $\mathcal{F}(a,z)$ denotes the joint distribution of assets and human capital.

$$\underbrace{\int_{o_t(a,z)=\{\text{Subsistence, Modern}\}} l_t(a,z)d\mathcal{F}_t(a,z)}_{\text{Labor Demand}} = \underbrace{\int_{o_t(a,z)=\{\text{Worker}\}} \theta_w^p d\mathcal{F}_t(a,z)}_{\text{Parents Labor Supply}} + \underbrace{\int (1-\eta_t(a,z))\theta_w^k d\mathcal{F}_t(a,z)}_{\text{Kids Labor Supply}} \tag{29}$$

where $l(a,z)$ corresponds to the labor demands derived in (25) and (27). Similarly, the capital market clearing condition

$$K \equiv \underbrace{\int_{o_t(a,z)=\{\text{Subsistence, Modern}\}} k_t(a,z)d\mathcal{F}_t(a,z)}_{\text{Firms' Investment}} + \underbrace{\int \eta_t(a,z)p_{s,t}d\mathcal{F}_t(a,z)}_{\text{Schooling Investment}} = \underbrace{\int a d\mathcal{F}_t(a,z)}_{\text{Asset Supply}}. \tag{30}$$

Schooling market clearing is

$$S_t = \int \eta_t(a,z)d\mathcal{F}_t(a,z). \tag{31}$$

By Walras' law, the market clearing condition for final goods is satisfied.

**Stationary Competitive Equilibrium** In addition to conditions *(i)-(iv)*, a stationary competitive equilibrium requires that the joint distribution of wealth and human capital investments is a fixed point of the equilibrium mapping and that prices are constant over time. In other words,

$$\mathcal{F}(a,z) \equiv \mathcal{F}_t(a,z) = \mathcal{F}_{t+1}(a,z) \tag{32}$$

$$r_t = r, \qquad w_t = w, \qquad p_{s,t} = p_s, \tag{33}$$

for all $t$ and feasible $(a,z)$.

### 2.6 Discussion of the Mechanics of the Model

This section characterizes optimal household choices. We start analyzing the perfect markets benchmark case first. This is, we shut down the credit market imperfections of our model. This allows to have separation between consumption and production choices. Next, we characterize the optimal choice in the imperfect credit market, which does not feature the separation property.

Consider a household at period $t$. The household is composed of a parent with *ex-post* talent $(\tilde{\theta}_e^p, \tilde{\theta}_w^p)$ and a kid with *initial* talent $(\theta_e^k, \theta_w^k)$. Note that at time $t$ the talent of the parent is sunk, while the kid can still improve upon her talent. We next analyze the occupational choices and educational investments within the household. In what follows, we use indicator functions to summarize the occupational choices. Let the indicator functions $\mathbf{1}_e^p(\tilde{\theta}^p, \theta^k)$ and $\mathbf{1}_f^p(\tilde{\theta}^p, \theta^k)$ take a value of one for a parent who decides to become an entrepreneur and who enters the formal sector, respectively. Note that the indicator functions depend on the acquired human capital of the parent and the innate ability of the kid because of the forward looking nature of the model.

**Perfect-Credit Benchmark without Human Capital Production** Consider an economy in which agents do not face any borrowing limits in the interim period, $\xi = \infty$, but market incompleteness between periods is as in the baseline model. Suppose that there is no human capital technology available. This is, $s = 0$ and effective human capital is $(\theta_e, \theta_w) = (\theta^{\kappa_e}, \theta^{\kappa_w})$. In this case, the household problem can be separated in two steps. First, the household maximizes the net income generated in the period by choosing an occupation for the parent. Then, this income is allocated optimally across periods and within the household.

To make further progress, we make the following assumption

**Assumption 3.** *Differences in the production of effective human capital from talent cannot favor* *"too" much effective human capital as a worker,*

$$\frac{\kappa_e}{1-\gamma-\alpha} > \kappa_w. \tag{34}$$

As we show below, this assumption guarantees that, in equilibrium, high talent agents become entrepreneurs. If Assumption 3 holds, our economy is very similar to the ones analyzed in Buera et al. (2011) and Buera and Shin (2013).[9]

The profits of an entrepreneur in the subsistence and modern technologies are

$$\pi^{\text{Subsistence}}(\theta, w, R) = \left(\theta^{\kappa_e}\left[\frac{\gamma}{w}\right]^{\gamma}\left[\frac{\alpha}{R}\right]^{\alpha}\right)^{\frac{1}{1-\alpha-\gamma}}, \tag{35}$$

$$\pi^{\text{Modern}}(\theta, w, R) = \left(A\theta^{\kappa_e}\left[\frac{\gamma}{w}\right]^{\gamma}\left[\frac{\alpha}{R}\right]^{\alpha}\right)^{\frac{1}{1-\alpha-\gamma}} - R\bar{k}, \tag{36}$$

where $w$ and $R$ are the equilibrium unit prices for labor and capital. In turn, the return of being a worker is $\theta^{\kappa_w} w$.

Suppose that there exists an agent with talent $\tilde{\theta}$ that is indifferent between becoming a subsistence entrepreneur and a worker, $pi^{\text{Subsistence}}(\tilde{\theta}, w, R) = \tilde{\theta}^{\kappa_w} w$. Given Assumption 3, it is clear that any agent with talent $\theta > \tilde{\theta}$ strictly prefers being an entrepreneur, and an agent with $\theta < \tilde{\theta}$ prefers to become a worker. Likewise, consider the case in which an entrepreneur with talent $\tilde{\theta}$ is indifferent between operating the subsistence or the modern technology. As $\pi^{\text{Modern}}(\theta, w, R) - \pi^{\text{Subsistence}}(\theta, w, R)$ is increasing in $\theta$ (recall that $A > 1$), all agents with $\theta$ greater (smaller) than $\tilde{\theta}$ strictly prefer to operate the modern (subsistence) technology. We note that given the Inada conditions in the production function, it is guaranteed that wages are going to be sufficiently higher in equilibrium so that some agents prefer to become workers. However, whether both technologies are operated in equilibrium depends on parameter values.

Finally, there exists an aggregate representation for total output of the economy of the form $AK^{\alpha}L^{\gamma}$ in the competitive equilibrium (and corresponding planning problem) of this economy. The specific form of $A$ depends on which technologies are used in equilibrium. See Buera et al. (2011) for a derivation.

We note that removing the within-period borrowing constraint, we are able to reproduce the production chosen by a planner (conditional on a given stock of capital). Indeed, the total capital stock of capital (and the intertemporal allocation of consumption can still be distorted as markets

[9]To map our economy to these papers, take $\kappa_e = 1$ and $\kappa_w = 0$.

to transfer goods across time (and different possible states of nature) are imperfect.

**Schooling Choices with Perfect-Markets** We start discussing the case in which there is only educational decisions but no occupational choice problem. To conduct this thought experiment, consider a stationary equilibrium (thus wages and interest rates are constant) and an aggregate production function in capital and labor with constant returns to scale. Furthermore, suppose that the decision to educate within a period is binary, so that agents only have to decide whether to educate a kid or not. In other words, there is only an extensive margin decision within the period and no intensive margin. In this case, $s$ simply denotes the periods of education. The household's human capital investment problem is independent of any other choices

$$s(\theta) = \arg \max_{s \in \{0,1,\cdots,\bar{s}\}} \sum_{t=s+1}^{2\mathcal{T}} \frac{(1+\psi_w s^{\zeta})\theta^{\kappa_w} w}{(1+r)^t} - \sum_{t=0}^{s} \frac{p_s}{(1+r)^t}. \tag{37}$$

Note that we have used the interest rate to discount investments and returns as it is the opportunity cost assets. The first important thing to note is that the unconstrained educational level is *only* a function of the type of the kid. The second thing to note is that the optimal level of education $s(\theta)$ is weakly increasing in $\theta$. This second result is because we have imposed the (standard) assumption that talent and schooling are complements. To sum up, in an unconstrained economy, the educational level of kids should be an increasing function of their talent and independent of the parents' effective human capital or household assets.

The same insights carry through if we allow for entrepreneurship. In this case, we can define the optimal level of education conditional on choosing to becoming a worker, subsistence or modern entrepreneur in an analogous manner to (37) (where the net present value of wages would be substituted by the corresponding profits). The optimal choice for an agent would be given by

$$s(\theta) = \arg\max \left\{ \mathcal{V}^{\text{worker}}\left(s^{\text{worker}}\right), \mathcal{V}^{\text{modern}}\left(s^{\text{modern}}\right), \mathcal{V}^{\text{subsistence}}\left(s^{\text{subsistence}}\right) \right\}, \quad \text{with} \tag{38}$$

$$\mathcal{V}^{\text{worker}} = \max_{s \in \{0,1,\cdots,\bar{s}\}} \sum_{t=s+1}^{2\mathcal{T}} \frac{(1+\psi_w s^{\zeta})\theta^{\kappa_w} w}{(1+r)^t} - \sum_{t=0}^{s} \frac{p_s}{(1+r)^t}, \tag{39}$$

$$\mathcal{V}^{i} = \max_{s \in \{0,1,\cdots,\bar{s}\}} \sum_{t=s+1}^{2\mathcal{T}} \frac{\pi^i\left((1+\psi_e s^{\zeta})\theta^{\kappa_e}\right)}{(1+r)^t} - \sum_{t=0}^{s} \frac{p_s}{(1+r)^t}, \qquad i = \{\text{modern, subsistence}\}. \tag{40}$$

The occupational and educational choice would indeed be made jointly, as there would exist an educational choice that is optimal for each occupation given the talent of a kid $\theta$. Note that

Assumption 3 and the result that the optimal educational level $s(\theta)$ is increasing in $\theta$ imply that entrepreneurs have higher levels of education than workers.

We note that in order to obtain this result, we implicitly made use that there is no constraint in moving assets intertemporally. Thus, achieving efficiency in human capital investments given equilibrium prices requires the ability of potentially borrowing more long-term than production efficiency given prices. Indeed, these are notions of constrained-efficiency because prices themselves reflect market imperfections. Thus, the previous statements of "efficiency given prices" can be interpreted as partial equilibrium. This is in contrast with the general equilibrium analysis (that we perform) in which prices are endogenous objects. For example, if we change borrowing conditions, and compare equilibria before and after the change in general equlibibrium, agents investments may change because *(i)* the borrowing conditions change (holding constant prices) and also because *(ii)* equilibrium prices change.

**Equilibrium Choices with Borrowing Constraints** We consider now the case in which households can choose both occupations and investments in human capital. Suppose that we are in a stationary equilibrium, so that prices are constant over time. In this environment, households can be constrained in two types of investment: educational investments and capital investments. Indeed, borrowing constraints may not bind at the same time for all households. If the unconstrained levels of schooling and capital defined in the previous two discussions cannot be attained, (i.e., if the borrowing constraints bind), the educational and occupational choices of a household are jointly determined. As a result, in this environment distortions can appear at the extensive and intensive margin of these two choices. Distortions at the extensive margin imply occupational choices that would not be chosen in the unconstrained equilibrium, while distortions at the intensive margin imply levels of human and physical capital different from the optimal levels.

To make these ideas more precise, write all net income generated in a period within a household by $\mathcal{I}(z, k, \eta)$. This term includes net profits and wage income.

$$\begin{aligned} \max_{c,\eta\in[0,1],a',l,k\geq 0,} \; & U(c) + \beta \mathbf{E}_{z'} v(a', z') \\ & - \lambda_1 \left( a' + c - (1+r)(a - p_s \eta) - \mathcal{I}(z, k, \eta) \right) - \lambda_2((1+\xi)a - p_s\eta - k + \mathbf{1}_e^m \bar{k}), \end{aligned} \tag{41}$$

where $\mathbf{1}_e^m$ denotes an indicator function for whether a household operates a modern technology, $\lambda_1$ and $\lambda_2$ are Lagrange multipliers on the budget constraint and the borrowing constraint respectively.

We have omitted the updating rules for education and the upper bound on the years of schooling (they are described, e.g., in 22). To gain intuition, suppose that we are in a region where $\mathcal{I}$ is differentiable. The first order conditions can be written as

$$U'(c) = \lambda_1, \tag{42}$$

$$\beta \mathbf{E}_{z'} \frac{\partial V'(a', z')}{\partial a'} = \lambda_1 (1+r), \tag{43}$$

$$\beta \mathbf{E}_{z'} \frac{\partial V'(a', z')}{\partial \eta} = \lambda_1 \left( (1+r) p_s - \frac{\partial \mathcal{I}}{\partial \eta} \right) + \lambda_2 p_s, \tag{44}$$

$$\lambda_1 \frac{\partial \mathcal{I}}{\partial k} = \lambda_2 \qquad \text{(if parent is an entrepreneur)}. \tag{45}$$

Equations (42) and (43) are the first-order conditions with respect to $c$ and $a'$ and have a standard form (note that we are assuming that $a' > 0$, as otherwise there would be an additional constraint). The other two equations reflect how the investment choices within a period are made and how the borrowing constraint can distort allocations.

Equation (44) shows the trade-off of investing in human capital. The left-hand side captures the future benefits of educational investments: future utility is increasing because the effective type of the future parent is higher. The right-hand side reflects the cost. First, there is the pure opportunity cost of using initial assets to invest in education, $(1+r)p_s$. Second, by sending kids to school, the household has to forgo the labor income of the kid. This effect is captured by $-\partial\mathcal{I}/\partial\eta$. In case the borrowing constraint binds, an additional investment wedge appears. This is captured in the third term of the right hand side, $\lambda_2 p_s$. If the parent of the household decides to become a worker, then the Lagrange multiplier $\lambda_2$ reflects the shadow value of relaxing the constraints to education. If the parent of the household decides to become an entrepreneur, an alternative usage of initial assets appears: investing in the own firm. The value of this investment is captured in the left hand side of (45). Indeed, for this margin to be relevant it has to be the case that the entrepreneur is constrained and that the net return of investing in the own firm is above $1 + r$. In this case, there exists a trade-off between investing in education and the household firm. The marginal asset is allocated to the investment with the higher return, either the household firm or education.

# 3 Empirical Application

Our goal is to explore the role of borrowing constraints on occupational and educational choices. To this end, we calibrate the model to match stylized facts for the U.S. and Mexico. We guide many of the choices of our quantitative exercise (e.g., specification of the human capital formation) motivated by studies on Mexico. In particular, we make use of the Mexican Life Family Survey (MxFLS) (in combination with the Progresa/Oportunidades program), as we discuss in Section 3.2. Our empirical strategy is to first pin down most of the parameters in the model using the U.S. as a benchmark stationary equilibrium. This has the advantage that our choice of moments is very similar to Buera and Shin (2013), Bassetto et al. (2015) and Erosa et al. (2010). We then change the parametrization of the borrowing constraints to capture the level of financial development of Mexico.

We analyze how much of the differences in the correlations we observe in the MxFLS between wealth, talent, education and occupational choices can be accounted for by our framework. We also discuss other implications, like the growth rate of firms. Finally, starting from an invariant distribution that matches the level of financial development of Mexico, we improve the the within-period borrowing constraints to the U.S. level in the form of a one-time shock. We analyze the transition path of the economy to the new steady-state.[10]

## 3.1 Motivating Facts from Mexico

We use the case of Mexico as a paradigmatic middle-income country to motivate many of our modeling choices.

**Productive Structure** We start discussing the dual productive structure of Mexico. The McKinsey Global Report (Bolio et al., 2014) classified 95% of the registered companies in Mexico as "traditional." A traditional firm is characterized as "unlikely to be able to invest in productivity-improving equipment and technology and (it) may use manual methods or antiquated machinery. Traditional businesses may exist to provide a living for the owner and his or her family." These businesses usually have less than ten employees and employed around 42% of all registered workers in Mexico in 2009. In 1999, 39% of registered workers were employed in the traditional sector. Thus, its size has remained fairly stable. We identify this sector with our subsistence sector in the

[10]We can do other exercises within our framework, such as analyzing the role of conditional cash transfers (to education, entrepreneurship) vs. unconditional transfers in general equilibrium.

model, which operates a less-productive technology.

In contrast to the traditional sector, the McKinsey report identifies modern firms: "A modern enterprise uses the standard business practices found across organizations in advanced economies, with formal controls, resource allocation, and management systems. A modern firm typically hires qualified managers and uses machinery and information technology to raise productivity. Modern companies, even if they are owned by a sole proprietor, tend to be growth-oriented and have strategies and goals." Modern firms are bigger on average and are concentrated at the right tail of the firm-size distribution. In Mexico, large modern establishments (with more than 500 employees), employ about 20 percent of the census-registered workforce. We identify this sector with the modern sector in our model, which operates a more productive technology at the cost of incurring a fixed cost. In this context, this fixed cost can be interpreted as the cost of adopting modern technologies. Also, in our model (under assumption 3) they are operated by more talented and educated individuals.[11]

In terms of firm dynamics, Bartelsman et al. (2004) find that Mexico has the lowest rate of new company entries among major developed and emerging countries. In addition, Hsieh and Klenow (2014) show that, conditional on firm entry, the life-cycle of firms in Mexico exhibits less growth than the U.S. (roughly a third of that in the U.S.). This suggests both important barriers to entry and firm growth in Mexico.[12]

**Financial Development** Lending in advanced economies, as a share of GDP, is 4.5 times the level in Mexico. The country has fewer loans outstanding than Brazil and other Latin American peers. At 33 percent of GDP, Mexicos lending places it behind Ethiopia, a nation with much lower GDP per capita. In fact, the World Bank estimates that more than half of Mexico's small and medium sized businesses have insufficient access to financial services. Lack of access for businesses with 10 to 250 employees accounts for most of what the McKinsey Global report estimates to be a $60 billion credit gap for Mexican businesses.

This macro-measures of lack of financial development paint a picture consistent with the existing

[11]In terms of productivity growth, labor productivity has remained stagnant in the last 25 in Mexico. Perhaps interestingly, the gap in productivity between modern and subsistence firms has, however, been widening in the last 15 years. According the Bolio et al. (2014), productivity raised by 5.8 percent per year in the modern sector between 1999 and 2009, while it fell a 6.5% a year in the subsistence sector. Moreover, the smaller the enterprise, the steeper the decline: productivity fell by 6 percent a year in firms with three to five employees and by 9 percent a year in those with zero to two employees.

[12]Bergin et al. (2009) show that as of 2006, nearly half of Mexico's manufacturing exports and over 20% of its manufacturing value added are produced by maquiladoras, or export assembly plants, which import inputs from abroad, assemble or process the inputs to final outputs, and then export the finished goods.

micro evidence. For example, in a randomized experiment that gave cash and in-kind grants to small retail firms, McKenzie and Woodruff (2008) estimate the marginal return of investment to be three to five times higher than the market interest rates. They document that the effects were concentrated among firms that were more financially constrained. Indeed, randomized-control trial evaluations have shown ample evidence of high returns to capital for small firms in Mexico and many other developing economies (see for example de Mel et al., 2008 and the surveyed evidence in Banerjee and Duflo, 2005).

Finally, Beck et al. (2005) surveyed firms in different countries directly to elicit the existence of borrowing constraints. They find that the fraction of firms saying they face severe obstacles obtaining finance is highest in Mexico. Overall, the evidence presented here paints a picture consistent with borrowing constraints being an obstacle that firms face in Mexico.

**Other Policy Distortions** To be clear, there are many other unmodelled policy distortions that may induce firms to remain small (and even informal), reducing the incentives to invest in improving productivity. For example, companies under a certain size can purchase electricity at the consumer rate and may qualify for subsidies to cover a sizable amount of their production costs. Small companies also enjoy tax exemptions, while zoning insulates them from modern competitors that would force them to become more productive (Bolio et al., 2014). Another important distortion is the barriers to firm creation in Mexico. For example, it costs twice as much (as a percentage of average income) to register a business in Mexico as in Chile and seven times as much as in the United States.

**Education** Educational attainment has been increasing in Mexico during the XXth century. The literacy rate among citizens aged ten and older rose from around 40% in 1940 to more than 80% in 1985. The enrollment rates of 13-15 year olds increased from 69% in 1990 to 77% in 2000. The average years of education of the adult population in Mexico was 7.2 years in 2000, which represents 60% of the 12 years that the US achieved. Relative to other Latin-American countries, Mexico is in the upper part of the distribution in terms of years of schooling.[13] Most of the difference with the U.S. is explained by high-school enrollment. In 2007, only 50% of Mexicans between 15 and 19 years old were enrolled in public or private educational institutions.

Mexico also lags behind in terms of educational quality. Combining PISA scores for math, reading and science, Arias (2006) shows Mexico does worse than all developing countries except

[13] For example, in 2000, Argentina had 8.8 years on average, Ecuador, 6.4 and Bolivia 5.6.

for Brazil, both in absolute terms and relative to what one would predict based on expenditure per student in the country. For example, Only 0.3 % of Mexican students attain a score of 625 or higher (advanced).

Rodrigo Garcia-Verdu (2007) estimated that rising educational attainement accounts for 74% of Mexico's GDP growth over 1988-94 and 65% over 1995-2005. Puzzle: aggregate TFP growth was negative in both time periods. How can these to findings be reconciled with each other?

### 3.2 Household Evidence of Mexico

We use representative household data from the Mexican Family Life Survey (MxFLS) to investigate the relation between some key variables in our model in the data. The MxFLS is the first longitudinal survey representative of the Mexican population.[14] Over a period of ten years three rounds have been conducted in 2002, 2005-2006 and 2009-2012. The first wave was designed by the National Institute of Statistics and Geography (INEGI) and covered a sample of 35000 individuals from 8400 households. The follow up information on originally sampled households is very high: almost 90% were re-interviewed in the second and third waves. Beyond its national representativeness and longitudinal dimension the MxFLS covers a broad collection of themes including health, education and crime. The MxFLS data is particularly amenable to our purposes. This data set provides independent measures of parents' and children's cognitive ability (Raven's tests), household schooling decisions, occupational decisions, household income data and data on household assets.

We combine the information in the MxFLS with the implementation of the Progresa/Oportunidades program. Progresa/Oportunidades is a conditional cash transfer program aiming at poverty alleviation. It provides grants to improve education, health and nutrition. As explained in Angelucci and Giorgi (2009), the program started in 1997 and it has expanded to cover around 5 million households in more than 92,000 localities by the end of 2006, which represents about a quarter of all families in Mexico. The program provides grants in the form of nutritional subsidies, as well as scholarships for children attending third to ninth grade.[15] Behrman et al. (2011) have shown that this program has had long-run impacts on schooling, reductions in work for younger youths and shifts from agricultural to non-agricultural employment. During the first wave of Progresa (prior to 2001), the phasing in was randomly allocated. This allows us to use access to conditional cash

[14] It has been developed and managed by researchers from the Iberoamerican University (UIA), the Center for Economic Research and Teaching (CIDE) and Duke University.

[15] The recipients of the transfers are women. The grants, paid bimonthly, are conditional upon family visits to health centers, women participation in informal workshops on health and nutrition issues, and verification that children attended classes at least 85% of the time, (Angelucci and Giorgi, 2009).

transfers as an instrument (see details in Behrman et al., 2011).

**Returns to Education** We first report estimates of the returns to education. To estimate returns to schooling we use a standard Mincer regression,

$$\ln y_i = \alpha_0 + rS + \alpha_1 \text{Exp} + \alpha_2 \text{Exp}^2 + \beta X + \varepsilon_i \tag{46}$$

where $\ln y_i$ are the log-earnings of individual $i$ in 2009, $S$ denotes years of schooling, $r$ is the returns to schooling, Exp denotes potential experience and $X$ are a set of individual controls. These controls are Raven test scores, gender, marital status and whether an individual belongs to an "indigenous" group.

To identify the returns to schooling, $r$, we exploit the longitudinal dimension of the sample to link individuals that were affected by the random allocation of Progresa and that subsequently joined the job market. The sample size available to us is thus limited by the period the MxFLS spans. Individuals need to be young enough in 2002 (the first wave) to have potentially profited from Progresa at that time, but old enough to be working in the last wave 2009-2012. Thus, we focus on children below the age of 16 in 2002. In the first stage we regress years of schooling on experience, cognitive ability, age and the same set of dummies. We use a dummy for participation in the Progresa program as an instrument. In the second stage the dependent variable is annual income in 2009.

The results without instrumenting are reported in table 4. The return to schooling on the overall sample is around 9%. When we restrict our sample to workers only, we find an estimate of 8%. For entrepreneurs, the number of observations is reduced and the return to education is not precisely estimated. The point estimate suggest a larger return to education, but we cannot reject the null that the return is the same as for workers.

Table 5 reports the results when instrumenting years of schooling with Progresa. We find that the returns to education increase to 12% in this case and is precisely estimated. The first stage for Progresa is positive but not significant. We find that the significance of the first stage depends heavily on the weights used (it is significant in some specifications).

If we run our regression separately for workers and entrepreneurs, we find that the estimated returns for workers are very similar to the entire sample. For entrepreneurs, the point estimate is larger but imprecisely estimated. So we cannot reject that both of them are equal. One might worry that these estimates cannot be casually interpreted because agents select into occupations. To partially alleviate this concern, we control for individual talent through the Raven test scores. We see that the effect of the Raven test is not significantly different between workers and entrepreneurs. Through the lens of our model, to the extent that Raven test scores capture innate talent, this suggests that the parameter governing the effect of talent into different occupations, $\kappa_i$, is the same for workers and entrepreneurs. Thus, we assume in the quantitative analysis that

$$\kappa_e = \kappa_w \equiv 1, \tag{47}$$

and normalize it to one as, if $\kappa_e = \kappa_w$, this normalization is just a re-scaling of productivity.

To relate this specification to our theoretical exercise, note that if we take the log of the human capital production function, total earnings would be proportional to

$$\kappa \log \theta + \log(1 + \psi_i s^{\zeta}) \simeq \text{constant} + \frac{\psi_i}{\tilde{s}(\psi_i + \tilde{s}^{-\zeta})} \zeta s + \dots, \tag{48}$$

where we have used a first-order Taylor approximation around $\tilde{s}$. Thus, the fact that the returns to education are similar for entrepreneurs and workers can be rationalized through the lens of our model if

$$\psi_e = \psi_w = \psi. \tag{49}$$

We make this assumption in the empirical section. Thus note that $\psi$ controls the relative importance of education, as holding $s$ constant, a higher $\psi$ implies a higher contribution of education to effective human capital.

Anticipating our results in the quantitative section, consider $\tilde{s}$ to be the average value of the U.S., around twelve years. Our calibrated value of $\psi$ is greater to 2, in which case, $\psi/(\psi + \tilde{s}^{\zeta}) \simeq 1$. Thus, the coefficient on the Mincer regression for years of schooling is essentially capturing the curvature parameter $\zeta$ and not $\psi$.

**Household Educational and Occupational Choices** We also study the determinants of children's schooling decisions using the MxFLS. For this, we choose a sample of households with at least one child that was above the age of 11 in 2002. This ensures that in 2009 the child was old enough to have finished high school. All variables concerning the parents are averaged over the household head and spouse. The child's variables are averaged over children in the household above 11. The dependent variable is years of schooling of the child in 2009. Explanatory variables include assets and debt of the household in 2002, parents' and kids' cognitive abilities and parents' educational attainment. Cognitive abilities are measured in relative placement in the Raven test as measured by the quintile placement of that wave. By using quintiles, we remove any cohort effects in Raven tests, which have been documented to be present in these types of tests. Furthermore, we add dummies for the occupations of the parents in 2002 and interact them with assets and debt levels. We define three categories: workers, subsistence entrepreneurs and modern entrepreneurs. We define subsistence entrepreneurs as individuals reporting their main job as being a peasant on their own plot or a self-employed worker. We identify modern entrepreneurs if the position of the main job is boss, employer or business proprietor. Workers are not entrepreneurs that receive income. We also run the regressions for sub-samples of the households with above median asset holdings and below median asset holdings.

As a first pass on the data, table 6 reports the average schooling and Raven test scores for parents and kids. For parents, we find that the average values for subsistence entrepreneurs are very similar to the entire population for both Raven test scores and education. In contrast, we find that modern entrepreneurs have significantly higher Raven test scores by one decile and two more years of education. This evidence points towards the fact that there is positive selection of modern entrepreneurs. For kids, we see that for subsistence entrepreneurs, the Raven test scores are similar to the entire population, but educational levels are half a year less than the entire population. For modern entrepreneurs, we find that the education level is one year higher than the population average and that the Raven test score is one decile higher than the population average. This latter fact implies that the correlation in Raven test scores between parents and kids is very high, on the order of .9, shown in table 7.

We then explore the correlation between schooling choices of the kids and the family background. Results are reported in tables 8, 9 and 10. Overall, we find that parents' schooling and kids' ability are almost always significant in increasing kids' years of schooling. Parents ability is significant in the full sample of individuals above age 11 in 2002. However, the higher kids' ability the smaller is the effect of the parents.

In table 8, we use the sample of kids with age above 11 in 2002 for which we have information in all variables. We do not find an effect of household assets on education in the entire sample. However, if we look at the households below the median level of assets, we find that household assets have a positive effect on schooling. Moreover, for this subset of the population, we observe that agents with a higher level of debt tend to educate their kids more. These two results taken together suggest that households invest part of their assets in education but that they may be constrained in the total amount that they can borrow. We also control for dummy variables for occupational choices of the parents, which are mostly not significant (the only significant effect for entrepreneurial variables is the interaction with debt for the bottom 50% of asset holders).

Because around a quarter of our observations do not have information on household debt, we report in table 9 the same regression omitting household debt as a regressor. This increases the number of observations. The correlation of household assets and education remains very similar to table 8. In households below the 50% percentile of household assets, assets are strongly positively correlated with education of the kids. We find a negative point estimate for all households but its magnitude is negligible.

Also, we find that Raven test scores of parents and kids and parents' education is positively correlated with the education of the kids. Having a modern entrepreneur parent significantly increases years of schooling. Also for individuals with a modern entrepreneur the higher the level of assets, the lower is the level of schooling for the bottom 50 % of asset holders. This suggests a trade-off between investing into human capital of children and investing into the households' business. The effect shrinks immensely when asset holdings fall in the top 50 %. At these asset levels financial constraints do not seem to be binding any longer as they are for poorer households. For children that do not have a modern entrepreneur parent assets increase schooling levels when they fall in the bottom 50 %. This supports the idea that there might be some large fixed costs in the modern sector, which need to be covered.

As a robustness check, table 10 runs the same regression on individuals aged 11 to 21 in 2002. The rationale here is that debts and assets in 2002 may only really matter for schooling decision of individuals that still face potential schooling decisions in that period. The overall results are similar to the previous tables. Here the dummy on modern entrepreneur parents is negative and highly significant for the bottom 50% of asset holders. This is again consistent with the notion that modern entrepreneurs made a choice to invest in their business rather than in their kids' education.

### 3.3 Calibration Strategy and Quantitative Analysis

We calibrate the other parameters of the model to values that are standard in the literature or can be obtained from macroeconomic data from the U.S. or Mexico.

As a first step, we impose a set of structural parameters on preferences without calibration that are constant throughout the quantitative exercises. Then, we calibrate a set of structural parameters of preferences, technology and distribution of talent that remain constant throughout all exercises. Finally, we calibrate a set of parameters that may change over transitions/equilibria. These parameters mainly govern financial distortions.

**Time Periods** We assume that there are two periods per stage, i.e., agents live for four periods. Each period is calibrated to 12 years. Thus, youth and adulthood last 24 years each in our calibration, and agents live for 48 years. We set the maximum years of schooling to $\bar{s} = 18$, which is the total amount of years of formal schooling from age 6 until completion of a 4-year college degree. The choice of the length of time periods is partly driven by computational constraints. We note that there is a trade-off in selecting the length of the periods. On the one hand, having long time periods helps overcome the intratemporal market incompleteness that affects the choice of human capital (as we discussed in Section 2.6). On the other, allowing for shorter time periods allows households to bootstrap out of borrowing constraints by saving period-by-period.

**Talent Distribution** Following Buera and Shin (2013), we assume that talent follows a truncated and discretized Pareto distribution. The current specification assumes 10 types. We over-sample at the right tail of the distribution.[16]

**Parameters Invariant across Time and Economies imposed Ex-Ante** A number of fairly standard parameters are imposed without calibration. As in Buera and Shin (2013), we let $\sigma = 1.5$. The Pareto weight on a child is calibrated to generate 30% of the consumption of an adult (see Krueger and Ludwig, 2013 and the references therein).[17] We set the one-year depreciation rate to $\delta = 6\%$, which implies a depreciation rate of 52% when accumulated over 12 years. We choose $\alpha = .26$ to match an aggregate capital income share of 30%, and $\gamma = .53$. Thus, in an aggregate production function representation of the economy with constant returns to scale, the entrepreneurial share of production would be 21%.

The parameter governing probability of inheriting talent from the parents is .72. This number is in the upper range of the numbers reported in Bowles and Gintis (2002) on average correlations in IQ measures between parents and kids. This persistence level is also used by Castro and Sevcik (2014). It is however somewhat lower than the correlations we estimate in average Raven tests in the Mexican Life Family Survey (MxFLS).

[16] We plan the final version to have up to 20 types. Note that because a household unit is made out of a parent and a kid, if there are 10 possible talent levels, we have $10^2$ types in the household (note that in the second period of the household, there is an additional state which is the level of education of the kid in the first period). Also, because the education level is an additional state variable, this increases the computational burden.

[17] Normalizing to 1 the weight on the parent, it implies a weight on the child of $.3^{-1.5}$ implies a $\lambda_{kid} = .16$ .2

Table 2: Ex-Ante Imposed Parameters and Restrictions

| Preferences | | Technology | | Talent | | Human Capital | | | |
|---|---|---|---|---|---|---|---|---|---|
| $\sigma$ | 1.5 | $\alpha$ | .26 | Pareto Distrib. | | $\bar{s}$ | 18 | $\kappa_w$ | 1 |
| $\lambda$ | .25 | $\gamma$ | .53 | # Types | 10 | $\phi$ | .72 | $\kappa_e$ | 1 |
| | | $\delta$ | .52 | | | $\alpha_s$ | .66 | $\psi_e$ | $\psi_w$ |
| | | | | | | $\omega$ | .1 | $\vartheta_1, \vartheta_2$ | 1.5, 1.85 |

As we discussed in the previous section, motivated by the fact that we do not observe sizeable differential returns to education between workers and entrepreneurs, we set $\psi_e = \psi_w$. We let $\zeta = .1$ to match a 10% returns to education in the Mincer regression, which is what we obtain in our analysis of the MxFLS and is in the ballpark of the US estimates. Also, in the instrumented regressions on earnings in the MxFLS we cannot reject that the effect of Raven tests affects differentially more workers or entrepreneurs. Thus, we set $\kappa_e = \kappa_w = 1$. Finally, for the returns to experience per period, $\rho_1$ and $\rho_2$ we use the average number from Lagakos et al. (2012) across young and older workers, $\rho = 1.8$. Recall that experience improves effective types in a multiplicative way, $\theta_i \to \rho_j \theta_i$, $j = \{1, 2\}$ and $i = \{e, w\}$. For the production function of human capital, lacking a better estimate, we impose a labor share $\alpha_s = .66$ as in the aggregate economy. Table 2 summarizes the value of all ex-ante imposed parameters.[18]

**Calibrated Parameters Matching Moments** It remains to calibrate the discount factor $\beta$, the productivity of the modern sector, $A$, and the educational sector $A_s$ relative to the subsistence sector (which we normalized to one), the relative importance of education to supplying labor without education $\psi$ (recall that we have set $\psi_e = \psi_w$), the curvature parameter of the human capital production function, $\zeta$, and the tail of the Pareto distribution for talent, $\nu$. To this end, we select to match a number of moments of the U.S. economy. In order to discipline the discount factor $\beta$, we choose to match a yearly interest rate of 4.5%.[19] To inform our choices in the production function of human capital, we choose to match the expenditure share in education relative to GDP (7%), and the average years of schooling in the U.S. (12.8). To discipline the talent distribution and the production function specification, we choose to match the employment share of the top

[18]In terms of computation, we have a coarse grid of 20 points for educational levels which we use as state variables. In the within problem, we allow for finer partition (200 points) and then interpolate linearly to the two closest 2 points and assign a lottery over those.

[19]Thus, the interest rate targeted in the simulation is accumulated within the length of a period, $1.045^{12} - 1 = 0.696$.

Table 3: Parameters and Moments (Preliminary Results)

| Target Moments | | Model | Parameter Value |
|---|---|---|---|
| Yearly Interest rate | 4%–4.5% | 4.5% | $\beta = .55$ (Discount factor) |
| Top 10% emp. share | 69% | 59% | $\nu = 4.5$ (Pareto tail) |
| Expenditure share of GDP in education | 7% | 6.7% | $A_s = .67$ (Productivity Educ.) |
| Average Years Schooling | 12.8 | 12.9 | $\psi = 4.3$ (Returns Education) |
| Percentage of Entrepren. | 7% | 6.3% | $\zeta = .45$ (Curvature Human Cap.) |
| Top 5% emp. share | 51.7% | 46% | $\bar{k} = 4$ (Fixed Cost) |
| Top 5% earnings | 30% | 43% | $A = 4$ (Modern Productivity) |
| Credit market instr. to non-fin. assets | 70% | 72% | $\xi = 4.8$ (Borrowing constr.) |

10% firms, and the average income of entrepreneurs to workers. Finally, to inform our choice on the level of borrowing constraints we choose to match the external-finance to operating capital. Indeed, all these moments are jointly determined.

Table 3 reports the target moments, the model-generated moments and the corresponding parameter values used. Next to each target, we have the parameter that in our experience tends to most affect the targeted moment. For example, the discount factor $\beta$ tends to affect the interest rate, and so on. While these results are still preliminary, we approximate the moments fairly well. We anticipate with some more running time we can match the moments even better. The calibration also is quite close to some untargeted moments.[20]

In our calibration, we find that the fraction of entrepreneurs operating the subsistence technology is less than .01%. This result is robust to different parameter specifications around the chosen values. Thus, the subsistence technology is dominated by the modern technology.[21]

[20]This point will be discussed further in the future. For example, we find that total wealth share of entrepreneurs is 45% which is close to the 42% reported in Bassetto et al. (2015). Perhaps unsurprisingly it also squares well with the top 10% of the earnings share. We also plan in analyzing whether the distribution of educational attainment resembles the data. In terms of variance, our current calibration seems to over predict the variance of 3 years of schooling from the US data.

[21]This implies an identification problem in the sense that the current calibration does discipline directly this technology. However to the extent that the factor shares are the same in both technologies and that the productivity levels of the modern and schooling technologies are defined relative to the traditional technology, we are implicitly using it.

### 3.4 Long-Run Impacts of Financial Frictions (Incomplete, please refer to authors for preliminary results)

We use the parameter values calibrated to the US data in table 3 for our exercise, except for the financial frictions parameter $\xi$. This parameter is re-calibrated to match a domestic credit to GDP ratio consistent with Mexico. Estimates from the World Bank development indicators and Rajan and Zingales (1998) suggest a range on the order of 20% to 30%. We re-calibrate the stationary equilibrium by changing only the financial constraints parameter $\xi$ to match the level of financial development. We find that $\xi \sim .25$. Thus, these two economies have the same technologies except for the financial constraint parameter $\xi$.

We find that the differences in output per worker coming from these differences are sizable. The counterfactual economy computed to match the Mexican level of development is poorer as measured in income per capita. Human capital per capita decreases by

- Diffs In TFP
- Diffs in Occupational Choice
- Diffs in Human Capital
- Diffs in Inequality: top 5%, employment, average size

The model generates policy functions that are consistent with the MxFLS evidence. Poor households that become entrepreneurs tend to educate less their kids.

Points to discuss and compare with the US

- Decompose effect on Human Capital and Entrepreneurship.
- Correlation wealth to human capital
- Household policy choices.
- Firm size and growth

**Understanding the Mechanism** Suppose that we shut down endogenous educational choices in the model by setting $\psi = 0$. Holding all other parameters constant except financial constraints, we have find that the differences in output per worker and productivity are reduced.

### 3.5 The Dynamics of the Removal of Financial Frictions (TBA)

As a benchmark exercise, we consider the effects of alleviating financial frictions on growth and inequality. To this end we consider the effect of that would have in the economy calibrated with Mexican financial constraints to increase the fraction of available borrowing by a 25%. That is increasing $\xi$ to $1.25\xi$. This would correspond to a long-run improvement in the external finance to GDP ratio of the economy of , which would roughly correspond to moving from Mexico to Colombia

**Counterfactual exercises** Other potential policy-related exercises that can/may be done are, (1) assess the effect of conditional cash transfers to education as in Progresa, (2) Consider subsidies to small entrepreneurs.

## 4 Conclusion

TBA Please refer to authors for preliminary results.

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# A Tables

Table 4: Mincer Regression, kids under 16 in 2002, not instrumented

| | All HH, weighted | Workers, weighted | Entrep., weighted |
|---|---|---|---|
| | Ln(Annual Income 2009) | Ln(Annual Income 2009) | Ln(Annual Income 2009) |
| Yrs Schooling | 0.0922*** | 0.0817*** | 0.167 |
| | (0.0298) | (0.0288) | (0.114) |
| Experience | 0.192*** | 0.194*** | -0.0672 |
| | (0.0398) | (0.0405) | (0.231) |
| Experience*Experience | -0.00764*** | -0.00803*** | 0.0143 |
| | (0.00188) | (0.00194) | (0.0197) |
| Points in Raven Test | 0.528* | 0.697*** | -1.909 |
| | (0.272) | (0.256) | (1.271) |
| Female | -0.261* | -0.145 | -2.465*** |
| | (0.136) | (0.124) | (0.582) |
| Married | 0.0551 | 0.0776 | 0.187 |
| | (0.193) | (0.197) | (0.409) |
| Indigenous | -0.286 | -0.177 | -0.872 |
| | (0.252) | (0.217) | (0.547) |
| Constant | 8.284*** | 8.262*** | 9.824*** |
| | (0.324) | (0.333) | (0.914) |
| Observations | 34629 | 34659 | 34977 |

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Mincer Regression, kids under 16 in 2002, instrumented and weighted

| | All HH, 2nd stage<br>Ln(Annual Income 2009) | All HH, 1st stage<br>Yrs Schooling | Workers, 2nd stage<br>Ln(Annual Income 2009) | Workers, 1st stage<br>Yrs Schooling | Entrep, 2nd stage<br>Ln(Annual Income 2009) | Entrep 1st stage<br>Yrs Schooling |
|---|---|---|---|---|---|---|
| Yrs Schooling | $0.127^{***}$ | | $0.110^{***}$ | | 0.320 | |
| | (0.0444) | | (0.0424) | | (0.210) | |
| Experience | $0.259^{***}$ | $-1.171^{***}$ | $0.263^{***}$ | $-1.175^{***}$ | 0.0938 | -0.242 |
| | (0.0586) | (0.0850) | (0.0614) | (0.0878) | (0.239) | (0.252) |
| Experience*Experience | $-0.0122^{***}$ | $0.0272^{***}$ | $-0.0130^{***}$ | $0.0267^{***}$ | 0.00165 | -0.0346 |
| | (0.00443) | (0.00710) | (0.00464) | (0.00742) | (0.0234) | (0.0232) |
| Points in Raven Test | 0.391 | $1.735^{***}$ | $0.569^{*}$ | $1.631^{***}$ | $-2.837^{*}$ | $2.565^{***}$ |
| | (0.317) | (0.444) | (0.295) | (0.458) | (1.687) | (0.910) |
| Female | $-0.320^{**}$ | $0.680^{***}$ | -0.196 | $0.677^{***}$ | $-2.347^{***}$ | $0.620^{*}$ |
| | (0.153) | (0.184) | (0.139) | (0.193) | (0.590) | (0.366) |
| Married | 0.0195 | 0.0470 | 0.0491 | 0.0630 | 0.0427 | -0.373 |
| | (0.204) | (0.271) | (0.209) | (0.289) | (0.453) | (0.289) |
| Indigenous | -0.364 | -0.123 | -0.247 | 0.0156 | -0.648 | $-1.199^{***}$ |
| | (0.253) | (0.266) | (0.205) | (0.282) | (0.761) | (0.389) |
| Participation in Progresa | | 1.516 | | 1.924 | | -1.218 |
| | | (1.877) | | (1.997) | | (1.403) |
| Age | | $0.986^{***}$ | | $0.998^{***}$ | | $0.694^{***}$ |
| | | (0.0609) | | (0.0630) | | (0.114) |
| Age*Progresa | | -0.156 | | -0.187 | | 0.0581 |
| | | (0.156) | | (0.166) | | (0.109) |
| Constant | $7.880^{***}$ | 0.445 | $7.919^{***}$ | 0.398 | $8.477^{***}$ | 0.881 |
| | (0.434) | (0.549) | (0.442) | (0.571) | (1.617) | (1.363) |
| Observations | 34551 | 34551 | 34589 | 34589 | 34969 | 34969 |

Standard errors in parentheses

$^{*}$ $p < 0.1$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$

Table 6: Data Summary

| | All HH | Subs. Ent. | Mod. Ent |
|---|---|---|---|
| Kid's Quantile (Raven) | 0.505*** | 0.489*** | 0.603*** |
| | (0.00661) | (0.0133) | (0.0229) |
| Kids' schooling (yrs) | 10.04*** | 9.497*** | 11.36*** |
| | (0.0825) | (0.181) | (0.272) |
| Parent's Quantile (Raven) | 0.458*** | 0.459*** | 0.616*** |
| | (0.00659) | (0.0103) | (0.0206) |
| Parents' schooling (yrs) | 5.591*** | 5.626*** | 7.636*** |
| | (0.0944) | (0.142) | (0.319) |

Standard errors in parentheses

Kids older than age 11 in 2002. Parents are averaged over household head and spouse. Kids are averaged over all kids in the household. Quantile ranges from 0 to 1.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Talent correlation

| | (1) |
|---|---|
| | Kid's Quantile in Raven Test, weighted |
| Parent's Quantile in Raven Test | 0.959*** |
| | (0.0116) |
| Observations | 7570 |

Standard errors in parentheses

Kids older than age 11 in 2002. Parents are averaged over household head and spouse. Kids are averaged over all kids in the household. Quantile ranges from 0 to 1.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Kids' schooling choices, age above 11 in 2002

| | All HH, weighted | Bottom 50 % Assets, weighted | Top 50 % Assets, weighted |
|---|---|---|---|
| | Kids' schooling | Kids' schooling | Kids' schooling |
| HH assets in billion | -7.094 | 14751.2* | -12.94* |
| | (7.585) | (7688.7) | (7.537) |
| HH debt in billion | 4160.4 | 11711.3*** | 2256.7 |
| | (2733.9) | (3363.0) | (2615.2) |
| Parent's Quantile in Raven Test | 2.008** | 0.0236 | 2.130 |
| | (0.941) | (1.376) | (1.351) |
| Parents's yrs of schooling | 0.310*** | 0.330*** | 0.273*** |
| | (0.0330) | (0.0601) | (0.0388) |
| Kid's Quantile in Raven Test | 4.795*** | 4.538*** | 4.093*** |
| | (0.839) | (1.128) | (1.197) |
| Parent Subsistence Ent. | -0.439 | -1.352 | -0.318 |
| | (0.312) | (0.981) | (0.334) |
| Parent Modern Ent. | 0.645 | -1.854 | 0.730 |
| | (0.446) | (1.275) | (0.458) |
| Parent Subsistence Ent.*Assets | 9.583 | 26458.1 | 8.116 |
| | (10.91) | (21651.4) | (11.36) |
| Parent Subsistence Ent.*Debt | -2132.3 | -17942.8* | -985.1 |
| | (5522.0) | (9920.0) | (5113.4) |
| Parent Modern Ent.*Assets | -7.739 | -10834.7 | -6.080 |
| | (8.979) | (31604.9) | (8.945) |
| Parent Modern Ent.*Debt | 698.4 | 651936.7*** | 2021.4 |
| | (3174.2) | (230094.5) | (3078.9) |
| Number of HH members | -0.256*** | -0.251*** | -0.238*** |
| | (0.0657) | (0.0864) | (0.0857) |
| Kid's age | 0.0385 | -0.0226 | 0.0381 |
| | (0.0239) | (0.0420) | (0.0288) |
| Kid's quantile * Parent's quantile | -3.129** | -2.163 | -2.587 |
| | (1.523) | (2.535) | (2.006) |
| Constant | 6.730*** | 7.570*** | 7.368*** |
| | (0.729) | (1.201) | (0.974) |
| Observations | 4813 | 2424 | 2388 |

Standard errors in parentheses

Kids older than age 11 in 2002. Parents are averaged over household head and spouse. Kids are averaged over all kids in the household. Quantile ranges from 0 to 1.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Kids' schooling choices, age above 11 in 2002, dropping debt for bigger sample

| | All HH, weighted | Bottom 50 % Assets, weighted | Top 50 % Assets, weighted |
|---|---|---|---|
| | Kids' schooling | Kids' schooling | Kids' schooling |
| HH assets in billion | -21.54*** | 13152.1*** | -23.72*** |
| | (7.768) | (4423.6) | (7.403) |
| Parent's Quantile in Raven Test | 1.754*** | 0.0542 | 3.246*** |
| | (0.642) | (0.724) | (1.060) |
| Parents's yrs of schooling | 0.347*** | 0.349*** | 0.311*** |
| | (0.0198) | (0.0316) | (0.0260) |
| Kid's Quantile in Raven Test | 4.848*** | 3.987*** | 5.786*** |
| | (0.512) | (0.614) | (0.879) |
| Parent Subsistence Ent. | -0.254 | -0.433 | -0.218 |
| | (0.194) | (0.461) | (0.269) |
| Parent Modern Ent. | 0.632** | 1.634** | 0.550 |
| | (0.318) | (0.706) | (0.376) |
| Parent Subsistence Ent.*Assets | 42.40*** | 762.9 | 40.95*** |
| | (16.13) | (10468.4) | (14.57) |
| Parent Modern Ent.*Assets | 20.10** | -44363.0** | 21.96*** |
| | (8.091) | (17736.7) | (7.879) |
| Number of HH members | -0.176*** | -0.173*** | -0.158*** |
| | (0.0383) | (0.0447) | (0.0608) |
| Kid's age | 0.00733 | -0.0252 | 0.00681 |
| | (0.0155) | (0.0214) | (0.0204) |
| Kid's quantile * Parent's quantile | -2.858*** | -1.277 | -4.692*** |
| | (0.996) | (1.408) | (1.532) |
| Constant | 6.630*** | 7.300*** | 6.344*** |
| | (0.434) | (0.618) | (0.671) |
| Observations | 6417 | 3236 | 3180 |

Standard errors in parentheses

Kids older than age 11 in 2002. Parents are averaged over household head and spouse. Kids are averaged over all kids in the household. Quantile ranges from 0 to 1.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Kids' schooling choices, age above 11 and below 22 in 2002

| | All HH, weighted | Bottom 50 % Assets, weighted | Top 50 % Assets, weighted |
|---|---|---|---|
| | Kids' schooling | Kids' schooling | Kids' schooling |
| HH assets in billion | -8.052 | 17490.9** | -13.32* |
| | (7.856) | (8081.8) | (7.146) |
| HH debt in billion | 2825.0 | 4405.1 | 1820.8 |
| | (2780.5) | (7874.5) | (2503.3) |
| Parent's Quantile in Raven Test | 1.017 | -1.617 | 2.187 |
| | (1.063) | (1.477) | (1.474) |
| Parents's yrs of schooling | 0.310*** | 0.326*** | 0.261*** |
| | (0.0361) | (0.0644) | (0.0418) |
| Kid's Quantile in Raven Test | 3.634*** | 3.214** | 3.680** |
| | (0.955) | (1.253) | (1.436) |
| Parent Subsistence Ent. | -0.453 | -1.386 | -0.334 |
| | (0.381) | (1.143) | (0.370) |
| Parent Modern Ent. | 0.267 | -2.505*** | 0.448 |
| | (0.476) | (0.732) | (0.513) |
| Parent Subsistence Ent.*Assets | 76.50 | 31910.9 | -58.85 |
| | (127.1) | (23928.2) | (91.70) |
| Parent Subsistence Ent.*Debt | 11802.8 | -5413.2 | 10948.6 |
| | (8308.0) | (17040.4) | (7363.2) |
| Parent Modern Ent.*Assets | -3.401 | -8712.9 | -3.702 |
| | (9.773) | (18956.9) | (9.177) |
| Parent Modern Ent.*Debt | 2342.0 | 728323.0*** | 2333.5 |
| | (3141.9) | (117446.1) | (2942.9) |
| Number of HH members | -0.288*** | -0.203** | -0.341*** |
| | (0.0687) | (0.0929) | (0.0928) |
| Kid's age | 0.0943* | 0.00822 | 0.118** |
| | (0.0506) | (0.0921) | (0.0527) |
| Kid's quantile * Parent's quantile | -1.541 | 0.512 | -2.524 |
| | (1.729) | (2.670) | (2.280) |
| Constant | 6.765*** | 7.533*** | 7.052*** |
| | (1.064) | (1.700) | (1.295) |
| Observations | 5962 | 2876 | 3084 |

Standard errors in parentheses

Kids older than age 11 in 2002. Parents are averaged over household head and spouse. Kids are averaged over all kids in the household. Quantile ranges from 0 to 1.

$^{*}$ $p < 0.1$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$