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Hit and Run?

Income Shocks and School Dropouts in Latin America

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Abstract

How do labor income shocks affect household investment in upper secondary and tertiary schooling? Using longitudinal data from 2005–15 for Argentina, Brazil, and Mexico, this paper explores the effect of a negative household income shock on the enrollment status of youth ages 15 to 25. The findings suggest that negative income shocks significantly increase the relative risk of students exiting upper secondary and tertiary education in Argentina and Brazil, but not in Mexico. For the three countries, the analysis finds evidence that youth who exit school due to a household income shock have worse employment outcomes than similar youth who exit without a household income shock. Differences in labor markets and safety net programs likely play an important role in the decision to exit school as well as the employment outcomes of those who exit across these three countries.

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Hit and Run? Income Shocks and School Dropouts in Latin America[1]

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1. INTRODUCTION

Does a negative household income shock affect the educational attainment of the children in that household? This question has attracted significant attention among economists, as understanding the adjustment mechanisms of households to shocks is crucial from a policy perspective. The impact of household shocks on education is of particular relevance in Latin America—a region with low levels of skilled labor, high levels of inequality, high frequency of income shocks, and low rates of access to credit. Additionally, the education advances of the last decades still fall short (see section 3: Trends in School Enrollment). Limited and inequitably distributed access to education and human capital formation leave many individuals unable to compete for high-productivity jobs throughout the region, reducing household welfare and economic growth.

In this study, we focus on the extent to which household income shocks in Argentina, Brazil, and Mexico are associated with exits from upper secondary and tertiary school. Understanding how parental investments in education respond to income shocks is important because parents may face imperfect insurance against shocks (see Cochrane, 1991; Blundell, Pistaferri and Preston, 2008, for example). Income shocks during upper secondary and tertiary schooling can have persistent effects on human capital, both by reducing formal education and by generating low-quality job matches for youth. Therefore, learning about households' response to shocks is informative for the design of education policies (human capital-enhancing) and social policies (inequality-reducing) targeting more disadvantaged families with young children.

The main focus of the existing body of work has been to identify the effect of a macroeconomic income shock to school enrollment rates mainly in primary and secondary school. We add to the existing literature on income shocks and educational attainment in several ways. First, we focus on youth, defined as individuals aged 15-25. That is, the analysis goes beyond considering the impact on basic schooling but instead focuses on educational attainment needed for relatively skilled jobs. This is of particular relevance in Latin America in which education expansion efforts have achieved near-universal coverage at the primary level, but still lag in terms of secondary and tertiary completion rates.

Second, we focus on idiosyncratic shocks that are experienced by households rather than aggregate shocks, such as those caused by macroeconomic crises or natural disasters. Aggregate shocks can distort the effect of a household income shock since they can directly impact the labor market. For example, an aggregate shock that leads to increased job loss will, on one hand, increase the likelihood of a household receiving an income shock while, on the other hand, decrease the opportunity cost of remaining in school due to reduced labor demand.

Third, the majority of the existing literature has focused on single country evidence, whereas we compare the experience of three countries—Argentina, Brazil and Mexico—allowing us to learn

more about how the transmission of income shocks to schooling differs across types of labor markets and to have a broader scope to our empirical results.

In our empirical analysis we use duration models, which take into account the fact that the likelihood of exiting school is not independent of the student's age, to assess the relationship between school exit rates and household income shocks. To complete our analysis, we also look at initial employment outcomes for youth after the shock. This allows us to better understand the immediate costs of school exits due to household income shocks, and how outcomes differ from those of individuals who exit school for other reasons.

Our results suggest that negative shocks experienced by the household's main earner – either a large reduction in income or a job loss leading to unemployment - increase the relative risk that students exit upper secondary or tertiary education in the three countries. The magnitudes of these results differ across the level of schooling of the student and across countries, and also depend on the severity of the shock. A negative labor income shock on the household's main earner is associated with higher relative risk of school exit for students in both secondary and tertiary education in Brazil and for students in tertiary education in Argentina. This effect is not found in Mexico. However, an unemployment shock leads to higher dropout rates for students in secondary school in Argentina and Mexico.

The remainder of the paper is structured as follows. Section 2 provides a review of the related literature, and the conceptual framework used in understanding the relationship between parental income and enrollment of offspring in upper secondary and higher. Section 3 describes key salient characteristics of education such as trends in enrollment rates and youth activity status in the three countries. Section 4 describes the data. Section 5 reports the main empirical strategy and results. Section 6 considers how outcomes among those who exit school differ when the school exit is accompanied by a parental income shock. Section 7 concludes.

2. RELATED LITERATURE AND CONCEPTUAL FRAMEWORK

By and large, theory predicts a positive link between parents' income and the schooling attainment of youth in the presence of credit constrains. In a typical model of schooling as an investment, parents borrow against future earnings to finance investment in education, both direct costs of schooling and the opportunity cost of the student's time. However, if borrowing constraints are binding or access to credit varies by parents' income level, then the separability of the consumption and investment decisions breaks down. As a result, as lower-income families are less likely to have access to credit and savings, time allocation of family members may be one of the major resources available for adjustment.

Empirical research has shown a clear link between household income and schooling. Behrman and Knowles (1999) review 42 studies covering 21 countries, and find a positive association between household income and schooling in three-fifths of these studies. Another example is

Edmonds (2006), which shows that increases in household income in South Africa increased school attendance of 10 to 17 year-olds.

One strand of the literature has looked at the relationship between schooling and economic crises, showing that economic downturns lead to declines in school enrollment, especially among poorer children. Fallon and Lucas (2002) summarize the evidence of the impact of economic crises on households, with particular attention to the 1990s financial crises in Southeast Asia and Mexico. They find that school enrollment drops during periods of economic crisis. This impact of crises or growth shocks on education has been found extensively throughout developing countries: for example, in Costa Rica by Funkhouser (1999); in Indonesia by Thomas et al. (2004); in Mexico by McKenzie (2003); and in Argentina by Rucci (2004). Yet, when summarizing the literature of the impact of economic crises and natural disasters on various dimensions of well-being including schooling decision, Skoufias (2003) concludes, "It would not be surprising if both the direction and the magnitude of the effect of aggregate shocks on child schooling and work turn out to vary from country to country depending on the level of urbanization and the financial and economic development."

Negative household employment shocks are associated with increased dropout rates. Duryea, Lam, and Levinson (2007) show how, in Brazil, male household head unemployment increases child labor and decreases school advancement, particularly for girls. In Mexico, Parker and Skoufias (2006) find that idiosyncratic shocks such as parents' unemployment and divorce have no impact on boys' schooling but reduce school attendance and school attainment among girls.[6]

Moreover, evidence suggests that the relationship between income shocks and schooling is mediated by access to credit markets. In one of the seminal papers of the literature, Jacoby and Skoufias (1997) use Indian panel data of rural households and find that, in a context of financial market failures, idiosyncratic household income shocks had a larger effect on school attendance than anticipated village-level shocks. Flug, Spilimbergo, and Wachtenheim (1997) examine secondary school enrollment rates using cross-country panel data for the period 1970-92, and find that differences in financial depth (as a proxy of credit availability) account for a third of the difference in secondary school enrollment rates between Latin America and developed countries. Jensen (2000) and Beegle, Dehejia, and Gatti (2005) show that agricultural shocks reduce school

[6] On the other hand, studies have found that positive labor conditions can also contribute to higher dropout rates by incentivizing youth employment at the expense of continuing education. For example, in Brazil over a 20-year period (1977–98), Duryea and Arends-Kuenning (2003) find that the employment rate of 14 to 16 year-old living in cities increases as local labor market opportunities improve, as they become more likely to leave school. Atkin (2016) looks at the impacts of globalization on the Mexican labor force and finds that, during the period 1986 to 2000, the massive expansion of export manufacturing altered the distribution of education. The new job opportunities created by the maquila plants increased the opportunity cost of schooling for youths on the dropout margin at age 16.

attainment in Côte d'Ivoire and Tanzania, respectively, finding that access to credit in Tanzania helps protect children from these shocks and keep them at school.

A Conceptual Framework for Understanding Human Capital Investment

We draw on the seminal model of Jacoby and Skoufias (1997) to analyze the response of human capital investment -measured by exits from school - to fluctuations in family income. The full model is presented in Appendix 1.

Consider a household i with a child eligible for schooling over the time interval $0 < t < T$ consecutive quarters. S_{it} is school enrollment given cumulative history of shocks at time t. The child's beginning of period human capital stock, H_{it}, is determined by $H_{it} = g(S_{it}; H_{it-1}; \theta_{it})$. The function g is increasing in S_{it} and H_{it}, and its functional form determines the cost, in terms of human capital, of using child labor as an insurance. θ_{it} is an education productivity shifter that can reflect child illness or the aggregate effect of earlier shocks that decrease the likelihood of children going to school.

Building on this earlier research and on canonical models of household production wherein households maximize the expected discounted value of utility (i.e. Cox, 1990), we assume that households include expected future utility of their children in their intertemporal household utility function. This component of utility is a function of expected future returns of human capital such that more years of schooling imply positive returns. The household's expectations of future returns to human capital are affected by characteristics of the student–including gender and ability–local labor market conditions, aspirations, and level of schooling completed.

A household chooses consumption and school time to maximize the expected discounted value of a time separable utility function by solving:

$$\max_{\{C_{it}, S_{it}\}} E_0 \left[\sum_{t=0}^{T} \beta^t U(C_{it}) + \varphi(H_{iT+1}, B_{iT+1}) \right]$$

where β is the subjective discount factor. At the end of the school period, the household leaves a bequest of financial asset, B_{iT+1}, and a child human capital stock, H_{iT+1}. The joint value of the bequest and human capital stock at the end of the schooling period is given by the increasing concave function φ.

The household's budget constraint is defined by the total income of household members, in particular the labor market income of the parents. The costs of school attendance are tuition, school supplies and related incidental costs. At the same time, the foregone labor earnings or household production of these students represent a clear opportunity cost for the household, one which increases as a function of the schooling already completed by the student. Taking these

factors into account, the household jointly decides how much of their income to allocate to the human capital development of child *i* versus household consumption.

This decision is further complicated by imperfect credit markets as the presence of credit rationing restricts the budget set of the household and, if binding, will generate an inefficiently low level of investment in human capital. Without access to credit, if a household receives a negative income shock, household income for that period falls, reducing the household's budget for consumption and investments – including schooling. This effect is particularly pronounced for low-income households who face more limited liquidity due to lower access to credit markets. The key trade-off is hence between schooling—which is assumed to increase consumption tomorrow—and youth production—which increases consumption today.

Aggregate shocks have both income and substitution effects on households. The income effect originates from changes in the resources available to the household for investment in human capital and consumption. On the other hand, the substitution effect arises from changes in the wage rates (for both children and adults), thus affecting the opportunity cost of time going to school (see Ferreira and Shady 2009). Idiosyncratic shocks should induce only an income effect on households, as these should not affect the wage rates of the local labor market. This paper focuses on the role of the income effect in the response of households to idiosyncratic shocks, controlling for macroeconomic aggregate shocks.

3. TRENDS IN SCHOOL ENROLLMENT

This section describes recent trends in upper secondary and tertiary education in Argentina, Brazil and Mexico.[7] Educational attainment in Brazil and Mexico has increased markedly in recent decades while Argentina's continues to be high by regional standards. Even so, upper secondary graduation rates in Mexico (49%), Argentina (65%) and Brazil (63%) lag behind those of OECD countries (85%).[8] These graduation rates represent a 10-year increase in completion rates of individuals ages 20-29 of 18 percentage points in Brazil and 13 percentage points in Mexico.

Secondary enrollment rates in Argentina and Brazil are higher than in Mexico, while Argentina has the highest tertiary enrollment rates (Table 1). In Mexico, a significant age of dropout is 14-15, when students transition from lower secondary to upper secondary school (*secundaria* to *bachillerato*). This transition point is largely missed in our sample, which begins at age 15. Importantly, for the three countries, the most crucial year for exiting education is between 17 and

[7] A more detailed description of the education system in each country is relegated to Appendix 3.

[8] Estimates for Argentina, Brazil, and Mexico are own estimates from the SEDLAC database (CEDLAS and World Bank). The OECD average is from OECD/CAF/ECLAC (2016).

18 - the end of secondary school. During these two years of age, enrollment rates drop by almost 20 percentage points in Argentina and Mexico and by 30 percentage points in Brazil.

Table 1: Enrollment rates by age, 2003 and 2013

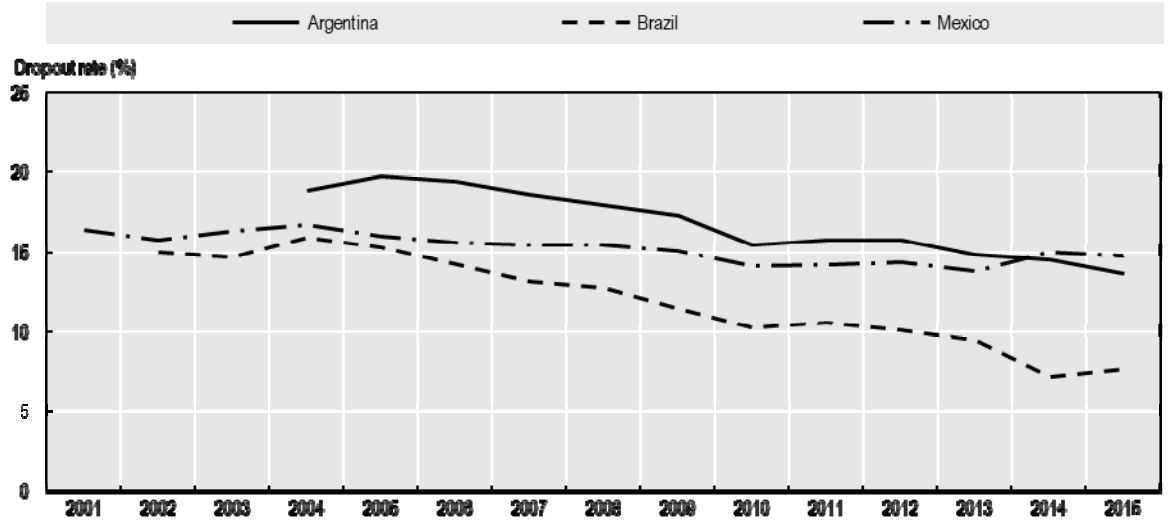
Ages	15	16	17	18	19	20	21	22	23	24	25
Argentina											
2003	88.5	87.5	78.4	60.3	52.9	42.5	39.6	42.6	42.5	28.4	25.4
2013	93.8	87.7	80.4	61.2	55.2	45.3	44.4	41.1	38.8	32.1	25.8
Brazil											
2003	89.6	83.5	76.1	58.1	44.9	35.2	31.3	27.3	24.9	18.6	15.7
2013	92.3	87.3	81	50.7	37.3	31.3	29.3	28.2	26.7	16.2	13.8
Mexico											
2002	71	62.2	59	41	36.8	35.6	29.7	28.4	24.1	14.5	9.5
2012	79.2	68.5	63.5	45.8	36.2	35.1	33.9	30.4	31.5	14.7	9.3

Source: CAF (2016).

Note: Data show age profile of education enrollment rates (enrollment percentages for each year of age). Enrollment rates are calculated by dividing the number of students of a particular age group enrolled in all levels of education by the size of the population of that age group.

Figure 1 plots the evolution of dropout rates from secondary school for each of the three countries over the last decade. While enrollment rates are very different in Argentina and Mexico, dropout rates from upper secondary are very similar. That is, while Mexican youth are less likely to be enrolled in upper secondary than Argentinian youth, conditional on being enrolled, dropout rates are similar for each age. The upper secondary dropout rates in Brazil reflect a positive development, as dropout rates have fallen to about half of what they were in 2000.

Figure 1: Dropout rates from upper secondary education (2001-2015)

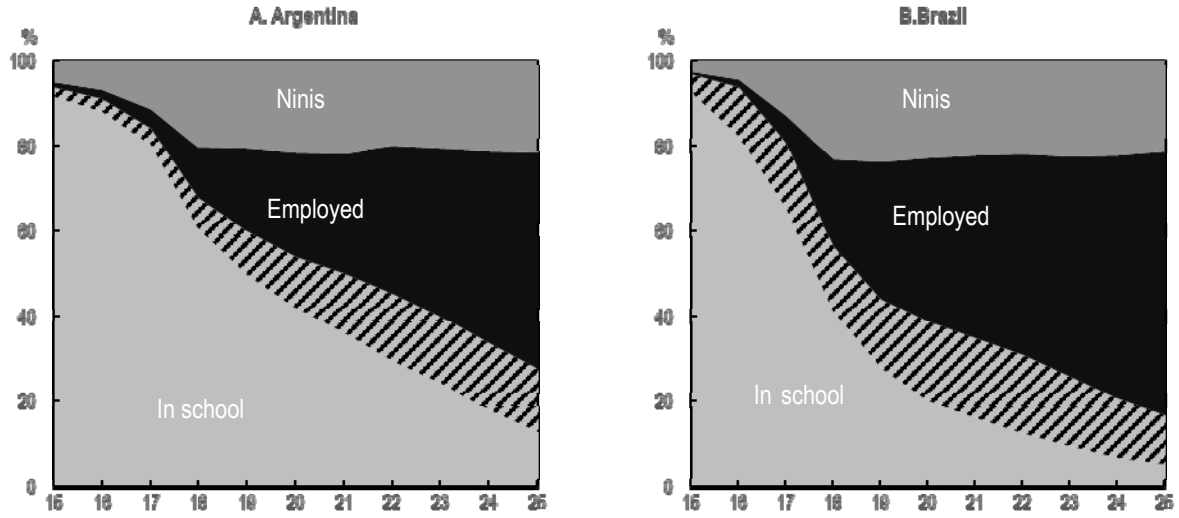


Source: MEC/INEP/Censo Escolar (2015) for Brazil, DINIEE (2016) for Argentina, and INEGI (2017) for Mexico.
Note: Dropout rate is defined as the percentage of students who were enrolled in school at year *t* and do not enroll in year *t+1*.

While free public secondary and tertiary education is available in the three countries analyzed, relatively few youth ages 18-25 are enrolled in school, and many are simultaneously working. Figures 2(a) through 2(c) report youth activity status (enrolled in school, employed, enrolled and employed, neither employed nor enrolled) by age for Argentina, Brazil and Mexico. In each country, there is a notable shift away from schooling and towards employment as age increases from 15 to 25. As shown by the school enrollment rates above, there is considerable cross-country heterogeneity in the distribution of school enrollment across age, with Argentinian students staying in school until older. In Brazil and Argentina, there is a larger overlap between school and work, as many employed young adults remain enrolled in school. This is less common in Mexico.

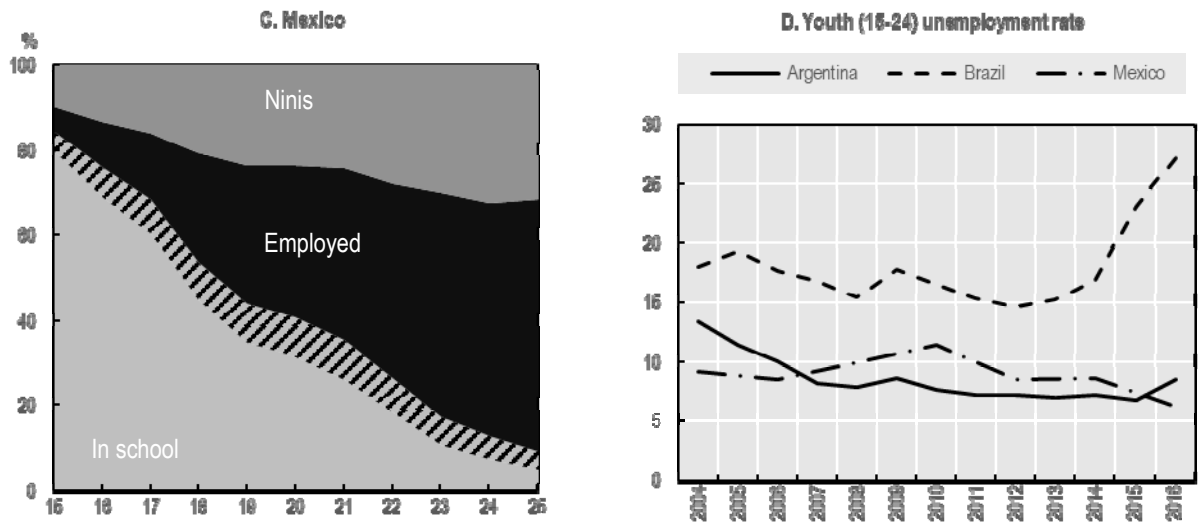
After the end of secondary school, the share of youth who are neither in school nor working (the so-called *ninis*) remains relatively stable at around 20-22% after age 18 in Argentina and Brazil and about 30% in Mexico.[9] While many *ninis* are out of the labor force, high youth unemployment rates in Argentina and Brazil account for some of the *ninis*.[10] The youth unemployment rate, as with the overall unemployment rate, is substantially lower in Mexico (Figure 4(d)).

Figure 2. Activity status for individuals age 15-25 by country, 2005-2015



[9] See De Hoyos et al. (2016) for a regional study of *ninis* in Latin America.

[10] In the three countries a person is considered unemployed if that person reported to be not employed but available to work and actively looking for a job during the week prior to the interview.



Source: Authors' tabulations using LABLAC (CEDLAS and the World Bank).
Note: Figures (a) – (c) report the share of individuals in school only, in school and employed (striped area), only employed, and neither in school nor working (*ninis*) by age. Estimations refer to the population weighted average of urban individuals for Argentina, Brazil and Mexico over the period 2005-2014. Figure (d) reports the ILO estimate of youth unemployment rates for individuals ages 15 through 24.

4. DATA

Our analysis draws on data from the Labor Database for Latin America and the Caribbean (LABLAC), a regional labor force harmonization effort produced by the World Bank and the Center for Distributional, Labor and Social Studies (CEDLAS) of the Universidad Nacional de La Plata in Argentina. LABLAC dataset is a complement of the Socio-Economic Database for Latin America and the Caribbean (SEDLAC) database on poverty and inequality that provides labor statistics at the highest frequency available in each country. The database contains quarterly information for Argentina (from 2003), Brazil (from 2005), and Mexico (from 2005), as well as other countries.

We limit our analysis to the three countries in LABLAC that have panel data with school enrollment information—Argentina, Brazil, and Mexico, which together comprise about 60% of the population of Latin America.[11] We restrict the sample to youth, aged 15 to 25, enrolled in school and living in urban households where at least one member had positive labor earnings. These are the youth at risk of facing a labor income shock that could affect their school

[11] Data for Argentina are from the *Encuesta Permanente de Hogares* (EPH), a quarterly household and labor force survey which covers the 31 largest urban areas, representing over 60% of the country's population. In this study, we use quarterly data from 2005Q1 through 2014Q1. Data for Brazil are from the *Pesquisa Mensal de Emprego* (PME), a monthly employment survey that covers the six largest metropolitan areas of Brazil. We use. Data for Mexico are from the *Encuesta Nacional de Ocupación y Empleo* (ENOE), the nationally representative labor force survey from Mexico. For Brazil and Mexico, 36 quarters of data are used in this study (2005Q1 through 2014Q4); 33 quarters are used for Argentina (2005Q1 through 2014Q1).

enrollment. Additionally, since we are interested in the household budget decision, we limit the sample to daughters and sons of the household's main earner (excluding, for example, other relatives or roommates that may have a separate household budget). We also exclude household heads that are themselves enrolled in school.

We construct one-year individual-level observations between the first quarter of 2005 to the last quarter of 2015, given that our data are based on a panel design where households are included for up to a year only. To build these one-year observations, we link observations of the individual in their first appearance in the data and in their appearance in the data four quarters later. For example, individual *i*'s information from 2016 quarter 2 (quarter=*q*) is linked with his or her information in 2015 quarter 2 (quarter=*q-4*). Using information on enrollment from the first time the individual is included in the sample (i.e. quarter= *q*-4) and the information from one year later (quarter=*q*), we construct a variable indicating whether the individual has exited school during that period.

Similarly, using information on the labor income of the household from the same two periods of observation, we identify households that suffered a negative income shock. To generate an income shock variable that is less likely to be influenced by the student's own schooling and employment decisions, we focus our attention on changes in the labor income of the household's main earner (defined as the member with the highest monthly earnings in *q-4*). To distinguish between a negative shock and normal income fluctuations, we calculate the distribution of the annual change in the real labor income of household main earners for each country and year of data. We use a value close to the median of these year-to-year fluctuations, a 25% reduction, to define a negative labor income shock; it is constructed as a dummy variable that takes the value of 1 if the household's main earner experiences a reduction of 25% or more in his/her labor income, and 0 otherwise.

Sample summary statistics for in-sample individuals living in households that received a negative income shock as described above compared to those who did not are reported in Table 2. While differences between the two groups are statistically significant for most characteristics, they are economically small. Youth across both types of households do not differ significantly in terms of age, gender, or years of schooling. There are, however, some differences in their activity status – while, by construction, all are enrolled in school, students in households that did not receive a shock are slightly less likely to be employed or economically active (including unemployed). Generally, households that experienced shocks are more likely to be headed by a woman, have slightly younger household heads, and have higher per capita labor earnings.

Table 2. Descriptive statistics of the sample by income shock status

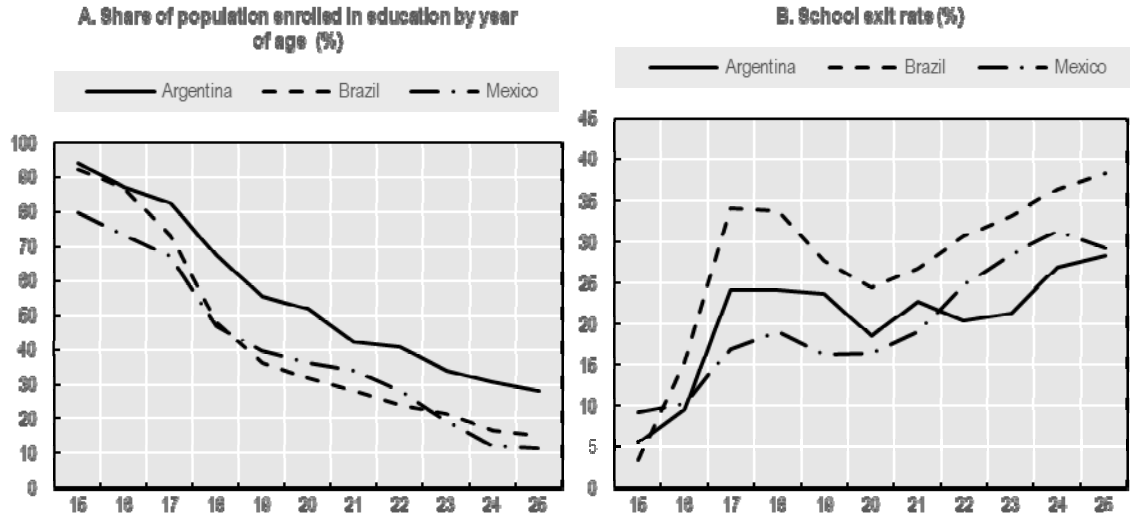
	Argentina			Brazil			Mexico		
	No Shock	Shock		No Shock	Shock		No Shock	Shock	
Sample size	28,081	12,647		66,782	20,843		42,992	21,743	
Weighted population	10,792,286	5,193,232		11,206,430	3,161,991		10,263,658	5,283,793	
Individual characteristics									
Age	17.9	18.1		17.8	18.0		17.5	17.7	
Male (%)	0.49	0.48	(n.s.)	0.51	0.51	(n.s.)	0.51	0.51	(n.s.)
Years of education	10.9	11.0		9.4	9.6		10.6	10.7	
Activity (%)									
School only	0.87	0.84		0.72	0.69		0.85	0.82	
School and employed	0.13	0.16		0.28	0.31		0.15	0.18	
Economically active	0.17	0.19		0.34	0.38		0.17	0.20	
Household's Main earner									
Age	45.1	44.3		42.8	42.7	(n.s.)	42.5	41.8	
Female (%)	0.29	0.31		0.31	0.36		0.26	0.31	
Years of education	11.4	11.4	(n.s.)	9.9	10.2		10.3	10.4	(n.s.)
Household									
Household size	4.9	5.0		4.1	4.1	(n.s.)	4.7	4.8	(n.s.)
Members employed	1.9	2.0		2.1	2.1		1.9	1.9	
Labor income p.c.	294	391		387	520		218	303	
Number of siblings	1.0	1.0		0.7	0.7		0.8	0.9	

Source: Authors' tabulations using LABLAC (CEDLAS and the World Bank).
Note: Labor income per capita is expressed in 2011 PPP-adjusted USD. Differences between mean values of characteristics of students with household shocks and those without household shocks are all statistically significant at the 1% level with the exception of the values followed by *(n.s.)*.

As described above, we limit the sample of analysis to individuals who are enrolled in school in quarter=*q-4*. As shown in Figure 3(a), this group becomes an increasingly smaller subsample of the age group as age increases from 15 to 25. Figure 3(b) shows the school exit rates per year of age for the sample. The likelihood of leaving school is higher as individuals get older, although the relationship is not monotonic. Since upper secondary education ends at age 17 or 18, there is a spike in exits around that age.[12] For instance, in Brazil the likelihood of exiting school doubles from 15% to 34% when moving from age 16 to 17, and then drops to 27% for individuals aged 19.

[12] See Appendix 3 for an explanation of the educational system in the three countries.

Figure 3. Enrollment and school exit rates, by age and country

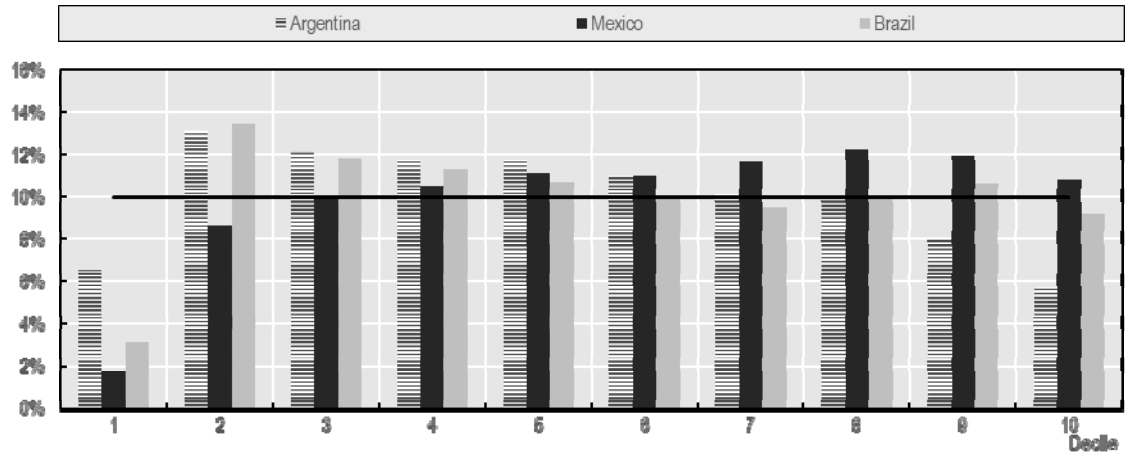


Source: Authors' tabulations using LABLAC (CEDLAS and the World Bank).
Notes: Figure 3(a) presents the share of the urban population at each age that is enrolled in school. Figure 3(b) presents share of individuals that leave school in any given year by age (enrolled in year *t* and not in year *t+1*). Estimations were calculated pooling all the data over the period 2005-2015.

Figure 3(b) shows that school exit rates for Mexican students are lower than those of the other two countries around the ages when secondary school is completed. This reflects, in large part, the observation made earlier in Figures 2 and 3(a): approximately 20 percent of Mexican urban youth have already exited school by the age of 15, a much higher number than in Argentina and Brazil (under 10 percent). Since enrollment and completion rates of secondary education in Mexico are significantly lower than in Argentina and Brazil, it suggests that more of the "cream skimming" may be happening between basic education and upper secondary school. If each individual *i* has some probability of exiting as a response to an income shock, the lower enrollment rate may suggest that more students with higher probability of exiting school in response to a shock have already exited by the age of 15 in Mexico as compared to Argentina and Brazil. This would leave individuals with lower probability of exiting school overrepresented in the Mexican 15-25 population relative to the other two countries.

Figure 4 confirms that the attrition from the population of enrolled youth is different in Mexico as compared to the other two countries; it results in significantly lower enrolment rates among students in lower income groups in Mexico relative to Argentina and Brazil. Figure 4 shows the distribution of the sample of enrolled youth across income deciles in the three countries. While in Argentina and Brazil, students are disproportionately more likely be in the second through fourth deciles, in Mexico students are disproportionately likely to come from the top half of the income distribution. That is, there are larger gaps in enrollment rates between low and high-income youth in Mexico compared to the other two countries.

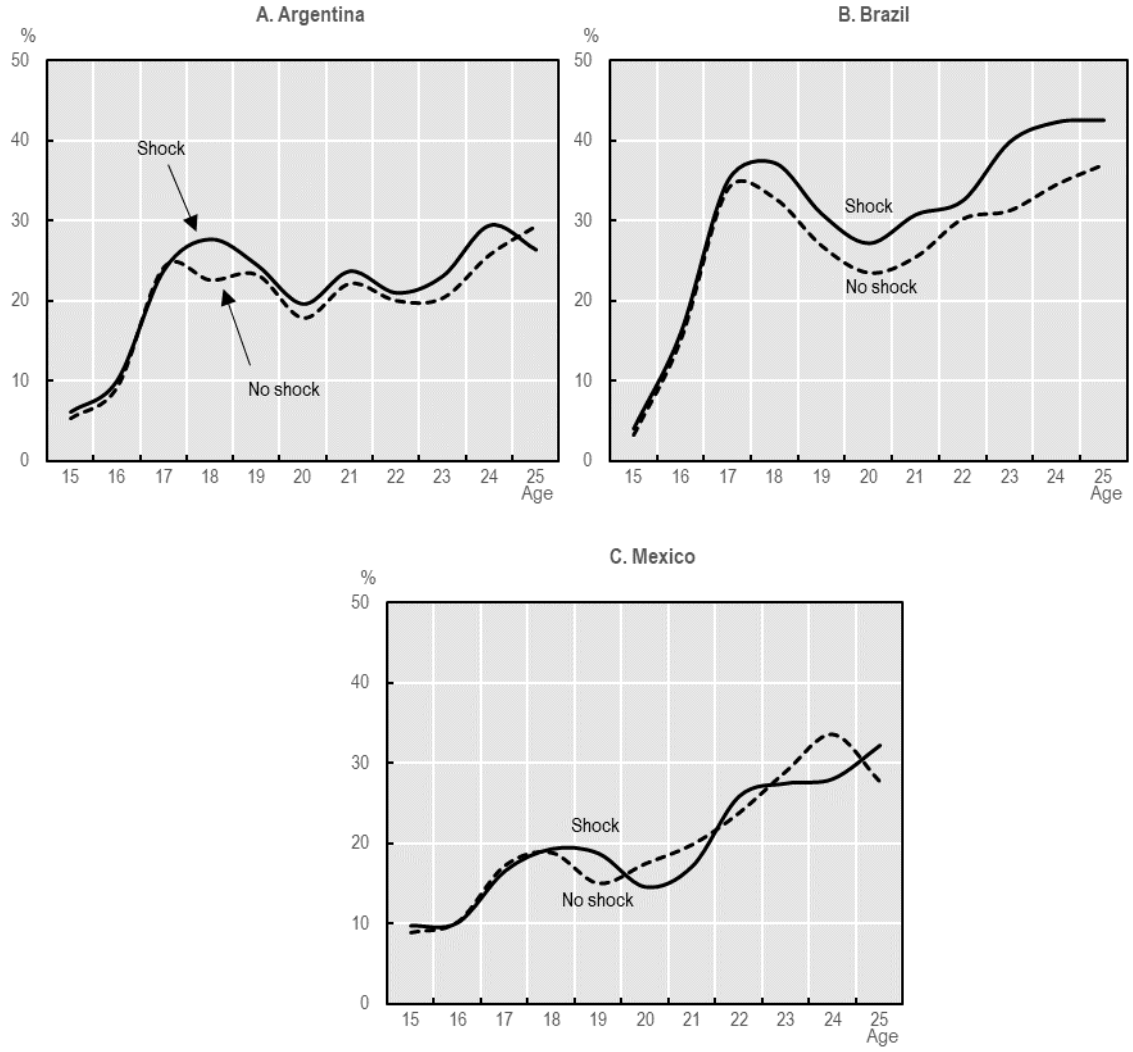
Figure 4. Income decile of enrolled students, age 15-24, by country



Source: Authors' tabulations using LABLAC (CEDLAS and the World Bank).
Notes: This figure presents the share of the population age 15-24 enrolled in school by income decile. Income deciles are calculated for the full urban population based on household per capita labor income. Estimations were calculated pooling all the data over the period 2005-2015.

Turning our attention to the relationship between household income shocks and school enrollment, Figure 5 shows some suggestive evidence that exit rates of students in households where the main earner received a negative labor income shock differ from those where there was no negative shock. In general, these trends suggest school exit rates of students older than 17 are correlated with household shocks in Brazil and Argentina. For instance, in Brazil, the exit rates of students over 18 living in households that experience a negative shock are higher than the ones that did not, suggesting that experiencing a shock is related with a decrease in the likelihood of transitioning into or continuing tertiary training. In particular, the likelihood of exiting school is 4.5 percentage points higher for students aged 18 that live in households that experienced a negative shock, compared to those whose household did not experience a shock. A similar pattern emerges in Argentina, though the differences in enrollment rates are more pronounced just around the time of transition from secondary to tertiary school. In Mexico, the two trends suggest a less clear pattern.

Figure 5. School exit rates by age and whether household's main earner suffered from a negative labor income shock



Source: Authors' tabulations using LABLAC (CEDLAS and the World Bank).
Notes: This figure presents share of individuals that leave school in any given year by age dividing all households into two subsamples: those where the household's main earner received a negative shock (labor income shock decreased by more than 25%), and those where the main earner did not receive a negative shock. Estimations were calculated pooling all the data over the period 2005-2015. Subsample is restricted to individuals dependent on household head, and households where at least one member receives a positive labor income. Sample size by age for each country is reported in Appendix 1.

5. EMPIRICAL FRAMEWORK AND RESULTS

Our goal is to model the conditional probability that an individual will exit from school during some time interval (i.e. a year), conditional on not having dropped out up to that point. To assess the relationship between school exit rates and household income shocks we use duration models,

in particular a semiparametric Cox's Proportional Hazard Model (Cox 1972).[13] This approach allows us to take into account the fact that the likelihood of exiting school is not independent of the time spent at school (see for instance Sanizah et al (2014) and Juajibioy (2016)).

Generally, the proportional hazard relationship allows estimating the hazard function at time *t* given a baseline hazard that is modified by a set of covariates, and it is parametrized as:

$$\theta_i(t) = \lambda_0(t)exp(x_i'\beta)$$

Where $\lambda_0(t)$ is the non-parametric baseline hazard at time *t*, x_i is the vector of characteristics for individual *i* used as explanatory variables and β is the corresponding vector of unknown coefficients. Assuming that the duration information has been recorded in terms of years spent in school/completed, a recorded duration of *t* years indicates the duration on the continuous time-scale, between *t*-1 and *t* periods. Therefore, the probability of exiting by time *t* conditional on x_i, given that the individual was still in school at time *t-1* is given by:

$$h_i(t|x_i) = Prob[T_i < t|t-1 \leq T_i] = 1 - exp\left\{-\int_{t-1}^{t} \theta_i(\tau)d\tau = 1 - exp\left[\int_{t-1}^{t} \lambda_i\, exp\{x_i'\beta\}d\tau\right.\right.$$
$$= 1 - exp[-exp]\{x_i'\beta + \delta(t)\}$$

where $\delta(t) = ln\left\{\int_{t-1}^{t} \lambda_i\, d\tau\right\}$.

We take this framework to the data and for each country we estimate the following baseline specification where exit rates are characterized according to the Cox proportional hazard model approach:

$$h_{irq} = h_0(q)exp\{\beta_1\ \delta_{irq} + \beta_2\ X_{irq-4} + \beta_3\ R_{rq-4} + \alpha_s\} \qquad (1)$$

This model is specified in terms of the hazard rate (h_{irq}), which can be interpreted as the instantaneous probability that the individual *i* of region *r* realizes a transition from school to out of school between quarter *q*-4 and *q* (four quarters later). A useful way is to look at the above specification in terms of a binary model. The binary variable takes the value of 1 if the individual exits form school during the year (i.e. between quarters *q*-4 and *q*) and 0 otherwise. $h_0(q)$ is an arbitrary unspecified baseline hazard function for continuous time. The variable of interest, δ, is a dummy variable that indicates whether the household's main earner experienced a negative shock between quarter *q-4* and *q*. The baseline model defines a household income shock as a decrease in the main earner's income of at least 25 percent, as described above. Figure A1 in the annex shows the frequency of these shocks by year for each country for the relevant population.

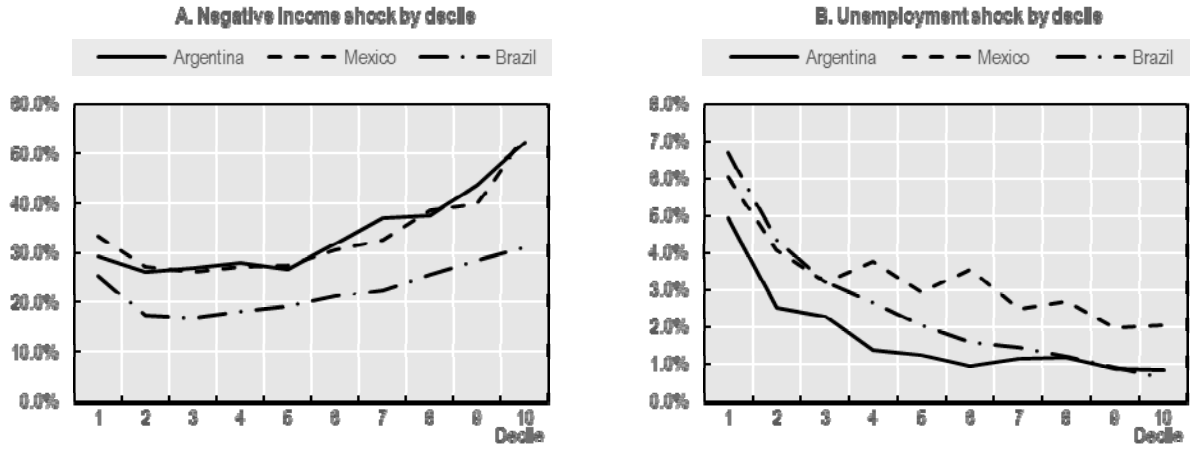
[13] We thank one of the referees for suggesting the use of Proportional Hazard Models.

In later specifications, this variable is replaced with a dummy variable indicating if the household suffered an unemployment shock, defined as the main earner becoming unemployed.

X is a vector of individual and household characteristics that includes individual *i*'s gender, employment status.[14] In order to control for differences in potential access to credit, *X* also includes controls for the income quintile of the household in *q-4* (that is, before the shock), and age, gender, and years of education of the household's main earner. The coefficients of the model are derived by maximum partial likelihood estimation. Duration models are estimated separately for the three countries, and also by whether the student was enrolled in secondary school or post-secondary school in time *q-4*.

The specifications also include secondary and tertiary school completion indicator variables (α_s) to distinguish between dropouts and exits from school associated with completion of the program. This indicator takes the value of 1 if the individual's educational attainment changed from secondary incomplete (in *q*-4) to secondary complete (in *q*), or from some tertiary (in *q*-4) to tertiary complete (*q*-4). However, this information is unavailable in the Mexican data, hence results are reported without the completion indicators for Brazil and Argentina as well (Table A2 in the Appendix).

Figure 6. Distribution of household shocks by income decile



Source: Authors' tabulations using LABLAC (CEDLAS and the World Bank).
Note: Figure A presents the percentage of households in which the main earner experienced a negative income shock between period *q-4* and *q,* defined as a reduction in his/her labor income of 25% or more, by income decile defined using the full urban household sample. Figure B presents the percentage of households in which the main earner experiences an unemployment shock between period *q-4* and *q,* defined as transitioning from employment into unemployment status, by income decile defined using the full urban household sample. Estimations were calculated pooling all the data over the period 2005-2015.

[14] Specifications including the number of siblings 25 and under in the household, number of household members employed, and the main earner's share of household labor income were also run, but these variables were not found to be significant. Similarly, *R*, a vector of local returns to education measured as the secondary and tertiary education wage premium (for individual *i*'s gender and region r) was included in alternative specifications but found to not have explanatory power.

As shown above, enrollment for individuals between the ages of 15 and 25 is uneven across the income distribution. Similarly, shocks are unevenly distributed across the income distribution (Figure 6). However, the relationship between income shocks and per capita income of the household is not monotonic as might be expected. The likelihood that the main earner suffers a decrease of at least 25 percent in his or her income is u-shaped in the three countries and higher for higher income households. On the other hand, the relationship between income and unemployment shocks is substantially higher for lower income households.

Table 3 shows the results of the Cox proportional hazards model estimates for students enrolled in secondary school and those enrolled in post-secondary education. The included control variables have the expected signs: the relative risk of school exit rate is higher if the student is also employed in the three countries; for most specifications, exiting school is negatively related with household income (measured by quintile of per capita labor income in *q-4*,) and proxies for household assets (the age of the main earner and years of schooling of the main earner). Having a female main earner is associated with higher risks of school exit in Argentina and for students in secondary school in Brazil, but not in Mexico.

In Argentina and Brazil, negative labor income shocks of the main earner were strongly associated with increased relative risk of tertiary school exit. Since the opportunity cost of school enrollment is expected to be higher for older students, if income shocks are driving school exits primarily due to an income effect, we would expect to see larger impacts of a negative shock for tertiary students. In Brazil, tertiary education students from households who experienced a shock experience a 20% higher risk of dropping out than students from households who did not experience a shock; in Argentina the effect is a little smaller at 15%. In addition, in Brazil, secondary school students from households who experienced a shock have an increase of 8% in the risk of dropping out relative to similar students who did not experience a shock.

In Mexico, however, the hazard risk of negative income shocks is not significant, suggesting no statistical relationship between it and school exits after controlling for the other characteristics included in the model. It is important to highlight that the results for Argentina and Brazil reported in Table 3 include the indicators for whether the student completed the level of schooling s/he was currently enrolled in *(q-4)* while, as noted above, this information is not available for Mexico and so cannot be included in the preferred specification. As reflected in Table A2 in the Appendix, while the inclusion of these variables does not change the results qualitatively for Argentina and Brazil, the direction of the change is different between the two countries. It decreased the magnitude of the coefficient of the shock in Argentina and increased them in Brazil. This suggests that the inclusion of these variables probably would not change the results for the Mexican sample either.

Table 3. School exits hazard and parental income shocks, by country and level of education

	Argentina		Brazil		Mexico	
	Secondary	Post Secondary	Secondary	Post Secondary	Secondary	Post Secondary
Negative income shock (quarter=q)	0.0508	0.147**	0.0803***	0.202***	-0.008	-0.015
	(0.042)	(0.061)	(0.015)	(0.027)	(0.038)	(0.053)
Male	0.270***	0.167***	0.102***	0.0803***	0.155***	-0.172***
	(0.039)	(0.059)	(0.012)	(0.025)	(0.036)	(0.050)
Age main earner (quarter=q-4)	-0.007***	-0.014***	-0.002***	-0.007***	-0.015***	-0.010***
	(0.002)	(0.003)	(0.001)	(0.001)	(0.002)	(0.003)
Female main earner (quarter=q-4)	0.151***	0.128**	0.029**	0.009	0.0001	-0.001
	(0.045)	(0.060)	(0.013)	(0.027)	(0.041)	(0.052)
Years of education main earner (quarter=q-4)	-0.068***	-0.074***	-0.028***	-0.046***	-0.104***	-0.040***
	(0.006)	(0.009)	(0.002)	(0.004)	(0.005)	(0.007)
Employed dummy (quarter=q-4)	0.282***	0.392***	0.164***	0.115***	0.304***	0.358***
	(0.066)	(0.068)	(0.014)	(0.028)	(0.045)	(0.060)
Quintile (quarter=q-4)	-0.114***	-0.102***	-0.069***	-0.082***	-0.064***	0.012
	(0.020)	(0.026)	(0.006)	(0.012)	(0.015)	(0.023)
Observations	26,844	13,874	60,981	25,797	43,347	21,306
Pseudo-R2	0.037	0.035	0.048	0.053	0.029	0.011
Chi-squared	1997	1134	11989	5765	762.2	136.1
Log likelihood	-16400000	-7392000	-19300000	-7045000	-21098	-7870

Source: Authors' calculations using LABLAC (CEDLAS and the World Bank).

Note: This table presents estimates of the relationship between schooling exit rates and a negative shock of at least 25 percent on the labor income of the household's main earner by country. Quarter, year, and country were considered as strata. Indicators for whether the individual completed secondary or tertiary between the first and last appearance in the data are included in the specification but not reported in the table above. These two control variables are not included in the Mexico model since they are not possible to construct given the survey structure. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively. Heteroskedasticity-robust standard errors are reported in parentheses.

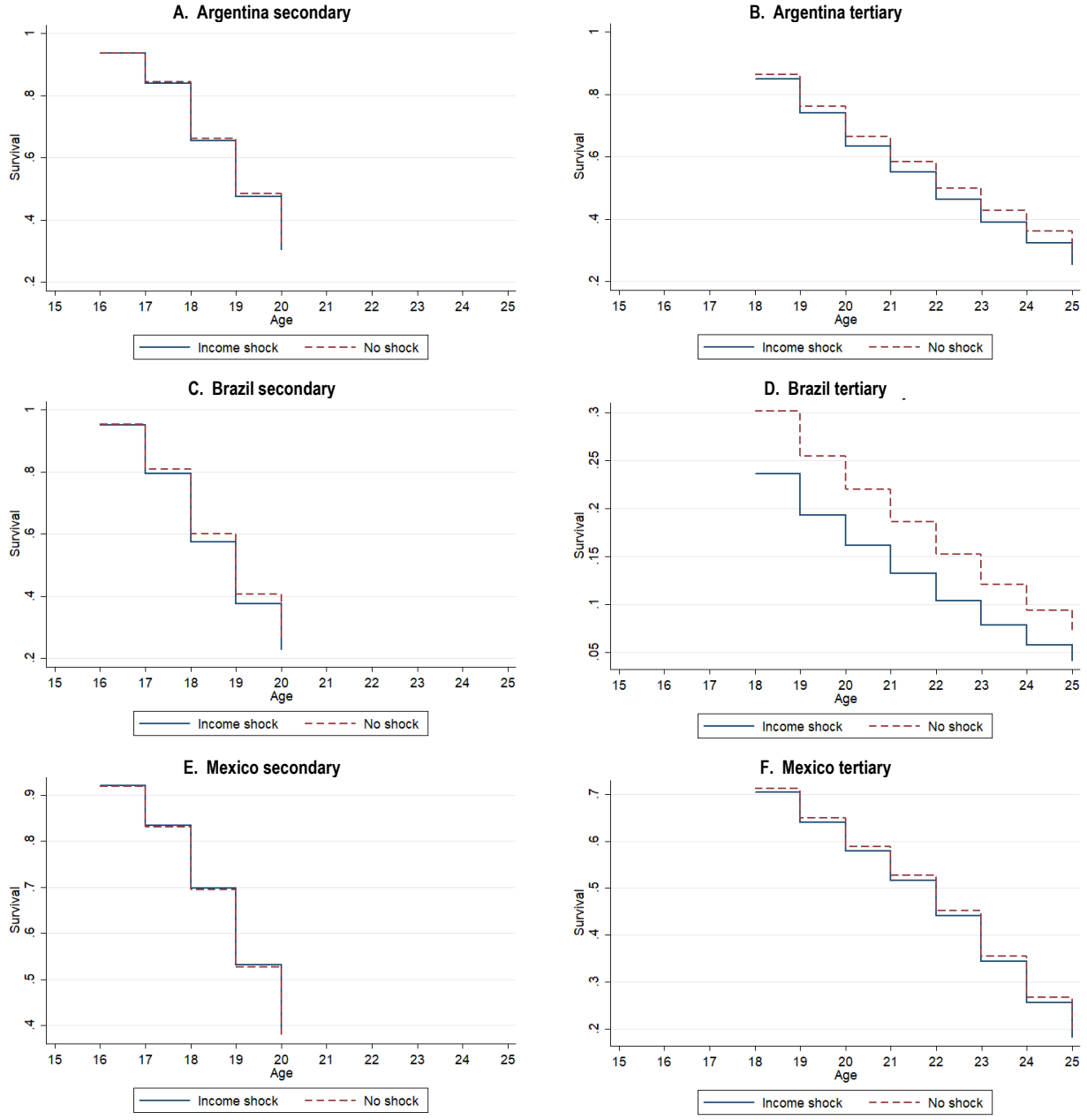
As discussed earlier, there are important differences in the population of youth who are exposed to this risk compared to the other two countries. In particular, Mexican youth having higher exit rates before age 15, suggesting more significant "cream skimming" happening before the analysis period. Another important factor in understanding why a negative income shock may have a weaker impact on school enrollment in Mexico is the likelihood that households with Mexican youth are less credit constrained than the other two countries. First, as shown earlier, enrolled students are from higher income households, suggesting more resilience to income shocks. The specification controls for household income quintile and characteristics of the main

earner that may be related with household assets (like education and gender), but this may be insufficient. Second, Mexico offers several programs to support secondary school students and increase access to tertiary education. Besides its well-known conditional cash transfer *Prospera* that includes families with children attending secondary school, there is a complex scheme of national scholarships designed to retain secondary students as well as to attract dropouts from households that are not beneficiaries of any other social program (*Beca para la Continuación de Estudios, Beca de Excelencia, Becas de Reincersion* among other). As a result, almost two out of five upper secondary students had public scholarships in 2016. *Prospera* covered nearly 1.2 million students and another 628,000 were covered by different scholarships offered by the Ministry of Education (Secretaría de Educación Pública de Mexico, 2017). While Brazil offers financing and scholarship options for tertiary education at the university, technical and vocational level (for example, *Fundo de Financiamento Estudantil*, *Programa Universidade para Todos*, and *Programa Nacional de Acesso ao Ensino Técnico e Emprego*), there are few scholarships for secondary education beyond the conditional cash transfers from *Bolsa Familia.* Similarly, in Argentina, beside some provincial initiatives, secondary education scholarships are targeted at specific vulnerable groups (i.e. indigenous population, children of war veterans, and rural students).[15]

The Kaplan-Meier survival estimates based on the specifications reported in Table 3 are graphed in Figure 7. It shows how survival rates of continued enrollment differ for secondary and post-secondary students in each of the three countries. In all cases, enrollment survival rates fall as students age, though the degree to which the survival changes across age groups differs across the six groups studied. The figures show a steeper drop off in enrollment survival rates in ages 18 and 19 in secondary school. Exit differences are less pronounced across years of age once enrolled in tertiary school. The figures also portray how suffering a household income shock shifts these survival rates. The most pronounced difference is for students in tertiary school in Brazil, though differences in the survival estimates among groups for secondary students in Brazil and tertiary students in Argentina are also statistically significant.

[15] Beginning in 2014, young people between the ages of 18 and 24 who do not work, work informally, or earn less than minimum wage qualify for the PROGRESAR cash transfer to support their studies both at secondary and tertiary level.

Figure 7. Kaplan–Meier survival estimates, by country and level of education



Source: Authors' calculations using LABLAC (CEDLAS and the World Bank).
Note: These graphs report the survival rates for school enrollment of students who experienced a household income shock and those who did not, as reported in Table 3. These figures are trimmed to show survival rates for the following age groups: 16-20 if enrolled in secondary school in quarter *(q-4)* and 17-25 if enrolled in post-secondary education in quarter *(q-4)*.

The baseline model was also applied to each gender separately (Appendix Table A3). Previous literature has found differential effects of shocks on schooling decisions depending on the gender of the child. In particular, the effects of both idiosyncratic and aggregate shocks are usually larger on boys than girls of younger age (see Beherman and Deolakikar 1999; Hyder et al. 2015).

Our analysis finds that household income shocks affect both male and female students in Brazil at both levels of schooling. However, the increased likelihood of school exit from tertiary education in the presence of a shock in Argentina is only present for young men. The coefficients for Mexican students continue to be insignificant, though a decrease in likelihood of male exit from tertiary school is found statistically significant at the 90 percent confidence level.

We also consider a model where the main earner becomes unemployed. Though this type of shock is less common (2% frequency rate vs. about 29% for the income shock), it implies more long-term employment uncertainty and a larger decrease in the main earner's labor income. As such, it has the potential to result in more severe household adjustments. The effect of an unemployment shock is significant for Argentinian and Mexican students enrolled in secondary school only. It is not significant for students in tertiary school in any of the three countries and does not affect secondary enrollment in Brazil (Table 4). The lack of relationship between unemployment shock and enrollment in Brazil may reflect the country's relatively higher rates of access to unemployment benefits; these may be sheltering households from experiencing severe income hardships in the presence of unemployment.

Table 4. School exit hazard and parental unemployment shock, by country

	Argentina		Brazil		Mexico	
	Secondary	Post Secondary	Secondary	Post Secondary	Secondary	Post Secondary
Unemployment shock (quarter=q)	0.380***	0.233	0.0568	0.160	0.302***	-0.005
	(0.128)	(0.214)	(0.037)	(0.098)	(0.098)	(0.134)
Male dummy	0.311***	0.136*	0.102***	0.091***	0.209***	-0.152**
	(0.047)	(0.073)	(0.013)	(0.030)	(0.043)	(0.062)
Age main earner (quarter=q-4)	-0.006**	-0.019***	-0.002***	-0.006***	-0.017***	-0.014***
	(0.003)	(0.004)	(0.001)	(0.001)	(0.002)	(0.003)
Female main earner (quarter=q-4)	0.138**	0.109	0.022	0.017	-0.012	0.079
	(0.056)	(0.076)	(0.015)	(0.032)	(0.049)	(0.065)
Years of education main earner (quarter=q-4)	-0.077***	-0.066***	-0.028***	-0.046***	-0.113***	-0.040***
	(0.008)	(0.011)	(0.002)	(0.005)	(0.006)	(0.008)
Employed dummy (quarter=q-4)	0.385***	0.408***	0.164***	0.131***	0.299***	0.334***
	(0.090)	(0.085)	(0.016)	(0.033)	(0.052)	(0.078)
Quintile (quarter=q-4)	-0.086***	-0.122***	-0.064***	-0.091***	-0.038**	0.022
	(0.024)	(0.032)	(0.007)	(0.015)	(0.020)	(0.029)
Observations	19,066	9,643	48,381	19,698	30,292	14,197
Pseudo-R2	0.0356	0.0324	0.0507	0.0582	0.0340	0.0126

Chi-squared	1196	640.1	9415	4082	597.3	99.62
Log likelihood	-11000000	-4558000	-15100000	-5073000	-13551	-4384

Source: Authors' estimates using LABLAC (CEDLAS and the World Bank).

Note: This table presents estimates of the relationship between schooling exit rates and an unemployment shock (the household's main earner transitioned from employment into unemployment). To assess better the unemployment shock effect, we have excluded the observations that received a negative income shock (except, if the income shock was due to the unemployment shock). The same set of repressors used for the regression reported in Table 3 is included for each regression. Quarter, year, and country were considered as strata. Indicators for whether the individual completed secondary or tertiary between the first and last appearance in the data is included in the specification but not reported in the table above. These two control variables are not included in the Mexico model since they are not possible to construct given the survey structure. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively. Heteroskedasticity-robust standard errors are reported in the second line of each country.

We also consider a logit model for the household income shock and the unemployment shock. For the household income shock, results are qualitatively consistent with the ones found for the Cox proportional hazards model for Brazil and Mexico (Appendix Table A.4). However, the results for the unemployment shock in all three countries and for the income shock in Argentina differ between the hazard model and the logit model. The difference between the logit and hazard results suggests the relationship between the likelihood of exiting school and the time spent in school is not independent, and that, as a consequence, a logit specification would result in biased estimates.

6. LIFE AFTER SHOCK: PRELIMINARY EVIDENCE

Dropping out from secondary and tertiary education has a wide range of consequences. Among those, it affects a youth's ability to access better economic opportunities, as, on average, higher education generates higher returns in the labor market. The lower future earnings and the lack of skills accumulation can make it more difficult to escape poverty as an adult (OECD/CAF/ECLAC 2016). Therefore, from a policy perspective, it is also important to understand the short-term consequences of leaving school "under duress" from a household income shock. We do this by considering the employment choice undertaken by those who exit school, compared to those who exit school in the absence of a household income shock. That is, what is the activity status in quarter *q* for youth who were enrolled in school in *q-4* but were not in school in quarter *q* and how does this differ between those who experienced an income shock and those who did not?

To consider this question, we use a discrete occupational choice model (multinomial logit model) to estimate the probability of working in either a formal or informal job relative to not working (being a *nini*), conditional on having dropped out of school. The goal of this section is modest. It seeks to obtain orders of magnitude for the likely effect of a negative income shock on the household's main earner on the type of employment status of those who exit school after such shock. To do so, the model makes three assumptions. First, it ignores how the decision of youth's time allocation is made within the household. Instead, the model of youth employment status is a reduced form of the outcome of such decision process. Second, youth's choice of employment

after dropping out is assumed to be made after all adults in the household have made their choice and it is assumed to not affect that choice. Third, the composition of the household is assumed to be exogenous. Under these assumptions, the dependent variable of the multinomial logit estimation represents the employment status of a young individual *i* of region *r* that left school between quarter *q-4* and *q*. The variable takes the value of 1 if the individual is not in education or employment (*nini*) in *q*; 2 if the individual holds a formal job in q; and 3 if the individual holds an informal job in q. The model includes a similar set of fixed effects and household characteristics as the specifications discussed above.

Table 5: Multinomial logit model for transition out of school – coefficient estimates

	Brazil		Mexico		Argentina	
	Formal	Informal	Formal	Informal	Formal	Informal
Negative income shock (quarter=*q*)	-0.340***	-0.198***	-0.250***	-0.057	-0.337***	-0.024
	(0.039)	(0.063)	(0.054)	(0.06	(0.08)	(0.071)
Male	0.425***	0.721***	0.626***	0.647***	0.655***	0.615***
	(0.05)	(0.08)	(0.064)	(0.074	(0.138)	(0.126)
Age (quarter= *q-4*)	0.197***	0.084***	0.171***	-0.004	0.318***	0.130***
	(0.008)	(0.013)	(0.011)	(0.013	(0.016)	(0.015)
Income share of main earner (quarter= *q-4*)	-0.456***	-0.13	-0.092	0.02	0.007	0.089
	(0.091)	(0.147)	(0.139)	(0.16)	(0.194	(0.177)
Employed (quarter= *q-4*)	1.432***	1.595***	1.160***	1.331***	1.411***	1.570***
	(0.042)	(0.067)	(0.067)	(0.076	(0.095	(0.091)
Quintile (quarter= *q-4*)	-0.006	-0.187***	0.070***	-0.049*	0.155***	-0.129***
	(0.018)	(0.029)	(0.025)	(0.028	(0.037	(0.036)
Constant	-4.038***	-3.354***	-3.116***	-0.086	-7.183***	-3.535***
	(0.262)	(0.419)	(0.272)	(0.314)	(0.488)	(0.443)
Observations	19,930	19,930	9,669	9,669	6,906	6,906
Pseudo-R2	0.142	0.142	0.090	0.090	0.136	0.136

Notes: The table reports coefficients of a multinomial logit analysis for the transition out of school. The omitted category is "not in education or employment (*nini*)". Results from each country are estimated using a multinomial logit model which includes the following variables not reported in this table: number of siblings in the household, characteristics of the main earner (age, gender, and educational attainment), secondary and tertiary wage premium by gender, regional, quarterly, and year fixed effects.
***, ** and * denote significance at 10%, 5% and 1% levels, respectively.
Source: Authors' estimates using LABLAC (CEDLAS and the World Bank).

Table 5 reports the coefficients of experiencing an income shock on the relative likelihood of entering into each of the activities conditional on having exited school where the reference category is becoming *nini*. In all countries, once demographic, socioeconomic and family characteristics are controlled for, a negative income shock has a negative effect of being employed, either in a formal job relative to those who left school and did not experience a negative shock. In Brazil, this effect is also found for informal employment. This suggests that school exits caused by income shocks are associated with a lower probability of finding a higher

quality job in the formal sector. This is consistent with a model in which household income shocks are pushing young workers into worse employment outcomes (i.e. becoming *nini* and being in informal jobs). The results are even more severe in cases in which the school exit is associated with an unemployment shock; for those youth, they are less likely to be employed in either the formal or informal sector (Table A5 in Appendix 2). This pattern is consistent across the three countries.

7. CONCLUSIONS AND POLICY IMPLICATIONS

This study contributes to the literature assessing the impact of negative shocks on schooling attainment in emerging economies. The simple framework outlined in this paper suggests that, even as middle-income countries have made significant gains in reaching universal primary schooling and providing low-cost secondary and university education, household income shocks can dampen the extent to which these policies lead to increases in the skilled labor force. This hypothesis is tested on Argentina, Brazil, and Mexico, countries with significant differences in labor markets, transfer programs, and social insurance.

A negative labor income shock on the household's main earner is associated with higher relative risk of school exit in Argentina for students in tertiary education and for students in both secondary and tertiary education in Brazil. However, a decrease in the household's labor income does not lead to a higher relative risk of Mexican youth exiting school. This significant difference between Mexico and the two countries is likely related to two key factors: 1) Mexican youth enrolled in school are more likely to be selected from higher income households than the other two countries, suggesting the households are better able to absorb the income shocks, and 2) Mexico has several public transfer programs specifically meant to support enrollment of students in secondary and tertiary, which may serve to as an alternative income source for households undergoing a labor income shock. The analysis also finds that household income shocks affect both male and female students in Brazil at both levels of schooling. Yet, the negative relationship between a shock and enrollment in tertiary school in Argentina is only present for young men while the effects remain statistically weak for Mexican students of both genders.

We also find that an unemployment shock for the main earner, a more severe type of labor market shock, has a different effect on the hazard rate of school exits relative to the impact of an income shock. In Argentina and Mexico, students in secondary school experience an increased likelihood of exit, while those in tertiary do not. In Brazil, on the other hand, while both levels of schooling seemed to suffer from income shocks, neither is affected by unemployment shocks. This may be related to the higher access to unemployment benefits found in Brazil and their high wage replacement rate.

While the propensity to exit in response to household-level shocks differed across students enrolled in secondary as compared to those in tertiary and between the three countries, in all

countries individuals who dropped out "under duress" from a household shock had worse employment outcomes on average. They were more likely to not be employed (in *nini* status) or to be employed in the informal sector relative to those who exited school without a household shock. This result supports the hypothesis that household shocks may be driving some students to exit school prematurely and that youth who drop out of school as a result of a household shock accept worse employment opportunities than other dropouts.

It is important to note some of the caveats of our empirical analysis. First, though we put a high effort in accounting for endogeneity, it may continue be an issue in the analysis. In an ideal setting, we would randomize which households receive a negative income shock, and which do not, and then analyze the differences in school drop-out behavior between both types of households. Such experiment is clearly not feasible.

Second, our results are specific to a selected sample. On the one hand, we do not observe the youth who dropped out during middle school (ages 12-15), or before. The sample we analyze is comprised of students enrolled in school, which presumably is a self-selected sample based on unobservable characteristics. The characteristics of such students are probably different from the individuals who already dropped out during middle school (or even elementary school), and that we do not observe in the data. As noted in the analysis, this likely has an impact on the results in the particular case of Mexico where exit rates of younger students are higher. Nonetheless, the analysis of such population is useful for policymaking focusing on building labor forces with more skilled workers. While many steps have been taken to reduce exits at lower levels of schooling, this analysis suggests that more may be needed to protect students in upper secondary and tertiary education as well.

Third, our results are silent about the educational choice of rural students. The surveys we use in our analysis are representative at the urban level only, which limit the scope of our conclusions. While this is a limitation, the reality is that secondary completion rates are often much lower for rural students as are tertiary enrollment rates. Furthermore, the urban population represents the large majority in the three countries analyzed. Again, we still see such conclusions as useful for policymaking analyzing urban settings, where most of the population of the countries we analyze live.

Fourth, our analysis is silent on whether the shock and the exit from school is temporary. Unfortunately, due to data limitations, we cannot observe the same individual for more than four quarters, thus we cannot investigate whether the exit rate is permanent (i.e. can be consider as dropout) or temporary. However, once an individual exits school, the probability of reenrollment is low (for example, Guarcello , Mealli, and Rosati 2003).

Finally, our main treatment variable¬—the negative income shock—is based on changes in labor income, which we construct based on survey responses. A skeptical reader might question the incentives of individuals to truthfully report their income. There is some evidence that top incomes are underreported in household surveys. Nonetheless, our negative shock is created based on the distribution of changes in reported labor income. As long as income is consistently underreported, our results would still hold. We concede, however, that our analysis has little to say on the behavior of households from the top of the distribution, as such households tend not to answer surveys in the first place.

The desirability of social policies depends crucially on how well households can privately insure against idiosyncratic income shocks, which in turn depends on the access to financial markets. Therefore, these results point to some policy implications and directions. If income shocks drive young people out of school and reduce the future stock of skilled labor, then social safety nets or expanded access to educational credit lines that act as insurance mechanisms could play an important role in reducing the adverse effects of shocks on household income and thereby support increases in skilled labor.

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APPENDIX 1
Theoretical framework

This appendix presents the theoretical framework of a human capital accumulation model under uncertainty and incomplete markets underlying this paper, based on Jacoby and Skoufias (1997).

The model

Consider a household *i* with a child eligible for schooling over the time interval 0< *t* < T consecutive quarters.

S_{it} is school attendance given cumulative history of shocks at time *t,* and this augments the child's beginning of period human capital stock, H_{it}, according to $H_{it} = g(S_{it}; H_{it}; \theta_{it})$.
Where θ_{it} is an education productivity shifter that can reflect child illnesses or aggregate shocks that avoid children going to school.

g is increasing in S_{it} and H_{it}, and its functional form determines the cost, in terms of human capital, of using child labor as an insurance.

We assume that households maximize a utility function defined over current consumption and future (offspring's) consumption. Parents supply inelastically labor, whose returns are used to finance current consumption. Children's time can be used either to further increase current consumption through work, to accumulate human capital, or for leisure. Human capital determines children's future consumption. The household can change the intertemporal allocation of consumption by changing the children's labor supply.

Therefore, a household chooses consumption and school time to maximize the expected discounted value of a time separable utility function by solving:

$$\max_{\{C_{it}, S_{it}\}} E_0 \left[\sum_{t=0}^{T} \beta^t U(C_{it}) + \varphi(H_{iT+1}, B_{iT+1}) \right]$$

Where β is a subjective discount factor. At the end of the school period, the household leaves a bequest of financial asset, B_{iT+1}, and a child human capital stock, H_{iT+1}. The joint value of bequest and human capital stock at the end of the schooling period is given by the increasing concave function φ.

The only cost to attend school is the forgone earnings, so child wage, W_t, which, at this age, is assumed to be independent of human capital stock.

The dynamic of school attendance is governed by the following Euler equation:

$$E_{t-1}\left[\rho_{it}\left(\frac{W_t}{W_{t-1}}\right) z_{it}\right] = 1 \qquad (1)$$

With W_t being the child wage determined in the child labor market and assumed to be independent of the human capital stock while the child is still in school.

$z_{it} = g_H(t)\frac{g_s(t-1)}{g_s(t)}$ is the marginal rate of transformation between school attendance in adjacent periods where $g_H(t) = \partial g(S_{it}; H_{it}; \theta_{it})/\partial H_{it}$.

And ρ_{it} is the "shadow price" of date t consumption relative to date t-1 consumption, determined by financial market structure.

Impact of income fluctuations on school attendance
Assuming that:
$g(S_{it}; H_{it}; \theta_{it}) = (1-\delta)H_{it}f(S_{it}; \theta_{it})$ where δ is the human capital depreciation rate ($0< \delta < 1$) and where

$$f(S_{it}; \theta_{it}) = \exp\left\{\gamma - \gamma \exp\left(-\frac{1}{\gamma}[S_{it} - \theta_{it}]\right)\right\}, \qquad \gamma > 0$$

f is chosen to be log-concave, $f(0,0)=1$ and $f'>0$, $\forall\gamma$ so that $log\ z_{it} = \frac{(\Delta S_{it} - \Delta\theta_{it})}{\gamma}$
to focus on income uncertainty, if all changes in θ_{it} are anticipated, removing expectations, taking logs and rearranging (1) yields:

$$\Delta S_{it} = -\gamma[log\ \rho_{it} + \Delta log\ W_t - log\ (1+\vartheta_{it})] + \Delta\theta_{it} \qquad (2)$$

Where ϑ_{it} is the mean-zero error in forcasting $\rho_{it}\left(\frac{W_t}{W_{t-1}}\right)z_{it}$.

Equation (2) states that school attendance decreases with an increase in the child wage or with an adverse education productivity shock (i.e. a negative $\Delta\theta_{it}$).

Role of financial markets
If markets are complete, households are able to reallocate resources across time and states at fixed prices (lifetime budget constraint). As a result, ρ_{it} is constant across households in the same market, thus implying a separation between human capital investment and consumption decisions. This also means that a child's school attendance is not affected by idiosyncratic income shocks. However, since consumption C_{it} equals full income net of schooling costs, $F_{it} - W_{it}S_{it}$, aggregate income shocks (i.e. shocks to F_{it}, that is full income) are transmitted to school attendance by increasing the shadow price of consumption in the period in which it occurs, thus making school attendance in that period more expensive.

If markets are incomplete, meaning that consumption is not ex-ante insurable, the separation between human capital investment and consumption decisions breaks down, depending on households' ability to transfer resources across time.

The relationship between assets at the beginning of t and the end of t-1 is given by the function $R_t : A^*_{it} = R_t(A_{t-1})$.

In perfect credit markets $R_t = (1 + r_{t-1})A_{t-1}$ where r_{t-1} is the market interest rate.
Assuming that marginal cost of borrowing is increasing, so $R''_t < 0$ for $A_{t-1} \leq 0$.

In absence of insurance, the household does not face anymore an expected wealth constraint, but rather it faces $C_{it+}A_{it} = R_t(A_{it}) + F_{it} - W_{it}S_{it}$

ρ_{it} is now the the household specific intertemporal marginal rate of substitution in consumption (scaled by β).

Additionally, when R_t is differentiable, ρ_{it} is restricted by $E_{t-1}[\rho_{it}R'_{it}] = 1$; rearranging and taking logs gives:

$$log\ \rho_{it} = -logR'_t(A_{t-1}) + \log(1 + \omega_{it})$$

Where ω_{it} is the mean forecasting error in $\rho_{it}R'_{it}$ that arises form unanticipated income shocks that lead to revisions in a household's intertemporal marginal rate of substitution in consumption.

The presence of ρ_{it} in (2) means that the forecast error in that equation, ϑ_{it}, and thus school attendance, must depend on unanticipated income shock, either aggregate or idiosyncratic - not merely on aggregate shocks as under complete markets.

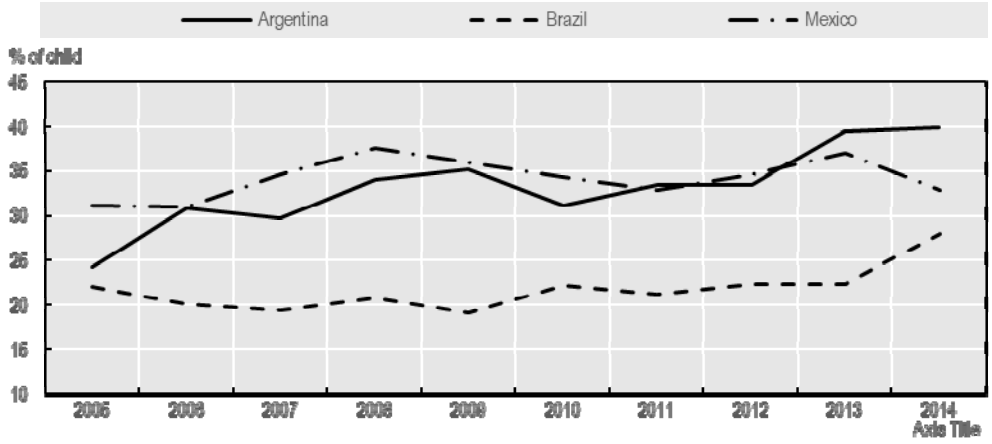
APPENDIX 2
Additional tables

Table A1. Number of observations by age of student in period t=0

Age	Argentina	Brazil	Mexico
15	7,874	17,492	14,120
16	7,315	16,934	11,952
17	6,387	14,034	10,102
18	4,725	9,403	7,836
19	3,714	7,191	5,719
20	3,140	6,038	5,009
21	2,529	5,278	4,006
22	2,090	4,648	2,989
23	1,646	3,720	1,858
24	1,308	2,887	1,144
25	1,020	2,194	698

Source: Authors' tabulations using LABLAC (CEDLAS and the World Bank).

Figure A1. Frequency of negative income shocks in monthly labor income



Source: Authors' tabulations using LABLAC (CEDLAS and the World Bank).
Note: This figure presents the percentage of households in which the main earner experienced a negative income shock between period *q-4* and *q,* defined as a reduction in his/her labor income of 25% or more.

Table A2. Hazard model regression results of school exit and shocks by level of education, without secondary and tertiary completion indicators

	Argentina		Brazil	
	Secondary	Post Secondary	Secondary	Post Secondary
Negative income shock (quarter=q)	0.0369	0.194***	0.0501***	0.200***
	(0.0450)	(0.0596)	(0.0181)	(0.0307)
Male dummy	0.218***	0.0760	-0.0665***	-0.0672**
	(0.0415)	(0.0577)	(0.0156)	(0.0287)
Age main earner (quarter=q-4)	-0.00488**	-0.0114***	0.00131	-0.00343***
	(0.00228)	(0.00271)	(0.000799)	(0.00129)
Female main earner (quarter=q-4)	0.144***	0.0987*	-0.00220	-0.0254
	(0.0457)	(0.0597)	(0.0167)	(0.0309)
Years of education main earner (quarter=q-4)	-0.0613***	-0.0719***	-0.00964***	-0.0151***
	(0.00658)	(0.00847)	(0.00237)	(0.00456)
Employed dummy (quarter=q-4)	0.296***	0.420***	0.278***	0.252***
	(0.0638)	(0.0663)	(0.0179)	(0.0335)
Quintile (quarter=q-4)	-0.124***	-0.0659***	-0.0594***	-0.0757***
	(0.0214)	(0.0251)	(0.00787)	(0.0141)
Observations	26,844	13,874	60,981	25,797
Pseudo-R2	0.0169	0.0238	0.00277	0.00625
Chi-squared	288.2	196.8	385.2	223.8
Log likelihood	-15197	-5618	-52639	-16171

Source: Authors' calculations using LABLAC (CEDLAS and the World Bank).

Note: This table presents estimates of the relationship between schooling exit rates and a negative shock of at least 25 percent on the labor income of the household's main earner by country. Quarter, year, and country were considered as strata. This specification does not include the secondary and tertiary completed indicators. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively.

Table A3. Hazard model regression results of school exit rates and household main earner income shocks by level of education, gender by country of student

Table A3. Argentina

	Secondary		Post Secondary	
	Male	Female	Male	Female
Negative income shock (quarter=q)	0.0348	0.116*	0.284***	0.0857
	(0.0605)	(0.0676)	(0.0937)	(0.0866)
Age main earner (quarter=q-4)	-0.00571*	-0.00844**	-0.0219***	-0.00792*
	(0.00299)	(0.00408)	(0.00424)	(0.00427)
Female main earner (quarter=q-4)	0.118*	0.257***	-0.0183	0.323***
	(0.0613)	(0.0761)	(0.103)	(0.0850)
Years of education main earner (quarter=q-4)	-0.0730***	-0.0720***	-0.0910***	-0.0770***
	(0.00821)	(0.0101)	(0.0140)	(0.0125)
Employed dummy (quarter=q-4)	0.347***	0.274**	0.655***	0.306***
	(0.0891)	(0.119)	(0.108)	(0.0987)
Quintile (quarter=q-4)	-0.143***	-0.0772**	-0.0473	-0.0984***
	(0.0260)	(0.0350)	(0.0399)	(0.0364)
Completed secondary (quarter=q-4)	1.848***	2.161***		
	(0.0674)	(0.0793)		
Completed tertiary (quarter=q-4)			2.187***	2.292***
			(0.124)	(0.105)
Observations	13,887	12,957	5,895	7,979
Pseudo-R2	0.0313	0.0432	0.0304	0.0362
Chi-squared	835.8	905.1	443.8	494.1
Log likelihood	-8724000	-6596000	-3033000	-3839000

Source: Authors' calculations using LABLAC (CEDLAS and the World Bank).

Note: This table presents estimates of the relationship between schooling exit rates and a negative shock of at least 25 percent on the labor income of the household's main earner by country. Quarter, year, and country were considered as strata. The completed secondary and completed tertiary control variables are not included in the Mexico model since they are not possible to construct given the survey structure. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively.

Table A3B. Brazil

	Secondary		Post Secondary	
	Male	Female	Male	Female
Negative income shock (quarter=q)	0.0778***	0.0692***	0.188***	0.229***
	(0.0214)	(0.0217)	(0.0457)	(0.0393)
Age main earner (quarter=q-4)	-0.00392***	-0.000899	-0.00982***	-0.00552***
	(0.000961)	(0.00100)	(0.00185)	(0.00172)
Female main earner (quarter=q-4)	0.0756***	-0.00328	0.109**	-0.0228
	(0.0193)	(0.0194)	(0.0490)	(0.0392)
Years of education main earner (quarter=q-4)	-0.0325***	-0.0234***	-0.0526***	-0.0419***
	(0.00285)	(0.00271)	(0.00693)	(0.00549)
Employed dummy (quarter=q-4)	0.180***	0.157***	0.135***	0.124***
	(0.0204)	(0.0217)	(0.0490)	(0.0381)
Quintile (quarter=q-4)	-0.0649***	-0.0782***	-0.106***	-0.0834***
	(0.00884)	(0.00897)	(0.0211)	(0.0172)
Completed secondary (quarter=q-4)	1.931***	2.487***		
	(0.0265)	(0.0369)		
Completed tertiary (quarter=q-4)			2.192***	2.341***
			(0.0517)	(0.0479)
Observations	32,498	28,483	11,739	14,058
Pseudo-R2	0.0418	0.0612	0.0495	0.0572
Chi-squared	5877	5476	1903	2563
Log likelihood	-9771000	-8032000	-2929000	-3552000

Source: Authors' calculations using LABLAC (CEDLAS and the World Bank).

Note: This table presents estimates of the relationship between schooling exit rates and a negative shock of at least 25 percent on the labor income of the household's main earner by country. Quarter, year, and country were considered as strata. The completed secondary and completed tertiary control variables are not included in the Mexico model since they are not possible to construct given the survey structure. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively.

Table A3C. Mexico

	Secondary		Post Secondary	
	Male	Female	Male	Female
Negative income shock (quarter=q)	-0.0773	0.0645	-0.150*	0.0802
	(0.0512)	(0.0568)	(0.0795)	(0.0748)
Age main earner (quarter=q-4)	-0.0126***	-0.0202***	-0.0112***	-0.0132***
	(0.00256)	(0.00301)	(0.00383)	(0.00339)
Female main earner (quarter=q-4)	0.0920*	-0.128**	0.0507	-0.00723
	(0.0530)	(0.0639)	(0.0805)	(0.0716)
Years of education main earner (quarter=q-4)	-0.104***	-0.111***	-0.0390***	-0.0417***
	(0.00625)	(0.00807)	(0.00952)	(0.00906)
Employed dummy (quarter=q-4)	0.375***	0.277***	0.335***	0.399***
	(0.0548)	(0.0832)	(0.0934)	(0.0786)
Quintile (quarter=q-4)	-0.0747***	-0.0715***	0.0254	0.0379
	(0.0203)	(0.0241)	(0.0348)	(0.0312)
Completed secondary (quarter=q-4)				
Completed tertiary (quarter=q-4)	0.000	0.000	0.000	0.000
Observations	22,456	20,891	10,464	10,842
Pseudo-R2	0.0334	0.0353	0.0115	0.0125
Chi-squared	444.6	332.2	55.59	80.81
Log likelihood	-9686.000	-7495.000	-2800.000	-3339.000

Source: Authors' calculations using LABLAC (CEDLAS and the World Bank).
Note: This table presents estimates of the relationship between schooling exit rates and a negative shock of at least 25 percent on the labor income of the household's main earner by country. Quarter, year, and country were considered as strata. The completed secondary and completed tertiary control variables are not included in the Mexico model since they are not possible to construct given the survey structure. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively.

Table A4. Logit regression of likelihood of a student exiting school, by country and type of shock

		(I) Income shock		**(II) Unemployment Shock**	
		Secondary	Post Secondary	Secondary	Post Secondary
Argentina	Coefficient	0.160***	0.079	0.488***	0.267
	St. Err.	(0.048)	(0.059)	(0.133)	(0.211)
	Observations	26,844	13,874	17,608	9,643
	Adjusted R-squared	0.143	0.0489	0.125	0.234
	School Exit Rate (%)	0.179	0.158	0.106	0.151
	Shock Rate (%)	31.68	33.93	2.477	2.001
Brazil	Coefficient	0.249***	0.409***	0.116	0.319**
	St. Err.	(0.037)	(0.046)	(0.095)	(0.148)
	Observations	60,981	25,797	48,381	19,698
	Adjusted R-squared	0.551	0.380	0.558	0.396
	School Exit Rate (%)	0.233	0.209	0.229	0.200
	Shock Rate (%)	21.23	23.71	2.946	1.965
Mexico	Coefficient	0.016	-0.042	0.222***	0.237***
	St. Err.	(0.05)	(0.89)	(0.068)	(0.084)
	Observations	43,346	21,306	44,506	30,291
	Adjusted R-squared	0.111	0.0718	0.0803	0.117
	School Exit Rate (%)	0.153	0.147	0.152	0.155
	Shock Rate (%)	33.17	35.90	4.034	4.207

Source: Authors' estimates using LABLAC (CEDLAS and the World Bank).

Note: This table presents estimates of four logit regressions per country, by school level (secondary or post-secondary) and for two types of shocks: 1) A labor income shock on the household's main earner (the household main earner's total labor income fell by at least 25 percent); and 2) unemployment shock (the household's main earner transitioned from employment into unemployment), to assess better the unemployment shock effect, we have excluded the observations that received a negative income shock without an unemployment shock. The same set of repressors used for the baseline Hazard model regression reported in Table 3 is included for each. As with the Hazard model, completion of secondary and tertiary school indicators are only available for Argentina and Brazil. Results are available upon request. Without these two indicator variables, Brazil's coefficients are smaller in magnitude (remaining significant), Argentina's are smaller in magnitude for secondary school and larger for post-secondary under the unemployment shock and with no difference for the income shock. School Exit Rate (%) reports the weighted share of individuals who exited school in each sample; Shock Rate (%) reports the share of individuals who lived in households with a negative shock in each sample. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively. Heteroskedasticity-robust standard errors are reported in the second line of each country.

Table A5 – Probability of becoming a nini given a school exit

	Argentina		Brazil		Mexico	
	Formal	Informal	Formal	Informal	Formal	Informal
Unemployment shock (quarter=*q*)	-1.170***	-1.061***	-1.430***	-1.942***	-0.992***	-1.173***
	(0.286)	(0.247)	(0.114)	(0.234)	(0.15)	(0.185)
Male	0.649***	0.662***	0.459***	0.754***	0.641***	0.670***
	(0.141)	(0.13)	(0.053)	(0.083)	(0.066)	(0.076)
Age (quarter=*q*-4)	0.322***	0.142***	0.212***	0.099***	0.177***	0.003
	(0.017)	(0.016)	(0.008)	(0.013)	(0.012)	(0.014)
Income share of main earner (quarter=*q*-4)	0.065	0.201	-0.380***	-0.019	-0.108	0.032
	(0.2)	(0.184)	(0.097)	(0.154)	(0.145)	(0.165)
Employed (quarter=*q*-4)	1.557***	1.714***	1.594***	1.787***	1.314***	1.490***
	(0.099	(0.096)	(0.044)	(0.071)	(0.071)	(0.08)
Quintile (quarter=*q*-4)	0.125***	-0.124***	-0.054***	-0.233***	0.03	-0.071**
	(0.038	(0.036)	(0.019)	(0.03)	(0.026)	(0.029)
Constant	-6.966***	-3.591***	-3.952***	-3.277***	-2.810***	0.164
	(0.501)	(0.46)	(0.277)	(0.439)	(0.284)	(0.328)
Observations	6,525	6,525	18,526	18,526	9,057	9,057
Pseudo-R2	0.143	0.143	0.163	0.163	0.100	0.100

Notes: The table reports coefficients of a multinomial logit analysis for the transition out of school. The omitted category is "not in education or employment (*nini*)". Results from each country are estimated using a multinomial logit model which includes the following variables not reported in this table: number of siblings in the household, characteristics of the main earner (age, gender, and educational attainment), secondary and tertiary wage premium by gender, regional, quarterly, and year fixed effects.
***, ** and * denote significance at 10%, 5% and 1% levels, respectively.
Source: Authors' estimates using LABLAC (CEDLAS and the World Bank).

APPENDIX 3

Educational systems in Argentina, Brazil and Mexico

In this Appendix we provide a brief description of the educational systems of the countries considered in the study. We focus on the description of secondary education, the most crucial stage for the cohort examined. It is important to note that the concept of "compulsory" education in these three countries is not necessarily enforced on the student or the youth's family. Rather, it is more akin to a right to free education.

Argentina

Argentina has 13 years of basic education that includes pre-primary, primary and secondary education for children ages 5 to 17/18. Primary school starts at age 6. As of the effectiveness of the new education law of 2006 (Ley n° 26.206 *Ley de Educación Nacional*), each jurisdiction had to choose between two options: a structure of six years of primary and six years of secondary education; or seven years of primary and five for secondary. Secondary education consists of two stages: two to three years of *ciclo básico* (lower secondary education) and three to four years of *ciclo orientado* (upper secondary education) which is focused on a specific set of skills or area of knowledge, for entry into higher education or the labor market. Secondary education can be *bachiller* typically designed for entry into higher education, artistic or technical and professional which is six or seven years long (one year longer than bachiller or artistic) and prepares students for technical jobs as well as for higher technical education.

Brazil

Since 2013, *Educação básica* (primary education) has a nominal duration of 14 years and it includes both primary school (1° *Grau, Primeiro Grau, Ensino Fundamental*) and general secondary education (2° *Grau, Segundo Grau, Ensino Médio*). After receiving this certificate, pupils can take the examination for higher education. At the same time, after completing primary education, students can enroll in vocational education (*Certificado de Técnico Básico*). The duration can vary from several months to some years. After this certificate, students can proceed to secondary vocational education whose duration is of one to three years or three to four years, depending on the type of education: secondary vocational education or a combination of secondary vocational and general education. Constitutional Amendment No. 59 (2009) increased the duration of compulsory education from 9 to 12 years (6-18 year-olds), and Law No. 12 796 (April 2013) made enrolment of 4-year-olds in ECEC compulsory. All states and municipalities have until 2016 to comply with these policies (OECD, 2015).

Mexico

Mexico made upper secondary education compulsory in 2012, in order to attain universal coverage by 2022 (OECD, 2015). The Mexican education system is organized into four levels: preschool, basic education, upper secondary education, and higher education. The Mexican educational system has 15 years of compulsory education which generally ends at age 17-18.

The expected graduation rate from secondary education is at age 17 or 18.[1] Basic education is made up of pre-school (*preescolar*) (for children aged 5-6 years), *educación primaria* (primary school) with a nominal duration of six years (for pupils aged 8-12 years old), and *secundaria* (junior secondary school), with a nominal duration of three years (14-15 years old). Junior secondary school consists of general education (*educación secundaria*) and vocational education (*educación secundaria técnica*). After obtaining a certificate of basic education, pupils can enter senior secondary education (*educación media superior*) which lasts three years.

Senior secondary education has three types of curricula: 1) General senior secondary education (*propedeútica/preparatoria/bachillerato*), which prepares pupils for higher education and culminates in the Bachiller certificate; 2) General senior secondary education with a vocational component (*bachillerato tecnológico or bachillerato bivalente*). This type of education also provides admission to higher education, and culminates in the Bachiller Técnico certificate; 3) Purely vocational education (*educación profesional técnica or terminal*). This type of education also lasts 3 years. Upon completion of the program, students are awarded the Técnico certificate, also known as Técnico Profesional or Profesional Técnico. Students who want to pursue higher education must possess a Bachiller or Bachiller Técnico certificate.

Table A.5 Years of compulsory education and secondary education graduation age

Country	Total years compulsory education	Age in which compulsory education ends	Expected age of graduation (secondary)
Argentina	13	17-18	17-18
Mexico	15	17-18	17-18
Brazil	14	17-18	17-18

[1] http://www.dof.gob.mx/nota_detalle.php?codigo=5301832&fecha=10/06/2013