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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 likelihood that students in upper secondary and tertiary school exit school in Argentina and Brazil, but not in Mexico. For the three countries, the analysis finds evidence that youth who drop out due to a household income shock have worse employment outcomes than similar youth who exit school 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 volatility, 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 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 or 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 individual 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.

Finally, we also look at initial 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.

## 2. LITERATURE REVIEW 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) report a review of 42 studies covering 21 countries where they 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 10–17-year-olds.

Significant research has looked at the relationship between schooling and household income in the context of economic crises, showing that economic downturns lead to declines in school enrollment, especially among the poor and younger 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."

There is also a body of evidence of a tight connection between local labor conditions, household income, and schooling decisions. On one hand, studies have found that positive labor conditions incentivize 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 14–16 year olds living in cities increases as local labor market opportunities improve, as they become more likely to leave school. Guarcello, Mealli, and Rosati (2003) observe a similar response in Guatemala and point out that child labor has a high degree of persistence because children who are sent to work are subsequently less likely to return to school. On the other hand, negative household employment shocks are also associated with increased dropout rates. In a related vein, 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.

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 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 Educational Choices*

We draw on the seminal model of Jacoby and Skoufias (1997) to analyze the response of human capital investment -measured by dropout behaviors- 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 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 $H_{it} = g(S_{it}; H_{it}; \theta_{it})$. 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. $\theta_{it}$ is an education productivity shifter that can reflect child illness or aggregate shocks that avoid 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.

That is, 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 $\beta$ is a subjective discount factor. At the end of the school period, the household leaves a bequest of finanacial 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 $\varphi$.

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 human capital development 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.

This paper focuses on the role of the income effect in the response of households to idiosyncratic shocks, controlling for macroeconomic aggregate shocks. 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.

# 3. TRENDS IN SCHOOL ENROLLMENT

Educational attainment in Brazil and Mexico has increased markedly in recent decades while Argentina's continues to be high by regional standards. Upper secondary graduation rates in Mexico (49%), Argentina (65%) and Brazil (63%) are now closer to those of OECD countries (85%).[6] 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. Likewise, upper secondary completion rates are converging with those of OECD countries.

*Table 1: Enrollment rates by year and 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.

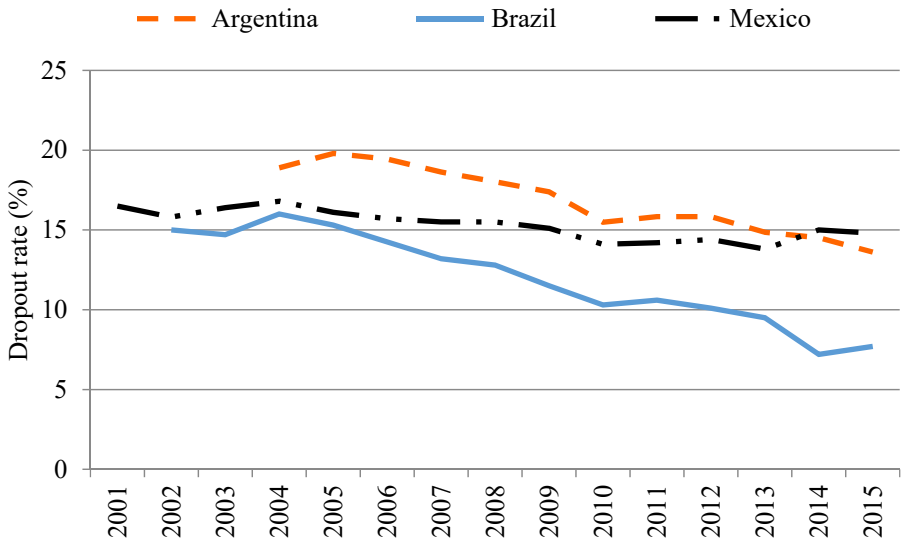
This section describes key salient characteristics of education in Argentina, Brazil and Mexico, while a more detailed description of the education system in each country is relegated to Appendix 3. Secondary

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

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 (*secondaria* to *bachillerato*). This large drop in enrollment 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 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.

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. The dropout rates provided for Brazil are not comparable as they reflect lower secondary school. However, they reflect a positive development, as dropout rates have fallen to about half of what they were in 2000.

*Figure 1: Dropout rates from secondary education in Argentina, Brazil and Mexico (2001-2015)*

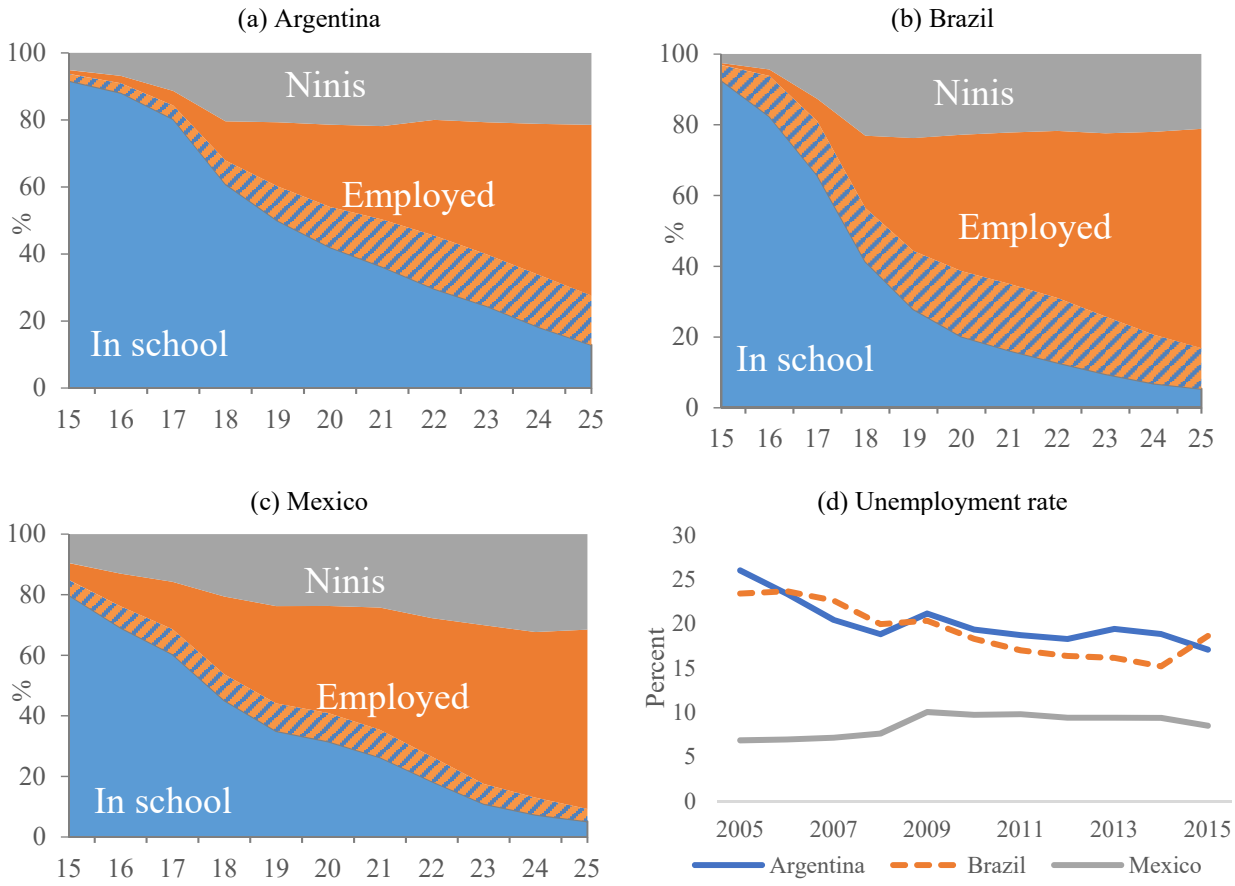



*Source:* MEC/INEP/Censo Escolar (2015) for Brazil, DINIEE (2016) for Argentina, and INEGI (2017) for Mexico.
*Note:* Dropout rate is defined as the percentage of students who were enrolled in school at year *t* and do not enroll in year *t+1*. The rates of Argentina and Mexico are for upper secondary (*secundaria ciclo orientado* and *bachillerato*, respectively). The rates for Brazil are calculated based on lower secondary (*Ensenio Medio*) and hence are not comparable.

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 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 years. As shown by the school enrollment and dropout 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 percent in Mexico.[7] While many *ninis* are out of the labor force, high youth unemployment rates in Argentina and Brazil suggest that unemployment accounts for some of the youth who are neither working nor in school. 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*




*Source:* Authors' tabulations using LABLAC (CEDLAS and the World Bank); youth unemployment rates are from ILOSTAT database (International Labor Organization.

*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 LABLAC, a regional labor force harmonization effort produced by the World Bank and CEDLAS at the National University of La Plata in Argentina. We limit our analysis to the three countries in LABLAC that have panel data and school enrollment information—Argentina,

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

Brazil, and Mexico, which together comprise about 60% of the population of Latin America.[8] We construct one-year individual-level panels, restricting the sample to individuals aged 15 to 25 who reside in urban areas and are observed at least twice in the data between the first quarter of 2005 to the last quarter of 2015.

Sample summary statistics by whether a negative income shock was received by households' main earner are reported in Table 2. While differences between the two groups are statistically significant for most characteristics, they are typically very 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 definition, 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 labor earnings.

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

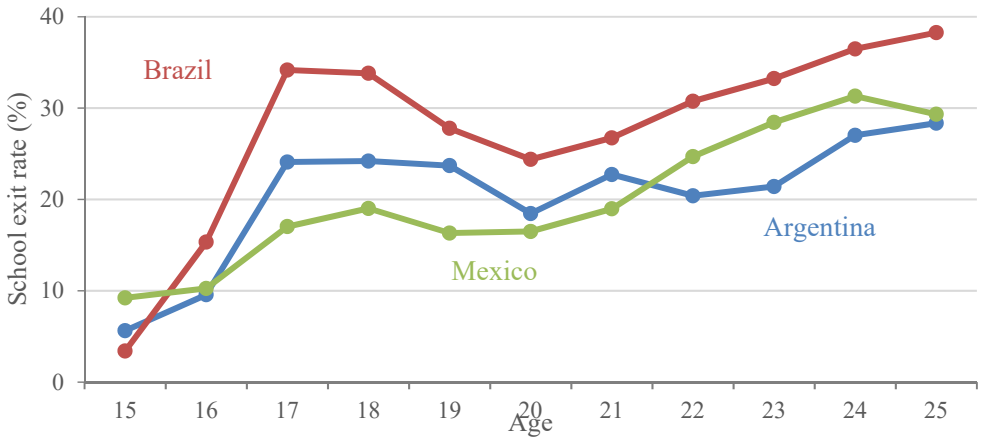
| | Argentina | | Brazil | | Mexico | |
|---|---|---|---|---|---|---|
| | No Shock | Shock | No Shock | Shock | No Shock | Shock |
| Sample size | 28,081 | 12,647 | 66,782 | 20,843 | 42,992 | 21,743 |
| Weighted population | 10,792,300 | 5,193,200 | 11,206,400 | 3,162,000 | 10,263,700 | 5,283,800 |
| *Individual characteristics* | | | | | | |
| Age | 17.9 | 18.1 | 17.8 | 18.0 | 17.5 | 17.7 |
| Male (%) | 0.49 | 0.48 | 0.51 | 0.51 | 0.51 | 0.51 |
| Years of education | 10.9 | 11.0 | 9.4 | 9.6 | 10.6 | 10.7 |
| *Activity (%)* | | | | | | |
| Just in school | 0.87 | 0.84 | 0.72 | 0.69 | 0.85 | 0.82 |
| Working and in School | 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 | 42.5 | 41.8 |
| Female (%) | 0.29 | 0.31 | 0.31 | 0.36 | 0.26 | 0.31 |
| Years of education | 11.4 | 11.4 | 9.9 | 10.2 | 10.3 | 10.4 |
| *Household* | | | | | | |
| Number of members | 4.9 | 5.0 | 4.1 | 4.1 | 4.7 | 4.8 |
| Number employed | 1.9 | 2.0 | 2.1 | 2.1 | 1.9 | 1.9 |
| Labor income p.c. (2005 PPP) | 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:* ***, ** and * denote significance at 10%, 5% and 1% levels, respectively.

[8] 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. Data for Brazil are from the *Pesquisa Mensal de Emprego* (PME), a monthly employment survey that covers the six largest metropolitan areas of Brazil. Data for Mexico are from the *Encuesta Nacional de Ocupación y Empleo* (ENOE), the nationally representative labor force survey from Mexico.

Figure 3 shows the school exit rates for the sample of youth aged 15-25 in the three countries. 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.[9] 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.

*Figure 3. School exit rates by age and country*



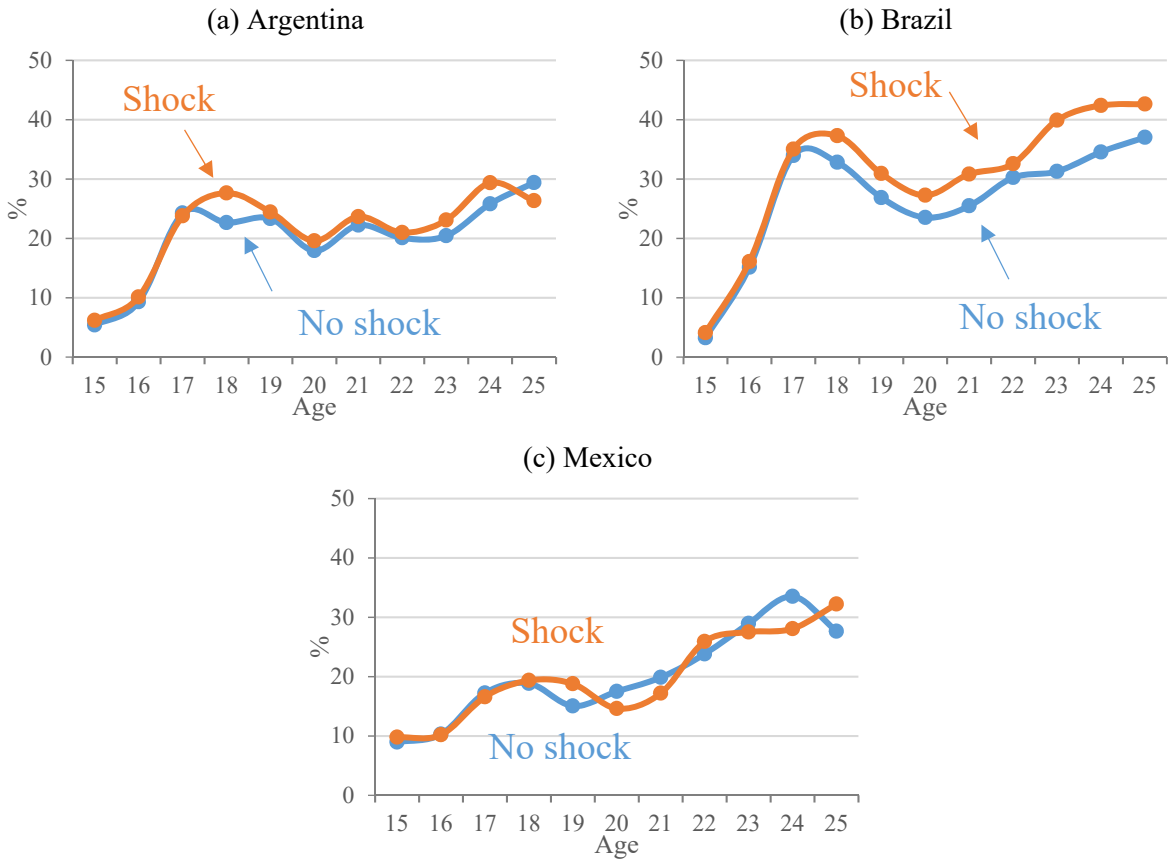

*Source:* Authors' tabulations using LABLAC (CEDLAS and the World Bank).
*Notes*: This figure presents share of individuals that leave school in any given year by age (enrolled in year *t* and not in year *t+1*). Estimations were calculated pooling all the data over the period 2005-2015.

Figure 4 shows some preliminary evidence comparing the exit rates of students in households where the main earner received a negative labor income shock and those where there was no negative shock. In general, these trends suggest school exit rates are affected by 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 decreases the likelihood of continuing tertiary training for all age groups. 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. In Argentina, on the other hand, income shocks seem to be correlated with a lower likelihood of transitioning from secondary to tertiary school. In Mexico the two trends suggest a less clear pattern.

These figures show unconditional probabilities of dropping out of school, and therefore are insufficient to establish causality since there may be other factors driving these trends. For instance, it could be the case that relatively poorer households are more likely to experience shocks since they have more volatile jobs, and that lower income youth are less likely to continue in school due to lower household budgets. In the next section we explore formally what predicts whether an individual drops out from school or not.

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

*Figure 4. 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 RESULTS

To assess the relationship between school exit rates and household income shocks we assume a linear probability model, where the dependent variable ($Exit_{irct}$) takes the value 0 of region $r$, in country $c$ is enrolled in periods t and t+1 (four quarters later), and the value 1 if individual $i$ is enrolled in period t and not in period t+1. We restrict the sample to youth, ages 15 to 25, enrolled in school in the first period living in 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 enrollment. Additionally, because we are interested in the household budget decision, we limit the sample to sons and daughters of the household head (excluding, for example, other relatives or roommates that may have a separate household budget). We also exclude household heads that are enrolled in school.

In the baseline specification, we assume that exit rates can be characterized according to the following equation:

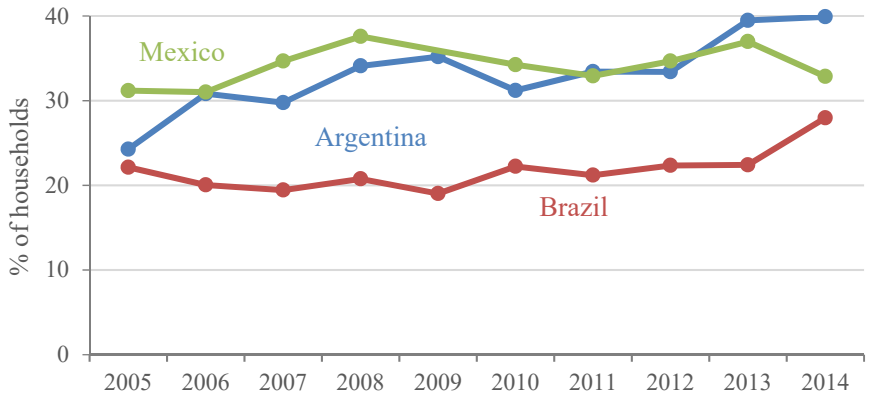
$$Exit_{irct} = \beta_0 + \beta_1\ \delta_{irct} + \beta_2\ X_{irct} + \beta_3\ R_{rct} + FE + \varepsilon_{irct} \quad (1)$$

The variable of interest, $\delta$, is a dummy variable that indicates whether the household experienced an income shock between period $t$ and $t+1$. The baseline model defines a household income shock as a large decrease in the main earner's income, as described below. $X$ is a vector of individual and household characteristics that includes individual $i$'s gender, employment status, number of siblings 25 and under in the household, number of household members employed, main earner's share of household labor income, per capita labor income of the household, and age, gender, and year of education of household's main earner; $R$ is a vector of local returns to education measured as the secondary and tertiary education wage premium (for individual $i$'s gender and region $r$).

Since there are certain ages where students encounter natural transition points that lead to higher dropout rates, the age of the student is included in the regression as a vector of age fixed effects rather than as a continuous variable. *FE*, the set of fixed effects, also includes a secondary and tertiary school completion indicator,[10] regional fixed effects, quarterly fixed effects, year fixed effects, and $\varepsilon_{irct}$ is the error term.

To distinguish between a shock and normal income fluctuations, we calculated the distribution of percentage change in the real labor income of the household's main earner for each country and year sample. We use the median of these year-to-year fluctuations, a 25% reduction, as our definition of a labor income shock. For robustness, we run the regressions with different shocks (from a 10% reduction to a 100% reduction) and find that the results remain qualitatively similar. These results are included below. Figure 5 shows the frequency of these shocks by year for each country for the relevant population.

*Figure 5. 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 *t* and *t+1,* defined as a reduction in his/her labor income of 25% or more.

[10] This indicator is 1 if the individual's educational attainment changed from secondary incomplete to secondary complete, or from some tertiary to tertiary complete. Since this information is not available in the Mexican survey, it is instead proxied by the age at which completion would be expected (18 for secondary and 23 for tertiary).

This paper focuses on the role of the income effect in the response of households to idiosyncratic shocks. Hence, the model needs to control for macroeconomic aggregate shocks. However, controlling for country and time fixed effects, the approach taken here, might not fully absorb the substitution effects, as the perception of labor market conditions may be crucial for dropouts. For example, the perceived opportunity cost for a student may be more affected by a parent's labor outcome than by the regional labor market.

*Table 3. OLS regression of likelihood of a student exiting school, by country*

| | Argentina | Brazil | Mexico |
|---|---|---|---|
| Negative income shock | 0.988*** | 2.291*** | -0.305 |
| | (0.321) | (0.254) | (0.252) |
| Male | 2.727*** | 2.262*** | -0.552* |
| | (0.497) | (0.283) | (0.301) |
| Employed (year=*t*) | 8.542*** | 3.920*** | 7.995*** |
| | (0.945) | (0.413) | (0.650) |
| Income share of main earner | 8.942*** | 3.562*** | 11.203*** |
| | (2.623) | (0.929) | (1.729) |
| Labor income per capita | -1.555*** | -1.776*** | -0.219 |
| | (0.215) | (0.149) | (0.182) |
| Age main earner | -0.115*** | -0.093*** | -0.105*** |
| | (0.020) | (0.013) | (0.016) |
| Female main earner | 0.546* | 0.300 | 0.183 |
| | (0.316) | (0.222) | (0.259) |
| Years of education main earner | -0.881*** | -0.690*** | -0.707*** |
| | (0.046) | (0.033) | (0.031) |
| Secondary wage premium | 0.015** | 0.008 | 0.001 |
| | (0.007) | (0.006) | (0.006) |
| Tertiary wage premium | -0.012* | 0.001 | -0.002 |
| | (0.007) | (0.003) | (0.004) |
| Constant | 22.989*** | 17.552*** | 17.914*** |
| | (1.674) | (1.338) | (1.208) |
| Observations | 36,824 | 75,333 | 56,112 |
| Adjusted R-squared | 0.393 | 0.561 | 0.260 |
| School Exit Rate (%) | 14.62 | 20.69 | 11.12 |
| Shock Rate (%) | 32.53 | 21.51 | 34.06 |

*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. Coefficients were estimated through OLS regressions. Number of siblings under 25, number of household members employed and fixed effects for each year of age, quarter, year, completion of educational levels (secondary and tertiary) and state were included in the regressions but are not reported. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively. Heteroskedasticity-robust standard errors are reported in parentheses.

Table 3 shows the results of the baseline equation for each country.[11] In the three countries, school exit rates are higher if the student is employed and as a function of the share of household labor income attributable to just the main earner, independent of whether the earner experiences a shock. On the other hand, exit rates decline with age and education of the main earner. While men in Argentina and Brazil were more likely to exit school than women, it was the opposite in Mexico (though with only weak significance). Similarly, students from households with higher labor earnings in Argentina and Brazil were less likely to exit school, but not in Mexico. Gender of the household head and local wage premia of completing secondary school or tertiary were weakly significant in Argentina but not in the other two countries.

In Argentina and Brazil, negative labor income shocks were strongly associated with increased rates of school exit. In Brazil, youth from households who experienced a shock were 2.3 percentage points more likely to drop out; in Argentina the effect is much smaller at just under 1 percentage point. In Mexico, however, the coefficient of negative income shocks is negative and not significant, suggesting no statistical relationship between it and school exits after controlling for the other characteristics included in the model. A deeper discussion of why Mexican students may be responding differently than those in Argentina and Brazil is included later in this section.

The baseline equation was also applied to gender-specific and age-specific analysis to test for differential effects across different types of students. 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 bigger on boys than girls of younger age (see Beherman and Deolakikar 1999; Hyder et al. 2015). Our analysis does not find gender differences in how older students respond to household income shocks in Argentina and Brazil (Appendix Table A2). In Mexico, however, a negative income shock reduces the likelihood that men drop out but has no statistically significant effect on women.

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 older students. The results of running equation 1 with interactions between age and negative income shock show an increase in the likelihood of school exits on the order of 3.5 to 3.9 percentage points for students 18 and older, but only in Brazil (Appendix Table A3). These ages coincide with the end of secondary school and transition into tertiary school and with the first few years of tertiary. In Argentina and Mexico, the interaction term was only weakly significant for individuals aged 16 years old in Argentina and those aged 15 years old in Mexico.

We also consider three additional types of household income shocks. As an extension to the baseline model, the first of these alternative household shocks is the magnitude of the negative income change to the main earner's income, measured as the log of the absolute value of the reduction in the main earner's income between the two time periods. The other two are household shocks that are expected to be more

[11] Despite having a binary dependent variable, the regressions reported use Ordinary Least Squares. The results based on logit models are reported in Table A4 in the Appendix. Results are consistent between OLS and logit models.

severe than a reduction of at least 25 percent in the main earner's income: first, the main earner becomes unemployed; and second, the total labor income of the household falls by at least 25 percent.

Measuring the shock using a continuous variable yields results consistent with those of the original specification (Table 4, column I). An unemployment shock for the primary earner implies more long-term employment uncertainty and, in most cases, a larger decrease in the main earner's labor income and, hence, has the potential to result in more severe household adjustments. Though this type of shock is less common (2% frequency rate vs. about 29% for the income shock), the effect is significant and larger in magnitude in Argentina and Mexico than a reduction of at least 25% of the main earner's income (the income shock) (Table 4, column II). In Brazil, however, this shock is not associated with increased likelihood of a school exit.

*Table 4. OLS regression of likelihood of a student exiting school, by country and for alternative income shocks*

| | | **(I) Log of income shock** | **(II) Unemployment Shock** | **(III) Household income shock** |
|---|---|---|---|---|
| Argentina | Coefficient | 0.147*** | 5.386*** | 1.472*** |
| | St. Err. | (0.053) | (1.519) | (0.339) |
| | Observations | 36,824 | 35,309 | 36,824 |
| | Adjusted R-squared | 0.393 | 0.397 | 0.393 |
| | School Exit rate % | 14.62 | 14.38 | 14.62 |
| | Shock rate | 55.89 | 1.660 | 28.15 |
| | Mean shock size | 5.428 | | |
| Brazil | Coefficient | 0.318*** | 0.973 | 2.466*** |
| | St. Err. | (0.041) | (0.761) | (0.262) |
| | Observations | 56,112 | 52,647 | 56,112 |
| | Adjusted R-squared | 0.260 | 0.267 | 0.261 |
| | School Exit rate % | 11.12 | 11.09 | 11.12 |
| | Shock rate | 61.84 | 2.966 | 31.51 |
| | Mean shock size | 5.043 | | |
| Mexico | Coefficient | -0.030 | 3.580*** | -1.353*** |
| | St. Err. | (0.045) | (0.889) | (0.255) |
| | Observations | 75,333 | 71,102 | 75,333 |
| | Adjusted R-squared | 0.561 | 0.567 | 0.561 |
| | School Exit rate % | 20.69 | 20.41 | 20.69 |
| | Shock rate | 60.42 | 2.200 | 20.09 |
| | Mean shock size | 4.695 | | |

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

*Note:* This table presents estimates of nine OLS regressions of the relationship between schooling exit rates and the following shocks: 1) unemployment shock (the household's main earner transitioned from employment into unemployment); 2) household income shock (the household's total labor income fell by at least 25 percent), and 3) log of income shock (the decrease in earnings of the main earner, measured in log units). Coefficients were estimated through OLS regressions. The same set of

repressors used for the regression reported in Table 3 is included for each regression. School exit rate reports the weighted share of individuals who exited school in each sample; the shock rate reports the share of individuals who lived in households with a positive shock in each sample; and the mean shock size reports the average magnitude of the negative income shock included in column III. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively. Heteroskedasticity-robust standard errors are reported in the second line of each country.

The impact of a reduction of at least 25 percent to total household labor income shock (as opposed to a shock to the main earner) on school enrollment, while more severe, was less frequent than the two types considered above (Table 4, column III). Again, there is evidence of a positive and significant effect of a negative household income shock on school dropout in both Argentina and Brazil, while in Mexico the coefficient is negative and significant. As expected given the higher severity of the shock, the size of the coefficient is larger for shocks to the total household income than to the shocks experienced by the main earner.

In Argentina, the shocks to the main earner's income behave as expected: both the income shock and the unemployment shock lead to higher exit rates from school. The unemployment shock, which implies a reduction of 100% in labor income for the earner, is more severe and hence has a larger effect on exit rates. In Brazil, on the other hand, a negative income shock is associated with higher exit rates, but the impact of an unemployment shock is not statistically significant. And in Mexico, it is the opposite: an income shock does not increase school exit rates, but an unemployment shock does. Why do households in Mexico and Brazil react so differently? It may be related to labor market differences, in particular, Brazil's relatively high formality rate and resulting access to unemployment insurance system reduces losses in labor income associated with unemployment, potentially buffering households from significant income shocks. Mexico, on the other hand, has high informality rates and hence fewer people have access to unemployment insurance. This difference in access to unemployment insurance may imply a larger income effect for Mexican households than Brazilian households when facing unemployment spells.

## Understanding school exits in Mexico

While Argentina and Brazil each showed increased propensity for school exits when faced with a negative income shock across the different specifications above, Mexico's results presented evidence of either no change in propensity or, if anything, a decrease in school exits. One plausible explanation for the differences in the Mexican results from the other countries can be found in the highly selected sample of people attending secondary education in the country. As shown above, enrollment and completion rates of secondary education in Mexico are significantly lower than in Argentina and Brazil, suggesting that much of the "cream skimming" happens between basic education and upper secondary school. If each student has some probability of exiting as a response to an income shock, this may suggest that more students with higher probability have dropped out earlier in Mexico than in Argentina and Brazil, leaving individuals with lower probability of dropping out overrepresented in the Mexican 15-25 population relative to the other two countries.

A second factor is that Mexico offers several programs to support secondary school students and increase access to tertiary education. These programs effectively serve as insurance against household labor income shocks and provide economic incentives to remain enrolled when households receive a shock. 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 1,277,800 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).[12]

Finally, the results for Mexico, especially the negative effect of a shock on male school enrollment, suggest that the opportunity cost of school in Mexico is an important factor. Mexico's specific export-industry structure increases the opportunity cost of upper secondary education. Atkin (2016) looks at the impacts of globalization on the 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. In addition, there are significant differences in formality rates and unemployment rates between Mexico and the other two countries. Mexican workers are significantly less likely to work in the formal sector (in 2014 informality accounted for 62 percent of wage workers in Mexico vs 34 percent in Argentina and 35 percent in Brazil) and unemployment rates are much lower (as shown above). Higher rates of formality suggest a labor market that is more rigid even as access to unemployment insurance is more common. It implies lower opportunity costs of attending school for Argentine and Brazilian youth, as they face higher rates of unemployment, while Mexican students, facing a largely informal market with low unemployment, may face higher relative opportunity costs.

# 6. LIFE AFTER SHOCK: PRELIMINARY EVIDENCE

Dropping out form 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 year $t+1$ for youth who were enrolled in school in year $t$ and were not in school in year $t+1$ and how does this differ between those who experienced an income shock and those who did not?

[12] 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.

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, $Emp_{irct}$ represents the employment status of a young individual $i$ of region $r$, in country $c$ that left school between year $t$ and $t+1$. The variable takes the value of 0 if the individual is not in education or employment (*nini*) in $t+1$; 1 if the individual holds an informal job in $t+1$; and 2 if the individual holds a formal job in $t+1$. As with the other models above, it includes fixed effects to control for completion of secondary or tertiary school.

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

| | Argentina | | Mexico | | Brazil | |
|---|---|---|---|---|---|---|
| | Formal | Informal | Formal | Informal | Formal | Informal |
| Negative income shock | -0.981*** | -0.553*** | -1.034*** | -0.731*** | -1.038*** | -0.809*** |
| | (0.165) | (0.153) | (0.111) | (0.120) | (0.060) | (0.090) |
| Employed (year=*t*) | 21.602 | 22.348 | 22.273 | 22.655 | 21.356 | 22.110 |
| | (974.732) | (1,098.895) | (755.391) | (1,008.842) | (444.367) | (919.818) |
| Male | 0.452 | 0.559* | 0.577*** | 0.362** | 0.371*** | 0.651*** |
| | (0.315) | (0.303) | (0.143) | (0.157) | (0.085) | (0.122) |
| Income share of main earner | 1.873*** | 0.821* | 0.415 | -0.263 | 1.488*** | -0.339 |
| | (0.473) | (0.437) | (0.357) | (0.385) | (0.197) | (0.279) |
| Labor income per capita | 0.631*** | 0.053 | 0.478*** | 0.032 | 0.440*** | -0.175** |
| | (0.125) | (0.110) | (0.103) | (0.109) | (0.056) | (0.079) |
| Number of siblings under 25 | 0.116 | 0.241*** | 0.104 | 0.034 | 0.021 | -0.121** |
| | (0.092) | (0.085) | (0.073) | (0.078) | (0.042) | (0.060) |
| Female main earner | -0.002 | 0.101 | -0.022 | -0.251* | -0.067 | 0.019 |
| | (0.173) | (0.164) | (0.119) | (0.131) | (0.062) | (0.089) |
| Years of education main earner | 0.024 | -0.013 | -0.013 | -0.054*** | -0.029*** | -0.062*** |
| | (0.026) | (0.024) | (0.015) | (0.017) | (0.010) | (0.013) |
| Constant | -27.455 | -28.987 | -12.085 | -22.339 | -29.901 | -33.604 |
| | (974.840) | (1,098.992) | (755.490) | (1,008.948) | (444.410) | (919.868) |
| Observations | 5,255 | 5,255 | 6,293 | 6,293 | 15,885 | 15,885 |

*Notes:* The table reports coefficient of a multinomial logit analysis for the transition out of school. The omitted category is "not in education or employment (*nini*)". Each cell corresponds to a multinomial logit estimation which includes the following variables not reported in this table: age, age-squared, number of household members employed, age of main earner, secondary and tertiary wage premium by gender, regional, quarterly, and year fixed effects, and completion of educational levels (secondary and tertiary) dummies. ***, ** 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 an informal or formal job relative to those who left school and did not experience a negative shock. This suggests that school exits caused by household income shocks are associated with a higher probability of becoming *nini* and lower probability of finding a job. Furthermore, the coefficient of the probability of finding a formal job relative to becoming *nini* is greater in size than the one of finding an informal job. 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).[13] 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 a significant effect of income shocks on school dropout and the resulting impact on future human capital development. Yet, the empirical analysis reveals stark differences between school exit decisions in Mexico as compared to Argentina and Brazil. These differences suggest the importance of labor markets (especially access to employment opportunities for youth due to industrial composition or large informal sectors) and public safety net programs in determining enrollment rates in upper secondary and tertiary education.

A negative labor income shock on the household's main earner is associated with significant increases in school exit rates in Argentina and Brazil. While a decrease in the household's labor income does not lead Mexican youth to exit school, we find that an unemployment shock for the main earner, a more severe type of labor market shock, does increase exit rates among Mexican students. Neither Argentina nor Brazil showed differential exit rates in response to income shocks by gender of the student; however, male students in Mexico were less likely to exit when their household experienced a shock.

While the propensity to exit in response to household-level shocks differed between Mexico and the other two countries, in all countries those who dropped out "under duress" from a household shock had worse outcomes. 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 suggests that youth who drop out of school as a result of a household shock accept worse employment opportunities than other dropouts.

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

[13] Similarly, experiencing an unemployment shock increases the relative probability of becoming a *nini* relative to working (either formally or informally). Results from a logit model analysis using as a dependent variable, a binary variable taking the value of 1 if the individual is *nini* in the second period and 0 if the individual is employed, show that experiencing a shock increases the probability of being *nini* rather than employed, and this effect is larger in the presence of an employment shock rather than an income shock (see Table A5 in Appendix 2).

school and reduce the future stock of skilled labor, then social safety nets 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 $\theta_{it}$ 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 $\beta$ 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 $\varphi$.

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 $\rho_{it}$ 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 $\delta$ 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 $\theta_{it}$ 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 $\vartheta_{it}$ 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, $\rho_{it}$ 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 $C_{it+}A_{it} = R_t(A_{it}) + F_{it} - W_{it}S_{it}$

$\rho_{it}$ is now the the household specific intertemporal marginal rate of substitution in consumption (scaled by $\beta$).

Additionally, when $R_t$ is differentiable, $\rho_{it}$ 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 $\omega_{it}$ 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 $\rho_{it}$ in (2) means that the forecast error in that equation, $\vartheta_{it}$, 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).

*Table A2. OLS regression of school exit rates and household main earner income shocks interacted with gender of student, by country*

| | Argentina | Brazil | Mexico |
|---|---|---|---|
| Negative income shock | 1.149*** | 1.922*** | 0.275 |
| | (0.424) | (0.336) | (0.349) |
| Shock * Male | -0.337 | 0.738 | -1.165** |
| | (0.633) | (0.495) | (0.490) |
| Male | 2.828*** | 2.092*** | -0.162 |
| | (0.523) | (0.299) | (0.341) |
| Employed | 8.545*** | 3.919*** | 8.001*** |
| | (0.945) | (0.412) | (0.650) |
| Income share of main earner | 8.948*** | 3.567*** | 11.204*** |
| | (2.623) | (0.929) | (1.728) |
| Labor income per capita | -1.556*** | -1.778*** | -0.216 |
| | (0.215) | (0.149) | (0.182) |
| Age main earner | -0.114*** | -0.093*** | -0.105*** |
| | (0.020) | (0.013) | (0.016) |
| Female main earner | 0.545* | 0.304 | 0.176 |
| | (0.316) | (0.222) | (0.259) |
| Years of education main earner | -0.880*** | -0.690*** | -0.707*** |
| | (0.046) | (0.033) | (0.031) |
| Secondary wage premium | 0.015** | 0.008 | 0.001 |
| | (0.007) | (0.006) | (0.006) |
| Tertiary wage premium | -0.012* | 0.001 | -0.002 |
| | (0.007) | (0.003) | (0.004) |
| Constant | 22.943*** | 17.634*** | 17.721*** |
| | (1.676) | (1.339) | (1.212) |
| Observations | 36,824 | 75,333 | 56,112 |
| Adjusted R-squared | 0.393 | 0.561 | 0.261 |
| School Exit Rate (%) | 14.62 | 20.69 | 11.12 |
| Shock Rate (%) | 32.53 | 21.51 | 34.06 |

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

*Note:* This table presents estimates of the relationship between schooling exit rates and household main earner income shock by country. Coefficients were estimated through OLS regressions. Number of siblings under 25, number of household members employed and fixed effects for each year of age, quarter, year, completion of educational levels (secondary and tertiary) and state were included in the regressions but are not reported. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively. Heteroskedasticity-robust standard errors are reported in parentheses.

*Table A3. OLS regression of school exit rates and household main earner income shocks interacted with gender of student, by country*

| | Argentina | Brazil | Mexico |
|---|---|---|---|
| Negative income shock | 0.413 | 3.856*** | -0.952 |
| | (0.732) | (0.561) | (0.628) |
| Shock* Age=15 | -0.061 | -3.009*** | 1.378* |
| | (0.893) | (0.642) | (0.787) |
| Shock* Age=16 | 1.620* | -2.736*** | 0.339 |
| | (0.960) | (0.719) | (0.807) |
| Shock* Age=17 | 0.798 | -2.496*** | 0.743 |
| | (1.078) | (0.878) | (0.684) |
| Shock* Age=18 | 1.093 | -0.294 | 0.078 |
| | (1.282) | (1.098) | (1.059) |
| Shock* Age=19 | 0.431 | -0.111 | 1.767 |
| | (1.409) | (1.209) | (1.105) |
| Age | 0.987*** | 1.365*** | 2.201*** |
| | (0.125) | (0.084) | (0.169) |
| Male | 2.738*** | 2.263*** | -0.555* |
| | (0.497) | (0.283) | (0.301) |
| Employed | 8.545*** | 3.891*** | 7.998*** |
| | (0.945) | (0.413) | (0.650) |
| Income share of main earner | 8.929*** | 3.626*** | 11.197*** |
| | (2.623) | (0.929) | (1.728) |
| Labor income per capita | -1.553*** | -1.769*** | -0.224 |
| | (0.215) | (0.149) | (0.182) |
| Age main earner | -0.114*** | -0.093*** | -0.105*** |
| | (0.020) | (0.013) | (0.016) |
| Female main earner | 0.547* | 0.313 | 0.181 |
| | (0.316) | (0.222) | (0.259) |
| Years of education main earner | -0.880*** | -0.691*** | -0.707*** |
| | (0.046) | (0.033) | (0.031) |
| Secondary wage premium | 0.015** | 0.008 | 0.001 |
| | (0.007) | (0.006) | (0.006) |
| Tertiary wage premium | -0.012* | 0.001 | -0.002 |
| | (0.007) | (0.003) | (0.004) |
| Constant | 8.349*** | -2.616 | -15.320*** |
| | (2.428) | (1.762) | (2.789) |
| Observations | 36,824 | 75,333 | 56,112 |
| Adjusted R-squared | 0.393 | 0.561 | 0.260 |
| School Exit Rate (%) | 14.62 | 20.69 | 11.12 |
| Shock Rate (%) | 32.53 | 21.51 | 34.06 |

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

*Note:* This table presents estimates of the relationship between schooling exit rates and household main earner income shock by country. Coefficients were estimated through OLS regressions. Number of siblings under 25, number of household members employed and fixed effects for quarter, year, completion of educational levels (secondary and tertiary) and state were included in

the regressions but are not reported. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively. Heteroskedasticity-robust standard errors are reported in parentheses.

*Table A4. Logit regression of likelihood of a student exiting school, by country and for alternative income shocks*

| | | (I) Income shock | (II) Household income shock | (III) Unemployment Shock | (IV) Log of income shock |
|---|---|---|---|---|---|
| Argentina | Coefficient | 0.113*** | 0.181*** | 0.466*** | 0.018** |
| | St. Err. | 0.042 | 0.043 | 0.121 | 0.007 |
| | Observations | 35,161 | 35,161 | 33,732 | 35,161 |
| | Adjusted R-squared | 0.227 | 0.227 | 0.237 | 0.228 |
| | School Exit rate % | 10.34 | 10.34 | 10.12 | 10.34 |
| | Shock rate | 32.48 | 27.97 | 1.651 | 55.81 |
| | Mean shock size | | | | 5.436 |
| Brazil | Coefficient | 0.298*** | 0.318*** | 0.095 | 0.044*** |
| | St. Err. | 0.032 | 0.032 | 0.086 | 0.006 |
| | Observations | 35,161 | 35,161 | 33,732 | 35,161 |
| | Adjusted R-squared | 0.227 | 0.227 | 0.237 | 0.228 |
| | School Exit rate % | 10.34 | 10.34 | 10.12 | 10.34 |
| | Shock rate | 32.48 | 27.97 | 1.651 | 55.81 |
| | Mean shock size | | | | 5.436 |
| Mexico | Coefficient | -0.041 | -0.166*** | 0.383*** | -0.003 |
| | St. Err. | 0.034 | 0.036 | 0.088 | 0.006 |
| | Observations | 47,594 | 47,594 | 44,644 | 47,594 |
| | Adjusted R-squared | 0.169 | 0.17 | 0.179 | 0.17 |
| | School Exit rate % | 13.14 | 13.14 | 13.12 | 13.14 |
| | Shock rate | 33.98 | 31.25 | 3.005 | 61.69 |
| | Mean shock size | | | | 5.045 |

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

*Note:* This table presents estimates of twelve logit regressions of the relationship between schooling exit rates and the following 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), 2) household income shock (the household's total labor income fell by at least 25 percent), 3) unemployment shock (the household's main earner transitioned from employment into unemployment), and 4) log of income shock (the decrease in earnings of the main earner, measured in log units). Coefficients were estimated through logit regressions. The same set of repressors used for the baseline regression is included for each. School exit rate reports the weighted share of individuals who exited school in each sample; the shock rate reports the share of individuals who lived in households with a positive shock in each sample; and the mean shock size reports the average magnitude of the negative income shock included in column IV. ***, ** 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*

| | Negative Income shock | | | Unemployment shock | | |
|---|---|---|---|---|---|---|
| | Arg | Bra | Mex | Arg | Bra | Mex |
| Shock | 0.729*** | 0.989*** | 0.913*** | 3.121*** | 3.393*** | 2.181*** |
| | (0.138) | (0.058) | (0.103) | (0.403) | (0.171) | (0.222) |
| Employed dummy | -22.142 | -22.543 | -21.466 | -21.167 | -21.130 | -22.000 |
| | (776.865) | (678.781) | (374.309) | (542.714) | (422.821) | (560.937) |
| Male dummy | -0.515* | -0.423*** | -0.495*** | -0.698** | -0.482*** | -0.514*** |
| | (0.271) | (0.082) | (0.134) | (0.295) | (0.093) | (0.145) |
| Income share of main earner | -1.263*** | -1.133*** | -0.147 | -2.632*** | -2.878*** | -1.220*** |
| | (0.399) | (0.190) | (0.334) | (0.500) | (0.250) | (0.400) |
| Labor income per capita | -0.286*** | -0.318*** | -0.300*** | -0.166 | -0.234*** | -0.083 |
| | (0.100) | (0.054) | (0.095) | (0.113) | (0.062) | (0.107) |
| Number of siblings under 25 | -0.183** | 0.007 | -0.075 | -0.210** | 0.017 | 0.000 |
| | (0.079) | (0.041) | (0.068) | (0.088) | (0.046) | (0.076) |
| Household members employed | -0.030 | -0.146*** | 0.099 | -0.018 | -0.167*** | 0.016 |
| | (0.085) | (0.039) | (0.070) | (0.093) | (0.043) | (0.078) |
| Age main earner | -0.012* | 0.007** | 0.008 | 0.002 | 0.018*** | 0.021*** |
| | (0.007) | (0.003) | (0.005) | (0.008) | (0.003) | (0.006) |
| Female main earner | -0.062 | 0.050 | 0.106 | 0.044 | 0.208*** | 0.096 |
| | (0.149) | (0.061) | (0.112) | (0.163) | (0.067) | (0.126) |
| Years of education main earner | -0.005 | 0.035*** | 0.027* | -0.018 | 0.016 | 0.023 |
| | (0.022) | (0.009) | (0.014) | (0.024) | (0.010) | (0.015) |
| Secondary wage premium | 0.000 | -0.000 | -0.001 | -0.003 | -0.001 | -0.005 |
| | (0.004) | (0.002) | (0.003) | (0.004) | (0.002) | (0.003) |
| Tertiary wage premium | -0.004 | -0.000 | 0.001 | -0.002 | 0.001 | 0.003 |
| | (0.003) | (0.001) | (0.002) | (0.004) | (0.001) | (0.002) |
| Constant | 24.493 | 24.226 | 20.788 | 23.272 | 22.779 | 20.118 |
| | (776.866) | (678.781) | (374.309) | (542.715) | (422.821) | (560.938) |
| Observations | 5,255 | 15,885 | 6,293 | 4,959 | 14,786 | 5,891 |

*Source:* Authors' calculations using LABLAC (CEDLAS and the World Bank).
*Note:* The sample is limited to individuals who exited school during the period of analysis. Coefficients were estimated with a logit regressions. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively. Heteroskedasticity-robust standard errors are reported in parentheses.

## 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.

### 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 2006, *Educação básica* (primary education) has a nominal duration of 12 years (11 years until 2006) 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. The first eight years of primary education are compulsory for children aged 6-14 is compulsory up to (and including) age 14.

### Mexico

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.[1] The expected graduation rate from secondary education is at age 17 or 18.[2] Basic education is made up of pre-school (*preescolar*) (for children aged 5-6 years), *educación*

[1] In the Mexican system, compulsory refers to the levels of schooling that must be provided to students in a local area, rather than the minimum schooling that is compulsory for each child by law.
[2] http://www.dof.gob.mx/nota_detalle.php?codigo=5301832&fecha=10/06/2013

*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.6 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 | 8 | 14 | 17-18 |