

A data set for studying intergenerational human capital accumulation in Peru

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Abstract

A new data set on almost 1200 households in Peru is presented. Estimations of income and heredity of education appear to be similar to those run on the last LSMS dataset. EVEP data set provides data about educational expenditure, vision of education and several variables measuring the propensity to invest in education. Results seem to validate a log-linear form for human capital accumulation. Propensity to invest in education rises with human capital and presents a threshold at the University level. Social reproduction may have increased in Peru because of the development of private schools especially in Lima.

Key words: human capital, education finance, development

JEL Classification: 012, I22, J24

¹I am grateful to J. Falco, I. Santa Cruz and R. Eguzquiza for their precious help.

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1 Introduction

Human capital intergenerational accumulation process has been deeply studied from the theoretical point of view. Since Ben Porath (1965), a geometric form has been assumed between the main inputs of human capital production: educational expenditure and past human capital, which can be the one of parents or teachers. After the modern version proposed by Glomm and Ravikumar (1992), this kind of formulation have been commonly used to investigate many theoretical problems such as the public/private educational system trade-off, the impact of endogenous preferences, Cardak (1999) or the inequality-efficiency problem, Benabou (1996). However, such models of human capital growth have not been completely estimated since. Relations between human capital and productivity growth have been considered either at the macroeconomic level, Barro (1991), Kiriakou (1991), Benhabib and Spiegel (1994) or Wossman (2002) or at the microeconomic level, Mincer (1958), Becker (1964). Intergenerational dependence of human capital has also been investigated in many countries and especially in Peru, Pasquier-Doumer (2005). However, methodology differs for this two kind of work and studies which investigates both these phenomena in the same framework are scarce.

Since Glomm and Ravikumar, such intergenerational process are used to investigate the impact of fiscal policy on the distribution of human capital. Assuming that taxation level is determined by the preferences of the electors, especially a median voter when it exists, the distribution of human capital may be endogenous. This assumption has potentially dramatic consequences on the way to promote growth and even the possibility for a country to accede to development, Perotti (1993). When preferences are endogenous, a development trap due to the inter-

action of politic and capital accumulation may occur, which could prevent too unequal or too poor countries to achieve the transition toward development, Cahu (2006).

Several studies have tried to bring to light a link between distribution of income, and thus inequality on taxation and then growth trough cross-country regressions Alesina and Rodrik (1994), Persson and Tabellini (1994). Microeconomic studies of relationship between political behavior and inequalities are more difficult to set up because specific large panel data at different times would be necessary. Since now, there existed no panel data which permitted to investigate at the same time the relation between productivity, education, human capital accumulation and the endogeneity of preferences. Using a panel data at one time, the endogeneity of preferences can be considered through heterogeneity of preferences among the population. Nevertheless, such studies are insufficient to complete the analysis of the political economical equilibrium because strategic behaviors and behavioral interactions may occur, that cannot be easily apprehended. We present in this paper a new survey, EVEP 2006³, specially made in Mai 2006 in Peru (Regions of Lima and Puno) to study the intergenerational human capital accumulation process, taking into account an possible endogeneity of preferences. Before presenting this new dataset and the main results, we begin by applying the same methodology on the last LSMS panel data on Peru. Our aim is to estimate simultaneously Mincerian's regressions and heredity of education and to obtain some benchmark results.

³Encuesta sobre la Vision de la Educacion en el Perú

2 Study of human capital accumulation process through the last LSMS panel data on Peru

The ENNIV 94 (Encuestas de Hogares Sobre Medición de Niveles de Vida) is the last one of a four survey series on household standard of living, conducted from the standardized methodology LSMS, promoted by the world bank. It is based on a 3544 housing sample, whose 1344 were located in rural area in every regions of Peru in 1994. Among these 2252 were already investigated in 1991. 3623 households were identified. Monetary amount were standardized with monthly price index by regions. This survey constitutes an accurate representation of Peru and provides many useful informations on households, like education or position on the labour market.

2.1 Heredity of schooling

Quality of education in Peruvian public school is low and links between success at school (measured through repetitions and drop out) and parental background have been shown in several studies. Contingency tables are often used for this kind of exercise because many variables are discrete. Nevertheless, this method does not allow to use the same variables as in the Mincerian regressions in order to estimate a coherent model. We then use simple regressions assuming that level of schooling are continuous to explain the schooling expectancy. We use parental schooling and the type of educational structure (public or private), which is in Peru a good indicator of educational quality, especially at the compulsory levels. Educational expenditure cannot be used here because the survey only provides this

kind of data for the youngest agents. We use here the exponential of schooling as a proxy for human capital, which is consistent with Mincer's theory. We also use functions of the age to take into account the possibility of post-compulsory formations. Schooling increases with the age until the age of 30, which seems to be a upper boundary for ending studies. A quadratic form appears to be more precise because in addition to this evolution along the life it is necessary to describe an evolution with generations, as long as the average educational attainment rises. Regressions are run on the sample (A) of persons who have finished their studies and declare be on the labor market. Regressions are also run on the overall sample (B) in order to have an idea about the bias induced by the presence of the youngest agents in the sample.

Here we will call "social reproduction" the sum of partial derivative of schooling according to father's and mother's schooling. It measures the strength of the link of heredity between children's and parent's education. This social reproduction is lower on the overall sample for two reasons. First, a general rise of educational attainment has permitted to reduce the inequality in the education area. Second, taking into account individuals which have not completed their studies lowers the inequality of schooling between agents and then brings down the social reproduction coefficient. Taking into account geographical and ethnic variables lower this coefficient because rural and indigenous populations have less access to education. Moreover, taking into account the type of school structure lowers this coefficient too because a part of the social reproduction is linked to the possibility for wealthier households to send their children to private schools.

To take into account some endogeneity bias, we can use instruments variable available like repetitions, the ability to read a newspaper or the fact that the

| Model | (1) | (2) | (3) | (4) | (4') |
|-----------------------------|-----------------|------------------|-----------------|-----------------|-----------------|
| Method | OLS | OLS | OLS | OLS | OLS |
| Sample | A | A | A | A | B |
| Explained var. | S | S | S | S | S |
| Father's education | 0.113 (6.9) | 0.117 (7.1) | 0.090 (5.5) | 0.077 (4.7) | 0.063 (6.4) |
| Mother's education | 0.184 (10.6) | 0.177 (10.2) | 0.150 (8.6) | 0.135 (7.6) | 0.088 (8.3) |
| $\ln(\min(\text{Age}), 30)$ | 6.75 (36.2) | - | 6.35 (33.8) | 6.25 (33.2) | 7.84 (115.5) |
| Age | - | 0.818 (25.2) | - | - | - |
| Age ² | - | -0.113 (18.4) | - | - | - |
| Rural area | - | - | -1.03 (8.1) | -1.04 (8.2) | -0.45 (6.4) |
| Quechua | - | - | -0.52 (2.4) | -0.51 (2.4) | -0.30 (2.5) |
| Private school | - | - | - | 0.68 (4.6) | 0.47 (5.1) |
| Intercept | -12.8 (22.5) | -4.35 (10.5) | -9.86 (15.2) | -9.48 (14.6) | -14.7 (58.6) |
| N | 2229 | 2229 | 2229 | 2229 | 4549 |
| R^2 | 0.45 | 0.45 | 0.47 | 0.47 | 0.77 |

Table 1: Endogeneity of schooling in Peru, from ENNIV94 data

person was going to school by foot. The number of repetitions does not appear to be a reliable instrument because this data is not available on the all sample. Indeed basic estimations does not remain unchanged on this sample. We use then the reading variable, which is not correlated with parental schooling but correlated with schooling.

$$\langle \text{Read the newspaper, Father's schooling} \rangle = 0.0597$$

$$\langle \text{Read the newspaper, Schooling} \rangle = 0.2084$$

We can also consider that parental level of schooling, which is strongly correlated to household's income, may have an influence on the type of school the

children attend. Ommiting this property may introduce a selection bias in the estimation. We use then a probit model to predict the type of school attended and we introduce the residual in the previous estimations to correct the bias.

| Model | (5a) | (6a) |
|-----------------------------|--------------------|-------------------|
| Method | Probit | Probit |
| Explained var. | Read the newspaper | Private education |
| Father's schooling | 0.044 0.030 | 0.096 0.000 |
| Mother's schooling | - | 0.083 0.000 |
| $\ln(\min(\text{Age}, 30))$ | 1.22 0.000 | 0.83 0.000 |
| Rural area | -0.33 0.021 | -0.26 0.055 |
| Quechua spoken | -0.39 0.015 | -0.08 0.726 |
| Transport by feet | 0.36 0.014 | - |
| Intercept | -1.24 0.046 | -4.75 0.000 |
| N | 2992 | 2329 |
| $\mathcal{P}(\chi^2)$ | 0.0000 | 0.0000 |

Table 2: Endogeneity of quality factors(p-value are below estimates)

Social reproduction coefficient decreases from 0.20 to 0.25 which is not so huge if we consider the inequality level in Peru and the strong impact of parental education on school success. However, this regression does not take into account the quality of human capital, like repetitions for example. Schooling is lower in the rural area and among the population who speak Quechua. The type of educational structure has a strong impact, even after some correction of the bias. Taking into account endogeneity bias does not modify the results although our instrument does not provide much information.

| Model | (3) | (5b) | (6b) | (7b) |
|-----------------------|-----------------|-----------------|----------------|-----------------|
| Method | OLS | IV | IV | IV |
| Explain. var | <i>S</i> | <i>S</i> | <i>S</i> | <i>S</i> |
| Father's schooling | 0.090 (5.5) | 0.094 (5.4) | 0.090 (5.5) | 0.094 (5.8) |
| Mother's schooling | 0.150 (8.6) | 0.147 (8.5) | 0.143 (8.6) | 0.146 (8.5) |
| ln(min(Age,30)) | 6.35 (33.8) | 6.39 (34.3) | 6.35 (33.9) | 6.39 (34.5) |
| Rural area | -1.03 (8.1) | -1.08 (8.5) | -1.03 (8.1) | -1.08 (8.5) |
| Quechua spoken | -0.52 (2.4) | -0.63 (3.0) | -0.52 (2.4) | -0.63 (3.0) |
| Read res. | - | 3.87 (6.6) | - | 3.84 (6.5) |
| Priv. res. | - | - | 0.67 (4.5) | 0.66 (4.5) |
| Intercept | -9.86 (15.2) | -10.0 (15.3) | -9.9 (15.3) | -10.0 (15.6) |
| <i>N</i> | 2229 | 2229 | 2229 | 2229 |
| <i>R</i> ² | 0.47 | 0.48 | 0.47 | 0.48 |

Table 3: Endogeneity of schooling after correction of some bias

2.2 Education returns

Available data allows a precise study of the returns of schooling in the labor market. Contrary to traditional analysis, a study at the individual level is not possible. Indeed a significant group of the households have workers of different generations, which increases the number of workers in the household although an accurate measure of the aggregated income is only available. Moreover, informal employment is the rule in Peru and duration of work and wages can change dramatically from a week to another. In addition to that, a large part of the expenditure corresponds to collective consumption, which makes difficult to estimate an individual labor supply function. For all these reasons, we choose here to consider for each household a representative worker, which has the average characteristics (schooling, age and sex) of all workers of the household. The labor supply is after that less erratic

and income are more easily comparable from a household to another. Workers with missing values are not considered. As the labor market is mostly informal, very few workers have access to unemployment insurance. Therefore there is no bias in the income induced by unemployment. Nevertheless, some endogeneity bias may occur. To solve this problem, we use two instruments, number of repetitions at school and the ability to read a newspaper or not. As discrete variables, they provide few informations but the results seems robust anyway.

We use discrete variable for taking into account the maternal language and the area (urban or rural). The income of an household i is denoted Y_i , its average human capital H_i , its number of workers N_i . The the indicator variables δ_i^{URB} and δ_i^{QCH} precise if the household lives in urban area or not and if its head speaks Quechua or not. The estimated form is then

$$\ln Y_i = \alpha_0 + \alpha_{URB}\delta_i^{URB} + \alpha_{QCH}\delta_i^{QCH} + \ln(H_i) + \beta \ln(N_i) + \zeta Q_i \quad (1)$$

The average human capital of a household i obeys to the Mincer's law, where S_i is the average schooling, X_i the average age of workers and X_i^2 the average square of age.

$$\ln(H_i) = \eta_S S_i + \eta_X X_i - \eta_{XX} X_i^2 \quad (2)$$

Without taking into account endogeneity bias, education return are high, more than 8%. Taking into account the endogeneity biais, education returns reach 11%. Performance at school and on the labor market are negatively correlated like usual.

The ENNIV94 survey provides useful data for a first study on human capital accumulation. But this data set does not allow to estimate the impact of educational expenditure on human capital accumulation. Moreover, the investment

| Model | (1) | (2) | (3) | (4) | (5) | (6) |
|-----------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| Method | MCO | MCO | MCO | MCO | MCO | MCO |
| Explained var. | ln(Income) | ln(Inc) | ln(Inc) | ln(Inc) | ln(Inc) | ln(Inc) |
| Schooling | 0.098 (13.8) | 0.081 (11.4) | 0.089 (13.0) | 0.076 (10.9) | 0.048 (5.9) | 0.059 (7.2) |
| Age | 0.027 (2.3) | 0.019 (1.7) | 0.020 (1.8) | 0.028 (2.6) | 0.024 (2.3) | 0.024 (2.3) |
| Age ² | -0.0002 (1.3) | -0.0001 (0.8) | -0.0001 (1.1) | -0.0002 (1.8) | -0.0002 (1.7) | -0.0002 (1.7) |
| Rural area | - | -0.65 (7.2) | -0.51 (5.7) | -0.51 (5.9) | -0.50 (5.9) | -0.50 (5.8) |
| Quechua spoken | - | -0.33 (4.8) | - | - | - | - |
| Lima | - | - | 0.65 (8.9) | 0.58 (8.2) | 0.62 (8.8) | 0.61 (8.7) |
| Private school | - | - | - | 0.73 (7.7) | 0.59 (6.2) | 0.65 (6.9) |
| University | - | - | - | - | 0.47 (6.1) | - |
| University by year | - | - | - | - | - | 0.023 (4.2) |
| Workers | 0.40 (7.7) | 0.38 (7.6) | 0.38 (8.0) | 0.38 (8.1) | 0.38 (8.2) | 0.39 (8.4) |
| Intercept | 4.35 (16.4) | 4.91 (19.0) | 4.22 (16.5) | 4.18 (16.9) | 4.52 (18.2) | 4.41 (17.5) |
| <i>N</i> | 851 | 821 | 815 | 807 | 807 | 806 |
| <i>R</i> ² | 0.24 | 0.31 | 0.36 | 0.40 | 0.42 | 0.41 |

Table 4: Mincerian's regression on ENNIV94 panel data

behavior cannot be fully investigated to complete the model. That is why we have build and realized the EVEP survey 2006, which provides current data.

3 Building EVEP survey

3.1 Issues of the survey

EVEP was supposed to fulfill many objectives, among which we can evoke:

- Bring up to date data about labor market and education on Peruvian households. Last survey was indeed completed in 2001. The educational back-

ground may indeed have evolved rapidly, because of the development of private education and urban migrations.

- Better know and understand the feelings of the population about the educational system. Such kind of surveys are rare and their possible use by politicians do not guarantee their partiality.
- Determine the human capital production process in Peru and more precisely: the weight of social reproduction, the impact of educational expenditure on the quality of education and the links between education and income.
- Test of the hypothesis of heterogeneous preferences for education. Verifying such an assumption may have large consequences on the politics the country should implement to promote human capital growth.
- Measure the popular approbation of new ways of finance for education. This survey evokes then credit for education, elitist or affirmative action politics, additional tax for education or some ways to limit the risk of educational investment.

3.2 Organisation of the survey

EVEP survey, Encuesta sobre la Vision de la Education en el Peru (Survey about educational demand in Peru), was completed in Mai 2006 in Lima and in the area of Puno in two ways by 10 investigators. Data were collected indeed through direct interviews or by a form. The second protocol was little used because it induces many vacant answers and then rejection of the form. It was especially used to collect data about students. The questions was initially build from the ENNIV94

survey and modified to reach the objectives. It was amended in collaboration of R. Egusquiza, searcher in educational science of the University Ruiz de Montoya. This draft was first tested in Lima during several days before the redaction of the final version, in order to ensure that all questions were perfectly understandable. The duration of an interview was about 10, 15 minutes. Each interview or collected form has been then approved or rejected considering the number of vacant answers and the coherency of answers.

3.2.1 Questions of the EVEP 2006 survey

The survey has 7 sections: main characteristics of the interrogated person and his household for identification, education of the person, his parents and his wife/husband, feelings about the educational system, feelings about fiscal policy, feelings about credit for education, feelings about affirmative action and questions about the children. Despite of the ENNIV94 survey, it has not been chosen, after some experimentation, to codify the answers in the form fulfilled by the investigator. First, it occurs that this system complicates the work of the investigators, who had to concentrate to codify the answers better than explaining the questions. This method also slows down the interview, which may tire the interrogated person and deprive the quality of their answers. The last version of the survey is ergonomic (see previous figure XX). Questions are clearly clarified and one can answer by filling the cells. The survey ends by collecting the feelings of the interrogated people about the survey. Personal data are required to ensure the identity of the interrogated people. This precaution allows to identify incoherent declarations, guarantees that each person was interrogated only one and certifies the work of the investigators. In practice, few people are reluctant to give their I.D.,

ENCUESTA sobre la VISION de la EDUCACION EN EL PERÚ
Universidad Antonio Ruiz de Montoya

La presente encuesta permite comprender mejor las expectativas de las familias para mejorar nuestro sistema educativo.

- A1 Sexo Masculino Femenino
A2 ¿Cuántos años tiene?
A3 ¿En que distrito de Lima vivé?
A4 ¿Cuál es su idioma materno? Castellano Quechua Otro
A5 ¿Cuántas personas viven en su hogar?

Figure 1: Sample of questions of the EVEP 2006 survey

phone number and signature. Some of the questions have been modified, deleted or added according to the results of the preliminary survey. Initially, the survey had some qualitative questions, in order to target the main points (see next figure).

- C2 ¿Puede ud describir el colegio ideal?

Figure 2: (Can you describe the perfect school ?)

Answers have permitted to identify the main issues of the feelings about education, which were then codified in several questions (see next figure).

Another particularity of this survey is that additional qualitative questions about how the interrogated person live his school time were added. Questions about motivation, success, parental support or tastes provide insights about the performance at school. These answers may be used as instruments to correct endogenous bias in Mincer regressions.

3.3 Main statistics

The survey counts 1183 observations of people living in Lima (973) and in the region of Puno (210) in both rural and urban area. This sample is not consequently representative of overall Peru but only of this two regions. The target of the survey

- | | |
|--|---|
| <p>C1 ¿Según su opinión, cuáles son los objetivos mas importante del colegio? Enumera en orden de importancia. (What do you think the the main issues of school are ?)</p> | <p><input type="checkbox"/> Ganar mas Tener un trabajo <input type="checkbox"/> Acceder a la universidad <input type="checkbox"/> Transmi valores <input type="checkbox"/> Tener una mejora de vida <input type="checkbox"/> tener una posición social <input type="checkbox"/> Tener conocimientos <input type="checkbox"/> Otro (cuál) <input type="checkbox"/> No <input type="checkbox"/> no mucho <input type="checkbox"/> si <input type="checkbox"/> bastante</p> |
| <p>C4 ¿Esta satisfecho con la educación que recibió? (Are you satisfied of the education you receive ?)</p> | <p><input type="checkbox"/> muy mala <input type="checkbox"/> mala <input type="checkbox"/> regular <input type="checkbox"/> bue muy buena</p> |
| <p>C5 ¿Y cómo considera la calidad de la educación pública peruana actual? (How do you consider the education of public school nowadays ?)</p> | <p><input type="checkbox"/> Local <input type="checkbox"/> Mobiliario <input type="checkbox"/> Programa alimentario <input type="checkbox"/> disminuir alumnos por a <input type="checkbox"/> Capacitación de profesores, <input type="checkbox"/> aume los sueldos de profesores <input type="checkbox"/> aumentar computadores <input type="checkbox"/> otro</p> |
| <p>C6 ¿Si ud pudiera, que cambios haría en los colegios públicos del Perú? Enumera en orden de importancia. (If you can change something in public school , what would you do ?)</p> | <p><input type="checkbox"/> Si <input type="checkbox"/> No</p> |
| <p>C7 ¿Piensa que se debería aumentar el número de horas en el colegio? (Do you think that the government should lengthen the daily duration of school ?)</p> | <p><input type="checkbox"/> Si <input type="checkbox"/> No</p> |

Figure 3:

was all person above 15 who were not studying in the secondary or primary school anymore. 48% of the interrogated people were males.

The survey gathers several ethnic origins, apprehended by their maternal language. So 11% of the sample speaks Quechua, 0.9% other indigeneous languages and the other speak spanish. Social background are measured by the nivel of education of the household chief and the average monthly aggregated income. Income are deeply higher in Lima than in provincial area. Answers about parents and the interrogated person itself may be used to have an idea of the evolution of social characteristics through time.

In Lima, median income is about 120 soles by month while it is only 50 in Puno's district. If we plot the level of education by generation, we can see that educational development was huge.

- B3 How many time did you repeat a grade ?
- B5 Did you go to school by foot ? Yes No
- B7 Do you believe that your parents considered your education like something important ? No a little important very
- B8 Did you enjoy school ? I hated Not really Yes Yes, very much
- B9 Do you consider that you were a ... pupil ? Bad average good very good

Figure 4: Qualitative questions about personal schooling

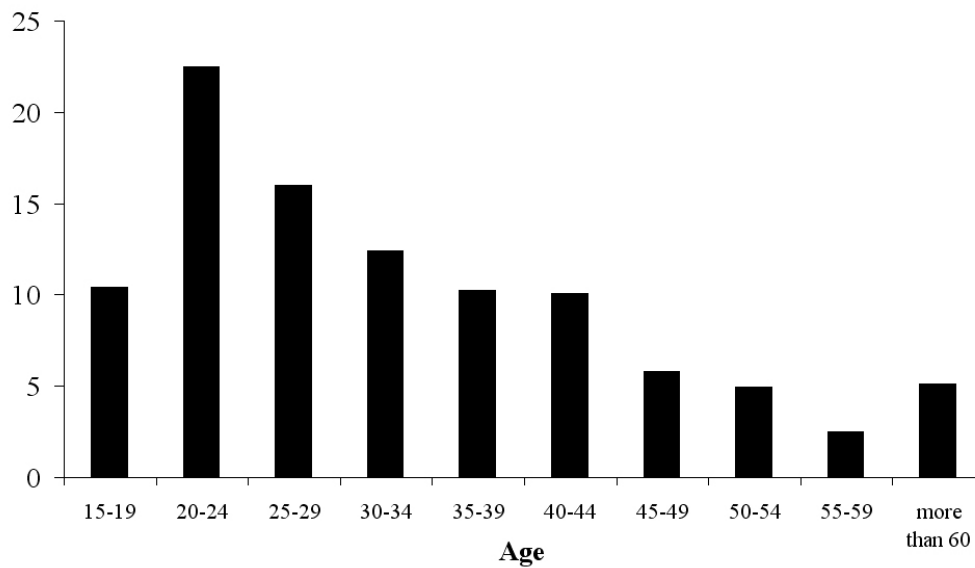


Figure 5: Distribution of ages in the EVEP survey

Illiteracy rate did indeed fall from 8% to 1% and secondary school extends. Higher education did also increase with many new universities but also higher private institutions. Education had dramatically increased in Lima and the movement Fe Y Alegria, managed by the Church, has contributed to this development. In one generation, the size of non government sector become three times larger, which reveals a higher demand for quality.

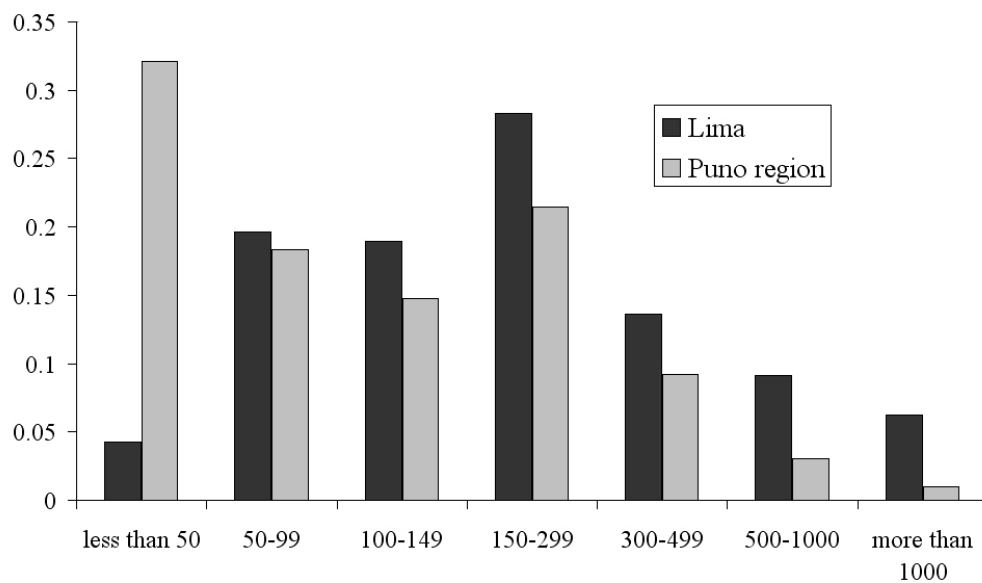


Figure 6: Distribution of monthly income per par inhabitant in soles

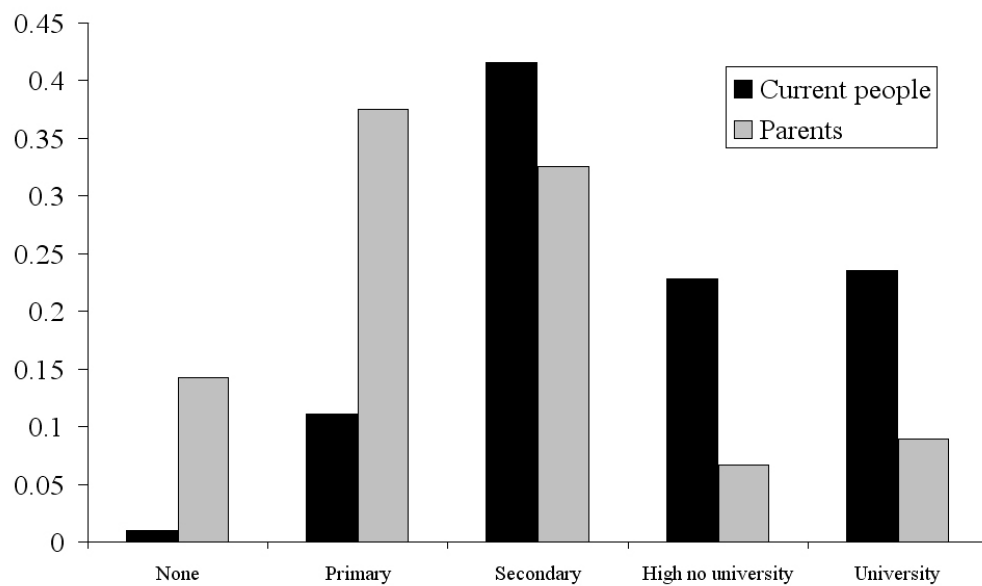


Figure 7: Evolution of educational level in Lima by generation

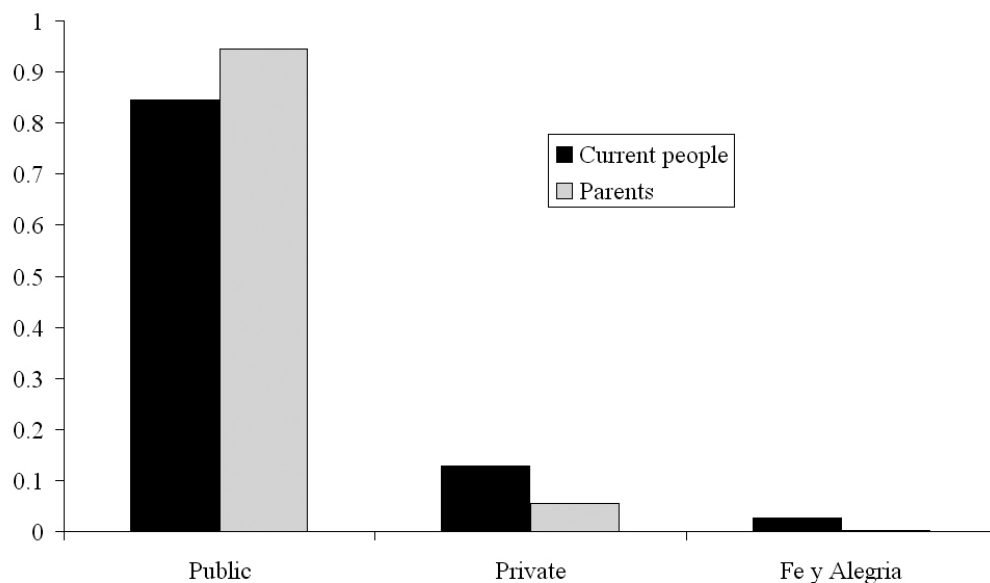


Figure 8: Evolution of private school in Lima

3.3.1 Feelings and demand about the educational system

Although education in Peru is not famous for its quality, a majority of citizen declare being satisfied of it (53%) and consider the quality as good or sufficient. From this point of view this facts does not seem to contradict the medium voter theorem: Peru invests not enough or not well in education's quality because a majority of citizens is satisfied. The half of population complaining supports the dynamic of private education.

To transmit values appears to be the first purpose of school, before acquisition of knowledge and improvement of life standard. This is consistent with the survey of Foro Educativo, completed in 2001. Education is not for Peruvian people a way to earn more money or get a social position. As education as a strong impact on income, this lack of awareness of population may explain why educational investments are insufficient. Peruvian people do not see education like an investment in

human capital but rather like a way to solve some domestic problems. Accede to university is indeed a more important objective than get a job, because everybody believe that graduating in an university is necessary to get a formal job. Objectives of school do not vary with the social background, which proves that such beliefs are strongly established in the society.

| | |
|-----------------------|----|
| Earn more | 2 |
| Get a job | 13 |
| Accede to university | 15 |
| Transmit values | 23 |
| Live a better life | 18 |
| Get a social position | 5 |
| Get knowledge | 22 |
| Others | 1 |

Figure 9: Purpose of school according to interrogated people

Nevertheless the population has a very precise idea of the changes needed to improve public education. Lack of competence of teachers is not surprisingly the first obstacle to quality (31%). The population is also concerned about the motivation of teachers because 13% declare that wages are not sufficiently high. Moreover, there are too many pupils in each classroom for 12% of the interrogated people. Materialist considerations like furniture or food assistance do not seem to be so important.

| | |
|------------------------------|----|
| Buildings | 8 |
| Furniture | 11 |
| Food assistance | 11 |
| Rise of compensations | 13 |
| Better formation of teachers | 32 |
| More computers | 5 |
| Less pupils in each class | 12 |
| Others | 8 |

Figure 10: Changes needed in school

4 Some findings about human capital accumulation in Peru

4.1 The model

We use the data of the EVEP panel to calibrate an intergenerational human capital accumulation model. To study human capital accumulation, it is necessary to estimate simultaneously, (1) the relationship between the human capital of parents and children, (2) the relationships between income and human capital and (3) the behavior of households regarding their investment in human capital and their consequences on human capital accumulation. This kind of empirical work is very rare because it requires a great amount of specific data. As a theoretical framework for these estimations, we will use the traditional forms. For (1) we use Mincerian regressions. For (2) we use the Glomm and Ravikumar's, 1992 model.

$$h_{t+1} = f(h_t, \theta_t, E_t) \quad (3)$$

$$y_t = g(h_t) \quad (4)$$

$$E_t = s(h_t, y_t) \tag{5}$$

4.2 Human capital formation

From the several qualitative variables which control for the particularities of schooling, only repetitions and assumed success/failure appear to be pertinent variables to correct for endogeneity bias. Sex, taste for school and mean schooling of the parents are used as instruments, although these two last variables are not significant to explain directly education. Results of two step least square estimation are significant. The following array presents the estimation. Although the geographical area is not the same, we can note several change in this estimation if we compare to the results on ENNIV94 panel data. First, social reproduction has increased from 25% to 40% if we sum the effects on both father and mother education. Second, the impact of origin and rurality is more important. Third, attending private school seems not to have an influence. One simple reason may explain these three findings. The sharp development of private education in the 90's might have induce a stronger link between income and school success. Father's education is now more important because it is related to the household's income. As private education is concentrated in rural areas and especially Lima, it can explain a larger quality gap between rural and urban education. As a corollary, private education seems not to influence the length of schooling because it increases the quality rather than the length of schooling. Indeed schooling has known a general rise, because of the Fujimori's regime. But this policy was not followed by an increase of the educational investment, what has induced a fall of the education's quality in the urban area. Crossed terms between parental education

| Model | (1) | (2) | (3) | (4) |
|---------------------|-----------------|-----------------|-----------------|-----------------|
| Method | OLS | OLS | OLS | IV |
| Explained var. | S | S | S | S |
| Father's schooling | 0.207 (6.1) | 0.206 (6.1) | 0.170 (5.3) | 0.20 (6.4) |
| Mother's schooling | 0.150 (4.4) | 0.153 (4.5) | 0.094 (2.9) | 0.13 (4.0) |
| Age | 0.16 (4.0) | 0.17 (4.2) | 0.19 (5.1) | 0.21 (5.6) |
| Age ² | -0.002 (4.7) | -0.002 (4.8) | -0.003 (6.1) | -0.003 (6.3) |
| Rural area | -1.45 (3.7) | -1.41 (3.6) | -1.16 (3.2) | -1.41 (3.9) |
| Quechua | -1.51 (4.5) | -1.49 (4.5) | -(ns) | -1.51 (4.8) |
| Fe Y Alegria school | - | 1.41 (1.7) | - | - |
| Repetitions | - | - | -0.91 (5.7) | -0.67 (4.2) |
| Taste for school | - | - | 0.31 (1.6) | 0.66 (3.8) |
| Success in school | - | - | 0.65 (3.4) | 0.66 (3.6) |
| Parental interest | - | - | 0.58 (4.5) | 0.49 (3.8) |
| Gender | - | - | - | -0.81 (3.8) |
| Intercept | 9.4 (10.4) | 9.2 (10.1) | 3.4 (3.2) | 3.08 (2.9) |
| N | 826 | 826 | 793 | 770 |
| R^2 | 0.33 | 0.33 | 0.35 | 0.38 |

Table 5: Human capital formation regressions

or educational expenditure do not appear significant, what supports a log-normal form for the human capital accumulation process.

Simple calculations can allow to check this assumption. A probit model on the choice of school (public or private) indicates that mother's education is the key variable, with speaking quechua and studying in provincial area. Mothers who studied in private schools seems to put their children more often in this kind of structures. Social reproduction is not only driven by education but also by culture.

Moreover, for households putting their children in private structure the fees

| Model | (a) | (b) |
|---|-----------------|---------------|
| Method | Probit | OLS |
| Explained var. | Private school | Fees |
| Father's schooling | - | 15.2 (3.4) |
| Average parental schooling ² | 0.0056 (6.5) | - |
| Mother in private ed. | 1.12 (4.6) | - |
| Lima | 0.62 (2.3) | - |
| Educ. in Province | -0.79 (4.7) | - |
| Quechua | -0.83 (2.4) | - |
| Gender | -0.51 (3.6) | |
| Intercept | -2.5 (6.0) | 9.2 (0.2) |
| <i>N</i> | 703 | 79 |
| <i>R</i> ² | 0.30 | 0.12 |

Table 6: Explaining models for the choice of educational structure

which are a good indicator of the institution's quality only depends of father's education. It is indeed household's income which determines the choice of institution. The personal characteristics we introduced are significant although they seems to be correlated with parental education. We then run a two stage estimation. Taste for school is very exogenous and we use this variable directly. After correction of the bias, results are even more significant. Social reproduction stays at a high level, 33%. Moreover, taking into account parental interest allows to see that gender matters. Girl's education is less important for parents but they compensate this lack of support with more motivation and better performance.

| Model | (1) | (2) | (3) | (4) | (5) | (6) |
|--------------------|----------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Method | OLS | OLS | OLS | OLS | OLS | OLS |
| Explained var. | $\ln(\text{Income})$ | $\ln(\text{Inc})$ | $\ln(\text{Inc})$ | $\ln(\text{Inc})$ | $\ln(\text{Inc})$ | $\ln(\text{Inc})$ |
| Schooling | 0.098 (13.8) | 0.081 (11.4) | 0.089 (13.0) | 0.076 (10.9) | 0.048 (5.9) | 0.059 (7.2) |
| Age | 0.027 (2.3) | 0.019 (1.7) | 0.020 (1.8) | 0.028 (2.6) | 0.024 (2.3) | 0.024 (2.3) |
| Age ² | -0.0002 (1.3) | -0.0001 (0.8) | -0.0001 (1.1) | -0.0002 (1.8) | -0.0002 (1.7) | -0.0002 (1.7) |
| Rural area | - | -0.65 (7.2) | -0.51 (5.7) | -0.51 (5.9) | -0.50 (5.9) | -0.50 (5.8) |
| Quechua | - | -0.33 (4.8) | - | - | - | - |
| Lima | - | - | 0.65 (8.9) | 0.58 (8.2) | 0.62 (8.8) | 0.61 (8.7) |
| Private school | - | - | - | 0.73 (7.7) | 0.59 (6.2) | 0.65 (6.9) |
| University | - | - | - | - | 0.47 (6.1) | - |
| University by year | - | - | - | - | - | 0.023 (4.2) |
| Workers | 0.40 (7.7) | 0.38 (7.6) | 0.38 (8.0) | 0.38 (8.1) | 0.38 (8.2) | 0.39 (8.4) |
| Intercept | 4.35 (16.4) | 4.91 (19.0) | 4.22 (16.5) | 4.18 (16.9) | 4.52 (18.2) | 4.41 (17.5) |
| N | 851 | 821 | 815 | 807 | 807 | 806 |
| R^2 | 0.24 | 0.31 | 0.36 | 0.40 | 0.42 | 0.41 |

Table 7: Mincer's regressions on EVEP 2006 data

4.3 Educational returns

We use the same method as previous to evaluate educational returns. We calculate average schooling, average age and index variables for private education or university. Gender is not significant in Mincer's regressions. Even if the sample of the two surveys are not the same, it can be noted that many estimations are similar. Indeed, experience, rurality or number of workers in the household have the same impact on income in both panel data. In contrary to that, educational returns have changed since 1994.

First, educational returns have much fallen, about 2%. Educational growth

and urban migrations remained at a high level during the period. As educational returns are decreasing and higher in rural area, it is logical that these mutations induces lower returns. In addition to that, education's quality has not risen in the meantime and the development of private education may have provoked a flow of the best pupils to private schools.

Second, education returns at the university level have much increased during the period. In 1994, they did not differ significantly from the returns at other levels of education. This rise of returns is about 2% by year of study at the university and explain why higher education is so popular. In the same time, rates of returns have deeply fallen in both primary and secondary education. Indeed the general rise of education level was not followed by a comparable increase of skilled employment. Consequently, many young workers are overeducated, which betters their perspective of employment but deprives the ones of the unskilled workers. As the share of graduated workers increase, competition on the labour market rises too.

Third, we consider the impact of expenditure on the educational returns. We build an index as the logarithm of the monthly fees in private structures. Different fees are comparable in time because interrogated people have to explicit a level of fees in reference to the current tarification. We assume here that expenditure is similar in every public structure. To compare public and private expenditure, we have estimated annual educational costs by pupil thanks to microeconomic data in public structures and we have divided it by ten in order to compare with the fees paid by the parents in private schools. We take the logarithm of this estimation, which is quite rough and does not allow to take into account heterogeneity of investments in public schools. We then calculate the average of this indicator

| Model | (7) | (8) | (9) |
|---|----------------------|-------------------|-------------------|
| Method | OLS | OLS | OLS |
| Explained var. | $\ln(\text{Income})$ | $\ln(\text{Inc})$ | $\ln(\text{Inc})$ |
| Schooling | 0.053 (6.5) | 0.049 (5.6) | 0.049 (5.6) |
| Age | 0.016 (1.6) | 0.025 (2.4) | 0.024 (2.3) |
| Age ² | -0.0001 (1.1) | -0.0002 (1.8) | -0.0002 (1.6) |
| Rural area | -0.50 (5.8) | -0.53 (6.1) | -0.53 (6.1) |
| Lima | 0.68 (9.6) | 0.62 (8.6) | 0.61 (8.5) |
| University | 0.61 (7.6) | 0.46 (5.4) | 0.46 (5.4) |
| $\ln(\text{Expenditure})$ | - | 0.22 (6.8) | 0.20 (5.7) |
| $\ln(\text{Expenditure}), \text{sonorgrandson}$ | - | - | 0.03 (1.4) |
| Workers | 0.38 (8.1) | 0.37 (7.9) | 0.35 (7.1) |
| Intercept | 4.63 (7.6) | 4.06 (15.2) | 4.10 (15.2) |
| N | 815 | 740 | 740 |
| R^2 | 0.39 | 0.42 | 0.42 |

Table 8: Mincer's regressions with impact of educational expenditure

among the workers of each household and we introduce it into the last regression.

This variable appears to be very significant and it betters the R^2 . But it is also probably endogenous and we do not have any instrument to correct this bias because it would require to have disaggregated data about each working member of the household. We can nevertheless distinguish between educational expenditure whether the worker is the household chief or his child or grand child. In the second case, educational expenditure may be determined by the household's income, which depends especially of the household's chief personal data. We then calculate the same regression, after exclusion of the households where children or grand-children are working. Results remain quite similar although this sample is not well representative of the overall population. It excludes indeed many young

workers who live with their parents for social and economical reasons. Another way is to introduce explicitly the educational expenditure of the working children and grand-children. But elasticity between educational expenditure and income remains greater than 0.2, which is high.

4.4 A new specification of human capital

Using EVEP 2006 data, we have shown that educational expenditure seem to play a crucial role in human capital accumulation. Contrary to what is often expected, educational expenditure does not influence here the length of schooling but rather its quality, as it increases educational returns. Therefore, the number of years of study is not a sufficient variable to describe human capital. To be consistent with our previous estimations, we build a new variable for human capital, mixing qualitative (educational expenditure) and quantitative (years of schooling). With EVEP data, we estimated two equations to take into account capital human accumulation. If we denote for an individual i belonging to the generation t , $S_{i,t}$ his schooling, $y_{i,t}$ the income of his household and $E_{i,t}$ the educational expenditure he received, this system can be written:

$$\begin{cases} S_{t,i} = \gamma_0 S_{t-1,i} + b_{t-1} + \epsilon_i \\ \ln(y_{t,i}) = a_t + \alpha_0 S_{t,i} + \delta_0 \ln(E_{t,i}) + \eta_i \end{cases} \quad (6)$$

These empirical forms can be combined to obtain a model of accumulation similar to Glomm and Ravikumar's one. Let us denote h the human capital as:

$$h_{t,i} \equiv C_t e^{\alpha_0 S_{t,i}} E_{t-1,i}^{\delta_0} \quad (7)$$

The relation between income and human capital becomes then:

$$y_{t,i} = \phi_{t,i} h_t \quad (8)$$

The terme $\phi_{t,i}$ is a random parameter which describes personal returns of human capital on the labour market. To make correspond the empirical and theoretical forms, we have to note that the variable C_t is approximatively a constant among the old generations. Indeed as private education was very scarce among the older generations, educational expenditure can be considered as a constant.

$$\ln(h_{t+1,i}) = \ln(C_{t+1}) + \alpha_0 \ln(S_{t+1,i}) + \delta_0 \ln(E_{t,i}) = \ln(C_{t+1}) + \alpha_0 \gamma_0 S_{t,i} + \alpha_0 \varepsilon_i + \alpha_0 b_t + \delta_0 \ln(E_{t,i}) \quad (9)$$

$$= \gamma_0 (\alpha_0 S_{t,i} + \delta_0 \ln(E_{t-1,i}) + \ln(C_t)) + \delta_0 \ln(E_{t,i}) + \ln(C_{t+1}) - \gamma_0 \ln(C_t) - \gamma_0 \delta_0 \ln(E_{t-1,i}) + \alpha_0 \varepsilon_i + \alpha_0 b_t \quad (10)$$

By identification and assuming that C_t is constant through time:

$$C_t \equiv \exp \left\{ \delta_0 \frac{\gamma_0}{1 - \gamma_0} \ln(E_{t-1}) \right\} \quad (11)$$

The model can therefore be calibrated by identifying the theoretical parameters and the estimated ones.

$$\alpha \equiv \alpha_0 ; \delta \equiv \delta_0 ; \gamma \equiv \gamma_0 \quad (12)$$

We can now use these parameters to define for each individual a new variable h as measure of human capital consistent with both the Glomm and Ravikumar's

theoretical model and our estimations.

$$h_{t,i} = \exp \left\{ \alpha St, i + \delta \ln (E_{t,i}) \right\} \quad (13)$$

4.5 Propensity to invest in education

Now that we have characterized the human capital accumulation function, it is necessary to take into account the endogeneity of investment. The accumulation function (1) that we estimated takes a log-normal form:

$$\ln(h_{t+1}) = \ln(\theta_t) + \gamma \ln(h_t) + \delta \ln(E_t) \quad (14)$$

In this section, we take into account the fact that educational expenditure can depend of parental human capital, $E(h)$. As we build a measure of human capital such that income is a linear function of human capital, it is logical to assume that E is an increasing function of h . Nevertheless, there are different configurations depending of the way education is financed. First, when we consider that education is public and financed by an income flat tax, E becomes linear in the aggregated human capital. Moreover, if the tax rate is determined through a democratic vote, we may assume that the preferred tax rate depends of the human capital of the voter. We have interrogated people about their willingness to pay for education. However such a process is not convincing for various reasons. First, a majority of citizens declare that taxes are sufficiently or too high. Not surprisingly, many people complains about the level of corruption and argue that taxes are not used to improve public services. Households are also budget constrained and are not able to pay more taxes. Indeed if we ask the people why they do not want to pay

| | |
|--------------|--------|
| insufficient | 3.38% |
| sufficient | 39.59% |
| too much | 57.03% |

Table 9: Do you think that you are paying insufficient, sufficient or too taxes ?

more taxes (for education), 58.95% declare that they do not have enough money and 32.87% that they do not trust the state. Second other mechanisms may interfere with human capital to explain the willingness to pay taxes. This kind of question appears moreover to be too complicated for many interrogated people. Nevertheless, we have asked people about the amount of money they were willing to give to an additional public fund for improving quality of public school. Results do not appear to be correlated with human capital, once we take into account the household income and whatever the configuration. We then ask the people to split 100 monetary unit of public expenditure between several public services such as health, education, security, army, food assistance, employment, water supply or others. As this question isolate the problem of willingness to pay taxes and the problem of the importance of education, results appears to be more interesting. As the average tax rate is about 20% in Peru, we can compare the two indicators, dividing the second one by 5. The first one corresponds to a direct marginal propensity to invest in public education (DMPCE) and the second an indirect propensity to invest in education (IPCE). First almost every interrogated people

| Variable | Observations | Mean | Standard deviation |
|----------|--------------|--------|--------------------|
| DMPCE | 1090 | 0.0428 | 0.329 |
| IPCE | 1165 | 0.0725 | 0.070 |

Table 10: Comparisons of two measures of propensity to invest in public education

(98.6%) answered the IPCE question, whereas only 92.3% of the sample answered

the DMPCE one. Evaluating a direct propensity to invest in education is therefore more difficult. Moreover, although the mean of the variable are comparable (IPCE is 1.71 times higher than DMPIE), the standard deviation of DMPCE is 4.7 times higher. The indirect measure appears to be more accurate. If we use this indicator, education and even the human capital indicator we built using both schooling and level of expenditure appears to have a strong influence of this propensity to invest in public education. In every cases, the fact that the interrogated people studied in an university has an additional impact on this variable. Therefore, the influence of human capital on the investment behavior is not continuous. This is a key finding as it may justify the existence of a development trap related to human capital in Peru. In addition to that, both schooling and education expenditure (model 2) appears to explain this variable. The quality of education has an impact on the investment behavior.

As we saw it, education is not entirely public in Peru. It may also interesting to study the difference of private investment in education among the households. For that, we use like previously two types of indicators to estimate both marginal and normal propensity to invest in private education. To measure the marginal propensity, we ask like before to the people to split 100 monetary unit of an additional monthly income between various categories: food, clothes, housing, water, education, health, savings and others. We then estimate an indirect marginal propensity to invest in private education (IMPRE) Results are not so clear that for (IPCE). Indeed all agents should not face this kind of expenditure. University is still very important, even after correction of the fact that the interrogated person may have not finish its study yet. Neither human capital nor the number of children are significant. The explained variable is very correlated to the marginal

| Model | (1) | (2) | (3) | (4) | (5) | (6) |
|-------------------|---------------|---------------|---------------|----------------|-----------------|-----------------|
| Method | OLS | OLS | OLS | OLS | OLS | IV |
| Explained var. | IPCE | IPCE | IPCE | IPCE | IPCE | IPCE |
| Schooling | 0.71 (2.3) | - | - | - | - | - |
| Income | - | - | - | 0.025 (3.5) | 0.0028 (3.6) | - |
| Income _ res | - | - | - | - | - | 0.0027 (3.2) |
| Human capital (h) | - | - | 2.38 (2.9) | - | 1.05 (1.2) | 2.39 (2.9) |
| $e^{\alpha S}$ | - | 4.68 (1.9) | - | - | - | - |
| E^δ | - | 5.64 (2.2) | - | - | - | - |
| University | 16.6 (5.7) | 16.2 (5.2) | 16.7 (5.7) | 19.0 (7.5) | 17.2 (5.8) | 16.7 (5.6) |
| Executive | 15.9 (3.7) | 14.8 (3.2) | 14.5 (3.1) | 12.2 (2.6) | 13.0 (2.7) | 15.4 (3.2) |
| Intercept | 21.2 (5.9) | 10.6 (1.6) | 21.5 (7.3) | 27.0 (21.0) | 23.0 (7.7) | 21.0 (7.0) |
| N | 1044 | 1002 | 1002 | 1046 | 957 | 923 |
| R^2 | 0.095 | 0.102 | 0.103 | 0.105 | 0.120 | 0.121 |

Table 11: Education and indirect propensity to invest in public education

savings rate. We then regress this variable on others instruments and we use the residual to better the regression. This indicator appears to be more uncertain. Interrogated people explain themselves this phenomenon by noting that an additional effort in the public area is more efficient because all households should contribute in this case. Agents take into account fiscal externalities. The threshold effect at the university level remains very strong, about 13% of the private marginal expenditure.

We can also consider the current propensity to invest in private education using the declaration of the interrogated people about their actual expenditure for their children's education. Many households (44.8%) do not invest in private education, mostly because interrogated agent do not have any child. For agents who have at least one child and who have invested a non null amount of money in their

| Model | (1) | (2) | (3) | (4) |
|-----------------|----------------|---------------|----------------|----------------|
| Method | OLS | IV | IV | IV |
| Explained var. | IMPRES | IMPRES | IMPRES | IMPRES |
| University | 9.90 (4.7) | 13.0 (5.4) | 12.8 (5.5) | 13.0 (5.4) |
| Current studies | 5.44 (2.8) | - | - | - |
| Cur. stud. res. | - | 4.78 (2.1) | 5.59 (2.5) | 5.16 (2.3) |
| Savings | - | - | -0.22 (8.5) | - |
| Savings res. | - | - | - | -0.22 (8.2) |
| Intercept | 23.8 (10.5) | 28.6 (4.1) | 31.1 (4.6) | 26.5 (3.9) |
| N | 1140 | 1061 | 1061 | 1022 |
| R^2 | 0.062 | 0.063 | 0.122 | 0.123 |

Table 12: Education and marginal propensity to invest in private education

child's education, the minimal expenditure for each child is 10 monetary unit. By convention, we consider that every household have spent this minimal amount of money for each child, in order to use the logarithm of the private expenditure. All variables remain significant with other choice of this bottom investment. We define the actual propensity to invest in private education (APRE) as the sum for all children of the average yearly educational expenditure by child. Private education is very well explained by income and human capital. Although the impact of income appears to be decreasing, there is still a threshold in the investment function linked to the university level. Therefore the private educational investment function may also support the existence of a development trap in Peru.

5 Concluding remarks

The EVEP data set enable to bring to light to interesting properties about human capital accumulation in Peru. First, human capital accumulation process can be

| Model | (1) | (2) |
|-----------------|----------------|----------------|
| Method | OLS | OLS |
| Explained var. | $\ln(AMPRE)$ | $\ln(AMPRE)$ |
| $\ln(Income)$ | 0.42 (8.5) | 0.36 (8.2) |
| $\ln(Children)$ | 0.89 (13.3) | 0.88 (14.2) |
| Schooling | 0.038 (3.8) | <i>ns</i> |
| University | — | 0.67 (6.7) |
| Intercept | -0.26 (0.4) | 0.36 (1.2) |
| N | 601 | 632 |
| R^2 | 0.30 | 0.34 |

Table 13: Education and actual propensity to invest in private education

apprehended through the traditional geometric equation, like the in Glomm and Ravikumar. Second, the investment behavior appears to be heterogeneous and depends of the level of human capital. The relation between education investment and parental education appears to be discontinuous. This property may support the existence of several stationary distributions and then of a development trap.

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