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THE BUSINESS CYCLE HUMAN CAPITAL ACCUMULATION NEXUS AND ITS EFFECT ON LABOR SUPPLY VOLATILITY

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The business cycle human capital accumulation nexus and its effect on labor supply volatility

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Abstract

This paper studies the cyclicality of human capital accumulation by using a lifecycle RBC model with two types of heterogeneity: age and productivity in learning. Results show that individuals invest more in human capital during economic downturns. In particular, schooling acts as a buffer sector and allows agents to compensate for the shock by accumulating more human capital. However, human capital accumulation is more countercyclical for young and low-productivity individuals because they face lower opportunity costs of education and a higher marginal product of human capital. These results are confirmed empirically using US data from the Current Population Survey.

KEYWORDS: human capital accumulation, business cycles, labor supply.

JEL CLASSIFICATION: J24, E32, J22

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1 Introduction

Among US high-school students age 16 to 24 who graduated in 2009, 70.1% enrolled in college in October 2009. This is the historical high for college enrollment rate since 1959. At the same time, unemployment rate has reached the level of 10% in October 2009 which is also the maximum level for unemployment in the recent financial crisis[1]. This seems to be consistent with several studies in the literature regarding the cyclicality of schooling decisions. Enrollment in post-secondary education (PSE), in fact, is mainly affected by opportunity costs and financial costs of education. These, in turn, are affected by business cycle fluctuations. On one hand, during a recession high unemployment decreases opportunity costs of education and people substitute work for school. On the other hand, family income is lower and students may not be able to afford costs of education (Christian, 2007). If liquidity constraints are not too tight, the first effect dominates and enrollment is countercyclical. This is more likely to happen in OECD countries compared to non-OECD countries (Sakellaris and Spilimbergo, 2000).

From a theoretical point of view, several macroeconomic models have been developed to study the countercyclicality of human capital accumulation. Canton (2002), for example, used a discrete time stochastic version of the endogenous growth model developed by Lucas (1988) and Uzawa (1965). He showed that uncertainty leads agents to accumulate more human capital to compensate for future income losses. DeJong and Ingram (2001) instead, developed a Real Business Cycle (RBC) model with skill acquisition. In the presence of a positive TFP shock, in particular, human capital is more expensive than physical capital. Thus agents decrease study hours and accumulate less human capital. Within an overlapping generations framework, instead, Heylen and Pozzi (2007) proved that the optimal amount of education depends negatively on the ratio between current and future real wage. Since this ratio is more likely to decrease during recessions, investment in education is countercyclical.

Empirically, the results are more controversial. Mattila (1982), Polzin (1984), Kane (1994), Edwards (1976) Christian (2007) found no impact of business cycles on enrollment decisions. Betts and McFarland (1995), Dellas and Sakellaris (2003), and Dellas and Koubi (2003) found evidence in favor of countercyclicality. Finally, Sakellaris and Spilimbergo (2000) found a positive relationship between GDP

[1] Source: US Bureau of Labor Statistics.

growth and enrollment rates in non-OECD countries, and a negative relationship in OECD countries.

The cyclicality of schooling decisions has received particular attention in the literature because of its interesting implications. Economic downturns are bad for the economy. However, if enrollment rates are countercyclical, then crises are also the most efficient time to accumulate human capital and produce more skilled workers. This paper, in particular, further investigates the relationship between crises and human capital accumulation by looking at heterogeneity among agents. The main result is that crises impact different types of agents in different ways: young and low-productivity individuals are more likely to enroll in PSE. This is because it is cheaper for them to leave the labor market and go to school. In contrast, high-productivity agents and old people with work experience earn higher wages and are less likely to leave the market.

The countercyclicality of human capital accumulation has also important implications regarding the volatility puzzle in RBC models. One of the main shortcomings of these models, in fact, is the inability to predict labor supply volatility, which is lower than the empirical estimates. Several solutions have been proposed in the literature, including the introduction of indivisible labor (Hansen, 1985) or alternatives to market production (e.g. home production and education). These solutions assume that the RBC model systematically underestimates the volatility by excluding important factors that influence labor supply.

Recent papers (e.g. Hansen and İmrohoroğlu 2009; Gomme, Rogerson, Rupert, and Wright 2004), instead, have looked at the volatility puzzle from a different perspective. In particular, the RBC model may underestimate the volatility only for certain groups of individuals. In the data, for example, labor supply is more volatile for young compared to middle-age individuals. This fact cannot be captured by the baseline RBC model because of the representative-agent assumption. Therefore, introducing heterogeneity in the model may help to explain the volatility puzzle. This paper further investigates the topic by looking at human capital accumulation through formal education and heterogeneity among agents. In particular, the model is presented in Section 2. Section 3 presents the theoretical results and the implications about labor supply volatility. These results are tested empirically in Section 4 by using US data. Finally, Section 5 concludes.

2 The Model

Every year a new generation of equal size is born. Agents face an uncertain life span and may live for a maximum of 60 periods. In each period, they are endowed with one unit of time they can allocate among leisure, work and education. Individuals can work and study at the same time during their working life. Conditional on survival, they must retire at age 41. During retirement, labor supply and education are absent and the time endowment is completely allocated to leisure. In any period, there are two types of capital: physical and human capital. Physical capital is accumulated during life through investment, while the human capital stock increases by allocating time to education. Agents start their life with no physical capital and leave no bequests at the end of their life. The initial human capital stock, instead, is positive. This is due to the fact that period 1 in the model represents the 20-year-old cohort in reality. Therefore, the positive initial human capital stock captures the amount of human capital accumulated during mandatory education.

At the beginning of their life, agents maximize their expected lifetime utility:

$$\Sigma_{s=1}^{60}\left(\Pi_{j=0}^{s-1}\varphi_j\right)\beta^{s-1}\left[\frac{\left(c_{t+s-1,s}l_{t+s-1,s}^{\gamma}\right)^{1-\eta}}{1-\eta}\right],$$

by choosing consumption, investment in human and physical capital, and time spent working and studying. The subscripts t and s refer to time period and age, respectively. Further, E is the expectation operator, φ_j is the probability of surviving from age j to age $j+1$, β is the discount factor, c is consumption, l is leisure, γ is the disutility of non-leisure activities (i.e. working and studying), and η is the coefficient of relative risk aversion.

The cohort shares, θ_s, are constant over time and are determined by the survival probabilities $\left\{\varphi_j\right\}_{j=1}^{60}$: $\theta_s = \varphi_{s-1}\theta_{s-1}\,(s = 2,..,60)$ and $\theta_1 = 1-\Sigma_{s=2}^{60}\theta_s$, such that the sum of the shares is equal to one.

During the working period, the sources of income are labor and asset wealth accumulated from investment in physical capital. Labor income, in turn, depends on efficiency units of labor $n_{t,s}h_{t,s}$. In the retirement period agents receive a public pension and interest on the investment in physical capital. Therefore, the budget constraints are given by the following equations:

$$
\begin{aligned}
k_{t+1,s+1} &= (1+r_t-\delta)k_{t,s}+(1-\tau)w_t n_{t,s}h_{t,s}-c_{t,s} && \text{for s} = 1,..40, \\
k_{t+1,s+1} &= (1+r_t-\delta)k_{t,s}+b-c_{t,s} && \text{for s} = 41,..59, \\
c_{t,s} &= (1+r_t-\delta)k_{t,s}+b && \text{for s} = 60,
\end{aligned}
$$

where k is physical capital, h is human capital, n is labor supply, r is the rental rate of physical capital, δ is the physical capital depreciation rate, w is the wage rate, τ is the tax on labor income and b is the annual public pension benefit level.

Within the same cohort, agents are heterogeneous because of different levels of productivity in learning: high and low. High types are more productive in learning compared to low types. Therefore, they can accumulate more human capital given the same amount of time spent in education. In particular, human capital accumulation follows:

$$
h^i_{t+1,s+1} = (1-\delta_h)h^i_{t,s} + \Omega^i_s h^i_{t,s} {}^{i}e^{\phi_i}_{t,s},
$$

where $i = \{high, low\}$. The parameter ϕ_i determines how many units of time spent in education effectively contribute to human capital accumulation. This is to capture the quality of education (e.g. number of books in the university library, the student/teacher ratio and the number of laboratories in the university). This parameter depends on i because high types are more able to take advantage (in terms of human capital accumulation) of the quality of education compared to low types. Therefore, $\phi^{high} > \phi^{low}$. Further, δ_h is the depreciation rate of human capital and Ω^i_s refers to the productivity in learning which depends on age s. In particular, the productivity in learning declines as the agent becomes older because of the negative impact of aging on learning abilities. Further, as already mentioned, $\Omega^{high}_s > \Omega^{low}_s$ for any s.

Although Ω^i_s refers to the productivity in learning, it also affects the productivity in working. This is given by the fact that a higher productivity in learning implies more human capital accumulated in the next period, which determines the efficiency at work. Therefore, high types are more productive in both learning and working compared to low types.

In this model, individuals acquire human capital through education only. Therefore, the model does not account for learning by doing and on-the-job training. Moreover, since education does not affect utility, agents invest in education only to increase their human capital stock and earn a higher labor income. For this reason, in the retirement period there is no incentive to spend time in education and accumulate human capital, which progressively depreciates as the agent becomes older.

The production sector is given by competitive firms that produce output using efficiency units of labor L_t and physical capital K_t. The production function for the representative firm is Cobb-Douglas:

$$Y_t = Z_t K_t^{\alpha} L_t^{1-\alpha} ,$$

where Z_t is the aggregate technology level which follows an AR(1) process: $ln(Z_t) = \rho ln(Z_{t-1}) + \varepsilon_t$ with $\varepsilon_t \sim N(0, \sigma^2)$. In equilibrium, the prices of the production factors are equal to the marginal products:

$$w_t = (1-\alpha) Z_t K_t^{\alpha} L_t^{-\alpha},$$

$$r_t = \alpha Z_t K_t^{\alpha-1} L_t^{1-\alpha},$$

where α is the physical capital share of output.

Finally, the government collects labor income taxes, τ_t, from the workers and provides public pensions, b, to the retired agents using a pay-as-you-go system. Public expenditure must be completely financed by tax revenue in every period, therefore the budget balanced constraint for the government is given by:

$$\tau w_t L_t = b\xi,$$

where ξ is the fraction of the population receiving pension benefits at each date.

2.1 The equilibrium

Given the government policy b and τ_t, the initial physical and human capital stocks distributions, and the productivity sequence Ω_s^i, the equilibrium is a collection of policy rules for each ability type i, $c_s^i(k_{s,t}^i, h_{s,t}^i, K_t, L_t)$, $n_s^i(k_{s,t}^i, h_{s,t}^i, K_t, L_t)$, $e_s^i(k_{s,t}^i, h_{s,t}^i, K_t, L_t)$, $h_{s+1}^i(k_{s,t}^i, h_{s,t}^i, K_t, L_t)$ and $k_{s+1}^i(k_{s,t}^i, h_{s,t}^i, K_t, L_t)$, and the prices of production factors $\{w_t, r_t\}$ such that:

1. The individual policy rules solve the household's maximization problem.

2. Prices $\{w_t, r_t\}$ solve the representative form's maximization problem.

3. The government balanced-budget constraint is satisfied.

4. The market-clearing condition is satisfied:

$$Z_t K_t^{\alpha} L_t^{1-\alpha} = C_t + K_{t+1} - (1-\delta)K_t.$$

5. Individual decisions are consistent with aggregate outcomes:

$$L_t = \sum_{s=1}^{60} \left(n_{s,t}^{high} \times h_{s,t}^{high} + n_{s,t}^{low} \times h_{s,t}^{low} \right) \theta_s,$$

$$K_t = \sum_{s=1}^{60} \left(k_{s,t}^{high} + k_{s,t}^{low} \right) \theta_s.$$

2.2 Calibration

The calibration is consistent with the standard practice in the RBC literature. In particular, one model period corresponds to one year in reality. Table A1 in the Appendix reports the calibrated values. The capital share of output, α, is chosen such that the annual interest rate is 12% and the average physical capital to output ratio is 3. The depreciation rate of physical capital is set to 6%. The discount factor is determined by the Euler Equation for physical capital. The disutility of non-leisure activities, γ, is chosen to target the average time spent working to 0.33. The tax rate, τ, is calibrated based on a replacement ratio of 45%. The parameters for the Solow residual are chosen to be ρ =0.814 and σ =0.0142. These parameters are equivalent to the values estimated by Prescott (1986) for quarterly frequencies[2]. Finally, three values are considered for the coefficient of relative risk aversion η: 1.1, 1.5 and 2 . The results presented in the paper are based on $\eta = 1.1$ The Appendix reports the complete results.

Regarding the human capital accumulation function, three parameters must be calibrated: the depreciation rate of human capital δ_h, the parameter ϕ_i, and the productivity sequence Ω_s^i. There is no agreement

[2]See Heer and Maussner (2009), page 549.

in the literature about the depreciation of human capital. Estimates varies from 0.5% to 12%[3]. For this reason, we consider three values: 1%, 4% and 10%. The results and graphs presented in Section 2 and 3 are based on $\delta_h = 1\%$. Section 3.3 reports the comparison with the other two values. The parameter ϕ_i, instead, is calibrated using the first order condition with respect to time spent in education and the Euler equation for human capital. This combination gives $\phi_i = \left(\frac{1}{\beta} - 1\right)\frac{e_i^*}{n_i^* \delta_h}$, where $\frac{e_i^*}{n_i^*}$ is the ratio between the time spent in education and the time spent working averaged across all ages. Both e_i^* and n_i^* are calibrated using data from the "American Time Use survey" (ATU) 2003-2010[4]. In particular, e_i^* is the average time spent for taking classes, doing homework and research. n_i^* is the average time spent for working and work-related activities[5]. Empirically, low types are defined as those individuals who has a high school diploma or a lower schooling level, while high types are those enrolled in or graduated from any post-secondary education program[6]. The calibrated ratio is equal to 0.0147 for low types and 0.0395 for high types. This implies:

δ_h	ϕ^{high}	ϕ^{low}
1%	0.2368	0.0883
4%	0.0592	0.0221
10%	0.0237	0.0088

The productivity sequence is calibrated using the human capital accumulation function:

$$\Omega_s^i = \frac{h_{s+1}^{i*} - (1-\delta_h)h_s^{i*}}{h_s^{i*} e_s^{i*\phi_i}},$$

where e_s^{i*} is the average time spent studying for each age s and it is computed using annual data from ATU. The efficiency weights h_s^{i*}, instead, are calibrated following the methodology proposed by Hansen (1993) and using annual data from the "Current Population Survey, March Supplement" (1964-2010)[7].

[3]Depending on the schooling level, the estimates of human capital depreciation varies within 4.6%-13.3% in Johnson (1970), 1%-3.4% in Johnson and Hebein (1974), 0.5%-4.3% in Haley (1976), 0.7%-4.7% in Heckman (1976).

[4]The survey started in 2003 so it is not possible to calibrate the parameters using a larger time period.

[5]This includes, for example, time spent for commuting, security procedures or lunch with clients.

[6]This includes individuals with some college but no degree and individuals with an associate degree, college degree, Bachelor's degree, Master's degree, professional school degree or Doctoral degree.

[7]Earlier data cannot be used because one of the main education variables is available starting from 1986 only.

In particular, the averages of e_s^{i*} and h_s^{i*} are first obtained for eight different age groups (20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59) and the two productivity types. These values are then interpolated to obtain one value for each single age and type. It is worth mentioning that Hansen (1993) did not distinguish between high and low types. His methodology produces one sequence of h_s^* for the whole economy. However, the procedure has been extended in order to include the two types which are empirically defined as before. Finally, the sequence for h_s^{i*} is also used to calibrate the initial levels of human capital for high and low types (i.e. h_1^{i*}).

Figure 1 shows the calibrated efficiency weights and the productivity sequences during the working life. In particular, the efficiency at work increases when agents are young, has a peak around the middle age and then it starts to decline. Further, at any age high types are more efficient at work than low types. The productivity in learning, instead, determines the human capital stock each agent can accumulate given the human capital stock previously acquired and the amount of time spent in education. Clearly, this depends on age. In particular, the productivity decreases as the agent becomes older because of the negative impact of aging on learning abilities. Further, the productivity is higher for high types than for low types independently of age. The difference is minimized around age 20, which corresponds to age 40 in reality. In fact, while the productivity for low types declines at an approximately constant rate, the productivity of high types declines faster early in life. This is due to the fact that starting from age 1, high types gradually enter the labor market and loose productivity in learning (which decreases if unused). Low types, instead, are already in the labor market. Therefore, there is no sharp decline for them.

2.3 Solution method

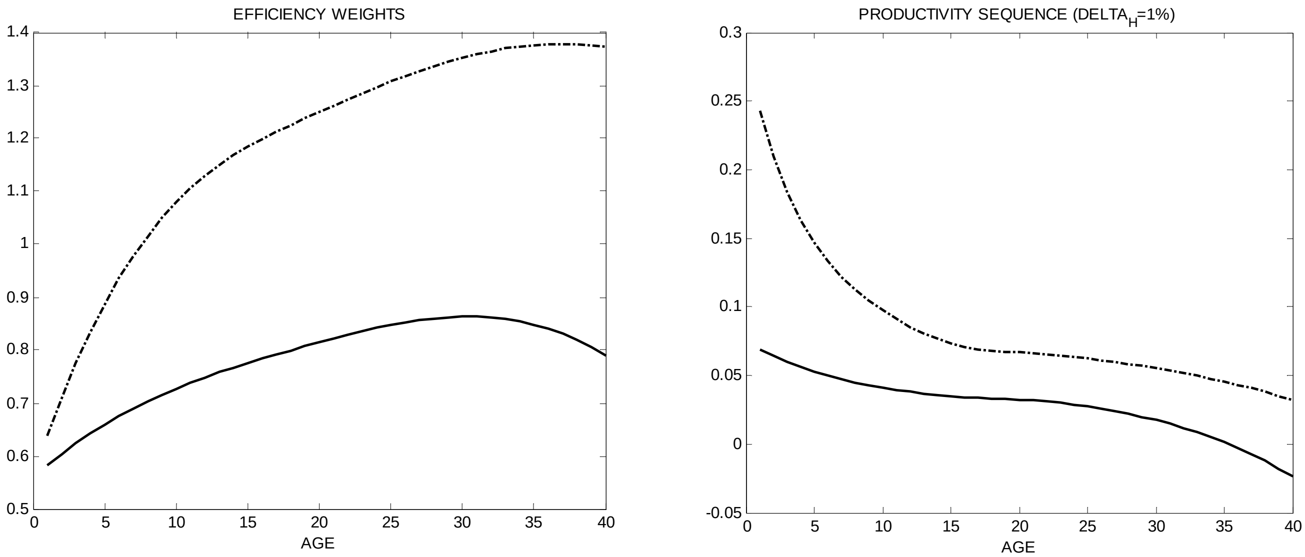
The non-stochastic steady state (i.e. $Z = 1$) in the 60-period Overlapping Generations model has been computed using a guess and verify method. The algorithm can be summarized as follows:

1. Guess the steady-state aggregate values for labor in efficiency units and physical capital.

2. Compute the factor prices w and r , and the tax rate τ .

3. Solve the household maximization problem for the two types separately by using backward induction.

Figure 1: Calibrated efficiency weights and productivity sequences during the working life



The dashed line represents the high type, while the solid line represents the low type.

4. Compute the aggregate values for labor in efficiency units L and physical capital K .

5. Update the initial guesses if they are different from the computed aggregate values in step 4. Repeat from step 2 until convergence.

In order to analyze the effect of business cycles on human capital accumulation, a negative technology shock has been introduced in the model. The transitional dynamics are computed by log-linearizing the first order conditions around the non-stochastic steady state. The impulse response functions are then obtained to describe the dynamics that lead the economy to the steady state after the shock. The results are discussed in the next section.

3 Results

The non-stochastic steady state is described in Table 1. Figure 2, instead, shows the steady-state levels for the main variables by age and productivity type. Since high types are very productive in learning, in the steady state they spend more time in education and accumulate more human capital. Further, at the beginning of their life, they work less and borrow more physical capital to "finance" education. Although there are no direct monetary costs for education, in order to study the agent must spend less time working

Table 1: Steady-state aggregate values ($\delta_h = 1\%$)

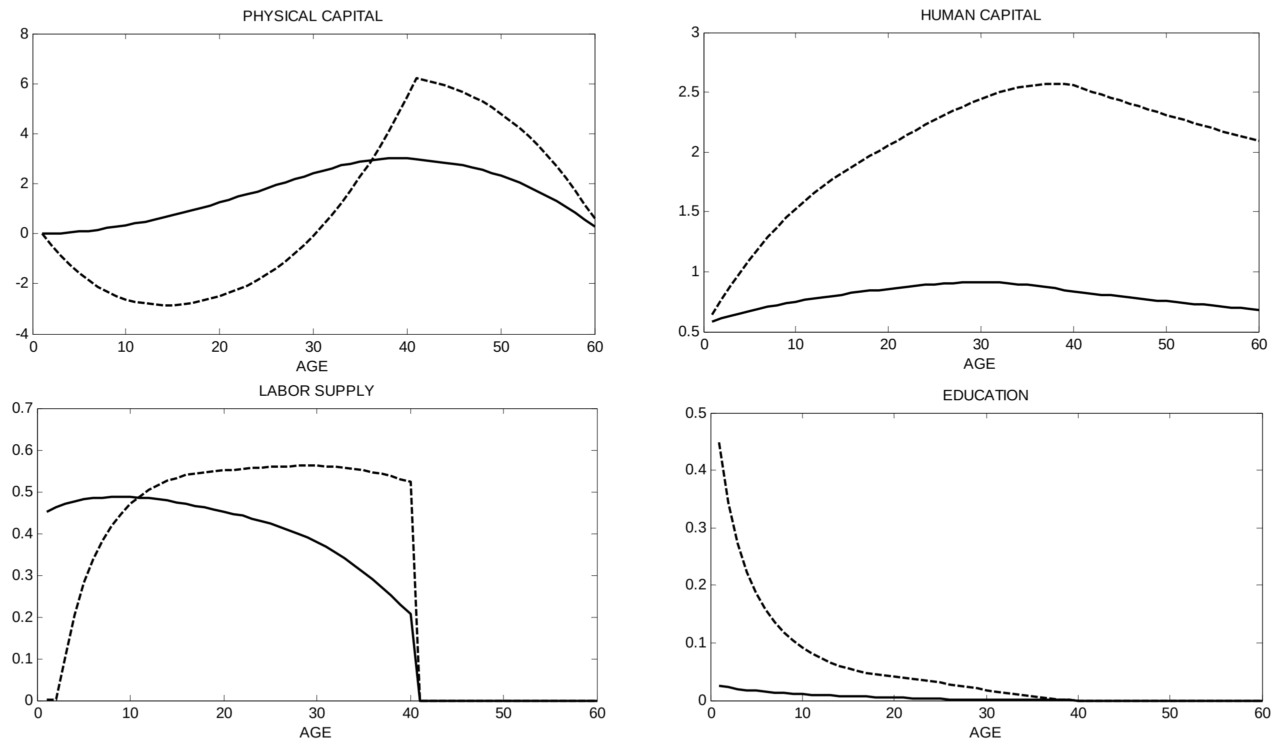
Aggregate values:	L^*	K^*	Y^*	w^*	r^*	b	τ^*
	0.47	1.13	0.65	0.87	0.15	0.15	0.08

Household problem:	$N*$	$K*$	$H*$	$E*$
high type	0.34	0.67	2.04	0.055
low type	0.31	1.6	0.80	0.005

and forgo part of her labor income. Therefore, the young high-type borrows physical capital to smooth consumption over time. Around age 20, the time spent studying is significantly reduced and the agent starts to invest in physical capital.

In order to analyze how agents' decisions are affected by business cycles, a negative one-standard deviation technology shock has been introduced in the model. Figure 3 shows the impulse responses for the aggregate economy. The graphs represent the percent deviation of each variable from the steady state after the shock. The curves show that physical capital, investment, consumption and hours worked are procyclical. Time spent in education and human capital accumulation, instead, are countercyclical. In particular, when the economy is hit by a negative technology shock, the marginal product of labor and physical capital decrease. Thus, both wage and rental rate of physical capital drop. Agents invest less in physical capital and reduce hours worked. Output and consumption decrease. Further, individuals invest more in education to accumulate more human capital and compensate for the reduction in labor income due to the wage contraction. This is manly due to the decrease in opportunity costs of education. During a crisis, in fact, the decrease in the wage rate reduces the opportunity cost of education, which becomes more attractive compared to labor. Individuals substitute time spent working for time spent studying. As a consequence, human capital accumulation increases in contrast with the decrease in physical capital accumulation. Agents substitute physical capital for human capital because the shock reduces the rate of return to physical capital investments compared to the rate of return to human capital investments. This implies that the education sector acts as a buffer sector. In particular, it allows agents to compensate for the reduction in labor income by increasing the human capital stock. However, as human capital increases, its marginal product decreases. Therefore, after approximately ten periods agents start to substitute back human capital for physical capital and the economy starts to converge to the original

Figure 2: Steady-state values by age and type ($\delta_h = 1\%$)



The dashed line represents the high type, while the solid line represents the low type.

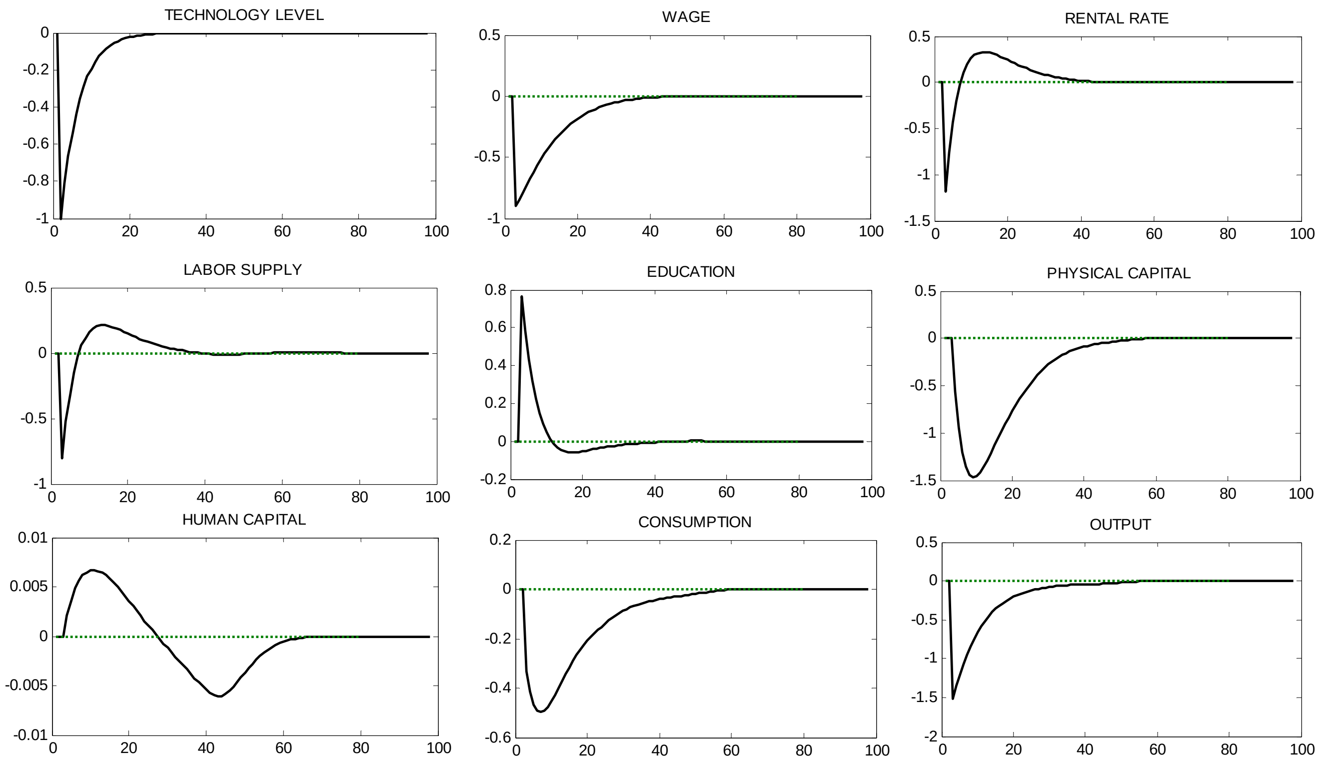
steady state.

3.1 Differences by ability type and age

Figure 4 shows the impulse responses for education and human capital by productivity type and age group. The first two graphs at the top show the behavior of the average high and low type. Time spent in education and human capital accumulation are more countercyclical for low types rather than high types. This is due to the fact that high-productivity agents have already accumulated a high amount of human capital before the crisis. They are more efficient at work and they earn a higher labor income. Therefore, it is more expensive for them to reduce hours worked and forgo labor income in order to study and accumulate more human capital. Further, the marginal product of human capital is lower for high types. Thus, they benefit less by substituting physical for human capital.

The two graphs at the bottom show the impulse responses for two age groups: 1-10 and 11-39 years of age. In particular, compared to young agents, older types (age group 11-39) increase education by a lower

Figure 3: Impulse responses for the aggregate economy ($\delta_h = 1\%$)

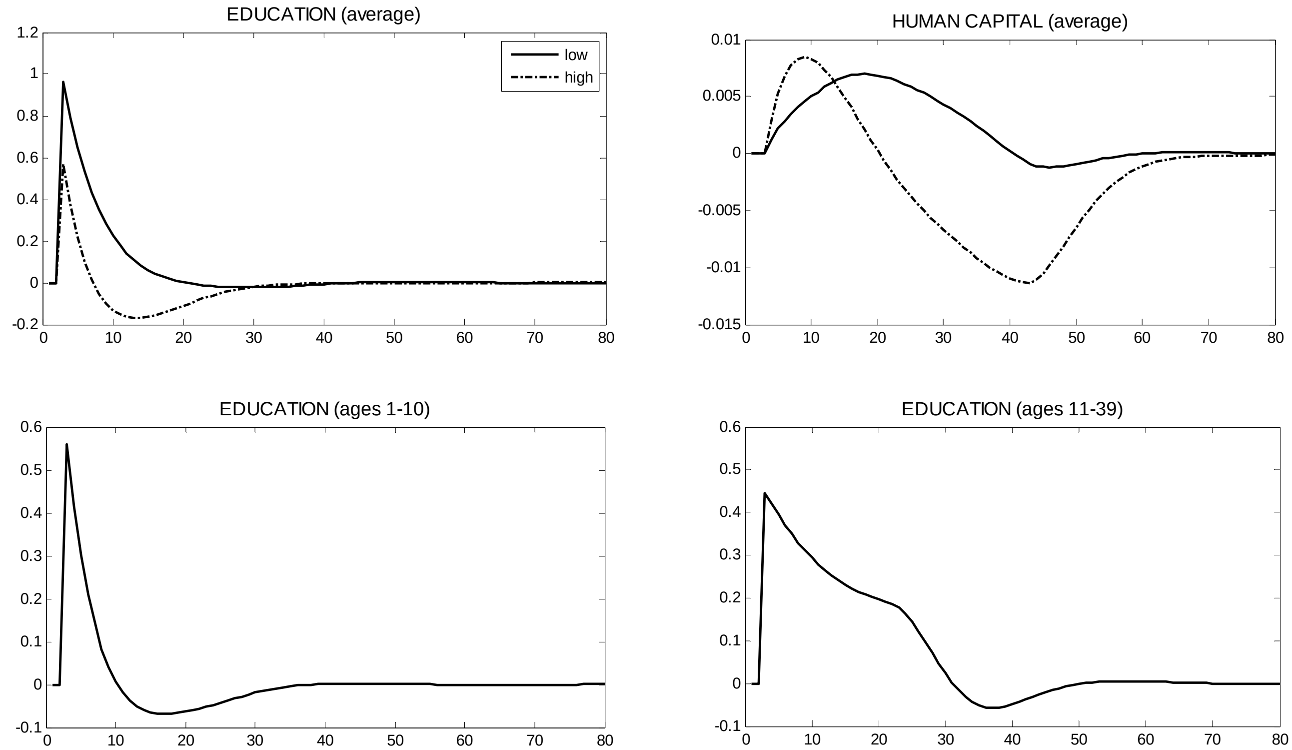


The x-axis represents the number of periods after the shock. The y-axis indicates the percent deviation from the steady state for each variable.

amount immediately after the shock but the deviation remains positive for a longer period of time. This is due to the productivity profile. Firstly, they have accumulated a higher steady-state human capital stock during their working life. Thus, they are more productive at work and less willing to reduce hours worked and accumulate extra human capital. Secondly, the productivity of young agents declines faster early in life. Therefore, young individuals take advantage of the education sector when it is more efficient to do so, that is immediately after the shock before the productivity declines quickly. The productivity of old types, instead, will decline slowly. Therefore, education takes more time to converge to its steady-state level for old agents.

These results are consistent with what can be observed in reality. During a crisis, labor market conditions are worse: it is harder to find a job or receive a high labor income. However, certain categories of individuals are more affected than others. In particular, young and low-productivity individuals face even harder labor market conditions. Young people do not have experience in the labor market yet. Low types are less efficient at work than high types because of the lower human capital stock. Therefore, when

Figure 4: Impulse responses by ability type and age group ($\delta_h = 1\%$)



The x-axis represents the number of periods after the shock. The y-axis indicates the percent deviation from the steady state for each variable. The dashed line represents the high type, while the solid line represents the low type.

the crisis hits the economy, these categories benefit more from the education sector and the substitution between physical and human capital.

3.2 Implications for labor supply volatility

Table 2 shows the business cycle statistics computed from 500 simulations of the model along with statistics from US data. The data about labor supply are from CPS, March Supplement (1964-2010). Hours worked are obtained using the answer to the question "How many hours did you actually work last week?". A proxy for education is obtained using enrollment rates in 2-year and 4-year colleges[8] published by the National Center for Education Statistics. Data for output, consumption and investment are from US Bureau of Economic Analysis. Output is measured by real GDP from 1964 to 2010. Both the actual and the simulated series are transformed by taking natural logarithms and detrended using the

[8]Enrollment is computed as a percent of all 18- to 24-year-olds.

Table 2: Real business cycle statistics

X	σ_X			$\frac{\sigma_X}{\sigma_Y}$			$corr(X,Y)$		
	Data	Model $\delta_h = 1\%$	Model NHC	Data	Model $\delta_h = 1\%$	Model NHC	Data	Model $\delta_h = 1\%$	Model NHC
Output	2.05	1.98	1.97	1	1	1	1	1	1
Consumption	1.90	0.49	0.65	0.93	0.25	0.33	0.91	0.84	0.92
Physical capital investment	8.77	18.48	13.02	4.28	9.34	6.62	0.86	0.95	0.98
Labor supply	1.68	1.20	1.08	0.82	0.60	0.55	0.86	0.94	0.98
Education	2.46	1.14	-	1.20	0.58	-	-0.26	-0.96	-
Labor supply low type	2.36	1.64	-	1.10	0.83	-	0.87	0.97	-
Labor supply high type	1.20	0.64	-	0.59	0.32	-	0.77	0.77	-
Labor supply (15-19)	4.67	-	-	2.28	-	-	0.74	-	-
Labor supply (20-24)	2.96	1.63	0.74	1.44	0.82	0.37	0.82	0.94	0.97
Labor supply (25-34)	1.98	0.72	0.87	0.97	0.36	0.44	0.86	0.92	0.96
Labor supply (35-44)	1.43	0.65	0.99	0.69	0.33	0.51	0.87	0.93	0.98
Labor supply (45-54)	1.32	0.80	1.23	0.65	0.40	0.62	0.88	0.94	0.98
Labor supply (55-60)	1.55	1.28	1.85	0.76	0.64	0.94	0.79	0.95	0.98
Labor supply (60+)	1.42	-	-	0.69	-	-	0.61	-	-

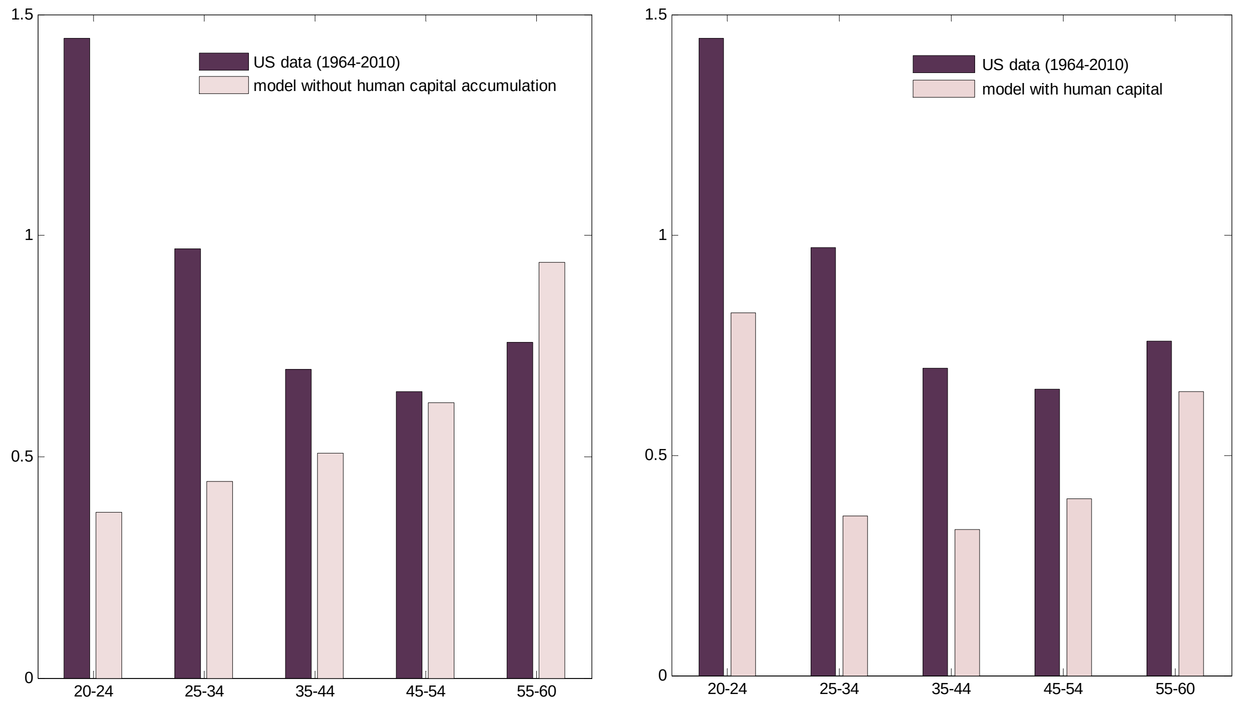
Model NHC refers to the model without human capital accumulation.
The model does not provide estimates regarding the labor supply of the first and last age group because the working period starts at age 20 and ends at age 60.

Hodrick-Prescott filter. The smoothing parameter is equal to 100.

The table compares RBC statistics from US data, the model with human capital ($\delta_h = 1\%$) and the baseline RBC model without human capital accumulation (model NHC). Regarding labor supply, the volatility of hours worked is underestimated by both RBC models. However, the model with human capital can explain a higher percentage of the volatility empirically estimated (73% against 67%). Further, the model with human capital is consistent with the data in predicting a higher volatility for low types compared to high types. During a crisis, in fact, low types are more likely to increase study hours and use the education sector as an alternative to work. Therefore, their labor supply volatility is higher compared to that of high-ability agents.

The introduction of human capital into the baseline RBC model has also some implication regarding the volatility profile. Figure 5 shows the volatility of hours worked (relative to output volatility) by age group. In the data and in the model with human capital the profile is U-shaped: labor supply is more

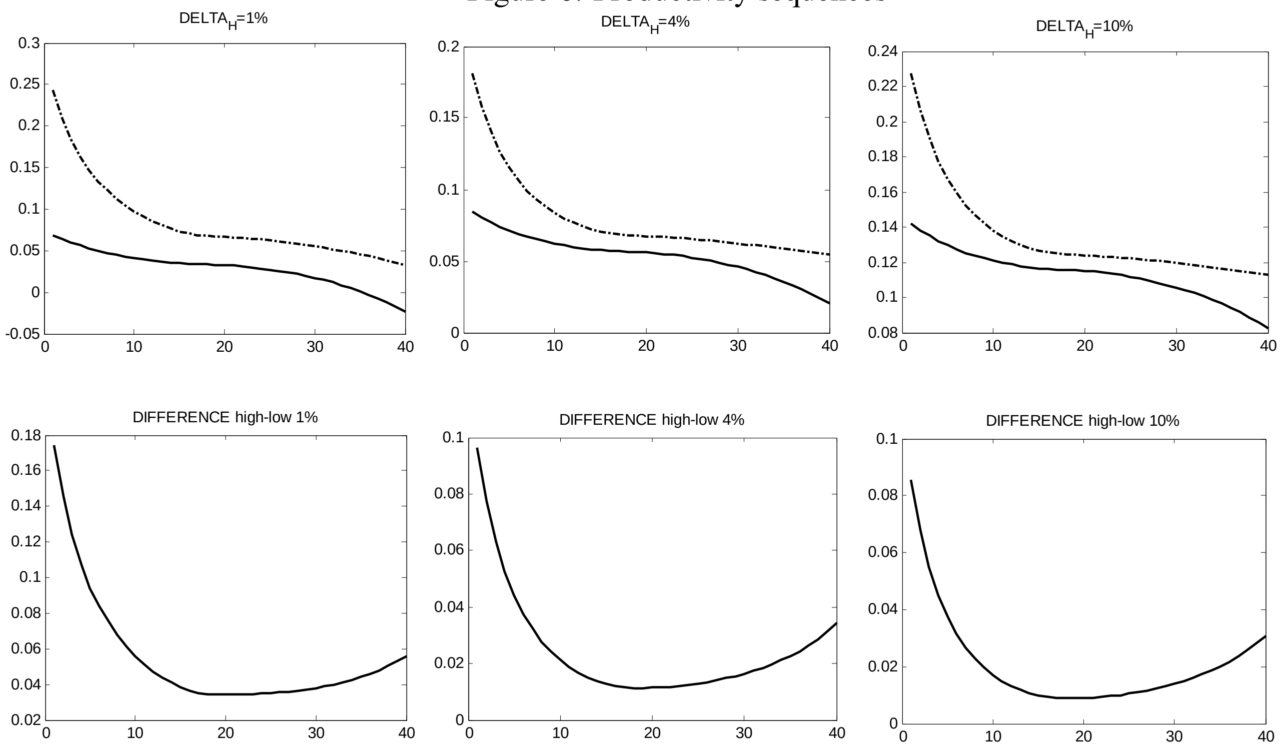
Figure 5: Labor supply volatility for the aggregate economy



The x-axis refers to the age group. The y-axis refers to the labor supply volatility.

volatile for young and old agents compared to middle-age agents. The baseline RBC model with human capital, instead, predicts an increasing volatility profile. Gomme, Rogerson, Rupert, and Wright (2004) showed that in the baseline RBC model with mandatory retirement labor supply volatility is increasing in age. Agents who are closer to retirement perceive the shock to be more transitory. Thus, the intertemporal substitution is higher and labor supply is more volatile. The introduction of the education sector, instead, has two effects. Firstly, it increases the average volatility because human capital accumulation provides an alternative to work. Secondly, it increases the volatility for young agents who are more productive in learning and benefit more from education. It also reduces that of older people who do not increase study hours as much as young individuals. This causes the volatility profile to assume a "U" shape. Therefore, introducing human capital into the baseline RBC model improves, both quantitatively and qualitatively, the predictions regarding the labor supply volatility.

Figure 6: Productivity sequences



The dashed line represents the high type, while the solid line represents the low type.

3.3 The importance of human capital depreciation

This section presents the results for different levels of human capital depreciation: $\delta_h = 4\%$ and 10%. Figure 6 shows the productivity sequences and Table 3 shows the steady-state aggregate values for the main variables. In particular, when human capital depreciates faster, the difference in the productivity between high and low types decreases significantly (especially for young agents). Since individuals are less productive in learning, in the steady state they spend less time in education, accumulate less human capital and invest less in physical capital because they earn a lower labor income.

Further, when human capital depreciates faster, the countercyclicality of education and human capital is reduced (Figure 7). Since high depreciation reduces the benefits from investing in knowledge, agents do not take advantage of the education sector during the crisis as much as they would do with a lower value of δ_h. The difference between low and high types is also reduced. Although education is still more countercyclical for low types than for high types, the difference between the impulse responses is lower. Further, human capital is more countercyclical for high types than low types. This is opposite to the result

Table 3: Steady-state aggregate values

Aggregate values:	L^*	K^*	Y^*	w^*	r^*	b	τ^*
$\delta_h = 1\%$	0.47	1.13	0.65	0.87	0.15	0.15	0.08
$\delta_h = 4\%$	0.35	0.89	0.49	0.90	0.14	0.12	0.08
$\delta_h = 10\%$	0.34	0.89	0.48	0.90	0.14	0.12	0.08

Household problem:	N_H*	N_L*	K_H*	K_L*	H_H*	H_L*	E_H*	E_L*
$\delta_h = 1\%$	0.34	0.31	0.67	1.6	2.04	0.80	0.055	0.005
$\delta_h = 4\%$	0.34	0.32	0.83	0.96	1.20	0.72	0.015	0.003
$\delta_h = 10\%$	0.34	0.32	0.85	0.92	1.04	0.66	0.01	0.003

in Section 3.1. With higher human capital depreciation, in fact, high-productivity agents accumulate less human capital in the steady state. Therefore, it is less expensive for them to give up labor income and increase study hours. This increases the incentive to use the education sector in order to react to the crisis.

Human capital depreciation has also an impact on the predictions regarding labor supply volatility. Table 4 reports the standard deviation of aggregate hours worked relative to output for the whole economy, high types and low types. The numbers in brackets show the percentage of the labor supply volatility that can be explained by the model. The model with low human capital depreciation can explain a higher percentage because education is more countercyclical in this case. As the human capital depreciation rate increases, the model predictions for the aggregate economy approach to the predictions from the baseline RBC model without human capital accumulation.

Figure 8 is consistent with these results. In particular, when depreciation is low, young agents are more likely to increase study hours and reduce hours worked. Therefore, their volatility is higher compared to the volatility produced by high levels of δ_h. As the human capital depreciation rate increases, the profile becomes more similar to the increasing volatility profile predicted by the model without human capital. This suggests that the introduction of human capital into the model provides an alternative to work and increases the volatility of hours worked. However, if human capital depreciates faster, the benefits from the education sector do not last long enough. As a result, the volatility predicted by the model with human capital is closer to the one predicted by the model without human capital. This effect is mainly visible on young types because they are more productive in learning and more likely to invest in education.

Figure 7: Impulse Responses for Education and Human Capital

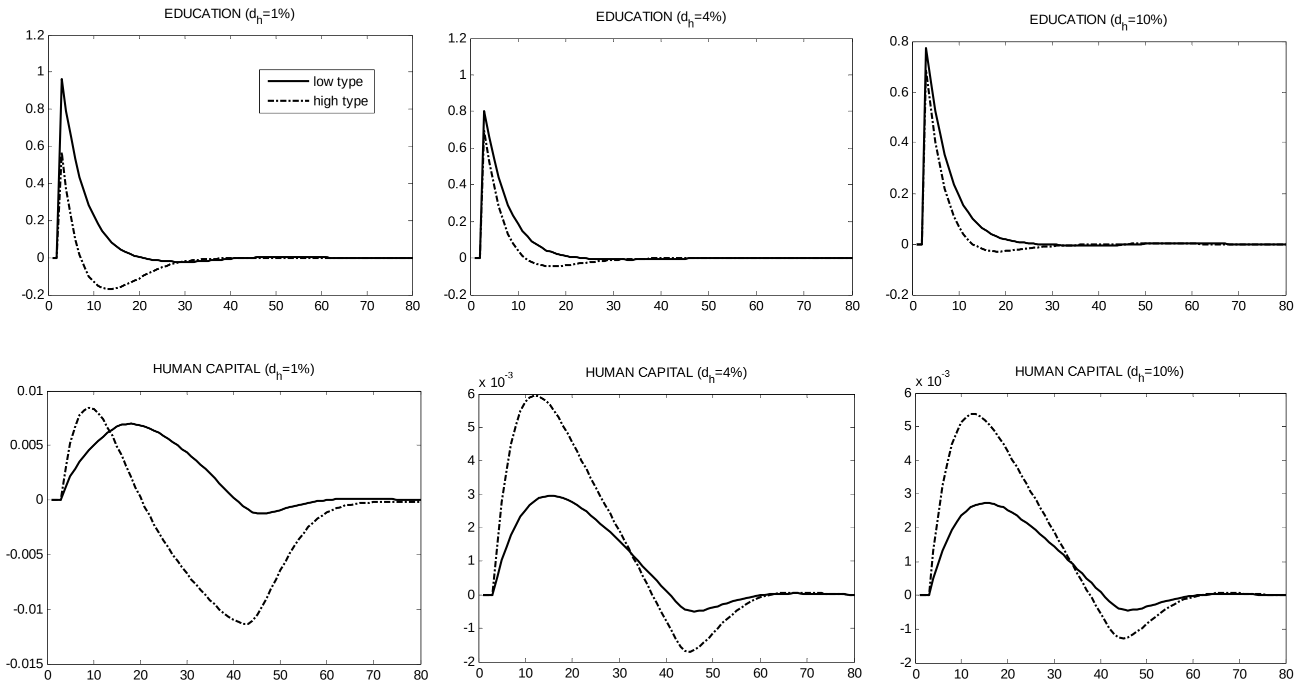


Figure 8: Labor supply volatility relative to output

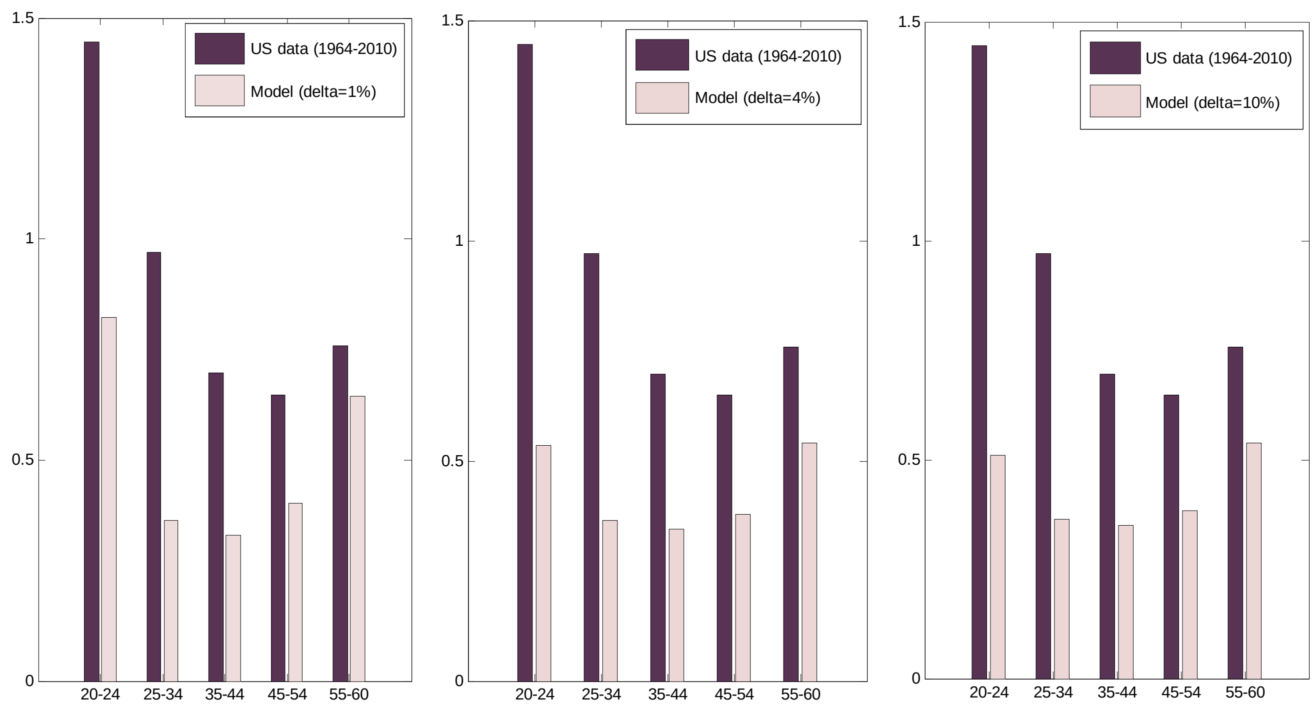


Table 4: Standard deviation of labor supply relative to output $\frac{\sigma_N}{\sigma_Y}$

	Aggregate economy	High types	Low types
$\delta_h = 1\%$	0.60 (73%)	0.32 (54%)	0.83 (75%)
$\delta_h = 4\%$	0.56 (68%)	0.47 (80%)	0.66 (59%)
$\delta_h = 10\%$	0.56 (68%)	0.48 (83%)	0.64 (58%)
NHC	0.55 (67%)	-	-

Note: NHC refers to the model without human capital.

4 Empirical Analysis

The theoretical results have been empirically tested using American data from the Current Population Survey, March Supplement (1986-2011)[9]. In particular, the sample includes 322,960 observations. Table A3 of the Appendix reports the mean of the main variables of interest.

As largely documented in the literature, enrollment rates in post-secondary education are affected by several factors: demographics, geography, family resources, parental education, tuition, college premium, nominal interest rate, inflation rate and national unemployment rate. The last variable, in particular, is considered to be a proxy for business cycle fluctuations. If there is a positive relationship between enrollment rates and unemployment, then enrollments in PSE are countercyclical.

Given the set of characteristics listed above, we estimate the probability of being enrolled using a probit regression:

$$Pr(enrolled_{it} = 1) = \Psi(constant + \alpha X + \beta U),$$

where $enrolled_{it}$ is a dummy variable equal one if individual i is enrolled at time t and zero otherwise, Ψ is the standard normal distribution function, X is the vector of specific characteristics and U is unemployment. A person is considered to be enrolled if she is attending a full-time or part-time program in a post-secondary institution. Table 5 reports the marginal effects from the probit estimation. Robust standard errors, corrected for clustering and stratification, are in parentheses[10]. The main variable of

[9]Questions regarding enrollment in post-secondary education are available in CPS starting from 1986 only.

[10]The information about clustering and stratification variables in CPS is not released to the public. Further, replicate weights are not available before 2005. Therefore, in order to correct the standard errors, we use proxies for clustering and stratification variables. In particular, we define the strata to be the state in which the individual lives. This is the smallest geographic unit that can be identified in CPS (public version). Households, instead, are used to identify clusters. As robustness check, we compare the standard errors from the estimation with replicate weights and the one with our proxies for clustering and stratification variables for the period 2005-2011. Results show that there is no significant difference in the estimated standard

interest is unemployment, which has a positive marginal effect. In particular, a one-percent increase in the unemployment rate increases the probability of being enrolled in PSE by 0.76%. This implies that enrollment rates are countercyclical, which is consistent with the theoretical results. Further, the estimated marginal effect is very close to the estimates computed by Dellas and Sakellaris (2003) and Dellas and Koubi (2003): 0.67% and 0.79%, respectively.

The impact of age on enrollment is positive but decreasing. Females have a higher probability to be enrolled than males, *ceteris paribus*. A single person is more likely to enroll in PSE compared to a non-single person. Family income and house ownership positively affect the probability of being enrolled; while family size decreases the likelihood of enrollment. If the head of the household is employed, the probability of college enrollment is higher. Schooling decisions are also affected by parental education. Note that the omitted category is represented by individuals whose parents completed at least one year at any PSE institution. The negative marginal effects imply that an individual is less likely to enroll in college if her/his parents did not go to college. Further, schooling decisions are more affected by father's education than mother's education. Regarding college premium, the marginal effect is positive and significant. A one-percent increase in the college premium increases the probability of being enrolled by 5.6%. This variable is computed by taking the log difference between earnings of high-school graduates and college graduates. Finally, a $1,000-increase in the amount received from the Federal Pell Grant Program[11] increases enrollment by 3.5%.

Some may be surprised by the positive effect of tuition on enrollment decisions. However, this variable has a double effect on enrollments. On one hand, higher tuition fees discourage enrollment because the cost of education is higher. On the other hand, tuition is positively related to the quality of education. Therefore, students may be willing to enroll in costly universities because they have a higher reputation. This is in accordance with the fact that over time enrollment rates in PSE have increased despite the increase in tuition.

In Table 6 we check the robustness of the results by including more control variables (i.e. quadratic

errors. See Davern, Jones, Lepkowski, Davidson, and Blewett (2006) and Davern, Jones, Lepkowski, Davidson, and Blewett (2007) for more details.

[11]This variable indicates the amount of money received from the Federal Pell Grant Program. Pell Grants are limited to college students with financial needs.

Table 5: Marginal effects from probit estimation

Dependent variable: college enrollment (=1 if enrolled in PSE, =0 otherwise)						
	WHOLE SAMPLE		HIGH TYPES		LOW TYPES	
Variable	dydx	Std.err.	dydx	Std.err.	dydx	Std.err.
Unemployment	0.0076***	(.002)	0.0015	(.003)	0.0121***	(.003)
Age	2.04***	(.019)	2.14***	(.037)	1.87***	(.022)
Age^2	-0.049***	(.0005)	-0.053***	(.0009)	-0.044***	(.0006)
Female	0.086***	(.003)	0.064***	(.004)	0.103***	(.004)
Single	0.041***	(.023)	0.048***	(.039)	0.037***	(.029)
Separated	0.068***	(.024)	0.047	(.044)	0.075**	(.031)
Divorced	0.151*	(.089)	-0.78	(.242)	0.19**	(.094)
Widowed	0.25***	(.016)	0.242	(.033)	0.254	(.018)
ln(family income)	0.013***	(.001)	0.018***	(.002)	0.011***	(.001)
ln(family size)	-0.048***	(.005)	-0.031***	(.008)	-0.064***	(.007)
House ownership	0.095***	(.005)	0.092***	(.010)	0.102***	(.006)
Head of HH employed	0.024***	(.004)	0.015**	(.007)	0.028***	(.005)
Metropolitan area	0.050***	(.004)	0.029***	(.006)	0.060***	(.005)
College premium	0.056**	(.019)	0.011	(.029)	0.079***	(.026)
Nominal interest rate	0.001	(.001)	-0.002	(.002)	0.002	(.002)
Inflation	0.007***	(.002)	.004*	(.003)	0.011***	(.002)
Tuition*1,000	0.018***	(0.01)	0.021**	(0.01)	0.017**	(0.01)
Pell Grant*1,000	0.035***	(0.00)	0.025***	(0.00)	0.045***	(0.00)
Mother's education:						
< high school diploma	-0.151***	(.005)	-	-	-0.145***	(.006)
= high school diploma	-0.092***	(.004)	-	-	-0.089***	(.005)
Father's education:						
< high school diploma	-0.174***	(.005)	-	-	-0.169***	(.005)
= high school diploma	-0.109***	(.004)	-	-	-0.109***	(.005)
Observations	322,960		112,488		210,440	
Pseudo R^2	.41		.45		.36	

The standard errors are reported in brackets. The stars indicate the significance level: * indicates 10-percent significance level , ** indicates 5-percent significance level, *** indicates 1-percent significance level.

The regression also includes ethnicity dummies, regional dummies and a linear time trend. There are no estimates for parental education in the "high types" group because the corresponding dummy variables are equal zero for this group. Family income, tuition and Pell Grants are in 2009 constant dollars.

Table 6: Robustness check (whole sample)

Dependent variable: College enrollment (=1 if enrolled in PSE, =0 otherwise)					
Marginal Effect Unemployment (Std. Error)	0.0076*** (0.002)	0.0029 (0.002)	0.0086*** (0.004)	0.0124*** (0.002)	0.0043* (0.002)
Linear Time Trend	✓	✓	✓	✓	✓
Quadratic Time Trend		✓	✓		
Cubic Time Trend			✓		
College Premium	✓	✓	✓		✓
Mean Weakly Earnings[1]				✓	
Nominal Int. Rate* Linear Trend					✓

1. Mean Weakly Earnings in non-agricultural sectors in 2009 constant dollars.

The stars indicate the significance level: * indicates 10-percent significance level , ** indicates 5-percent significance level, *** indicates 1-percent significance level. Each estimation also includes demographic variables, geographic variables, parental education, family resources, tuition and Pell Grant.

time trend, cubic time trend, interaction between nominal interest rate and time trend, mean weakly earnings in the non-agricultural sector). The full set of estimations is reported in Table A4 of the Appendix. In particular, enrollment in PSE is countercyclical in any model specification. The marginal effect for unemployment becomes insignificant only by including a quadratic time trend. However, this depends on the "high types" group as shown in Table A5 in the Appendix. In fact, the coefficient for unemployment is positive and significant for low types, while it is negative and non significant for high types. Therefore, the insignificance of the coefficient at the aggregate level is due to high-productivity agents.

Finally, the sample has been divided into two "productivity" groups in order to distinguish between high and low types. Parental education is used as proxy for the productivity in learning. In particular, high types are defined as those individuals whose parents studied at least one year at any post-secondary institution. Low types are those individuals whose parents have at most a high-school diploma. The results are presented in columns 2 and 3 of Table 5. In particular, a one-unit increase in unemployment increases the probability of being enrolled by 1.21% for low types. There is no significant effect, instead, among high types. This is consistent with the predictions of the theoretical model: the countercyclicality is stronger for low-productivity individuals. In Table 7 we check the robustness of these results by changing the criterion used to define high and low types. The first column reports the results using the original classification. In the second column, instead, high types are defined are those individuals whose parents have at least obtained a Bachelor's degree. In this case, the definition of low types is broader

Table 7: Robustness check (high and low types)

Dependent variable: college enrollment (=1 if enrolled in PSE, =0 otherwise)

	HIGH > high school diploma	LOW <= high school diploma	HIGH >= Bachelor's degree	LOW < Bachelor's degree	HIGH >= high school diploma	LOW < high school diploma
Unemployment	0.0015	0.0121***	0.0045	0.0095***	0.0046**	0.045***
	(0.003)	(0.002)	(0.004)	(0.002)	(0.002)	(0.011)
Observations	112,488	210,440	41,309	281,622	214,099	108,835

Each estimation includes the same variables as in Table 5. The stars indicate the significance level: * indicates 10-percent significance level , ** indicates 5-percent significance level, *** indicates 1-percent significance level.

than before. The new group of low types includes individuals who were considered high types before. Therefore, unemployment has a lower effect on low type's enrollment decisions. There is no change regarding high types: unemployment is still insignificant. In the third column, high types are defined as those individuals whose parents have at least obtained a high-school diploma. In this case, the definition of low types is stricter than before. The new group of low types is represented by extremely low ability individuals. Individuals with medium ability, instead, have been included in the group of high types. Therefore, the impact of unemployment is stronger for both low types and high types. Low types have now a really low level of productivity, therefore they have a greater incentive to enroll more in PSE during a crisis. The new group of high types now includes some of the individuals who were identified as low types before. This increases the coefficient for unemployment for them as well. Therefore, all changes in the results are consistent with the theoretical predictions from the model.

5 Conclusions

This paper shows that during an economic crisis the education sector helps the economy to react to the income reduction. The decrease in wages reduces the opportunity costs of education, while the decrease in the rental rate of physical capital decreases its marginal product. Therefore, agents invest more in human capital because it is cheaper (therefore more efficient) to do so. Education is less expensive and human capital is more attractive than physical capital. However, the magnitude of this effect depends on the depreciation rate of human capital. When depreciation is lower, the benefits from investing in knowledge are higher and the countercyclicality is stronger. This is especially true for young and low-productivity agents. In fact, since both are less productive at work, they are more likely to substitute work for schooling. These results are empirically confirmed using US data: a one-percent increase in the unemployment rate increases the probability of being enrolled by 0.76%. This marginal effect increases to 1.21% for low-productivity types, while it is not statistically different from zero for high types.

Regarding labor supply volatility, instead, the model cannot perfectly match the empirical evidence. However, it is able to predict a higher volatility for low types compared to high types, which is consistent with the data. Further, the model can produce a U-shaped volatility profile similar to the profile empirically estimated. However, these results are affected by the value chosen for the depreciation rate of human capital. In particular, the smaller the depreciation rate, the higher the ability of the model to match the empirical evidence regarding labor supply volatility.

Appendix

Table A1: Calibration

	parameter	calibrated value
Household maximization problem:	β	0.9434
	γ	1.92
	η	1.1
	δ	0.06
Production function:	α	0.36
Human capital accumulation function:	ϕ^{high}	0.2368
	ϕ^{low}	0.0883
	δ_h	0.01
	$h_{1,t}^{high}$	0.6386
	$h_{1,t}^{low}$	0.5832
Technology shock:	ρ	0.814
	σ	0.0142

Table A2: Data Sources

Variable	Source
Unemployment rate:	US Bureau of Labor Statistics
Interest rate:	World Bank
Inflation rate (calculated from CPI)	US Bureau of Labor Statistics
Tuition:	National Centre for Education Statistics
Other controls:	Current Population Survey

Table A3: Means of control variables

Variable	Whole sample	High types	Low types
Age	21.336	20.098	21.998
Female	0.460	0.471	0.455
Married	0.026	0.014	0.031
Separated/Divorced/Widowed	0.040	0.021	0.051
Single	0.934	0.965	0.918
College enrollment	0.230	0.328	0.177
Family income	100,218.6	136,185.6	80,993.38
Family size	4.511	4.390	4.576
House ownership	0.863	0.927	0.830
Head of household employed	0.791	0.865	0.751
Resident in metropolitan area	0.739	0.772	0.722
Amount Pell Grant received	510.087	780.769	365.403
Mother's education: less than high school	0.270	0	0.415
Mother's education: high school diploma	0.275	0	0.423
Mother's education: more than high school	0.454	1	0.163
Father's education: less than high school	0.263	0	0.403
Father's education: high school diploma	0.247	0	0.379
Father's education: more than high school	0.490	1	0.218

Table A4: Robustness check (whole sample)

Dependent variable: college enrollment (=1 if enrolled in PSE, =0 otherwise)								
Variable	dydx	Std.err.	dydx	Std.err.	dydx	Std.err.	dydx	Std.err.
Unemployment	0.003	(0.002)	0.009**	(0.004)	0.004*	(0.002)	0.012***	(0.002)
Age	2.075***	(0.02)	2.064***	(0.021)	2.036***	(0.019)	2.04***	(0.018)
Age^2	-0.05***	(5e-4)	-0.05***	(0.001)	-0.05***	(4.6e-4)	-0.05***	(4.5e-4)
Female	0.088***	(0.003)	0.087***	(0.003)	0.086***	(0.003)	0.086***	(0.003)
Single	0.256***	(0.02)	0.256***	(0.016)	0.255***	(0.016)	0.255***	(0.016)
Separated	0.042*	(0.02)	0.041*	(0.023)	0.041*	(0.023)	0.041*	(0.023)
Divorced	0.069***	(0.02)	0.068***	(0.025)	0.067***	(0.024)	0.067***	(0.024)
Widowed	0.154*	(0.09)	0.154*	(0.09)	0.149*	(0.088)	0.151*	(0.089)
ln(family income)	0.013***	(0.001)	0.013***	(0.001)	0.012***	(0.001)	0.013***	(0.001)
ln(family size)	-0.05***	(0.01)	-0.05***	(0.005)	-0.05***	(0.005)	-0.05***	(4.5e-4)
House ownership	0.095***	(0.01)	0.095***	(0.005)	0.094***	(0.005)	0.094***	(0.005)
Head of HH employed	0.024***	(0.004)	0.024***	(0.004)	0.024***	(0.004)	0.024***	(0.004)
Metropolitan area	0.051***	(0.004)	0.051***	(0.004)	0.050***	(0.004)	0.050***	(0.004)
College premium	0.025	(0.02)	0.011	(0.023)	0.024	(0.023)	-	-
Average weakly earnings	-	-	-	-	-	-	0.26***	(0.057)
Nominal interest rate	3.7e-4	(0.001)	0.003	(0.002)	0.006***	(0.002)	0.003**	(0.002)
Inflation	0.004**	(0.002)	0.005**	(0.002)	0.007***	(0.002)	0.006***	(0.002)
Tuition*1,000	-0.013	(0.01)	-0.006	(0.01)	0.009	(1e-5)	0.0195***	(1e-5)
Pell Grant*1,000	0.035***	(0.00)	0.035***	(0.00)	0.035***	(0.00)	0.035***	(0.00)
Linear time trend	-0.01***	(0.002)	-0.02***	(0.004)	-0.002	(0.003)	-0.01***	(0.002)
Quadratic time trend	4e-4***	(1e-4)	0.001***	(4e-4)	-	-	-	-
Cubic time trend	-	-	-2e-5*	(1e-5)	-	-	-	-
Linear trend* nom. int. rate	-	-	-	-	-4e-4***	(1.4e-4)	-	-
Mother's education < HS	-0.15***	(0.005)	-0.15***	(0.005)	-0.15***	(0.005)	-0.15***	(0.005)
Mother's education =HS	-0.09***	(0.004)	-0.09***	(0.004)	-0.09***	(0.004)	-0.09***	(0.004)
Father's education < HS	-0.18***	(0.005)	-0.18***	(0.005)	-0.17***	(0.005)	-0.17***	(0.005)
Father's education =HS	-0.11***	(0.004)	-0.11***	(0.004)	-0.11***	(0.004)	-0.11***	(0.004)
Observations	322960		322960		322960		322960	

Robust standard errors are reported in brackets. The stars indicate the significance level: * indicates 10-percent significance level , ** indicates 5-percent significance level, *** indicates 1-percent significance level. The regression also includes ethnicity dummies and regional dummies.

Table A5: Robustness check (quadratic trend)

Dependent variable: college enrollment (=1 if enrolled in PSE, =0 otherwise)

	WHOLE SAMPLE		HIGH TYPES		LOW TYPES	
Variable	dydx	Std.err.	dydx	Std.err.	dydx	Std.err.
Unemployment	0.003	(0.002)	-0.003	(0.004)	0.007**	(0.003)
Age	2.075***	(0.02)	2.25***	(0.041)	1.89***	(0.022)
Age^2	-0.05***	(5e-4)	-0.054***	(0.001)	-0.05***	(5e-4)
Female	0.088***	(0.003)	0.065***	(0.004)	0.105***	(0.004)
Single	0.256***	(0.02)	0.244***	(0.034)	0.254***	(0.018)
Separated	0.042*	(0.02)	0.049	(0.04)	0.037	(0.029)
Divorced	0.069***	(0.02)	0.048	(0.045)	0.076**	(0.031)
Widowed	0.154*	(0.09)	-0.077	(0.245)	0.19**	(0.097)
ln(family income)	0.013***	(0.001)	0.018***	(0.003)	0.012***	(0.001)
ln(family size)	-0.05***	(0.01)	-0.032***	(0.009)	-0.06***	(0.007)
House ownership	0.095***	(0.01)	0.094***	(0.01)	0.102***	(0.006)
Head of HH employed	0.024***	(0.004)	0.015**	(0.007)	0.028***	(0.005)
Metropolitan area	0.051***	(0.004)	0.029***	(0.006)	0.061***	(0.005)
College premium	0.025	(0.02)	-0.018	(0.033)	0.042	(0.029)
Nominal interest rate	3.7e-4	(0.001)	-0.001	(0.002)	0.002	(0.002)
Inflation	0.004**	(0.002)	-0.002	(0.003)	0.008***	(0.003)
Tuition*1,000	-0.013	(0.01)	-0.01	(0.02)	-0.02	(0.01)
Pell Grant*1,000	0.035***	(0.00)	0.026***	(0.00)	0.045***	(0.00)
Linear time trend	-0.01***	(0.002)	-0.012***	(0.003)	-0.009***	(0.002)
Quadratic time trend	4e-4***	(1e-4)	3e-4**	(0.003)	4e-4***	(1e-4)
Mother's education < HS	-0.15***	(0.005)	-	-	-0.15***	(0.006)
Mother's education =HS	-0.09***	(0.004)	-	-	-0.09***	(0.006)
Father's education < HS	-0.18***	(0.005)	-	-	-0.17***	(0.006)
Father's education =HS	-0.11***	(0.004)	-	-	-0.11***	(0.005)
Observations	322,960		112,488		210,440	

Robust standard errors are reported in brackets. The stars indicate the significance level: * indicates 10-percent significance level , ** indicates 5-percent significance level, *** indicates 1-percent significance level. The regression also includes ethnicity dummies and regional dummies.

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