

MACRO- AND MICROECONOMIC RISKS OF STUDENT LOANS IN AN INTERNATIONAL CONTEXT*

Máté VONA

*(Received: 1 March 2014; revision received: 9 September 2014;
accepted: 13 October 2014)*

The risk of individual investment in higher education is not a well-researched topic compared to the rate of return to education. In many countries tuition fees are low, but there is a possibility to borrow for investment in education. This can lead to irresponsible investment behaviour. The paper will show that the student loan market is too small to cause a macroeconomic crisis, but that it is a market with many stakeholders and irresponsible behaviour should not be encouraged. With the examination of a Hungarian sample, it can be concluded that in the context of higher education, signs of rational investment behaviour can be found. The risks of post-secondary studies are not yet fully understood and measured, and for this reason further research is suggested.

Keywords: economics of education, higher education finance, student loan, income-contingent loan, Hungary

JEL classification indices: G15, I22

* This research was supported in the framework of the TÁMOP-4.2.4.A/ 2-11/1-2012-0001 0001 “National Excellence Program – Elaborating and operating an inland student and researcher personal support system” and co-financed by the European Social Fund.

Máté Vona, Assistant Lecturer at the Faculty of Economics, University of Debrecen, Hungary. E-mail: mate.vona@econ.unideb.hu

1. INTRODUCTION

Considering the workers of a firm as some kind of capital can be dated back to Adam Smith. More recently, the theoretical school led by Shultz and Becker laid the foundation for a human capital investment theory. There are several questions at issue, from human capital measurement through labour market information asymmetries to human capital investment constraints. This paper contributes to the discussion by analysing the risk of individual human capital investment. The basic idea is that individuals are willing to spend time and/or money to invest in their own human capital because it will make them more valuable workers, among many other advantages, so they can earn more in the future. The cost of human capital is foregone earnings and monetary costs. The yield, for instance, can be a wage advantage because of enhanced productivity. It is a financial investment decision, particularly because human capital investment through higher education is a long-term investment and acquiring a degree can take 3, 5, or even more years. It is not easy to predict what the wage will be for a given qualification, or whether there will be any demand for it on the labour market. Moreover, individual features can cause cycles in earnings. We can consider education a risky financial investment.

An environment of agents making risky investments can create interesting scenarios. If they underestimate risks, and the investment is relatively cheap,¹ this can lead to investment bubbles and eventually to a crisis. Some suspect that this is exactly what is going on at the student loan market. The argument laid out by writers such as Davies – Harrigan (2012), McCluskey (2013) and also in the Hungarian press is the following: American student loans, like the main lending mechanisms such as Stafford and Perkins loans, are federal loans; the government is creating a bubble by allowing easy access to student loans, which has the effect of growing tuition fees. Higher tuition fees demand higher lending, which in turn creates higher tuition fees. Eventually, this will lead to a situation in which graduate borrowers will be unable to repay their debt and the government will be left with a huge amount of non-performing loans, a sure recipe for a debt crisis.

This problem has been identified outside of the US as well. The recent global economic crisis had a severe impact on the Hungarian economy that led to years of stagnation. It was one of the reasons behind the government's justifications to intervene in the status quo of the Hungarian higher education system. Most students recently starting in fields such as economics or law must pay a full cost

¹ For instance, if one has to choose between a high chance of unemployment with low possible wage offers and a currently low-interest rate student loan and easy education, the second option might be very tempting, but will not have a high return.

contribution. To aid this change in the costs of education, a new student lending vehicle was introduced (Balogh et al. 2013), called Student Loan 2.²

People everywhere spend a lot on risky investments in human capital. Is this something similar to an expansion of a bubble that will eventually lead to a crisis? If a higher education crisis happens, will it be similar to the recent US housing market correction? Can it be a trigger for a macroeconomic setback? This paper approaches these questions from two directions. First, it will consider whether the market is big enough to have a domino effect in the whole economy. Second, we will ask whether the investors can be considered financially reasonable, where they are least expected to be. By financial rationality we understand a behaviour which chooses higher risk only when it is rewarded by a higher return. The empirical section will introduce results from a Hungarian sample. The education programs chosen by the sample can be fitted to an equation that is derived from the financial theory of the efficient frontier.

The paper will conclude that even where the higher education market size is huge, the numbers are not high enough to be considered as a potential risk factor. Moreover, rational financial behaviour patterns will be found where they are least expected. Combining the two conclusions means that human capital investment market growth is not a macroeconomic threat. The results will even suggest that the deterrent effect of the risk might not be the most interesting microeconomic problem either.

2. LITERATURE REVIEW

Becker (1964) gave examples, a theoretical background, and the tools to calculate the rate of return to education, and since then it has been a very popular topic in the literature (Psacharopoulos – Patrinos 2004). The basic idea was that investment in education is no different from financial investments from the point of view of decision-making. The value of the investment is the net present value of the cash-flows generated by it, and the rate of return is where the net present value is zero. Some of the more interesting findings are that the rate of return is exceptionally high (more than 10%), and that in some cases this does not diminish with a higher level of education, which basically means that the more we invest, the higher the rate of return we experience. Moreover, the social return is usually positive as well (T. Kiss 2010).

² However, its popularity failed to live up to the expectations. Students were not really interested in the new scheme.

The risks of education investment have also been studied since the early 1970s. Some theoretical papers offer important insights (Levhari – Weiss 1974; Eaton – Rosen 1980; Hamilton 1987; Anderberg – Andersson 2003; da Costa – Maestri 2007; Anderberg 2009; Jacobs et al. 2009) and there is some very useful empirical literature (Carniero et al. 2003; Cunera et al. 2004; Chen 2008). There is a debate over whether we should consider education a risky investment in human capital and/or as an insurance against labour market risks. Chen (2008) finds that the divergence from the expected return for education was unforeseeable for the cohort she examined. This means that it cannot be traced back to family background or individual features. Consequently, we cannot predict if someone will be better or worse off with a degree than the average degree holder. Hillman (2014) published a study dealing with the fact that students with low incomes and from minority backgrounds have a disproportionately high chance of defaulting on their student loan. This constitutes a risk. However, Anderberg – Anderson (2003) pointed out that degree holders have better labour market statistics, lower unemployment rates, higher earnings, and better health conditions. In this sense, a degree is an insurance, although it should be added that it is not an automated insurance like a car insurance.

The possibility of taking out a loan for human capital investment is very important when we are discussing the issue of risk. It makes it possible to make investments today that might not be justified by a future income advantage. Human capital cannot serve as a mortgage, so in any case of default, the lender cannot be directly compensated. Thus, with student lending, a standard annuity loan is a bad risk because in low income periods it can trigger a default³ and the lender will be left with a huge outstanding sum. If this occurs *en masse*, the student loan company has to default as well. A risk management option can be to set the lending scheme to be income-contingent. With an income contingent loan, the borrowers pay a given share of their income. Theoretically, in this case, high losses can be deterred because there are no periods in life when the student loan repayment is a very high proportion of the income, or must be paid when the borrower is unemployed. The Hungarian student loan system works exactly like this, and the amount of payment is calculated from the level of income two years prior to the date the payments are due. However, it must be seen that serious and problematic over-investment will at some point cause financial turbulence under both financial schemes.

This section has summarised what must be considered when searching for risk factors. We must take into account those costs of education that can be immediate and postponed. The postponed costs are the greater risk factors because they

³ Bear in mind that the debtor also knows that nothing can be taken away from him or her.

can be financed by future income, which is not guaranteed. If the student loan system defaults because of the high level of individual defaults, it can affect the higher education system itself. The current level of student numbers could not be financed⁴ by the students alone, and universities would be in need of a bailout, the burden of which might fall on the taxpayers.

A modern financial market practice is securitisation. Various articles (e.g. Nasser – Norman 2011) and academic papers (e.g. Gillen 2008) have pointed out that even student loans were part of the securitisation process. A summary of this literature can be found in Semjén (2013). The process itself is beneficial for every participant. Securitisation can allow more lending to students and less risk for the lender, as this process allocates the risk only to those who are willing to take the risk of a portfolio which includes student loans. This statement holds as long as student loans do not become garbage loans that default in most occasions without any mortgage asset to be taken. And this can indeed be the case: Macchiarola – Abraham (2010) showed that even degrees that traditionally offered safe returns – like degrees in law – have lost this feature in the new economy.⁵ If these student loans turn out to be garbage loans and most of them default, this can seriously decrease the trust in these derivatives. Such derivative products can multiply the size of a market because a basic asset can be the underlying asset of several derivatives or be the beginning of a chain of derivative deals (Gillen 2008). There is no doubt that the student loan market exhibits most of the symptoms of a possible bubble (Macchiarola – Abraham 2010).

However, this argument is only valid if it is impossible to bail out student lenders or even the debtors. In the case of the housing market, it was impossible to bail out every failed loan, and it was also impossible to bail out every bank to keep the derivatives valuable.⁶ But if student lenders remain creditworthy in spite of student loan defaults, the derivatives will keep their value.

Based on the above, the following hypothesises will be examined:

- Hypothesis 1: There are many developed countries where private investment in higher education is large enough compared to factors which cause regular macro cycles, such as financial market value or government spending.

⁴ It is only a problem when the higher education financing system is highly reliant on private investment through tuition fees.

⁵ While mentioning this trend, we should not forget the expansion of education. More colleges and universities appeared, offering the same qualifications, but not necessarily the same quality (see, for example, Guri-Rosenblit et al. 2007 on the massification of education).

⁶ Serious moral hazard issues can be discussed here, as well.

- Hypothesis 2: There are many countries where the student loan debt market (postponed costs of investment) is comparable to housing debt, which we know can cause a crisis.
- Hypothesis 3: There is reason to think that the behaviour of average individuals when borrowing for education is not financially reasonable.

3. DATA AND METHODOLOGY

The first two hypotheses will be examined through the analysis of Eurostat, OECD,⁷ and World Bank databases. The investigation of the third hypothesis is more complicated. Calculating Net Present Value for large investor groups is more feasible. A very detailed example is available in Avery – Turner (2012). They point out that in spite of the growing costs and indebtedness, choosing higher education is still a rational and rewarding investment for most; but it is not universal and there are people who lose out.

It might not be surprising that US investors are more or less financially consistent about their investment in education. The US education system is one of those that demand the most private investment. Their tuition fees are high compared to the European education systems.

There are countries where the education system is in turbulent change, data availability is limited, and the initial financial investment is low. Hungary is a prime example of this. During the 2000–2010 period, the traditional 4-year college and 5-year university system was partially replaced by a 3-stage BSc-MSc-PhD system. This was called the Bologna Process. The Hungarian higher education system offers full-time training and part-time training as well. The education programs are available in state-funded form; however, if one studies for a second degree at a given level or cannot reach the minimum entry criteria,⁸ one can participate in the same education programs making a cost contribution or paying a tuition fee.⁹ Even when a full cost contribution is necessary, it is mostly around 500–1000 EUR per semester. Most recently, 77% of students taken on by the system have been in state-funded programs. Those who apply for higher education can choose a wide variety of education programs, from 2-year programs to even 6-year programs. Many of these programs are fairly new and were introduced by

⁷ OECD's "Education at a Glance" is the largest dataset that allows international comparison.

⁸ This is based on the applicants' secondary school performance, final exam grades, and, in some cases, entry exams taken for the higher education institute.

⁹ Even these education programs have minimum entry criteria, but these are lower than for state-financed programs.

the Bologna Process. Most of the applicants have access to state-financed programs. It is very difficult to make decisions in this environment because of the lack of information about the market value of these new types of degrees. Financial rationality is the least expected in such an environment.

For our research, Christiansen et al. (2006) can be a very useful methodological guide. They used a standard mean-variance analysis to better understand the risk-return trade-off. The original analysis was for risky security investments such as shares, bonds, or derivatives; this is the so-called Markowitz portfolio theory. They assumed that the available investment possibilities are different kinds of education degrees. Nowadays, the Markowitz portfolio theory is included in almost every financial textbook.

$$\sigma^2 = \beta_0 + \beta_1 E^2 - \beta_2 E, \quad (1)$$

where σ^2 is the variance of the portfolio return and E is the expected return of the portfolio.

Merton (1972) derived Equation (1) for the efficient frontier that is the set of optimal solutions of the investment problem.

Christiansen et al. (2006) suggest considering an education program as a portfolio of human capital investments. Different education programs offer different enhancements of skills and knowledge. The assumption is that a human capital investor would prefer one education program over another if it offers the highest return on a given risk level or the lowest risk on a given return level.¹⁰ They find that some types of higher education degree fit this model, but there are some that do not fit. Some programs, for instance humanities, arts or nursing, do not offer a higher return for more variance, but there are still people who hold such degrees and choose these professions. These programs are not on the efficient frontier, but within it. Even the authors point out that some assumptions of the original model probably do not hold for the higher education market. The basic assumption of the theory is that students choose their profession based on risk-return reasoning. This is more likely to be true for financial securities, but for professions it is not that likely.

We will make a similar examination of a data sample of the Student Loan Centre of Hungary. This is not a public database, but no data was provided to me or any of my colleagues that has any reference to the borrowers' identities.

¹⁰ The financial portfolio theory asks what the optimal investment is if we have a given budget X . X is completely devoted to risky investment. If we apply this theory to education programs we must assume that every education program requires that we invest the same budget. This issue will be discussed later.

Neither do my results have any relation to the business policy or profitability of the Student Loan Centre.

The database is for yearly annual gross real income from 2008 to 2012.¹¹ As already mentioned, the Hungarian student loan scheme is income contingent. The Centre receives income data in order to calculate the necessary payment.¹² The payment can be 6% or 8% of the income two years prior to the due date of the payment. The initial first two years' payment is based on the minimum-wage.

Individuals entered the sample if they had recorded income for any of the years in the indicated time period. The focus of the present study is education programs. Those programs were selected where at least 30 individuals' income was recorded for the whole time period. Only state-financed and full-time education programs were evaluated. Those who participated in more than one type of education program were excluded, as well as those who had no reported income.¹³ The equal costs assumption does not apply for those who participated in several International Standard Classification of Education (ISCED) programs. The final sample contained data for 20,146 individuals with 46,229 observations for 34 education programs. The data for the education programs are available in *Table 2 of Appendix A*.

4. EMPIRICAL RESULTS

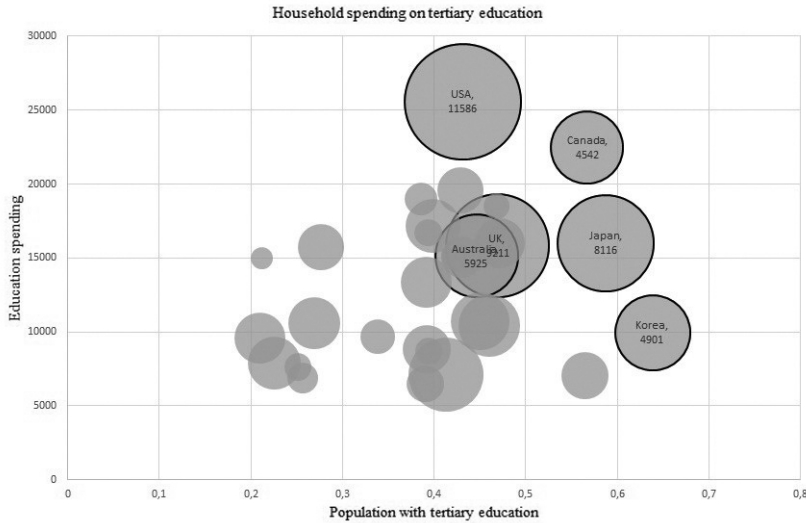
First, we look for countries where private investment in higher education can be a major macroeconomic factor. These countries should have a high investment in higher education and a large private investment as well. The first factor – high investment – is indicated in this paper by total spending on tertiary education per student. The second factor – private investment – is indicated by household spending, which is calculated from the ratio of household spending to total spending and the total spending value itself. In a country where higher education can be a risk factor, many people should have invested in higher education. In *Graph 1*, the population with a tertiary level of education measures this. The 25–34-year-old cohort is represented because it is the closest to the micro sample that will be discussed later,¹⁴ and because they might be the most interesting cohort in terms of future economic tendencies. Those countries are highlighted where total

¹¹ The price indices of the Hungarian Central Statistical Office (2014) were used for real income calculations. The previous year is 100. Year/Price Index: 2009/104.2; 2010/104.9; 2011/103.9; 2012/105.7.

¹² Their data is from the National Tax and Customs Administration of Hungary.

¹³ See *Appendix B* for more on the decision to exclude observations with 0 income.

¹⁴ See *Appendix*.



Graph 1. Household spending on tertiary education

Note: Horizontal axis: Population with a tertiary level of education, 25–34 years old, % in same age group; Vertical axis: Total spending on tertiary education, US dollars/student. Total spending multiplied by the ratio of household spending and total spending.

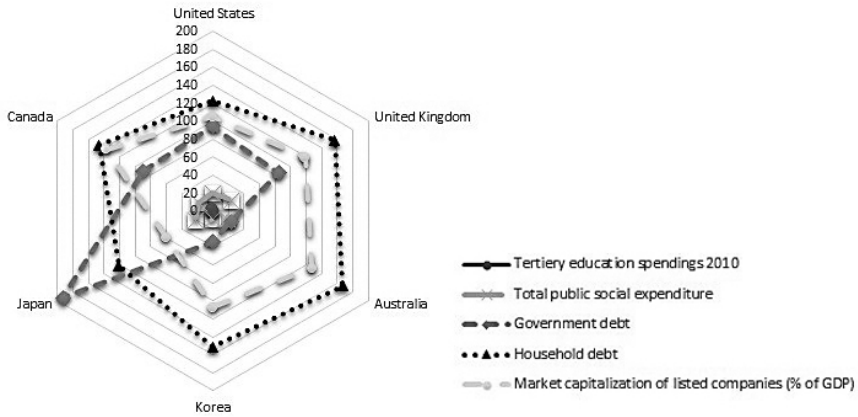
Source: OECD (2013).

investment per student is high, as well as private investment, and a large portion of the population is involved in higher education.

The US stands out as the largest circle with around 11,000 dollars spent per student from the household budget annually. Japan and the UK follow. Canada can be a major market if we look at total spending, but private spending is not that high. Tuition fees in Canada are lower. Canada and South Korea are also taken for further examination based on the extensive involvement of the population. In Japan, Canada, and Korea more than 50% of the age cohort obtain some kind of degree from tertiary education. If we consider the other countries,¹⁵ it can be noted that education expenditure can be high, but does not depend on household investment.¹⁶ For the average citizen in most of the OECD countries, choosing higher education has no greater financial risk than buying a new TV or a notebook computer. Data for the countries are available in *Appendix A, Table 1*.

¹⁵ Unnamed grey circles.

¹⁶ Chile is an interesting exception, but the total spending is much lower in Chile.



Graph 2. Total government spending, total government debt, total household debt, and the size of the stock market

Source: Worldbank (2013), Eurostat (2013).

With *Graph 1*, we can identify mainly the United States, Canada, the United Kingdom, Australia, Japan, and Korea as the countries where private financing can be a major economic factor. To decide whether or not it is, the total tertiary education spending (both private and public together) should be compared to the size of various major factors such as total government spending, total government debt, total household debt, and the size of the stock market.

Graph 2 shows that the total spending – private and public combined – is so small compared to major economic factors such as government and household indebtedness, government social spending, or the size of the stock market companies that it is condensed almost to a dot in the middle of the graph. Total spending on higher education is between 1 and 2.5% of the annual GDP, whereas social spending is around 20%, the stock market size is around 100% with large differences, and the debt data are even larger.¹⁷ If we made an intertemporal comparison, we would find that a regular variance, for example in government debt, can cover the whole of higher education spending. This shows that in extreme cases, the government has the ability to intervene in a smaller market such as higher education or the student loan debt market with a regular government bond issue.

The United States stands out as the country with the largest higher education market. However, if we compare the compiled student loan with the total

¹⁷ Although we compare various stock and flow variables, we emphasise this again to show the size differences, which is the real purpose behind the comparison.

household debt, we see that the share of student loans in the total level of debt has risen from 1% to merely 9% during the last decade, i.e. it is still small compared to mortgage loans. When the total student loan debt hit the 1 trillion dollar mark in the United States, there was intense debate in the press over whether student loans will be the next financial bubble, as was mentioned earlier. But, as we showed, even in the United States, where the tuition fees are the highest and student lending has the longest tradition, only 9% of household debt is made up of student loans (NyFed 2013).

The student loans are mostly federal loans. In the 2012–2013 academic year, 110 billion dollars were lent, but only 8% of this was non-federal. Non-federal loans are not necessarily private loans; they include loans to students from US states and from institutions, in addition to private loans issued by banks, credit unions, and Sallie Mae (CollegeBoard 2013). The main income of the state is not the repayment and the interest on these loans. Some of the outstanding loan is in the balance sheet of private companies such as commercial and investment banks, but the current tendency would have to continue for at least 2 decades (i.e. student loans should reach 30%) to become a major macroeconomic risk factor. So we can conclude that the student loan market and higher education spending are small in comparison with the markets that economic analysts pay most attention to when trying to assess the possibility of an economic downturn.

Based on these relations, we can reject Hypotheses 1 and 2. The next task is to evaluate Hypothesis 3 by testing Equation (1).

The first step is to fit Equation (2) to the data, therefore a return measure must be defined. Christiansen et al. (2006) will be followed. Two types of return will be calculated: raw logarithmic income and Mincer residuals. Only the Mincer residuals are discussed in our paper. Mincer (1958) introduced a very simple approach for the rate of return to education. The so-called Mincer equation can be expressed in the form of Equation (2):

$$\ln W_i = \beta_0 + \beta_1 s_i + \beta_2 x + \beta_3 x_i^2 + \varepsilon_i, \quad (2)$$

where s_i is years of schooling for individual i , and x_i is the experience of individual i .

It can be shown that if certain conditions are met, the coefficient of schooling (β_1) in the Mincer equation (Equation 2) is the rate of return to education (Heckman et al. 2005). The average ε_i , so the average residual will be the Mincer equation for an education group. The individual Mincer residual is defined in equation (3):

$$\varepsilon_{ijt} = \ln w_{ijt} - (\hat{\beta}_0 + \hat{\beta}_1 s_i + \hat{\beta}_2 x_i + \hat{\beta}_3 x_i^2), \quad (3)$$

where ε_{ijt} is the Mincer residual for individual i with education j , at time t .

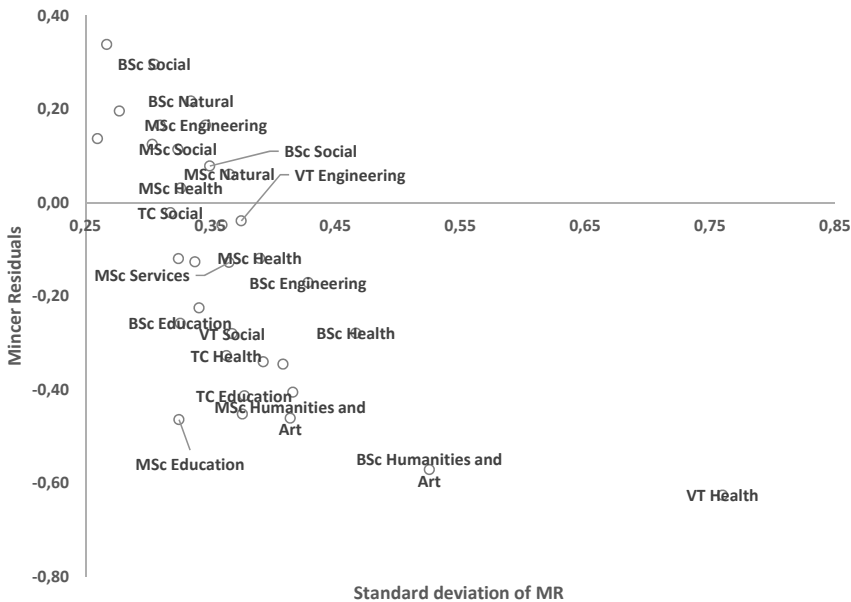
The Mincer residual can be understood as a redefinition of foregone earnings because it compares the earnings to the expected earnings with the same years of schooling. It asks whether an individual with a given education can earn more than what is expected purely on his/her years of education and experience.

Risk will be measured by the average standard deviation for an education group for both return measures. This is formulated by equation (4):

$$\sigma_j = \frac{1}{n_j} \sum_{i=1}^{n_j} \frac{1}{n_i - 1} \sqrt{\sum_{t=1}^{n_j} (\varepsilon_{ijt} - \varepsilon_{ij})^2}, \tag{4}$$

where σ_j is the standard deviation of return for education group j , n_j is the number of individuals in education group j , n_i is the number of observations for the individual i , and ε_{ij} is the average Mincer residual for individual i .

Graph 3 is the risk-return map, where the return is the Mincer residual and the risk is the time series standard deviation of it.¹⁸ Graph 3 offers the interesting suggestion that those who finished higher education after a vocational train-



Graph 3. Scatter-plot of average Mincer residuals and their standard deviations in some education programs, Hungarian student loan system

Source: Student Loan Centre.

¹⁸ The results for the Mincer model are presented in Appendix A, Table 3.

Table 1. Estimation of equation (1)

	Estimate	Std. Error	<i>t</i> value	<i>P</i> value
Intercept	0.09218	0.01427	6.460	3.34e-07
(Mincer residual) ²	0.52903	0.16469	3.212	0.00307
Mincer residual	-0.06042	0.06063	-0.997	0.32668
R ²	0.5258			
N	34			

ing course tend to underperform compared to the Mincer model prediction. BSc programs are spread widely, and MSc and traditional 4-year college programs are concentrated more narrowly around the 0 line. This seems to suggest that the Mincer predictions might be better for longer education programs. This might be a convincing argument if we assume that education needs an extended period to make an impact on future productivity.¹⁹

Table 1 summarises the results used to fit equation (1) to the data of Graph 3. The *P*-values suggest that the coefficient of the Mincer residual are not significant at the usual significance levels, but the squared residual is significant at 1% and the R² is 52.6%, so the model should not be rejected. There can be some kind of human capital or financial barrier that does not allow individuals to choose longer education programs with favourable risk-return combinations. For instance, MSc Health is one of the best combinations in a risk-return sense. The theory would claim that people must prefer MSc Health over BSc Health or vocational training (VT)²⁰ in Health Sciences. However, the fact is that these programs exist, so this might suggest, for example, that somebody who studies to be a nurse does not have the human capital requirements to be a surgeon.²¹ Another possibility is that foregone earnings might cause different levels of stress for different individuals. For example, someone might not be able to choose to stay out of the labour market for the extended time that a BSc+MSc combination demands, even if it is financially feasible by taking out a student loan.²²

The connection between risk and return suggested by Graph 3 and Table 1 makes an interesting addition to the arguments set out by Anderberg – Andersson (2003), da Costa – Maestri (2007), Anderberg (2009), and Jacobs et al. (2009). They established that education has an insurance effect up to a point. This is the

¹⁹ Or it might suggest some kind of counter-signalling behaviour, but this would lead us away from the human capital theory. For more on counter-signalling, see Feltovich et al. (2001).

²⁰ Vocational training is usually 2 or 3 semesters long in a higher education institute or in a specialised institute.

²¹ If the sample included secondary education grades or IQ test results, then this theory would be testable.

²² This theory would be testable if parents' income and wealth data were available.

coefficients of the mean-variance parabola estimated in *Table 1*. However, we should not immediately call for subsidisation because the lack of finance is not necessarily the reason behind non-optimal investment.

We found some places where a drastic change in private spending on higher education or repayments of student loans can threaten the macroeconomic balance. It was shown that even in the United States, student loan debt is not nearly as significant as mortgage loans. Student loans are on the federal state balance sheet, not on that of private companies. A sudden stop in the flow of private investment does not threaten the financing of higher education because the federal state plays a major role in this as well.

Some can argue that there are places where the government might not be powerful enough even to react to a smaller crisis in student lending and higher education financing. We have provided evidence that even in Hungary, where many students participate in state-funded programs, those who borrowed money for education in a complex and dynamically changing environment were still rational. The typical patterns of a financially rational choice of education programs can be found.

The combination of a relatively small market and financially rational behaviour suggests that the risk of macroeconomic crisis caused by a student loan market bubble is quite small.

5. CONCLUSION

We tested three hypotheses and stated that 1) there are some developed countries where private investment in higher education is large enough compared to factors which cause regular macro cycles such as financial market value or government spending; 2) there are countries where the student loan debt market (the postponed costs of investment) is comparable to housing debt, which we know can cause a crisis; and 3) there is a reason to think that the behaviour of the average individual who borrows for education is not financially reasonable.

The education investment data of the OECD was examined and there were six countries which stood out where private investment in education plays a major role, and higher education expenditure is high in global comparison. These are the United States, the United Kingdom, Canada, Australia, Japan, and South Korea. Nevertheless, none of the above-mentioned countries spends so much on higher education that it can be compared to the size of the financial market, or international debt markets. When different categories of the indebtedness of US households were compared, it was found that student loan debt only accounts for 9% of the total indebtedness, and this is small compared to mortgage loans. This

debt is owed to the central budget of the United States, as only 8% of the loans are non-federal.

When financial rationality was examined, a Hungarian borrower sample was chosen because Hungary has less experience in student loan financing and there were many new types of programs, with little labour feedback at the time of decision making. The sample included student loan borrowers, who participated in state-funded, full-time education programs. In our analysis, the methodology of Christiansen et al. (2006) was used. The risk-return trade-off predicted by the financial theory of portfolio investments could be traced back. Based on this result, we asserted that financial rationality is true for human capital investors even in a dynamically changing environment.

There were education programs that fitted at the non-optimal part of the efficient frontier. Various possible explanations were mentioned for these very interesting cases, and they can be interesting topics for further research. If there are short-term education programs on the non-optimal part of the efficient frontier, more studies could act as insurance, but after the minimal variance point, education is a risky investment. Interestingly, in the argument set out in the literature review it might be possible that both sides are right.

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APPENDIX A

Table 1. International education financing data for Graph 3 (2010–2011)

	Population with tertiary education, 25–34 years old, % in same age group	Education spending, tertiary education, US dollars/student	Household spending on tertiary education, US dollars/student, calculated
United States	43	25,576	11,586
United Kingdom	47	15,862	9,211
Japan	59	16,015	8,116
Australia	45	15,142	5,925
South Korea	64	9,972	4,901
Chile	41	7,100	4,836
Canada	57	22,475	4,542
New Zealand	46	10,418	3,343
Israel	45	10,730	2,926
Netherlands	40	17,161	2,560
Mexico	23	7,872	2,436
Portugal	27	10,578	2,358
Italy	21	9,580	2,281
Spain	39	13,373	2,244
Ireland	47	16,008	2,207
Poland	39	8,866	2,019
Russian Federation	57	7,039	1,930
Germany	28	15,711	1,854*
Sweden	43	19,562	1,839
France	43	15,067	1,460
Estonia	39	6,501	1,183
Slovenia	34	9,693	1,043
Denmark	39	18,977	949**
Belgium	42	15,178	832
Slovak Republic	26	6,904	805
Czech Republic	25	7,635	669
Finland	39	16,714	669*
Iceland	39	8,728	641
Norway	47	18,512	562
Austria	21	15,007	435

* Based on the 2000 total private investment in higher education.

** Based on the 2010 total private investment in higher education.

Table 2. Data calculated for some education programs in the Hungarian student loan borrower sample (2008–2012)

	EDUCATIONAL_GROUP	Raw logarithmic income	Standard deviation of RLI	Mincer residuals	Standard deviation of MR	Number of observations	Number of students	Length of total education (years)
1	VT Humanities and Art	14.33	0.28	0.20	0.28	74	36	14
2	VT Social	13.83	0.38	-0.28	0.37	1,963	902	14
3	VT Natural	13.79	0.39	-0.34	0.39	277	127	14
4	VT Engineering	14.18	0.35	-0.04	0.37	146	61	14
5	VT Health	13.25	0.84	-0.63	0.76	90	42	14
6	VT Services	13.68	0.41	-0.41	0.42	867	405	14
7	BSc Education	14.09	0.30	-0.26	0.33	533	208	15
8	BSc Humanities and Art	13.41	0.56	-0.57	0.53	124	69	15
9	BSc Social	14.38	0.36	0.08	0.35	1,817	746	15
10	BSc Natural	14.41	0.30	0.13	0.30	1,653	712	15
11	BSc Engineering	14.47	0.30	0.17	0.31	3,421	1,455	15
12	BSc Agricultural	14.13	0.35	-0.22	0.34	432	177	15
13	BSc Health	13.94	0.47	-0.28	0.47	93	41	15
14	BSc Services	14.63	0.27	0.34	0.27	757	338	15
15	BSc Social	14.61	0.31	0.30	0.31	4,750	2,061	15.5
16	BSc Natural	14.56	0.32	0.22	0.33	577	233	15.5
17	BSc Engineering	13.96	0.48	-0.17	0.43	859	416	15.5
18	BSc Services	14.03	0.35	-0.13	0.34	196	100	15.5
19	TC Education	14.01	0.37	-0.41	0.38	3,028	1,309	16
20	TC Humanities and Art	14.06	0.41	-0.35	0.41	830	360	16
21	TC Social	14.42	0.31	-0.02	0.32	1,323	577	16
22	TC Natural	14.36	0.29	-0.12	0.32	175	70	16
23	TC Engineering	14.56	0.21	0.14	0.26	181	90	16
24	TC Health	14.11	0.37	-0.33	0.36	1,820	788	16
25	TC Services	14.38	0.36	-0.05	0.36	1,518	659	16
26	MSc Education	14.02	0.34	-0.46	0.32	503	226	17
27	MSc Humanities and Art	14.08	0.41	-0.46	0.41	2,376	1,071	17
28	MSc Social	14.67	0.34	0.11	0.32	7,218	3,090	17
29	MSc Natural	14.55	0.37	0.06	0.37	2,474	1,102	17
30	MSc Engineering	14.68	0.36	0.17	0.35	3,123	1,346	17
31	MSc Agricultural	14.12	0.39	-0.45	0.38	764	330	17
32	MSc Health	14.54	0.35	0.03	0.33	579	262	17
33	MSc Services	14.44	0.38	-0.13	0.37	607	254	17
34	MSc Health	14.57	0.39	-0.12	0.39	1,081	483	18

Note: In an education program, all people were grouped together who participated in an education program based on the International Standard Classification of Education (ISCED) code. (See ISCED codes in Graph B of Appendix B.) For example, all who had participated in a program with ISCED code starting 1 and studied for 15 years in total (finishing education around the age of 22) finished BSc Education, whereas those who had participated in a program with ISCED code 7 and studied for 17 years total, were grouped in MSc Health. VT: Vocational training, BSc: Bachelor of Sciences, TC: Traditional College, MSc: Master of Sciences.

Table 3. Mincer equation

	Estimate	Std. Error	<i>t</i> value	<i>P</i> value
Intercept	11.656059	0.067222	173.40	<2e-16 ***
Years of schooling	0.136602	0.004146	32.94	<2e-16 ***
Experience	0.401274	0.007101	56.51	<2e-16 ***
(Experience) ²	-0.046715	0.001115	-41.91	<2e-16 ***
R ²	0.1009			
N	46229			

Note: The coefficients are significant, but the explanatory power of the model is very weak. Experience is calculated from the beginning of the loan repayment. The average experience is 2.74 years, so subjects are from the 25–34 age cohort, which was used in the international comparison. This does not necessarily correspond to work experience, but this is the best approximation that can be made on the available dataset. It is worth pointing out that the rate of return is 13.6%, which is a very plausible result.

APPENDIX B

Connection between loan and repayment

The Student Loan Centre receives its income information for the repayment calculations from the National Tax and Customs Administration of Hungary. However, if an individual has not prepared a tax return, this means he/she has 0 taxable income in Hungary. Many of the clients who pay back their loan belong to this category. In fact, 14.37% was the average 0 income ratio²³ among the 34 education groups. There can be several reasons for this, including the following:

- The borrower is inactive and does not receive any financial assistance, but uses his savings for repayment.
- The borrower is inactive and does not receive any financial assistance, but the family or relatives repay.
- The borrower works abroad and does a tax return there.
- The borrower has income, but does not report it.

The reasons for inactivity can be manifold; for instance, an individual graduates, but starts the repayment, or waits for better job opportunities, and in some cases they might not work because they are unable to. Interestingly, as *Table B* suggests, there is a strong negative linear connection between the raw log income of the education group and the ratio of 0 income. This suggests that 0 income is more of a decision than a risk. The option value of education is a rich field in educational economics as well (Eide – Waehrer 1998). 0 income can be an

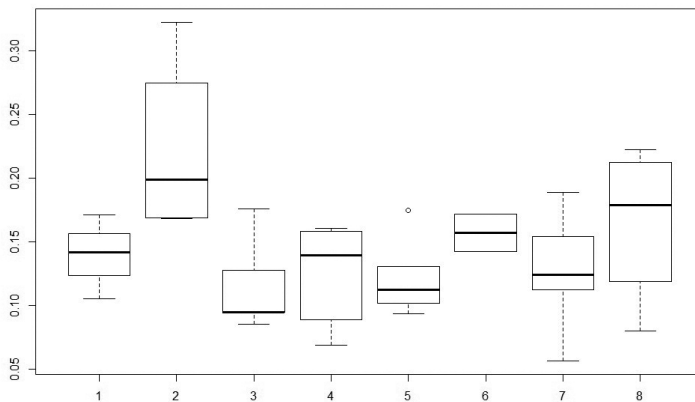
²³ The number of 0 income observations was compared to the total number of observations.

unexercised option if it is not the product of foreign earnings. Working abroad is very popular among young graduates.²⁴ The correlation between years of education and the 0 income ratio is -0.18 , which means they might be independent, but unemployment and the length of education usually shows a strong relationship. As *Graph B* suggests, there is no connection between the type of education and the 0 income ratio, except maybe that for ISCED code 2, i.e. humanities and arts, where it is higher than for ISCED code 3, i.e. social sciences and arts.

Table B. Connection between raw logarithmic income and the ratio of 0 income observations

	Estimate	Std. Error	<i>t</i> value	<i>P</i> value
Intercept	1.80375	0.24337	7.412	1.97e-08
Ratio of 0 income observations	-0.11680	0.01712	-6.823	1.02e-07
R2	0.5258			
N	34			

Based on the fact that 0 income does not necessarily mean unemployment or inactivity because of inability to work, it appears preferable to clear the sample from the 0 income data because it might cause less distortion to leave out some unintentionally unemployed workers than to hugely overestimate the risk and underestimate the return by retaining a lot of the 0 incomes of those who might have an income or still be studying. All the further calculations are for non-zero income individuals.



Graph B: Boxplot of the 0 income ratio by ISCED codes, student loan data sample, Hungary, 2008–2015

Note: ISCED codes: 1 – Education; 2 – Humanities and Arts; 3 – Social; 4 – Natural; 5 – Engineering; 6 – Agriculture; 7 – Health; 8 – Services.

²⁴ See, for example, the following article: http://eduline.hu/felnottkepzes/2014/2/7/A_BGFes_friss_diplomasok_harmada_tervez_kul_E18VDA