PhD Thesis Summary

Financial Risk Evaluation Methods in the Economics of Education

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1. Motivation

The economics of education traces its roots back to the first economic thinkers like Adam Smith. However the ideas that influence contemporary research date back to the 1960's and the 70's (Varga 1998). The emergence of this topic in that particular era in economics is not a coincidence. That was the time when the effects of high level general education started to take effect and masses of people gained access to higher education in the western world. It will be discussed in the dissertation how large is the group of those who are affected by the education system. Basically it cuts through the whole of society. If we assume that education is mainly an investment and its payoff is future income advantage, than it is natural to ask what the risks of that investment are. When I studied this field I was surprised that it is not as rich with studies as other topics, such as the rate of return to education or the economics of tuition fees. This led me to the topic of the dissertation which is risk evaluation methods in the economics of education.

2. Structure of the Thesis and Applied Methodology

The main question of the thesis is the following: what is the role of risk in individual higher educational choice and what are its short-term macroeconomic implications? Namely, whether it can cause a macroeconomic crisis if individuals experience negative rate of return to education on a mass level? For the better understanding of this question, I devote Chapter 1 of the dissertation to the interpretation of risk, individual educational choice and macroeconomic implication. These are concepts that can have many interpretations. I will approach the topic of risk and education using the tools of economics. In Chapter 1.1 the main concepts and definitions of risk and its measurement will be described, risk being one of the main topics of financial economics. In this dissertation investment risk will be discussed. It is related to uncertainty of future returns, however, in case of risk, some knowledge on possible outcomes is assumed. The main economic example of risky investment is investment in financial assets. In Chapter 1.1 a short introduction to the Markowitz model will be given based on Merton (1972). The main idea of the Markowitz portfolio theory is that there are efficient baskets of financial investments, in other words portfolios that are favourable. It is assumed that decision-makers prefer more return over less return at given level of risk and less risk over more risk at given level of return. *Risk is basically an economic bad in that sense*.

After the introduction to the economic theory of risk, it will be applied for higher education in Chapter 1.2. In economics the social role of education is explained by numerous theories. Consumption theory suggests that education is similar to other consumption goods. Human capital theory proposes that people choose to invest in education to increase their future productivity and to earn a higher level of income. Sorting theories argue that education is a solution for labour market information asymmetry. People study to signal their productivity and the education system is a screening device. (Varga 1998) Human capital and sorting theories have received the most attention so risk will be discussed in these two cases. The discussion will be narrowed down to higher education because that is the market where the financial stakes are the highest for individuals and individual decision-making is easier to accept as an assumption. Result 1 of the thesis will concern the role of these theories in evaluating the risk in educational choice. It will be concluded that in the main characteristics there is no difference in the role of risk in educational choice depending on the theory we use for education, however, there are some differences that can be useful, so they should be kept in mind.

Chapter 1.3 focuses on social implications. Individuals win or lose compared to the expected return. At a macroeconomic level risk appears as the interaction of the markets. Macroeconomic theory suggests that there is a long run level of national output and it is expected to grow in time if certain conditions are met. If the output of the economy decreases and it is under the long run level, we talk

about an economic crisis. If market risks add up[1] and underperformance is experienced, especially on a market that has a strong relation with the income of individuals; it can spread through the entire economy. This will decrease the aggregate demand, which as a result will lead to an economic crisis. In Chapter 1.3 the fundamental ways for funding higher education and the ideas behind an economic crisis caused by a setback at the higher education market will be discussed.

After the theoretical review in Chapter 1, in Chapter 2 an overview of the empirical literature of the topic is provided. First of all, the kind of heterogeneity measured is discussed, together with its measured determinants in the literature. Secondly, it is discussed in great detail who have used the Markowitz theory for education programmes[2] and what results they have had. Result 2 of the thesis will be derived from some empirics from Education at a Glance 2014. That set of data indicates that student loan markets are evolving fairly slowly. Thirdly, it is shown who suspects that education can create an economic crisis and what kind of empirical observations they found for their argument. All these topics will be dealt with in their respective subchapters.

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[1]By the term risks adding up I mean a situation where the worst case scenarios play out for many of the market participants at the same time.
[2]I refer to formal education when it has a certain duration and field of science; an education programme, for instance, a BSc in Engineering or an MSc in Health Science

In Chapter 3 data and methodology is introduced for the empirical results of the thesis. My thesis contributes to the literature on Markowitz theory in the economics of education. A sample of the Hungarian student loan borrowers is examined. This sample is especially interesting because student loan borrowers might be taking the highest risk compared to other ways of funding.

For the social implication study international data sources were used, including the World Bank and the Education at a Glance report of OECD.

Chapter 4 includes the analysis and the empirical results of my thesis. The first analysis concerns the role of risk in educational choices. In Chapter 4.1, I compare the measured risks and the returns with scatter-plots for my sample of 34 educational programmes of the Hungarian higher education system. Education programmes in this thesis are defined by a certain level of education and a certain field of education. For instance, they include a Bachelor's in Engineering or a Master's in Social Sciences. Result 3 of the thesis will suggest that the empirical findings are similar to the findings of Palacious-Huerta (2003), Christiansen et al. (2007) and Glocker – Storck (2014). Some educational programmes seem to fit the efficient frontier while other can be found within the feasible set. A possible explanation for it is that sample members are not following the Markowitz-type of ordering. Sharpe-ratios offer some explanations to this phenomenon. These results are new because these relations were only shown for the most developed countries including the United States, Germany and Denmark and not

especially for student loan borrowers. The Sharpe ratio findings are also new to the literature. These findings are summarized in Result 4. Chapter 4.2 will consider short-term social implications of risk accumulation on the education market. First, I narrow down my analysis to such countries where the average individual financial commitment to studies is the highest. The United States will remain as the prime candidate for an education market induced crisis. With the help of graphs and tables, I compare the relative size of the education market of these countries to other markets that are very closely related to macroeconomic performance. Result 5 of my thesis will state that the education market and the student loan market in the USA are still too small for such a social impact to appear. However, these markets are too small, a future exponential growth might increase them. Result 6 of my thesis argues that even in that case the fundamental features of education as a human capital investment limit the possibility for extreme market corrections.

My thesis will end with a conclusion highlighting my main results and the implications of them and will also outline future research possibilities.

3. Key Research Questions

Risks of education investment were pointed out as the motivation for the dissertation. First of all, the economics approach was chosen from among the branches of sciences that conduct education research.

Both theoretical and empirical studies have been made on the risks of human capital investment. As an example of the complex issue in question, there is an ongoing argument in the literature as to whether education increases or decreases labour market risk. Should it be approached as a risky investment or an insurance against a larger risk? (Anderberg – Andersson 2003, Jacobs et al 2009, da Costa – Maestri 2007). In the risk evaluation of education investment this question should be addressed.

This literature has led to two branches of human capital theory where risk has an essential role. One is financial, related to the tools of higher education financing. The other is more microeconomic and studies the role of risk in choosing among education levels, education programmes, and the role of individual features in this choice. These are the two topics the dissertation contributes to and the questions of the dissertation are derived from those fields.

Main question
What is the role of risk in individual higher educational choice and what are its short-term macroeconomic implications? Namely, whether it can cause a macroeconomic crisis if individuals experience negative rate of return to education on a mass level.

Sub-question 1
Do students follow Markowitz ordering behaviour in choosing the field of education they take part in if we apply the standard Markowitz theory of risky investments, where the risk is measured by

the standard deviation of the rate of return to education investment; then do the risk-return combinations for different fields of education fit a so-called efficient frontier which is the section of a hyperbola with a positive slope in the risk-return space?

Sub-question 2
Are there any patterns in the evolution of student loan markets or the products available on student loan markets? Are there any markets where private commitment to student loan systems is extreme?

Sub-question 3
Can student loan markets experience exponential growth? Can the decreasing enthusiasm at the end of such growth cause the kind of financial turbulence typical of such markets as the equity market, mortgage loan market or foreign exchange market?

Based on the literature of these questions and the databases available for the research, the following hypotheses were tested.

Hypothesis 1
Student loan borrowers in Hungary who paid back their loans between 2008 and 2012 do not follow the Markowitz ordering investment behaviour towards education programmes of different levels and they tend to choose programmes that do not belong to an efficient frontier in a risk-return space, defined by measures that are

tested in the branch of literature characterised by Palacious-Huerta (2003), Christiansen et al (2007) and Glocker – Storck (2014).

Hypothesis 1 will be answered in Chapter 4.1 and Result 3 and 4 will summarize it.

Hypothesis 2

High levels of education investment can be achieved without cost-sharing and a high level of private investment in education. Student loan schemes are introduced slowly and they appear in many models. There are outstanding countries in private investment and in the use of student lending.

The answer for Hypothesis 2 will be the result of the evaluation of the basic empirics and empirical literature of the field. It will be summarized in Result 2 in Chapter 2.

Hypothesis 3

Growth on the higher education market is an exponential growth process. Human capital investors overvalue the growth opportunities in their future income, so they pile up current debt at a level that they cannot finance from the earnings on their investment. When they realise the true return on their human capital investment (their true earnings after graduation) they will find that they cannot pay back their student loan debt. This will happen on a mass level. The student loan default rate will be so high that it will affect the financial markets. This can cause financial crises at least on a national level, but a future global crisis is also possible.

Hypothesis 3 will be examined with macro level comparison in Chapter 4.2 and Result 5 and 6 will conclude the outcome.

4. Results

Result 1 was based on the review of the theoretical literature.

Result 1

The literature review of economics of education has showed that two investment-type sets of theories are offered. Risk has different sources in human capital and sorting models but they have not been fully compared yet. The main result of my literature review is that in both theories risks can be summarized in the fluctuating nature of future income. However, in the case of human capital theory education produces some additional productivity irrespective of the credentials. This suggests that even an unfinished education program can have long-term effects. In case of signalling a dropout from education usually means large decrease in the return to education and even successful completion can have a minimal value if too many people have equivalent education signals. This can be attributed to the fact that the cost structure of education does not result in a separating equilibrium. That is important because it has to be taken into consideration in Result 6.

I have started to analyse my hypotheses by reviewing empirical literature. The review gave me the answer to Hypothesis 2. It was Result 2 of the thesis and it is derived in Chapter 2.

In Chapter 2 it was shown that elementary and secondary education are mostly obligatory and a major proportion of the age group takes part in education on those levels. From the point of view of risk in education, higher education is much more interesting. It is voluntary, expensive, and takes a lot of time to finish and adults are making decisions on entering or leaving the education system. Education as human capital accumulation has not only private but public benefits as well. It was shown that there are four participants who have an interest in individuals getting more education. First of all, the individuals themselves, the students. Then there are the households, the family and relatives who support the students. Future employer companies and other private entities can have an interest in a better educated future labour supply. Last, but not least there is the state, which should represent the interests of society in the potential externalities of education and help in overcoming the inefficiencies of the education market, such as information asymmetries and a lack of financing for students. The state should promote equal opportunities and fairness. Public higher education funding works in two ways; either it is higher education institutions that are supported or private entities such as students, households and companies. In many cases the state finances higher education institutions, many of them are state property, and then the institutions offer tuition-free education. Individuals in a human capital model base their decisions on the costs and return of an additional year or level of education. (Johnstone 2004)

Tuition fees or other financial costs, including living expenses, are not the only costs. Education is time consuming so the investor must take into consideration foregone earnings as the opportunity cost of education. To the best of our knowledge, the majority of expenses are foregone earnings. Educational choice is risky even if it requires marginal direct costs to enter a programme because the future earnings advantage in many cases does not justify the effort that was made or the earnings that had been given up. In some countries even the direct costs are fairly high because the state actively shares the costs of education with the private sector. If an education system is built on high tuition fees, there is a system to support the investors. Frequently used types of student aid include grants, scholarships and loans. Student loans are special in the sense that they do not decrease the risk of taking part in an education program, but only help to spread the cost between different time periods. Student lending is also special because it is different from other investment loans as the object of the investment cannot be mortgaged and the usual student borrower has no other possessions to be mortgaged. The second result was the result of the analysis of Hypothesis 2.

Result 2

Student loans are elements of cost-sharing and they tend to increase spending on education. They are the tools of financial support for students. Building up a large student loan market takes decades and the features of a market are difficult to predict. Some countries, however, stand out; here private investment is relatively high, and

student lending has an important role and tradition. This result is against the idea of a rapid spontaneous growth of a student loan market.

Result 2 is an important argument against the idea of a student loan crisis and gives fundamentals to narrow down the macroeconomic analysis to some special countries.

Another line of literature focuses directly on the returns of education and questions the apparent heterogeneity in return. The higher education system offers very different opportunities based on gender, ethnicity, college choice, family background and social status. The topic of rates of return to education is very well-researched but foreseeable and unforeseeable heterogeneity has a rich literature as well. As the education system is more open than ever, many people enter it in the hope of a great career. The issue of risk and wage differences deserve as much attention as expected returns. There is a line of literature that directly relates to the risk approach used in the theoretical review. They use Markowitz type of analysis to evaluate educational decisions. The literature suggests that not all educational decisions can be fitted into an efficient frontier predicted by the model. This suggests that some investors take too much risk. Is this true for student loan borrowers?

If these risks add up, it can lead to a crisis. Can it spread to a macroeconomic level? Some - mainly in the United States - suspect that the expending tuition fee and student loan market might be a

factor in the next economic crisis. If we are studying risk in education investment this topic must be addressed.

After the analysis of empirical literature, I have remained with two unanswered hypothesis, they were Hypothesis 1 and Hypothesis 3. An empirical analysis of a Hungarian Student Loan borrower sample was performed and a comparative analysis of the big student loan markets was introduced in Chapter 4.

Result 3 and 4 are derived in Chapter 4. In the micro analysis the line of literature of Palacious-Huerta (2003), Christiansen et. al. (2007) and Glocker – Storck (2014) is followed and the focus was on the field of education. An analysis of a data sample from the Student Loan Centre of Hungary was carried out. This is not a public database but no data was provided to me or any of my colleagues that has any reference to borrowers' identities. Neither do my results have any relation to the business policy or profitability of the Student Loan Centre.

The data sample is for a yearly annual gross real income from 2008 to 2012. The Hungarian student loan scheme is income contingent. They receive income data in order to calculate the necessary payment. The payment can be 6% or 8% of the income two years prior to the due date of the payment. The 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 examination is on education programs. Those programs were selected where at least 30 individuals' incomes were 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. The equal costs assumption does not apply to those who participated in several different ISCED-coded programs. The final sample contained data for 20,146 individuals in 46,229 observations for 34 education programs.

One of the main results was that if raw logarithmic income and time-series standard deviation was calculated (Figure 1), a set of experiences fits the theory of risky investment by Markowitz in the sense that they lie on the frontier of the feasible set of investment possibilities.

Figure 1: Scatter-plot of Raw Logarithmic Income and its standard deviation
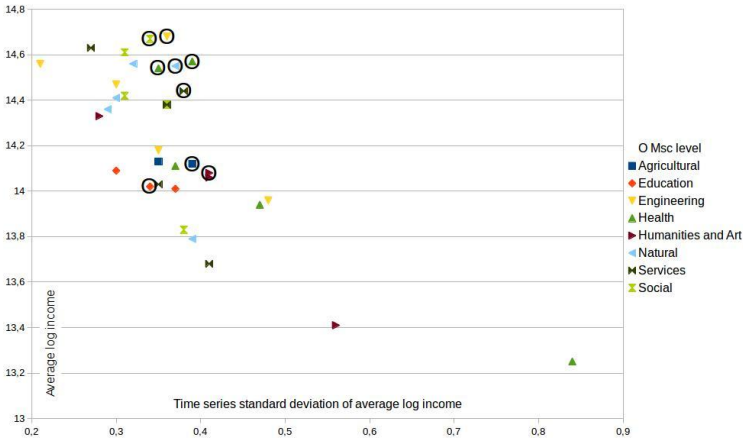
Source: Based on Student Loan Centre Data

Even the equation of the efficient frontier could be fitted, which is completely new to the literature. It fits the results with an R^2 of 0.79. Some programmes lie along a part of the frontier which is not optimal according to the theory because higher return-less risk combinations can be found. They are optimal only according to one criterion, by offering the minimum of risk for the given level of return. There can be several explanations for this. 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.

Figure 2: Scatter-plot of Mincer Residuals and their cross sectional standard deviations
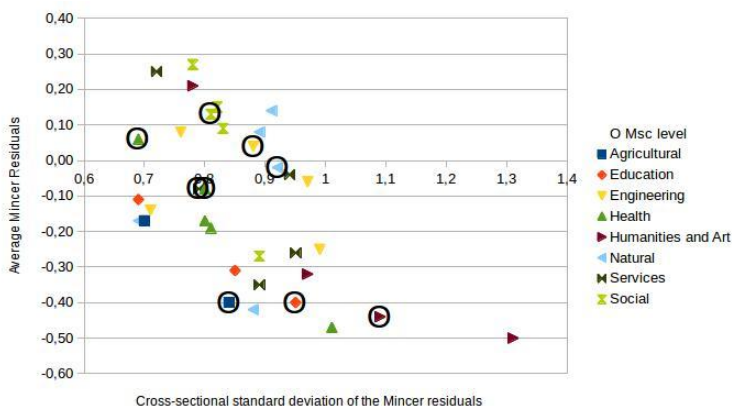
Source: Based on Student Loan Centre Data

For instance, an MSc in Health is one of the best combinations in a risk-return sense. The theory would claim that people must prefer

MSc in Health over a BSc in Health or VT in Health Sciences. It is interesting that we have found this in a student loan borrower sample because they had access to financial aid and they received it, so financial barriers are not necessarily the answer to heterogeneity. Result 3 of thesis was phrased based on these findings.

Result 3

With risk and return measured by the simple measures of average raw logarithmic income and the time-series standard deviation on a data sample of Hungarians who paid back their student loan between 2008 and 2012, a great fit for the frontier offered by the Markowitz-theory of risky investment can be found. Some of the risk-return combinations are not efficient. Due to the fact that the sample members are student loan borrowers, the role of financial barriers is not necessarily the explanation for this. There is uncontrolled heterogeneity in the sample and it can impose investment barriers that withhold access to higher levels of education investment. However, the time-series standard deviation of the average raw logarithmic income should be approached carefully because the results of the measure can be misleading. A strictly growing income series will produce a large standard deviation with this measure. Cross-sectional standard deviation is a better measure for risk.

The literature for rate of return calculations offers control variables such as gender, college choice and family background. In the dataset gender was known, college choice is controlled by the location of the college and social background is controlled by the place of

permanent residence. Mincer-residuals and their cross-sectional standard deviation were used for the sample (Figure 2). The result was a similar risk-return map that was observed in the literature and even similar type of education programmes were found to be more fitting to the model. Sharpe-ratios were also examined and it led to the conclusion in Result 4.

Result 4

The observation for return and risk of fields of education by Christiansen et al (2007) and Glocker – Storck (2014) was validated on a special sample of data. For the Hungarian student loan borrower sample it was seen that some fields of education seem to fit the so-called efficient frontier and some lie well within the feasible set of risk-return combinations. There is even an observable pattern that social sciences and law, high level health studies, and high level engineering studies seem to fit the frontier and short term education programs, humanities and art studies tend not to fit. The risk-return behaviour of human capital investors seems to be the same as in very developed countries. Sharpe-ratios offered some explanations for heterogeneity. Sharpe-ratios tend to decrease with the length of education; however, within a field there are mixed results. There is unobserved heterogeneity and there is a need for more sophisticated control variables.

These results indicate that even for student loan borrowers education can be a risky decision and in many cases the expected return is lower then what would be optimal. This made the comparative

analysis necessary. However, as Result 2 stated that student loan markets were slowly developing markets, exponential growth can change that. I compared the features of the student loan markets and human capital investment to other, more threatening in the sense of financial crises, forms of investments. This gave me Results 5 and 6. Chapter 4 analyses the possibility of a macro crisis triggered by a student loan exponential growth. It is pointed out that candidate countries for such a phenomenon mainly include the United States. The case of the United States is discussed in some detail. Result 5 was phrased in terms of a comparison of higher education spending to other markets, student loan debt to other sources of debt, the debt burden student loan creates and the status of those who have student loan debt over those who do not. *Hypothesis 3 can be rejected by Result 5 and Result 6.*

Result 5

The United States has the largest student loan market. Even after decades of growth that student loan market is smaller than the usual crisis-causing markets such as the equity market, household debt, or government debt. If we compare the compiled student loan with the total household debt we see that the share of student loans in the total level of debt has risen from 1% to 9% during the last decade, but it is still small compared to mortgage loans. In the 2012-2013 educational year 110 billion dollars were lent, but only 8% of this was non-federal. The state is heavily involved in financing higher education and there are existing channels where a bailout can be

easily performed. College graduates can expect an income that is enough to pay back their debt. There is only a possibility of a niche market crisis, such as a for-profit education crisis.

There are references to parts of Result 5 in the literature; in fact, it was phrased using them. As far as the author is aware, this kind of counter-crisis evidence collection has not been performed. But Result 5 only states that the current market is not a macroeconomic risk factor and those who expect a crisis predict exponential future growth. So additionally, Result 6 is offered, arguing that education investment cannot be a crisis factor because of its nature.

Result 6

The higher education market and the student loan market are not, by their nature, markets in which large positions can be accumulated, involving a major portion of the economy, and extreme future expectations can be created. The reasons can be summarized in the following 4 points:

1. Human capital investment can only be made by humans. Institutional investment (hedge funds, banks, pension funds, investment portfolios) can only support humans, but it is not tempting for them, compared to actual ownership of other financial assets.

2. There is a limited possibility to scale up investment in human capital. One cannot invest millions of dollars in education and expect millions back. With other investment assets this is possible.

3. Human capital investment has internal value. Human capital investment produces skills and knowledge that can be sold. Even if a human capital investment has little short run return, in the long run it is more likely to have a payoff. However if Result 4 is taken into consideration, it is arguable that education investment always produces some internal value.

4. Average real wages in society fluctuate very little over time. To experience 4 or 5-fold growth in tuition fees there has to be equal growth in real wage expectations. There are hardly any grounds for this.

Results of the thesis can be combined into a concluding remark to answer the research question: *The main question of the thesis can be answered in a nutshell by claiming that based on micro-level data it is very difficult to reject the idea that even some student loan borrowers take more risk than it is justified by future returns, but the possibility of a macro-level crisis triggered by student loan defaults can be rejected.*

The essence of the research was published in Vona (2014a), Vona (2014b), Vona (2015a) and Vona (2015b).

5. Possibilities for Further Research

The dissertation concludes with suggestions for further research. Usually a PhD dissertation is a report on certain milestones reached

during a research programme. Some results might open up new directions for further research and some can contribute to the work of other researchers. In this chapter possible spin-off research opportunities will be listed for the future, which might individually produce valuable papers if the results match the expectations.

Chapter 4 rejected the potential for a macro crisis to develop from a student loan crisis; however, based on the simple relationships in that section, we can easily highlight cases that could offer very exciting prospects for processing as a case study. A case in point is that of Chile, which has long been committed to a regime of financing of higher education that is numerically similar to a possible model that we could also recommend to countries following the large state involvement model. For the time being, these ratios are not yet reflected in a high per capita GDP; research with a case study could enable us to identify the economic impacts. The cases of Poland and Estonia lend themselves to case studies. The social embeddedness of the rapid emergence of Estonia could be an interesting topic.

Chapter 4 also highlighted for-profit higher education in the United States. It is a niche market within higher education, where disproportionate distributions can be witnessed; there are large private investments and a high dropout rate, so a thorough and in-depth analysis of that market can contribute to the existing literature.

Furthermore, student loans and their impact on educational choices is also a relatively poorly charted area in the literature. Fortunately, more and more secondary data enabling complex statistical analyses will become available concerning the financing of education. It will

be interesting to see the new issue of the OECD's Education at a Glance 2015.

The use of variance in the rate of return to education investment as the measure of risk is commonly accepted in the economics of education literature, both theoretically and empirically as introduced in Chapter 4. However, modern finance uses a different set of risk measures. These measures are quantile-based and focus on the tail of the loss distributions. Value at Risk, for example, answers the question: "What is the maximum of loss incurred in 95% of the best cases of our portfolio over the next two weeks?" (Acerbi, 2002). A similar question from an economics of education perspective would sound something like "What is the maximum of loss incurred in the 95% of the best cases of employment track records 5 years after graduation?" If the right data sample becomes available, interesting results can spin off from such an approach.

As reviewed in Hartog (2009), direct questioning of students is a branch of the literature. Risk-return mapping keeps indicating various education programmes that could provide topics for further analysis. A directed survey of students of health care, education, and economics studies about their motivations, expectations and attitudes could result in an interesting comparison and can be directly connected to the results of this research.

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List of publications related to the dissertation

Article(s), studies (4)

1. **Vona, M.**: Macro- and Microeconomic risks of student loans in an international context.
   Acta Oecon. 65 (4), 629-649, 2015. ISSN: 0001-6373.
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2. **Vona M.**: Nemzetközi trendek a diákhitelezésben.
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List of other publications

<u>Article(s), studies</u> (3)

5. **Vona, M.**: Innovation in the Service of Quality Higher Education - BME Case Study.
   In: Organizational and institutional innovation and enterprise clusters as sources of
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<u>Conference presentation(s)</u> (2)

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   Egyetem, Közgazdaságtudományi Kar, Sopron, 40-40, 2011. ISBN: 9789639883840

Total IF of journals (all publications): 0,179
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The Candidate's publication data submitted to the iDEa Tudóstér have been validated by DEENK on
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32