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University impact evaluation: counterfactual methods

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Abstract

Nowadays the realization that certain economic units, universities or other objects have impact on the economy of their region comes more and more into prominence. The economic impact study has become a standard tool to persuade state legislatures of the importance of expenditures on higher education. The most general definition is as „the difference between existing economic activity in a region given the presence of the institution and the level that would have been present if the institution did not exist.” In the practice we face a series of problems: separation of net and gross impact, identification of universities’ missions, territorial level choice, statistical model choice, estimation of induced and catalytic impacts, etc. Different methods used in literature make results hardly comparable, thereby our focus is to recommend a method to investigate universities in different countries: in the lack of regional input-output matrices a multiplier based approach for first and second missions (education and research), while an application of a set of indicators for third mission (knowledge transfer related) activities.

After a methodological review, we demonstrate our experiences based on example of the University of Lorraine (France), University of Szeged (Hungary) and 2 other small colleges in Hungary. Through this empirical evidence we can see the importance of benchmark of comparison; while these universities has about the same impact on per student level, there is a 200 times difference in the percentage of regional GDP. Equal or 200 times more important?

Keywords

local economic impact, university, public policy evaluation

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INTRODUCTION

Nowadays the realization that certain economic units, universities or other objects have impact on the economy of their region comes more and more into prominence. A growing demand appears to generate more precise studies regarding the quantification of economic impact of these entities. However, without a clear and uniform methodology, results are extensively scattered. The roots of these differences can be found

- in different activities of universities,
- in different methods of evaluation and
- in differences of local economies where universities are locked.

The roles of universities are also changing in time. As Wissema (2009) suggested, there are three generations of universities, while Pawlowski (2009) already mentioned fourth generation universities. The characteristics of these universities are summarized in Table 1.

Table 1. Characteristics of first, second, third and fourth generation universities

Aspect	First generation universities	Second generation universities	Third generation universities	Fourth generation universities
Goal	Education	Education and research	Education, research, and utilization of knowledge	Education, research, R+D+I, utilization of knowledge, and proactive economic development
Role	Protection of truth	The cognition of nature	Creation of added value	Local economic accelerator, strategy determination
Output	Professionals	Professionals and scientists	Professionals, scientists, and entrepreneurs	Professionals, scientists, entrepreneurs, and competitive local economy
Language	Latin	National	English	Multilingual (national and English)
Management	Chancellor	Part-time scientists	Professional management	Professional management and local experts

Source: Based on Lukovics-Zuti, 2014

The local economic impact of a large tertiary education institution such as a university is an issue which has attracted considerable attention in literature. Different methods used in literature make results hardly comparable. Generally, there are four substantial problems. First, the definition of impact (gross and net; direct, indirect, induced catalytic and other categories), second, measuring and estimating first-round university-related expenditures and avoiding double-counting, third, estimating the correct value of the multiplier or using the correct input-output model, fourth, the quantification of the third mission activities.

The structure of the paper is the following. In the first part, we take a theoretical overview of the impacts of universities. In the second part, we focus on measurement methods, solutions and problems. The empirical evidence for the two universities are shown in part 3, followed by a conclusion including a summary of open questions.

THEORETICAL OVERVIEW

The local economic impact of a large tertiary education institution such as a university is an issue which has attracted considerable attention in literature. *Beck et al* (1995, 246) define economic impact as „the difference between existing economic activity in a region given the presence of the institution and the level that would have been present if the institution did not exist.”

Florax (1992) and with modifications Garrido-Iserte and Gallo-Rivera (2010) showed that the regional and local effects of a university can be observed in many fields beyond economy (see Table 2).

Table 2. Classification of regional/local impacts of universities

Impact on	Example
Politics	Changes in the political structure, an increase in citizen participation, improvement in the organization of political processes
Demography	Impacts upon population growth, population structure and upon mobility
Economy	Impacts upon regional/local income, industrial structure, job market, labor mobility
Infrastructure	Impacts upon housing, traffic, healthcare services, retail
Culture	Greater offer in cultural goods, influence upon cultural environment
Attractiveness	Influence upon the region's (local) image, regional (local) identity
Education	Impact upon participation rate, changes in its quality
Social aspects	Impact upon the quality of life, the influence of the students, influence upon the region's (local) image and regional (local) identity

Source: After Florax (1992) and Garrido-Iserte – Gallo-Rivera (2010)

Table 5. Regional/local economic impacts of universities

Economic impacts of a university	Example
Employment at the university	Number of university jobs and related institutions
University income	State contributions, fees, benefits arising from entrepreneur activity, etc.
University expenditure	Purchase of goods and services by the university
Income and expenditures of the university employees	Wages and salaries, social security costs
Effects on the job market	Qualified job provision effect upon productivity; flexible working supply of the students
Generation of business	Companies created by university students and employees, with or without employment knowledge and technology
Knowledge marketing	The sale of knowledge in a variety of ways: from ideas, courses and patents

Source: Pellenbarg (2005)

Pellenbarg (2005) modified the table of Lambooy to achieve a complete list of economic impacts (see Table 5). However, this classification is a wide mixture of impacts of the three main missions of universities (education, research and university-enterprise cooperation) and has many double counting.

A series of articles sorts economic impacts by emergence. In some papers, we find input and output side effects, but a great variety of expressions can be found in the literature. While Dusek (2003) sorts the impact into input and output side effects (with students on both sides, see Table 3 and 4); the Segarra I Basco (2003) model divided backward and forward effects; Huggins and Cook (1997) transferred the keywords into drivers and outcomes, and in their approach, one cannot find hard measures on the driver side, while hardly have soft outcomes.

Brown and Heaney (1997) concluded that the input size effects may be better measured than output side effects, while the third mission of universities, the knowledge transfer has mainly social impacts. Notwithstanding, Beck et al (1995) argues that social (human capital) factors must be heeded, unless the major part of impacts would not be incorporated. We share that even the volume of the third mission activities is tough to recognize, the measurement of their impact on local economy can be correctly only through complex dynamic economic models. Lengyel (2008) emphasizes that input side impacts are better short-term ones while output side has long-term impacts.

Table 3. Regional/local impacts of universities on the input side

Actor	Changes
Households	+ income + employment + consumption
Local authority	+ tax base + services
Business	+ volume of business

Source: After Dusek (2003)

Table 4. Regional/local impacts of universities on the output side

Factor	Changes
Human capital	+ qualification + new firms + migration
Knowledge	+ university-business relations + extensive use of resources
Attractiveness	+ location choice of households and firms + cultural and social possibilities
Business	+ research and development, exhibitions

Source: After Dusek-Kovács (2009)

Garrido-Iserte and Gallo-Rivera (2010) also attached importance to the separation of short and long term effects, showing that emergence of the impact and its durability is not necessarily connected. The matrix of impacts in Table 6 can be a good starting point for policy evaluation exercises. The expenditure and knowledge based approaches are very similar to Brown and Heaney's (1997) skill-based and economic-based approaches.

Table 6. Classification of the economic impacts of the universities

Impacts upon	Short term	Long term	
Expenditures	Increase of the regional GDP Salaries Employment Taxes	Steady increase of regional GDP Investments on equipment	
Knowledge	Changes in the job market Development of human capital	<u>Subjective</u> Externalities Workers productivity Increase of income throughout life	<u>Objective</u> Patents Research and development

Source: Garrido-Iserte and Gallo-Rivera (2010)

Johnson (1994) argues to divide local and non-local (it is better a choice on which territorial level we identify impacts), direct and indirect impacts (see later), but he also attends to various negative impacts of universities and to the necessity of a net approach (i.e. individuals could spend more, if the government did not tax them to be able to pay the expenditures of universities – the double net question would be that people from where are taxed to pay the expenditures of the given university). The question of gross or net impact can be analyzed from many starting point. Generally, gross impact is easier to define and compute, as such questions arise that in the lack of the university

- what and where the staff would work,
- where students would pursue their studies (if at all),
- how large the difference of knowledge in the local economy would be, or
- what would be the difference of house prices.

We cannot forget that these questions are also linked to the choice of territorial level. The process can be observed when newly founded universities are investigated: e.g. most of the academic staff is coming from other (national) universities, while non-academic staff can be hired locally. Local house prices change slowly, so only complex comparative analysis (e.g. panel regression analysis) can detect the differences due to the presence of university.

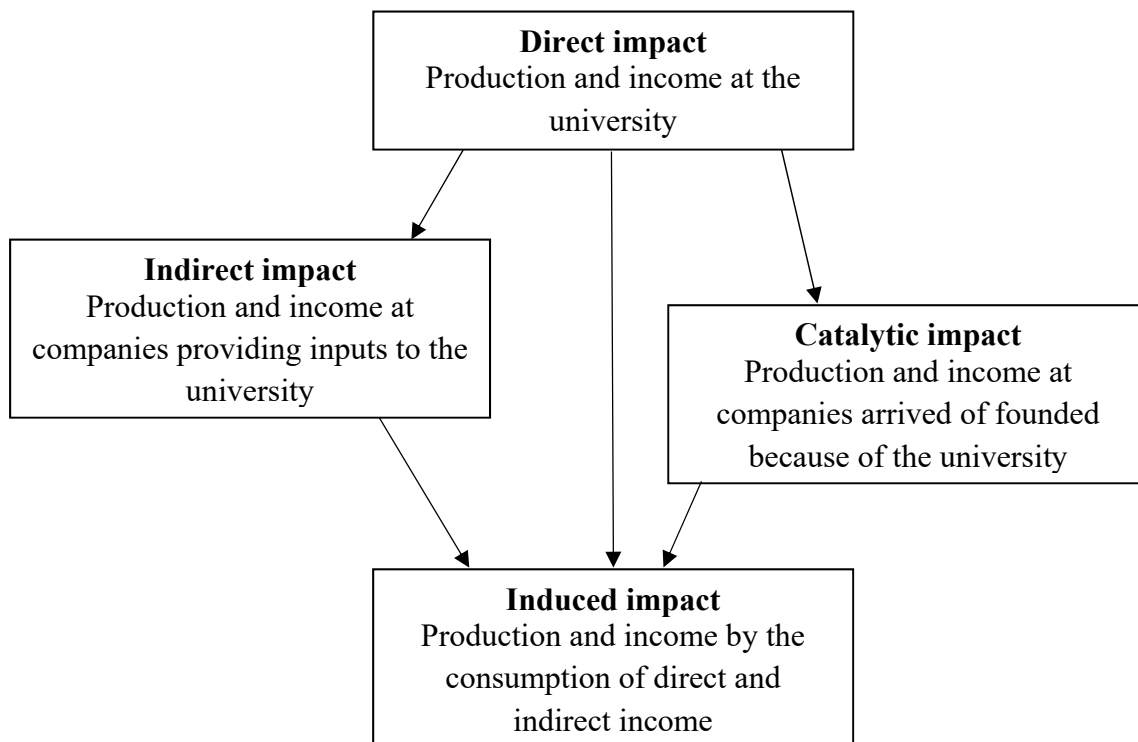


Figure 2. Direct, indirect, induced and catalytic effects
Source: own construction

The classification of impacts from the point of view that how directly the impact is related to the activity of the university is widely varied in the literature. We can find twofold, threefold, and fourfold classifications. The common point is the separation of direct and indirect impacts, where direct impacts include the expenditures of the university, the staff and the students. In a larger classification, we have induced impacts (Klophaus, 2008), while in the fourfold version, one can also find catalytic impacts (for these impacts see Lukovics-Dusek (2014) for university-related research, or Dusek-Lukovics (2011) for business service). The modified version of these classifications stands for universities as:

- direct impact: output, income and workplaces created on-site owing to the investments and operation of the university,
- indirect impact: income and employment generated in the companies providing inputs for the university,
- induced impact: income and employment generated with the multiplier impact owing to spending the incomes,
- catalytic impact: productivity growth achieved through the operation of the university, the income and employment created through the companies settling because of the university and the spending of the visitors arriving because of the university.

The contradictory and sometimes misleading mélange of the impacts can be well shown by juxtaposing (see Table 7) those of the Garrido-Yserte–Gallo-Rivera (2010) and the French school represented by Gagnol-Héraud (2001) and Baslé-Le Boulch (1999).

Table 7. Regional/local economic impacts of universities

Impact	Meaning	
	<i>Garrido-Yserte–Gallo-Rivera</i>	<i>Gagnol-Héraud</i>
Direct	related to the local expenditures of the university, staff and students of the university	consumption of the university, staff and students of the university
Indirect	multiplied income (each euro spent at the location by the university community (university, staff and students) generates indirect transactions in the location linked to businesses that do not have a direct relation to the university	impact through education of the work-power, development of synergies of R&D with regional enterprises
Induced	the expenditures of the people that visit the university, the effects upon financial institutions, the effects upon property value, and the impact upon location of new companies and so on	multiplier effect

Source: Garrido-Yserte–Gallo-Rivera (2010) and the Gagnol-Héraud (2001)

In this confusion, we would recommend to use induced impact to all effects that are generated by the multiplication process. In the Lukovics-Dusek classification, the separation of direct and indirect impacts is artificial (practically, we separate personal expenses from purchase of assets and investment, its cause can be the local analysis: on-site created income is always local – nevertheless not necessary locally spent). The catalytic impact of Lukovics-Dusek, the indirect impact of Gagnol-Héraud and the induced impact of Garrido-Yserte–Gallo-Rivera have almost the same content. While it is not widespread in the literature, the catalytic expression better describe the content of this category than indirect or induced (induced seems to be the worst choice).

We have to add two important remarks about the specialty of universities as economic units. Once, policy evaluation is often applied to production units (where a marketable product is the result) or infrastructure elements (rail lines, highways, and airports). Universities produce knowledge, the value of which is not practically measurable directly and exactly. Thereby classical separation of direct and indirect impacts is useless: the product of the university is not sold directly, the addition of expenditures and revenues of the universities is a simple example of double counting. Second, the comparison of public and private institutions can shade the question of primary impacts. Private universities can better commercialize their product and there is revenue is more dependent on local purchasing power.

In the case of universities to avoid misunderstandings ‘primary’ effect for direct impact of Table 7 (including direct and indirect of Lukovics-Dusek) should be better. However, induced impact as the multiplier effect of the local economy; and catalytic impact for all impacts that are over the static view of current expenditures and their multiplication. We can

already conclude that most of research has the goal to estimate primary and induced impact, but catalytic impact created by knowledge accumulation are less considered.

METHODOLOGY

The main methodological possibilities are the use of input-output matrix based models or the Keynesian multiplier model family. As up-to-date local or at least regional level input/output matrices are not available (neither for France, nor for Hungary), we could not use the first type of models. The use of such models are typical in the USA where such matrices are accessible in state level, but these models have a territorial scope of state level.

The question of using or not input-output matrices is also double. If such a matrix is available and is enough detailed, it can facilitate the calculation of primary impact: to find the primary impact we need the same data, induced impact can be get from the input-output model, but modifications of the input-output model that are necessary to get the catalytic impact seems to be more complicated than by other methods without input-output matrix. When this type of matrix is not available, its construction needs more resources than the advantages of its use can be.

The territorial scope is also linked to the possibility of use input-output matrix. While - in Europe - at national level we can find such matrices they are not too often at NUTS2 or NUTS3 level, while at local level they are very uncommon.

The territorial scope of our empirical analysis was local. In Szeged, the university is dominantly in the city (with one small faculty out of the city), in France we had the possibility for the survey only in Metz, and so a regional estimation of the impact of one campus would not be meaningful. Using a larger territorial scope would increase the absolute gross impact, but per capita or per GDP impact may be smaller. Whenever it was possible, we used data for 2014 (Kotosz et al 2016a and Kotosz et al 2016b)

In Bleaney et al (1992) we can find a mathematical deduction of the formula of the Keynesian regional multiplier. This method is the most often used one for computation, with a series of disadvantages and deficiencies. Its simplicity makes it so popular, as a relatively narrow scale of data is necessary. The method we applied is a modification of Caffrey – Isaacs (1971) and Bridge (2005) models, we can also call as a simplified ACE model in the terminology of Garrido-Yserte–Gallo-Rivera. The original Bleaney-model was modified at two points: (1) we use and apply local consuming habits (with rough estimation of local marginal propensity to consume), (2) we calculate primary production and consumption effect in two steps. The latter methodological background is described in Felsenstein (1997).

The multiplier is the function of the following factors:

- Personal income tax rate (average rate) [t]
- Value added tax (average rate) [n]
- Marginal propensity to consume [c]
- Local consumption proportion of students [d]
- Local consumption proportion of employees [e]
- Local consumption proportion of the university [b]
- Local consumption proportion of the local economy [f]

Armstrong-Taylor (2000) and Lengyel-Rechnitzer (2004) supposed a fix amount of spending of visitors and an equivalent local consumption proportion of students, employees

and the university. Instead of the latest, we applied a two-step estimation, so different proportions could be used. Thereby the formula of the multiplier is:

$$\frac{1}{1 - f \cdot c \cdot (1 - t) \cdot (1 - n)}$$

Expenditure data of the universities can be reached from public information (profit and loss statements). In the case of multi-campus institutions, allocation of expenditures by campus has been based on our estimation (when expenditures cannot be definitely allocated, we used keys related to relevant activities: number of students, number of academic/non-academic staff, area, etc.). We supposed that employees have an additional income of 20% over their salary at the university. Estimation of visitors' expenditures is based on conferences and other events attracting visitors. Otherwise visitors affect barely the total economic effect.

To map expenditure of student, we asked them to fill in a questionnaire (in 2014 in Szeged, and in 2015 in Metz). This element was based on a representative sample, we multiplied the sample mean by the number of students enrolled at the university/campus.

To estimate the locally valid consumption function, we can follow two different ways. From one part, we can use national statistics, as by empirical evidence (see Árvay-Menczel 2001, Vidor 2005) local and national functions are not significantly different. From the other part, local sample surveys can also serve as starting point. Our computations also showed that national or regional cross-sectional and time series data give largely different results, between 0.45 and 0.7 in both countries. We have local, survey-based results only for students. While Dusek (2003) found a high marginal propensity to consume in his survey of students (over 0.7), our results in Hungary are below 0.5, while in France around 0.5. In the model, we use a unique marginal propensity to consume, we applied the most reliable national and regional estimations with a consensus value of 0.6.

The lack of reliable geographical knowledge of students (in many cases they did not know in which county the university was working), pushed us to choose the local level as the city where the university is located (Szeged and Metz). By extending the geographical area, higher rates a local consumption data is taken, increase is not proportional with distance.

The local consumption proportion of students varied around 70-80% based on our survey data (in accordance with previous data from other surveys). This number is always higher than the rate of local students, which is around 30-40%. In our estimations, we used the value of 0.7 in Metz, and 0.8 in Szeged, as the results of the surveys.

Estimation of employees' local consumption proportion is one of the most problematic point of the process, as in neither cities we had not the right to ask employees by a questionnaire similar to students' one. As a result of the suburbanization process, we supposed that local consumption proportion is lower than students', we used 75% in Szeged, but only 60% in Metz.

Local consumption proportion of public universities in Europe is typically determined and restricted by national law. Well-known estimation problems arises with the limitation of local level (see e.g. Székely 2013), but this question is beyond the goals of the paper. We analysed the official documents of the universities and estimated these impacts by separating local and non-local items. We used a 70% value for Szeged and 80% for Metz.

For the average tax rates, we used recent estimations of the Hungarian National Bank for Hungary, and Ministry of Finance data for France. While average VAT rates are similar (16% in France, and 20% in Hungary), NUTS3 level average personal income tax rate is only 6% in Lorraine, while the national statistics of Hungary was 20.1% (for methodology, see Benczúr-Kátay 2010). This difference can be explained by inclusion of some social security contributions.

Generally, in scientific papers on impact studies, there are detailed *theoretical* comparisons of previously applied methods, but we cannot find international comparative studies where invariable method has been used. Even with deficiencies, we can internationally compare the impact of the analyzed universities.

EMPIRICAL EVIDENCE AND RESULTS

Even if the theoretical background is not unanimous, but well-known, estimation methods are wrought and discussed (see Siegfried et al, 2006 for a general comparison), and many international empirical example can be found in the literature (Armstrong 1993, Blackwell et al 2002, Bleaney et al 1992, Bridge 2005, Brownigg 1973, Carroll-Smith 2006, Cooke 1970, Huggins and Cooke 1997, Jabalameli et al 2010, Lewis 1988, Love and McNicoll 1988, Ohme 2003, Pellenbarg 2005, Robert-Cooke 1997, Simha 2005, Tavoletti 2007), until 2010 only one finished case study was known for Hungary, the case of the university of Győr (Széchenyi István University) (Dusek-Kovács, 2009). Some steps were also made in Pécs (Mezei, 2005), but this research has not reached the level of having at least one numerical result. An intensive phase of research started after 2010, the first results have been published in Kotosz, 2012 and Kotosz, 2013 for small colleges and in Kotosz et al (2016a) for the University of Szeged. In Lukovics-Dusek, 2014 we can also find an example impact study of a research-oriented future object.

In France, three scientific impacts studies are known, for the case of Strasbourg (Gagnol-Héraud, 2001), for Rennes (Baslé-Le Boulch, 1996), and for the University of Littoral (Mille, 2004). The latter paper can handle only partially the questions, without an expressed amount of euros as impact.

The higher education system in the two countries are similar in the sense that originally they are based on state-owned/state-financed universities, complemented by smaller private schools where education is more accentuated than research. As a soviet heritage in Hungary, an independent (from universities) academic research center network survived. In France, research centers are more integrated in the universities, often creating a matrix system of education and research. Education divisions may run under different names (faculties, education and research units, institutes). While in the Hungarian system, faculty positions are also divided to lecturers and researchers, France academic staff members are lecturer-researchers. These characteristics do not help the separation of education and research-related expenditures and incomes.

The French higher education system had not realize such shocks, and the number of students has a growing trend with more than 2,400 thousand students in 2014. The significantly higher wage level in France can be observed in a dominancy of personnel costs in the budget of public universities.

The University of Szeged was founded in 1872, and has about 25,000 students and 12 faculties. After various historic events, in 2000 it has unified almost all faculties working in the city. The Faculty of Medicine integrates a clinical center (hospital) with activities that cannot be separated (financially) from the university. Szeged has around 170,000 inhabitants, in a region which is among the 20 poorest regions of the European Union (measured in per capita GDP).

The first university in Metz was founded in 1970 based on smaller higher education institutions already existing in the city. In 2012, the universities of the Lorraine region have been unified to create the University of Lorraine which is the second largest university of France (by the number of students). The university has more than 50,000 students, 13,000 of them located in Metz where 6 faculties can be recognized. As our research concerns only the

city of Metz, university budget items had to be divided by keys. The city of Metz has about 120,000 inhabitants, in a region less developed than the French average (but over the EU average).

The main findings of our research for Szeged and Metz are summarized in Table 8.

Table 8. Economic impacts in Szeged and in Metz

Impacts	University of Szeged (million EUR)	University of Lorraine (million EUR)
Primary impact (revenue)	167	80
Induced impact (revenue)	52	39
Total impact (revenue)	219	119
Primary impact (production)	240	94
Induced impact (production)	74	46
Total impact (production)	314	140

Source: Kotosz et al 2016b

COMPARISON AND CONCLUSION

In the level of comparable results, we can analyze the impact per student or the impact per regional GDP. In Kotosz et al (2015b) 8 benchmark examples are compared. Some of these benchmark examples used input-output matrix, while others not. We can find in this comparison USA, Turkey, Spain, UK and Hungary-based institutions. Not only the multipliers (it is a widespread point of comparison) but impact per student and impact in percent of regional GDP is compared. By these results the impact per student is in the range of 3500-60000 USD (17 times difference), while the contribution to regional GDP is between 0.02 and 3.0% (150 times difference). All extremities were computed by input-output models.

The results around 10 thousand EUR impact per student in our target cities seems to be a general average impact; and it is not surprising. In the percentage of the regional GDP, the impact in the USA is generally in the range of 0.1-3.0%, while in Europe only 0.02-0.10%. Our results of 4% in Szeged and 0.02% in Metz are extremities. If we consider that the university clinic has already an impact of 3-5 times higher, the Lorraine has 8 times higher GDP; and a correct comparison at regional level would be the use of the impact of the whole University of Lorraine (about 5 times higher impact). These differences are more important than any data errors or small methodological differences.

Our main conclusions can be formulated in two ways.

1. Different benchmark will give huge differences in results, so usual methods are hardly able to make correct comparisons of different universities. As our empirical evidence proves, the same methodology applied in different regions for differently structured universities can show the same or 200 times more important impact.

2. We don't know too much about catalytic impact of universities (Kotosz et al, 2015a). Most of studies does not estimate the impact of such factors as added values of trainees, voluntary work of employees of the university, changes in the real estate market generated by the university, inventions in the local economy, and increase on total factor productivity. The exact impact mechanism of inventions or human capital accumulation caused increase of total

factor productivity is not known yet; simple input-output models not (Martin, 1998), but only complex regional economic models (like described in Varga 2007) can handle them after serious modifications.

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