JMNE (2014) 1:71-84
DOI 10.14667/2283-5911-21-1-006

ARTICLES AND TESTIMONIES

Economic Impact Analysis of the ELI R&D Infrastructure and Science Park

Miklós Lukovics • Tamás Dusek

Abstract The implementation of the ELI-ALPS laser research centre in Szeged will create unique opportunities for both Szeged and Hungary from political, scientific and economic development aspects, however the countless generated effects will only obtain their real, and extremely significant potential if a science park emerges around the ELI-ALPS that specializes in the execution of knowledge-based activities. The desired ELI Science Park will be quite specific and unique compared to other territorial concentrations. Prospectively a wide range of research activities will be present in the park. Only a minor part of this will be in connection with laseroriented applications and hence will be closely connected with the ELI-ALPS, focusing on IT, medical imaging, biology and biotechnology (proteins, particles, particle radiation, x-ray, examination of tumours, pharmaceuticals, materials science, and nanotechnology).

In our study we attempt to quantify the impact of the ELI-ALPS and the Science Park on the local economy based on a sophisticated international methodology. We quantify the so called direct, indirect, induced and catalytic effects separately. Regarding the general roles, we will quantify the measurable and well-predictable effects of income and workplace generation. The results will be compared to the income of the population of Szeged for the purpose of easy understanding. The discussion of this particular case also allows several reflections on the methodology of local economic impact studies.

Keywords Local economy - Economic impact - Local economic development - Science park

JEL Classification R11 - H70 - L89

Miklós Lukovics (✉)
Faculty of Economics and Business Administration,
University of Szeged, Hungary
e-mail: miki@eco.u-szeged.hu

Tamás Dusek
Department of Economic Analysis, Széchenyi István University,
Győr, Hungary
e-mail: dusekt@sze.hu

Introduction

Every new investment has some impact on local economy and society. Such impacts occur both as short-term effects, during the term of investment when the number of local construction contracts and employment increase, and as long-term effects during the operation of the new investment on wages, employment and other effects. It is obvious that such impacts may significantly vary depending on the type of investment, e.g. light industry investment or an assembly plant based on cheap, unskilled workers; a waste disposal that has special environmental effects; a refugee camp; a research laboratory; or an innovative high-tech enterprise that requires highly qualified personnel.

The implementation of the Extreme Light Infrastructure Attosecond Light Pulse Source (ELI-ALPS) laser research centre in Szeged will create unique opportunities for both Szeged and Hungary from political, scientific and economic development point of view. However, the countless generated effects will only obtain their real, and extremely significant potential if a science park emerges around the ELI-ALPS that specializes in the execution of knowledge-based activities. ELI-ALPS and the Science Park can be an exemplar of knowledge-intensive agglomeration encouraged by local development policy. However, the real impact of this important investment can be determined only ex post, historically, about some decades later. Today only an ex ante vision can be depicted, according to the known plans and expectations. The main aim of this study to quantify the impact of the ELI-ALPS and the Science Park on the local economy and beside this to contribute to the theory and methodology of local economic impact studies. First of all the concept of Science Park and the specific characteristics of ELI-ALPS Science Park will be examined. After it a brief overview about the general and critical questions of local economic impact studies will be presented. We give a typology of local economic impacts and discuss the spatial and temporal scope of investigations. In the empirical part of the study we quantify the so called direct, indirect, induced and catalytic effects separately. Regarding the general roles, we will quantify the measurable and well-predictable effects of income and workplace generation. The results will be compared to the income of the population of Szeged for the purpose of easy understanding.

On science parks and the ELI-ALPS Science Park in Szeged

The concept of science parks originates from the USA, home of the first science parks. The two earliest examples of successful science parks are around Stanford University and the Silicon Valley in the West Coast, and the universities of Boston and Cambridge and the area along Route 128 surrounding them in the East Coast. At both places a high concentration of important higher education institutes, research institutes and information technology firms created. Geographical proximity of academic research institutes and innovative enterprises and the cooperation between them often based on personal relationships led many times to successful and innovative business enterprises. By consciously copying that mainly spontaneous, concentrated development defined in space, science parks were formed from the early seventies first in England, then in western Europe and the whole world (Massey-Wield, 1992; Goldstein – Renault, 2004). The means of establishing and supporting science parks are providing venture capital, additional spending for education, incubator space, technical assistance (Glasmeier, 1988; Blass, 1998). Science parks are now found in many countries, from the most developed areas (e.g. western Europe, Japan, Singapore and Australia) to less developed and developing regions (e.g. Latin America, central and eastern Europe, and China).

The term *science park* is not standardised but the UK Science Park Association membership conditions form a good ground with their precise definitions. A science park is a property initiative which has formal operational links with a university or other higher education or research institution; is designed to encourage the formation and growth of knowledge-based businesses and other organizations normally resident on site; has a management function which is actively engaged in the transfer of technology and business skills to the organizations on site (UKSPA, 1985). Based on this definition an industrial research institute and the innovative businesses around it do not form a science park.

There are several types of links between science parks and universities. Sometimes the university operates the park. An example of that is Cambridge in England. Another type is when a joint venture operates the park, and the university or its independent department is involved in the enterprise, together with other participants (the city, the region, or a development-business agency). And it is also possible that the park is organisationally independent from the university but a formal and multilateral cooperation exists between them. The science park in Szeged is financed mainly by European Union funds and the Structural Fund. The total investment of Eli-Alps is 245 million Euro, of which 85% financed by the European Union. This also means the Eli-Alps Science Park will only have a small resource redistributive impact on the country level. However, on the level of European Union, the redistributive impact is undoubtful.

The goals of science parks are briefly as follows. Main goal is to promote foundation and growth of innovative enterprises and spin-off companies initiated by researchers in new, technology intensive sectors with a high proportion of intellectual work. Strengthening the ties between higher education and industry, supporting commercial use of academic and basic research, and assisting technology transfer and synergies between businesses are also important. It is not a priority but usually science parks influence and shape business activities and attitude of young researchers. And science parks purposefully serve a positive role in developing local economy, creating jobs that need qualified personnel, increasing income production, local image and attractiveness.

All these goals and impacts will be present at ELI-ALPS Science Park as well. Out of the more general roles, in this study our purpose is to express in numbers the measurable and well-predictable factors of income production and creating jobs. Success of the science park in Szeged can be expected due to the fact that the laser research centre will certainly be realised and will be present for a very long time. Another success factor is the attractiveness of the already existing research capacities of Szeged. It is hard to estimate the exact composition and size of ELI Science Park, but we can expect a wide spectrum of research activities. Only a smaller part of them will be connected to laser research applications and will have a close connection to ELI-ALPS. These will presumably include research on information technology, medical imaging, biology and biotechnology including proteins, particles, particle radiation, X-radiation, cancerous tumours, pharmaceutical technology, materials science and nano science. It is expected that a wide range of businesses will appear, strongly connected to the abovementioned enterprises, giving them inputs and receiving their outputs but having looser or no ties with ELI-ALPS. Finally, ELI-ALPS Science Park will stimulate foundation or growth of businesses that will not necessarily be located at the Science Park but will offer different services and outputs to the companies located in the Science Park.

The basic questions of local economic impact studies

There are two ways of analysing the role of an economic unit in local economy. The first and more widely used definition says that the economic impact may be defined as the difference

between actual economic activities and the economic activities in the absence of investigated economic unit. That difference can be defined in terms of production, income, employment, human resources, general business atmosphere, real estate market and other factors. (Barrow – Hall, 1995; Beck et al, 1995) So the first approach shows what would happen if that certain economic unit did not exist, how much less income, less employed persons, and other economic changes were present.

According to the second approach this change may be compared to the opportunities that would occur if the resources used by the enterprise were available somewhere else in production, e.g. if instead of an assembly plant other investment was realised. Failing to do such comparison would clearly identify almost all economic actors positive effect and could emphasise their positive role in local economy as all have some employees and all make some income during their operation. Thus while the first approach concentrates on gross or absolute impact, the second approach goes beyond that and also considers production, income, employment and other effects resulting from the possibility of alternative uses of an economic unit's resources. This second approach focuses on net impact and that may even be negative. However, before conducting the second approach, firstly a prior and temporary absolute investigation should be made. (Barrow – Hall, 1995; Drucker – Goldstein, 2007)

Although the second approach is more complex and is supposed to provide a fuller description, it also involves more speculation; its numeric results are less certain and virtually are never fully comprehensive. The first approach mainly focuses on numeric, observable and somewhat measurable factors. In general, both approaches are justifiable. Choosing the more suitable method is not unrelated to the economic unit to be examined. Assessing alternative uses of resources is reasonable and possible in most sectors of agriculture, industry and services, because there are close substitutes for the output of an enterprise and usually very slight economic spillover effect may be considered in the absence of an economic unit. It is easy to imagine the absence of most enterprises in the abovementioned sectors and their replacement by other enterprises. A new retail unit or restaurant somewhat decreases the turnover of the already existing retail units or restaurants, and the fact that it attracts customers away and a change in commercial routes must definitely be considered. This change may force to close some of the existing units because of being uneconomic due to the loss of consumers. This process has disadvantageous consequences to the geographically less mobile social groups. (Hillman, 1973; Guy, 1977)

A new assembly plant reduces the human resource available for the other businesses, and makes it more difficult or expensive for them to expand their capacities. Grime and Starkie (1968) shows that a totally new factory contributes extremely little direct impact on the unemployment problem. Mainly former employees of existing, other firms became employees of the new firm. The study examines the change of journey time to work also. This type of study is very rare, because companies (or other actors, like universities, ports, sport clubs, festivals and so on) are not interested in such type of research. They always want to stress on their positive impacts on the local economy therefore they are interested in biased studies. This is the characteristic features of studies by consultant companies and agencies made for public relation, marketing reasons or for obtaining subsidies, tax abatements or other form of legally guaranteed advantage in competition.

The ELI-ALPS laser research centre to be built in Szeged and the Science Park developing around it will have relative small local economic excluding effect, compared to industrial factories and retailers. In terms of employment it actually will be limited to administrative

personnel of enterprises.[1] As the investments are of very special and non-replaceable type we cannot identify an excluding effect in the sector, so there will typically not be an elimination of R+D activities of the same size as ELI-ALPS and the Science Park. Excluding or displacing impact will occur when the territorial level is changed from local to global and worldwide. Due to the completely international nature of ELI-ALPS Science Park activities displacement impact is small on national level and will rather be valid on global level, attracting research capacity and researchers to Hungary, and keeping researchers in Hungary who would work in another research institute abroad in the absence of ELI-ALPS and the Science Park, and the innovative enterprises would be founded somewhere else.

When comparing ELI-ALPS Science Park to typical enterprises, it has two characteristics beyond the abovementioned factors that significantly increase its role and weight in local economy. First, the employees will have higher-than average income and consumption. Second, among the input needs of businesses the proportion of high added value local services will be higher than usual. It is also worth to mention that the output will have a significantly higher export proportion than typical small enterprises, which means much higher market sales and potential to grow.

These special characteristics justify the use of the first approach to examine local economic impact, so we may disregard examination of effects arising from alternative use of resources. We will describe methodology of the analysis later on.

Types of local economic impacts and examination methods

By the 1970s there has already been a great amount of theoretical and empirical literature on local economic impact of different economic units and how to examine them. The analyses and methods can be classified in many ways; there is no one general and unified methodology. A unified methodology cannot be formed as local businesses vary greatly in size and quality, have different structures, and they have very different characteristics and spatial relations. Completely different factors may be important when analysing an administrative unit, a paper producing company, a sport club or event, a port or airport; or when a business is located in a small town with ten thousand or in a metropolis with ten million inhabitants. Research methods may also vary due to the goal of a research, as statistical data, sampling, econometric models, surveys and expert interviews are suitable to provide answers to very different research questions. Data availability may also restrict applicable methods.

Thus this part of the study shall not aim to standardise possible impacts and methods based on professional literature and earlier empirical works, but simply to emphasise points relevant to the analysis. This is useful because actual researches may use the same terms to describe different things, or they may operate a concept differently, or they may be analysing the very same things under different terms. At the same time some studies describe their methods and sources of data rather vaguely, which makes it difficult to analyse and generalise data.

Economic impact analysis usually describes two, three or four types of impact. Consequently, there are four general terms: direct impact, indirect impact, induced impact and catalytic impact.

[1] Note: when talking about science parks in general we use the term *science park*. When talking specifically about the science park in Szeged, which is the focus of this study, we use the name *ELI-ALPS Science Park* or simply *Science Park*. When we only refer to ELI-ALPS itself we use the name *ELI-ALPS*.

1. Direct impact: output, income and jobs resulting from the investments and operation of a given economic unit.
2. Indirect impact: income and employment generated at local businesses that offer inputs for a given economic unit.
3. Induced impact: local income and employment generated by the multiplier effect resulting from spending the directly and indirectly created income.
4. Catalytic impacts: changes in local economy generated by the operation of a given economic unit. This may include increased attractiveness of investment, local image, effects on the structure and composition of local economy, impacts on workforce qualification, education, dwellings and real estate market, local services and attracting visitors. This effect might be negative if the given economic unit creates a negative image, repulses other investors and reduces local attractiveness.

In the case of three impacts, the terms of direct, indirect and induced impacts are the most frequent, and in the case of two the direct and the indirect. Classifications when only two or three types of effects are described may be criticised because they blur the line between indirect, induced and catalytic effects while they are easy to distinguish and occur through easily distinguished modes of action, or they simply disregard one of the effects.

The most important and usually most precisely definable effects are the direct effects. Although it is not always differentiated, impacts originating from ordinary course of business and impacts from the development and investments may be separated. The separation is justified if significant investments and capacity expansions are realised in the examined period; the separate treatment of the regular smaller investments and maintenances would make the analysis unnecessarily complicated. In this study we deal only the impacts caused by the future course of business and not with the investments.

We shall concentrate on direct effects, indirect effects, and the part of dynamic effects arising from attracting visitors, which can be expressed in numbers to some extent. We will also provide an estimated induced effect, which is the most uncertain effect due to the difficulty of defining local economy. Among the catalytic impacts several one is unquantifiable, but extremely important. We do not give a quantitative estimation for example the changing structure and prices of real estate market, the shifts in cultural demands by the family members of workers in Science Park, the effect on local traffic and tourism and so on.

Spatial and temporal scope of the impact analysis

Szeged, the third biggest city in Hungary, has 161 thousand inhabitants. As opposed to smaller settlements, Szeged itself without its sub-region can be viewed as a large and complex economy, thus it can be defined as a local economy. This way the impacts of ELI-ALPS Science Park can be expressed in relation to Szeged economy as well. As not all employees at ELI-ALPS Science Park will be residents of Szeged, a part of the primary impacts will overflow to employment area of Szeged, while some impacts will occur on national level (through tax revenues). Indirect effects will also have an impact in a wider region, but they will be strongest in Szeged and will decrease gradually as the distance grows.

On worldwide, production and income must be equal. However, at local level, production and income effect can be significantly different from each other. Income effect is more important than production effect. Net labour incomes can be treated as the primary source of local incomes: most part of taxes is geographically centralized and redistributed, capital incomes are

more mobile and less localisable. Therefore we will focus on local income effect, we examine the taxes and revenues of state, but we ignore the local production effect.
The study applies to the time when ELI-ALPS becomes fully constructed. We cannot talk about full construction of the Science Park because international examples show that science parks may keep growing even after a decade of operation. We can expect a well-constructed Science Park by 2020, and our study may be used as estimation or forecast for that year. We deal with the effect of price level change by making the calculations on the price level of 2011 (because personal income tax details are known for that year, but otherwise the year has no effect on the outcome). After the start in 2015 the operational impact of the Science Park will have a tendency of increasing year by year.
Due to the fact that they are hard to express in numbers and to localise, we are not going to consider the investment's one-time impacts generated by creating the physical infrastructure, property and road construction, purchasing investment and durable consumer goods. Still, that is a very significant factor that has a spatial scope overreaching Szeged.

The vagueness of induced impact

The vaguest part of every local impact analysis is the induced impact, which originated from the export base theory. The theoretical shortcomings of this approach are well presented in the paper of Loveridge (2004). For a correct estimation the local consumption rate and tax rate are needed but not enough. Local rate is dependent on the spatial definition of local economy also. Beside local consumption, an input-output table with the localisation of every transaction would be necessary, but this is an impossible task at company level also. Moreover, the share of local value added of consumer goods is also needed, because the non-local part of locally consumed consumer goods must be imported, therefore it leaves the local economy. Survey based method of estimation was conducted during the seventies and eighties, but it was rare due to the enormous cost and complication of this type of research.
In an early paper (1944) the estimated multiplier was 7, which became popular among the politicians and economic development professionals (Loveridge, 2004). However, this is clearly largely overestimated result. Loveridge cited several later papers, which used multiplier between 1 and 2. (Loveridge, 2004, p. 307) Lewis (1986) publishes multipliers between 1.13 and 1.54, which are concerned to various regions of Great Britain. The lowest value belongs to Isle of Skye, the smallest local economy. Brownrigg (1973) estimated the multipliers between 1.24 and 1.54. In the study of Love and McNicoll (1988), the size of multipliers were between 1.34 and 1.43. Latham and Montgomery (1979) gave estimations to Kansas State, 34 different branches of economy, according to the input and output data. Their multipliers vary between 1.55 (other transportation equipment) and 3.10 (agriculture). Brown's (1972) multiplier was 1.4 at short term and 1.7 at long term. At various assumptions, the consumption multiplier varied between 1.02 to 1.11 in the study of Oakland et al. (1971). This study is unique, because the estimation was based on detailed household expenditure survey. However, it was conducted not a region or a whole city, but a district in Cleveland.
We can make neither household expenditure survey nor input-output survey. However, it is a reasonable assumption, that the results would be very similar to the previous studies of various cities and regions. Therefore, known the size of local economy and the tax rate, we will use a multiplier of 1.7[2].

[2] About the methodology and size of multiplier see the papers by Lever (1974), Steele (1972), Gordon (1973) and Kotosz (2013b). These are older studies, but the methodology did not change.

Direct impact of ELI-ALPS on income and employment

The plans of ELI-ALPS operation show that after ELI-ALPS is fully constructed, there will be around 250 employees, out of which 130 researchers and 120 persons working in service, technology and administration.[3] The researchers to be employed will have very special knowledge and they will be recruited from all over the world. Each researcher position may be regarded as new job that increases the total employment in Szeged. This is correct even if some positions will be filled with researchers from the University of Szeged, because then the previous university or research positions will need to be filled. In the short term those may primarily be filled by labour import.

It is known that researcher salaries will equal to western European researcher salaries calculated on the basis of purchasing power parity, which means they will nominally be lower than researcher salaries in Munich, London or Copenhagen. Considering that these positions are absolutely international, there could be no other way to attract or keep researchers. Since western European salaries are not standardised and there are several methods and results of calculating purchasing power parity, wages cannot exactly be determined but their order of magnitude can surely be calculated. Based on comparison of researcher salaries in several western European countries, and calculated upon prices in 2011, an average HUF 9 million (1 euro is approximately 300 HUF) gross researcher salary may be used for further calculations. This amount includes all benefits beyond the basic wage. This is 3.5 times the domestic gross average wage (HUF 2.56 million), almost 2.5 times the university associate professor basic wage, and 1.9 times the average wage in information and communication sector (393 thousand Hungarian forints per month in 2011).

When estimating non-researcher salaries we based our calculations on the fact that most of these jobs also demand special knowledge and high responsibility. Thus for those jobs an annual 4 million Hungarian forint may be used for calculations, which is significantly higher than the average Hungarian wage. Still this is a rather cautious estimation because annual average Hungarian wage in 2011 was HUF 4.7 million for the information and communication sector, HUF 5.5 million for the financial and insurance sector, HUF 4.56 million for the energy industry. This means that the wages calculated are definitely high but compared to similar positions they are average or even slightly lower. When comparing to white-collar work in the abovementioned sectors, our estimation is even more cautious, as white-collar workers in the energy sector have an annual average wage of HUF 5.7 million, and their wage is also higher than main average in the two other sectors.

Accordingly, gross annual income of employees is expected to be HUF 1170+480=1650 million. We can compare that to personal income tax base of the residents of Szeged in 2011, which added up to HUF 125.3 billion. Therefore ELI-ALPS itself will generate a primary, gross personal income equal to 1.32% of total Szeged income. Net amounts would be similar in proportion; both amounts would be lower by approximately 34%, the average amount of taxes and contributions on wages. At the same time the 27% social contribution tax payable by the employer, supplementing gross wage of ELI-ALPS employees could also be taken into consideration. That HUF 445 million adds to the central budget.

Due to the fact that salaries are significantly higher than the average, direct employment effect is not as strong as direct income effect. In Szeged there are approximately 75 thousand people employed, including commuters. ELI-ALPS with its 250 persons means 0.33%

[3] The sources of data of ELI-ALPS is ELI-ALPS Workshop held at Szeged in August 2013.

of that number. This size will make ELI-ALPS a medium-size and significant employer in Szeged.

Direct income and employment effects of the Science Park

ELI-ALPS impact estimation may be regarded accurate because expected number of employees is known. However, number of employees at the businesses in the Science Park is an uncertain element, so we are going to present two scenarios, a realistic and a pessimistic. The realistic scenario is that the science park will produce a high employment concentration within Hungary in the innovative sectors, and will qualify as medium-large on international level. According to the entrepreneurial interest until now, the Science Park will hold 50-80 tenants after it is fully constructed. Most of those tenants will have 10-20 employees, although there will be some smaller and some bigger ones also. By 2020 the total number of employees may reach 1500, half of which will be administrative and research supporting technical personnel, the other half will work in research and development. This is six times the number of ELI-ALPS (the "core unit") employees. The pessimistic approach calculates by 50% of the abovementioned figures, 25-40 tenants and 750 employees.

A large number of the tenants settling in the Science Park will be local research departments of international companies, with both Hungarian and international researchers. For the same reasons as described above for ELI-ALPS, wage level at such companies must be similar to international researcher and developer wage levels calculated upon purchasing power parity. However, to ensure a cautious estimation we presume average wages lower than at ELI-ALPS, annual HUF 8 million for researchers and HUF 3 million for administrative-technical workers. Table 1 shows full direct income effects including calculations regarding ELI-ALPS. Table 2 shows the estimations based on the pessimistic scenario, in which size of the Science Park is exactly half of the size in the realistic approach, and total effect is approximately 58% of the original. Local income effect can be defined based on net wage as taxes and contributions on gross wage increase the central budget income. Thus total direct local income effect may be expected to be HUF 6.5 billion.

Table 1 Estimated direct income and employment effect of ELI-ALPS Science Park (realistic estimation, data expressed in persons and million Hungarian forint)

Description	Number of persons	Annual gross average wage	Annual net average wage	Total annual gross wage	Total annual net wage
ELI-ALPS researchers	130	9	5.94	1170	772.2
ELI-ALPS personnel	120	4	2.64	480	316.8
ELI-ALPS total	250	6.60	4.36	1650	1089
Science Park researchers	750	8	5.28	6000	3960
Science Park personnel	750	3	1.98	2250	1485
Science Park total	1500	5.50	3.63	8250	5445
Total	1750	5.66	3.73	9900	6534

Source: author(s)

Table 2 Estimated direct income and employment effect of ELI-ALPS Science Park (pessimistic estimation, data expressed in persons and million Hungarian forint)

Description	Number of persons	Annual gross average wage	Annual net average wage	Total annual gross wage	Total annual net wage
ELI-ALPS researchers	130	9	5.94	1170	772.2
ELI-ALPS personnel	120	4	2.64	480	316.8
ELI-ALPS total	250	6.60	4.36	1650	1089
Science Park researchers	375	8	5.28	3000	1980
Science Park personnel	375	3	1.98	1125	742.5
Science Park total	750	5.50	3.63	4125	2722.5
Total	1000	5.78	3.81	5775	3811.5

Source: author(s)

Science Park independently (without ELI-ALPS) has a direct income effect that adds up to 6.6% of total income in Szeged, or in the pessimistic calculation it adds up to half of that, 3.3%. Hereafter we are going to use only the realistic estimates for calculation. When calculated together with ELI-ALPS the figure is 7.9% of the incomes in Szeged. Due to the spillover effects (indirect, induced and dynamic) and the fact that at the time of the operation of ELI-ALPS Science Park incomes in Szeged will be definitely higher because of ELI-ALPS Science Park, the actual proportion will be smaller to some degree.

Proportions would be the same when calculating with net incomes. As we previously stated, local income effect will not only affect Szeged but also its labour force area. It is difficult to calculate the exact size of that area, thus we express the effect in proportion of the precisely definable incomes in Szeged.

The difference between gross and net incomes, and the social contribution tax payable by the employer are extra incomes on a national level. That consists of HUF 9900-6534=3366 million deducted from the employees and HUF 9900*0.27=2673 million paid by employers. So just the ELI-ALPS direct effects themselves will create a little more than HUF 6 billion (20 million euro) increase annually in the central budget income.

ELI-ALPS Science Park indirect (secondary) income effects from backward linkages

For the sake of simplicity we estimate indirect effect for ELI-ALPS and the Science Park together. As aforesaid, indirect effect occurs at businesses that are connected to and offer products and services to businesses at ELI-ALPS and the Science Park, but not located in the Science Park. Such services may include sub-contractor orders within a research or any other service with high added value, maintenance, software development, troubleshooting, guarding and security, cleaning, transportation, furniture procurement and many other similar inputs necessary to satisfy needs connected to operation and development. It is hard to estimate the value precisely. We rely on the fact that in expenditure structure of universities the rate of materials expenditure and investment are approximately similar to personnel expenditure. (Dusek-Kovács, 2011) We suppose it is similar at research activities, at least great differences are not possible. Researches that require many materials might be exceptions, and such researches are likely to occur at ELI-ALPS and in many businesses in the Science Park. But we may assume that researches that need more materials than the average are so special that

the materials cannot be produced within the local economy, or if some parts of them can be made within input-output relations within the Science Park, those transactions will not leave the Science Park.

On the whole, beyond the gross income of HUF 10 billion, we can calculate with a materials expenditure and investment of HUF 10 billion that is not considered very special. Our hypothesis is that local economy may produce 30% of that, and on average half of that may have added local value to it. The proportion of local economy may be higher for services like guarding and security, cleaning, and other similar tasks that require more labour force, and lower for those that require more materials. Indirect income effect equals to the local added value, which is HUF 1.5 billion. Most of that is income from wages; a smaller proportion is capital income. As these are gross amounts, the real local effect will be the part of this income decreased by taxes and contributions. For the sake of simplicity we may calculate with implicit tax rate on work, which is approximately 42% in Hungary. This means that the HUF 1.5 billion indirect income effect will consist of 58%, HUF 870 million local (Szeged) income, the rest, HUF 630 million will occur at the central budget as an income from Szeged. It would be hard to estimate what proportion of the remaining 70% non-local input might be originated from Hungary. For this reason we do not calculate that item, but it will definitely contribute to the positive impacts on national level.

These calculations involve more estimations than the previous ones, but it is known that even the entrepreneurs themselves cannot exactly determine the rate of their local purchases. Still under all uncertainty, it is impossible that the actual data would deviate greatly from this, e.g. it is impossible that the value of impact would be only HUF 100 million or on the contrary, more than HUF 10 billion.

Dynamic income effect of ELI-ALPS from visitors

Operational concept of ELI-ALPS provides they let out a small portion of the total experiment time to outside researchers. High tech enterprises would send their researchers to Szeged; they would spend a couple of days at ELI with their research and then go back home. Of course, there will be companies within the Science Park who will also lease some research time, but their contribution to local economy have already been considered. At the same time Science Park tenants themselves will also attract some researcher tourism within their normal operation. And beyond all that, different scientific events and conferences by ELI-ALPS and the Science Park will also generate attendance.

According to the plans the average number of outside researchers at ELI-ALPS will be 30 per day. Taking the planned size of Science Park into consideration it is safe to count with a total of an average of 30 outside researchers per day at ELI-ALPS and the Science Park together. If a visitor spends HUF 20 thousand per day on average (accommodation, meals, transportation, services) that will add up annually to HUF 7.2 million per visitor, and HUF 216 million total, and half of that could contain local added value. It is difficult to estimate visitor nights spent in Szeged due to events so we shall not deal with that figure in this study. We may disregard that data also because even if those data were not insignificant their impact would still be much less important than that of other effects. Probably the indirect effect on the image, attractiveness and reputation of the city will outweigh the effect of income spent here by the visitors. Estimated value of indirect income impact is shown in Table 3. Effect of visitors is much lower than effect of procurements. This is close to what experience show at traditional processing industry companies and it is different from the effect of attractive universities (attracting

students to a city) or of certain significant sports events. When calculating by HUF 2.56 million annual work income (that equals to the average) the indirect effects will contribute to sustaining 365 local jobs.

Table 3 Estimated values of indirect income effects

	total output	local proportion of output	local added value of local proportion	Local income	central budget income
ELI-ALPS and Science Park procurements	10000	3000	1500	870	630
Visitor spending	216	216	108	63	45
Total	10216	3216	1608	933	675

Source: author(s)

Induced income effects

Up to this point we have been discussing ELI-ALPS Science Park's impact on generating primary incomes. As opposed to that, induced effect may rather be understood as a transposed effect that shows to what degree do the employees contribute to other incomes by spending their own income. Let us briefly explain the essence of this effect. The owners of the work income generated by the three effect discussed previously create a demand partly for products of local economy, partly for products from outer economy. The demand for local economy products creates a new secondary demand, which leads to a tertiary demand, then a quaternary and so on. Formally the incomes multiply similarly to the Keynes type multiplier effect principle. There is one important issue where this multiplication diverts from the Keynes effect, the use of the regional consumption rate.

Ceteris paribus, the extent of the multiplier effects depends on three factors besides the extent of the initial income. First is the size of the region. The smaller the region is, the more demand leaks out and the lower the effect is. If the whole of Hungary was examined the effect would be greater than on a county level, but it would be greater on a county level than on settlement level. Second, in a more complex and integrated economy, the effect is stronger than at a more specialised economy that relies more on import and only a smaller portion of demand might be satisfied by local businesses. Thus the multiplier effect is greater in a large city than in a small town or village. Third, the value of impact depends on the extent to which the effect is targeted towards products of different tax rates. If the proportion of higher tax rate products (e.g. tobacco, alcohol or fuel) is bigger, the effect is lower, because tax content is a centralised part of gross revenues and cannot be regarded on local level.

Setting aside detailed calculations of the multiplier, we may estimate it to be 1.7 based on numerous other, earlier estimations for economies of similar size.[4] This means we have to multiply the total of HUF 7467 million created by the three previously described primary incomes (direct effect, indirect effect and effect of visitor spending) by 1.7 to get the total effect: 7467*1.7=12694. Out of the total effect the part above 7467 (i.e. HUF 5227 million) will be the value of local income generated by the multiplier effect. This is net total, after tax deductions as the leaking effect of taxpaying has already been considered in the value of the multiplier effect.

[4] To mention just a few example to the previous estimations: Kotosz (2013a), Kotosz (2013b), Loveridge (2004), Lewis (1986), Love – McNicoll (1988), Latham – Montgomery (1979).

Knowing this net amount we can estimate the value of income for the central budget generated by the multiplier effect as taxes and contributions: gross income will be HUF 5227/0.62=8431, the difference between gross and net income HUF 8431-5227=3204 million. Thus the central budget income will have an expected HUF 3.2 billion increase due to the multiplier effect. We can estimate the employee effect of that HUF 5227 million by dividing that amount by HUF 1.7 million, the average annual net income. This equals to the employee effect of 3075 persons, calculated upon average wage. When calculating upon higher than average wage the number of employees would decrease but it would also mean higher income per person.

The result of this effect must be handled carefully. There are certain studies that somewhat overemphasise the significance of the multiplier effect, forgetting about three conditions necessary to understand it. First, this is an effect extended in time, second, it is not an effect specific for ELI-ALPS Science Park but it has a similar ratio to labour incomes at other businesses as well. Third, as opposed to the effects previously estimated, this involves double counting, thus it is not justifiable to add it to the previous effects. We should rather think of it as if ELI-ALPS Science Park was closed down it would lead to negative spillover effects.

The complete impact and summary

In this paper we focused on income effect that can be expressed in terms of money, and other directs effects that can be expressed in terms of number of employees, while did not deal with the catalytic effect that is more difficult to capture yet is also very important. Table 4 repeats income and employee effects in a simple way. Only an insignificant portion of the effects may involve displacing other activities, or is created by simple spatial rearrangement and not a primary effect actually. The reason for this is that ELI-ALPS and Science Park activities are unique, as we discussed in the introductory part. Beyond local economic impact there will be a significant income increase in the central budget too. Also due to the uniqueness of the activity, most of the direct part of central budget revenues is original income and only a very small portion may be regarded a redistribution of incomes.

Table 4 Summary of ELI-ALPS Science Park impact

	Net local income (million HUF)	Taxes and contributions to central budget (million HUF)	Number of employees (persons)
ELI-ALPS direct	1089	1006	250
Science Park direct	5445	5033	1500
Indirect (suppliers and visitors)	933	675	365
Direct+indirect	7467	6714	2115
Induced (overspilling to the region's economy due to the multiplier effect)	5227	3204	3075
Total	12694	9918	5190

Source: author(s)

The results themselves are naturally not nano-level precise, this is not to be expected when analysing this type of phenomenon. The end results for incomes are given within the order of magnitude of a billion, so e.g. the actual local net impact might turn out to be HUF 11.5 billion or HUF 13 billion, and employment effect might be 4500 instead of 5190. Still, it is impos-

sible to have a mistake above the order of magnitude; neither 20 thousand nor 1000 employees would be realistic estimates.

At the end we would like to remind you that the impacts expressed in numbers herein do not include all impacts. They only include those parts of impact that can be expressed in numbers. For example effects on the real estate market will be rather significant, the increasing demand for flats for rent would be more advantageous for owners and less advantageous for tenants but it is difficult to forecast exact price transitions. Family members of ELI employees may have special cultural demands. Those who will move here with their families may create a demand for special kindergartens and schools. These factors are rather society-related and even though they have economic effects we should not discuss them here.

References

Barrow M, Hall M (1995) The Impact of a Large Multinational Organization on a Small Local Economy. Regional Studies 29: 635-653

Beck R, Elliott D, Meisel J, Wagner M (1995): Economic impact studies of regional public colleges and universities. Growth and Change: 245-260.

Blass SJ (1998) Japanese Research Parks: National Policy and Local Development. Regional Studies 32: 391-403

Brown AJ (1972) The Framework of Regional Economics in the United Kingdom. Cambridge University Press, Cambridge

Brownrigg M (1973) The economic impact of a new university. Scottish Sournal of Political Economy 20: 123-139

Drucker J, Goldstein H (2007) Assessing the Regional Economic Development Impacts of Universities: A Review of Current Approaches. International Regional Science Review 30: 20-46

Dusek T, Kovács N (2011) A Széchenyi István Egyetem helyi termelési és jövedelmi hatásai [Local production and income effects of Széchenyi István University] – In: Felsőoktatási Műhely 6, 3: 33-40

ELI-ALPS Workshop at the University of Szeged, 23 August 2013

Glasmeier A (1988) Factors Governing the Development of High Tech Industry Agglomerations: A Tale of Three Cities. Regional Studies 22: 287-301

Gordon IR (1973) The Return of Regional Multipliers: A Comment. Regional Studies 7: 257-262

Grime EK, Starkie DNM (1968) New Jobs for Old: An Impact Study of a New Factory in Furness. Regional Studies 2: 57-67

Guy CM (1977) A method of examining and avaluating the impact of major retail developments upon existing shops and their users. Environment and Planning A 9: 491-504

Hillman M (1973) The social costs of hypermarket developments. Built Environment 2: 89-91

Hungarian Central Statistical Office

Kotosz B (2013a) Regionális multiplikáció és egy alkalmazása. Jelenkori társadalmi és gazdasági folyamatok, 8, no. 1-2: 39-45

Kotosz Bs (2013b) The Local Economic Impact of Higher Education Institutions in Hungary. In: Khavand, K. J. (ed): Intellectual Capital Management. Global Perspectives on Higher Education, Science and Technology. IICM, Zanjan: 45-60

Latham WR III, Montgomery M (1979) Methods for Calculating Regional Industry Impact Multipliers. Growth and Change 10, no. 4: 2-9

Lever WF (1980) Manufacturing Linkages, Industrial Dynamics and the Transmission of Growth. Regional Science and Urban Economics 10: 491-502

Lewis PM (1986) The Economic Impact of the Operation and Closure of a Nuclear Power Station. Regional Studies 20: 425-432

Love JH, McNicoll IH. (1988) The Regional Economic Impact of Overseas Students in the UK: A Case Study of Three Scottish Universities. Regional Studies 22: 11-18

Loveridge S (2004) A Typology and Assessment of Multi-sector Regional Economic Impact Models. Regional Studies 38: 305-317

Massey D, Wield D (1992) Evaluating Science Parks. Local Economy, 7: 10-25

Oakland WH, Sparrow FT, Stettler HL (1971) Ghetto Multipliers: A Case Study of Hough. Journal of Regional Science 11: 337-345

Steele DB (1972) A Numbers Game (or The Return of Regional Multipliers). Regional Studies 6: 115-130

UKSPA (United Kingdom Science Park Association) (1985) Foreword to Science Park Directory. United Kingdom Science Park Association, Sutton Coldfield, W. Midlands