The Measurability of Knowledge Creation in the 21st Century

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Abstract

The author describes how important statistics is in everyday life where we are continually faced with (and may be misled by) data and conclusions drawn from them. It is important to become familiar with statistics, which has a special language that must be learnt and understood by everybody.

The author describes how statistics is taught in Hungarian higher education, specifically in her school, the Budapest Business School (BBS) at different levels, in different forms of training, and in other areas as well. BBS, with about 20 000 students, is the largest business school in Hungary. It was created in 2000 by merging three formerly independent colleges, the College of Commerce, Catering and Tourism, the College of International Management and Business, and the College of Finance and Accountancy.

In the second part of her paper, she analyses the market of knowledge-based products. She concentrates on small and medium-sized enterprises, as users of business studies. She examines the market value of useful and practical knowledge, emphasising the difficulties of quantifying. The economy, society and human life are made up of complex processes, a fact which makes accurate measurement impossible.

It is the responsibility of teaching statistics to draw the students' attention to the limitations of statistics. Higher education can only perform its role if educators participate in research and contribute to extending the scope of knowledge.

Key words: measuring, statistics, teaching statistics, knowledge-based products

JEL Classification: C40

1 Introduction

What is meant by measuring?

The 21st century has to build a society based on knowledge. This is primarily motivated by the quest for growth, and the resources of achieving this goal are secured by the extra proceeds derived from knowledge owned by a privileged minority.

The concept of knowledge-based economy has frequently appeared in recent business publications. This is typically characterised by the accelerated flow of information, the linkage between business and science, and the increasing importance of knowledge.

According to modern economic theory economic growth is based on five factors. These are the following:

- The quantity of labour
- Physical capital
- Utilised resources
- The growth of human capital
- Technical advance

Economic growth, technical development, human resources and the knowledge-based society are factors related in an intricate but close connection.
More knowledge means more extra income – the correlation between these two factors should be found. But, like any correlation in the field of social sciences can only be expressed as a trend thus is stochastic. But there is a need to analyze such correlations, and define, evaluate, and measure them. Statistics can reveal cause and effect relationships and can even analyze them quantitatively. But interpreting these relationships clearly and unambiguously is at least as important.
Thinking statistically and understanding stochastic processes have become universally acceptable. Nothing can be taken for granted in the economy, in society or even in your private life. Some statistical indicators are widely used in everyday speech, such as GDP, consumer price index, employment rate, national debt, and so on. The general public is more interested in understanding the global financial crisis than, say, in understanding a classical ballad. Economic and social problems can be discussed in a new language – the language of numbers, or more precisely statistics. Those who don't understand this language cannot talk about economic or social problems. We don't want to attribute mystical powers to numbers; what's important is to define certain concepts and notions accurately.
When people quote what British Prime Minister Benjamin Disraeli (1804-81) allegedly said about statistics: "There are three kinds of lies: lies, damned lies and statistics", we have to bear in mind that it is not the numbers that lie, but their interpretation is wrong, incorrect, or perhaps an important point has been neglected or overlooked in the analysis, or the cause that caused the event was ignored. For example, a report says that this April the volume of sales was much higher than in the same month last year. But the report omits to mention that Easter was in March last year and it was in April this year – the comparison has been distorted.
Understanding such issues today is as important as literacy. But literacy today includes the ability to read statistics, too. To understand the language of statistics means we must be able to read and write correctly in this language if we want to communicate clearly and effectively. The rules of how to do that are stated in the Ethical Code of EUROSTAT at international level. This emphasises the responsibility of writers to only publish data that reflect reality. Being able to read statistics is a broad concept and includes the skill of probing what may be hidden behind the numbers and realising that there are no "absolutely reliable" figures.
It is the task of educational institutions to teach students these skills. We are convinced that besides digital literacy, knowing the "language of statistics" is equally important. This means that everyone must be familiar with statistical methods, although admittedly at different levels. The more information we are receiving in a digital world, the more competencies are needed to understand and analyse the wealth of data transmitted.

2 Teaching the Language of Statistics

The most important task of higher education can perhaps be defined as generating functional knowledge to be utilised in the economy and to provide for other needs of the society and subsequently pass on this knowledge to the students. That is why Budapest Business School has chosen this motto: We want to provide our students with useful knowledge.
Businesses are particularly interested in employing people who are well-versed in statistics and in quantitative methods in general. That's why BBS lays great stress on providing all students with the adequate knowledge, skills and competencies in computer science and information technology and in applying mathematical and statistical methods.
Understanding up-to-date quantitative methods is of special significance since the European Union wants to achieve a leading position in building a knowledge-based society by 2010. This means a challenge for educational institutions, especially colleges and universities,

which will have to strengthen practice oriented training and develop students' competencies. For IHEs, responding to the needs of the labour market at different levels of training, and securing the smooth transition between these levels are particularly difficult after the introduction of the Bologna process.

Teaching statistics in different modules and at different levels

In regard to teaching quantitative methods in its Bachelor's programs, BBS has responded to the challenges in the following way:

- In spite of a relative short time allocated for teaching quantitative methods, we tried to observe a logical sequence of the subject-matters in planning the curricula.
- We set up a system of prerequisites of the quantitative modules, which means, for example, that the prerequisite of taking a course in statistics is having studied Probability Theory, which requires the knowledge of certain topics of calculus.
- Linear Algebra and Operational Research are taught in different semesters.
- All that is supported by a separate module of Applied Computer Science.
- Statistics is taught in two semesters based on the contents accepted as a higher educational standard by all universities that run business programs. (BBS professors have actively participated in the elaboration of the concept.)
- Computer supported methods are indispensable in Business programs leading to a Bachelor's degree. We have different statistics software packages that are taught in a separate module of Applied Computer Science.
- Statistics is also taught in Vocational Training programs, at a lower level of post-secondary education. A specialised program of Statistical Analysis has been launched. The curriculum includes modules like Business Statistics, Social analyses, Data Mining and other electives. At present 30 students have enrolled in this program.

Turning to education at Master's level, we can say that BBS has six programs at this level:

- Business Teaching
- Marketing
- International Studies
- Finance
- Accounting
- Tourism Management

Statistics is taught at a higher level in two of these programs: Marketing and Finance. We think that the appropriate response to the challenges of the Bologna process is the assessment of the need of the labour market. To do that we have turned to big, often multinational companies and other professional organisations for help. We set up a Professional Advisory Board which gives us advice on our curricula; and external professional bodies also assist us in such matters and provide us with visiting instructors of specific subjects. We also plan to invite visiting professors from abroad.

Statistics taught for full-time and part-time students in different forms of training

The structure of education was primarily created to cater to the needs of full-time students. But in two colleges of BBS, the College of Commerce, Catering and Tourism, and the College of Finance and Accountancy, programs are offered to part-time students in the form

of Distance Learning (DL). At present, we have about 3000 students studying in this form of training. DL has a 12-year history, and is known for imposing specific requirements on instructors and teaching materials alike. In this form of education the teaching materials have to be suitable to be learnt without personal contact with the instructor, therefore they have to guide the student through the learning process; in other words, the teaching job is on the teaching material. This is true of electronic and printed materials alike. Each teaching module has its own learning package, which consists of a manual written specifically for DL purposes, a "guide book" describing everything the student should know about requirements, exams, etc., a collection of problems to be solved, including examples for self-examination, the assignments to be sent in, a collection of formulae (where necessary), audio material (where needed). Where e-learning material is available, students are given special directions. E-learning materials represent even more modern methods of learning and use additional learning tools (cross-referencing, links, animation, moving pictures, etc). Such material, which contains examples taken from small and medium-sized enterprises, is available for teaching Descriptive Statistics.

We strive to teach statistics using electronic support. We apply for grants to obtain funding for projects, and we have prepared a practical supportive material based on the most familiar tools (rates, averages, indices, etc.) that guides the students towards understanding formulae and theory.

Besides DL, some programs are offered in the form of correspondence courses. An example is the Marketing Master's program, which if offered also in the form of correspondence course, in which DL methods are increasingly applied. This is particularly important since studying for a master's degree requires special learning techniques and culture, which is built on the students' own work, enquiries and research. For statistical studies this means that students can work their way from collecting data, through analyzing them up to a final report. The students' progress in theory is controlled by giving them home assignments. But team work and the development of presentation skills are also encouraged.

Statistics in other forms of training

Statistics is not only taught in programs leading to degrees but we strive to reach other targets and we prepare special teaching materials for them. An example is the Virtual University for Entrepreneurs, a BBS program which includes a Statistics module based on electronic teaching material meant to teach SME entrepreneurs the basics of quantitative analysis.

BBS has also appeared in the series "How to be an Entrepreneur?" on Channel M2 of the Hungarian television. The College of Commerce, Catering and Tourism has also prepared an instructional film on statistics.

In Hungary there is a kind of post-secondary education, which we have called Vocational Training. These two-year-courses are meant to give training that will enable graduates to find jobs that do not need university degrees on the labour market. The programs and their curricula are always prepared by IHEs, the actual training is run either by universities or high schools under the guidance and control of the respective IHE. BBS had a pioneering role in the initiation of this kind of education that comes after secondary education but before enrolling in a university degree program, although there is still much to be done to publicise this kind of qualification on the labour market. BBS offers Vocational Training programs, for example in banking, accounting, and finance. Graduates from them will become technicians in the respective fields. Statistics studies play a significant part in this type of education, too.

In vocational training programs descriptive statistical methods are taught. Credits received in some modules of certain programs can be taken into account if the student enrols in a further academic program. This means that students in such fields are expected to meet the standards of university courses. In our case, we use the same textbooks in vocational training as in the

degree programs. But we have also written a special comprehensive glossary and exercises to accompany the guidebook issued to students. BBS vocational training programs have been accredited in 25 secondary schools, which means that BBS guarantees maintaining the standards of training in those schools. In this project which is extended to almost all parts of Hungary, about 1200 students are being taught statistics. We can say that BBS is practically in daily contact with these schools, and we meet the colleagues teaching in secondary schools each semester when experiences are discussed and shared. It is our duty to extend assistance to these schools since in many of them statistics is rarely taught as a separate subject, but they are integrated in other modules, such as, for example, Business Studies.
For a number of years, BBS had a vocational program of Computer-aided Statistics and Budgeting. Students studied statistics in a fairly large number of hours for four semesters. Students in vocational training have acquired the same knowledge as those studying for a Bachelor's degree, and furthermore they studied Business statistics and Social statistics, too. Graduates have all found jobs in line with their qualification or continued their studies at a higher level at BBS. Temporarily this program is not offered.

The experience of teaching statistics
Teaching statistics at BBS is an integral part of the Quantitative Methods module, but from what has been said earlier it must be clear that statistics also performs other functions in higher education. As a consequence of our joining the European Higher Education area, when a program or curriculum is planned, we have to increasingly pay attention to what skills and competencies should students acquire on completing each course. In each program at each level of education, we have to bear this in mind when planning curricula, courses, or course descriptions.

3 The market of knowledge-based products

The most important target group of BBS on the labour market is Small and Medium-sized Enterprises. On the one hand, we have programs specifically addressed to SMEs, on the other hand, a significant proportion of our graduates find jobs with such firms. Research indicates that markets favourably disposed to innovation are difficult to penetrate, thus the return of investment in innovation is low.
Knowledge-based economic growth is not determined by the weight and proportion of the components of knowledge-based input, but by the profitability of the factors of knowledge.
Allowing for a few simplified conditions, the value of transmitted knowledge, in the case of IHEs may be approximated by considering the extra income of the graduates; i.e. with the income over those who have similar jobs with only high-school (secondary school) qualifications. In this case, however, it is the value of the degree that is quantified and not knowledge itself, its usefulness or applicability. At the same time, however, we can assume that actually it is the surplus of knowledge that is appreciated.
On the other hand, we must be aware that knowledge is not utilised when it becomes a product or service, but when a knowledge-based product penetrates its respective market and produces extra income.
One may ask what factors the size of knowledge should be divided into. Is it necessary to analyse the structure of knowledge and its utilisation separately? The processes in the economy and society are composed of a host of elements, consequently it is not possible to measure them accurately.
The evolutionary school of theoretical economics makes a distinction between *knowledge creation* and *knowledge application*. By knowledge creation they mean the creation of innovation in basic and applied research, while knowledge application means gaining an edge

in entrepreneurship. These functions and the organisations that perform them are interrelated and they mutually interact. Thus we cannot unequivocally say that IHEs are responsible for knowledge creation and businesses for its exploitation. The reason for it - and the consequence of it - is that the transfer of knowledge is a two-way process between the players.

There is another approach to the analysis of knowledge creation by IHEs by comparing and ranking universities and colleges according to different points of view.

The pertinent question what we want to measure can be raised. The possibilities of measuring knowledge creation and knowledge transfer are closely related with innovation. According to a frequently quoted maxim, research is the conversion of money into knowledge while innovation is the conversion of knowledge into money.

Efforts have been made in Hungary to quantify the value of knowledge transfer. Based on Dutch and German research methods, businesses have been analysed in three dimensions.

The three dimensions are (1) geographical location, (2) technological dimension, and (3) organisational dimension. The geographical dimension defines in what geographical area the business is located. The technological dimension is determined by the line of business, and businesses are divided into categories using high or low technologies. The organisational dimension is established on the basis of size, i.e. the number of employees.

The scale of knowledge transfer has been measured on the basis of the distribution in the three dimensions. One of the most important findings was that the impact of research and development on knowledge-based organisation widely differs depending on the location. At the same time, the synergies of knowledge functions in the knowledge-based service sector are not linked to the geographical dimension.

To define knowledge creation as innovative ability requires a complex approach to measuring. There are various indicators to measure different kinds of innovative ability. It is not the same thing whether we want to measure innovation at macro or micro level. It is relatively easy to determine values of innovation at organisational level, but the effect of the same innovation might be dissimilar at macro level. And innovation at macro level may cause even the collapse of a business.

Most systems of indicators produce a relative type of measurement – they are based on measuring achievement compared to some kind of average.

4 Conclusion

We can see the importance of statistics for the economy and society of a country. At the same time we are aware of the mistrust of statistical data and methods, and know their limitations; this doesn't mean, however, that we don't need them. We also know that statistics, like other quantitative analysis, can only measure discrete elements, but not complex events. It is a task of teaching statistics to draw the attention of students to these facts and teach them under what conditions statistical methods can be applied. They have to be taught how to doubt, and how to look behind the figures, and to always ask themselves the questions "What is this much?" and "What is the change related to?" Usually it's not one piece of information that is not sufficient: we have to think in systems of indicators. To think statistically means we need an adequate amount of data to find out statistical significance or regularity.

If higher education prepares students for all that, they will be able to perform well on the labour market and introduce innovations that may benefit the economy. Knowledge converted into earnings doesn't only benefit the individual but contributes to the growth of businesses and the national economy.

One of the tasks of higher education is training, the other creation of knowledge. Knowledge is created in the workshops of universities – in the academic departments. That is why all

IHEs, and BBS among them, pursue significant research. We focus on applied research, knowing that there is no applied science as such, but science can be applied.

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