

# Teaching and Learning Econometrics in a Computer Laboratory: Empirical Evidence from TEMPUS CD\_JEP “Statistical Methods for Business and Economics”

Prof. Vesna Bucevska, Ph.D.,

## Summary

With the increased use of computer technology and software in econometrics instruction and learning, additional research and discussion is needed on the appropriate ways to apply computers and software in econometric classroom in order to get the students more interested in econometrics. This paper summarizes both teacher's and students experiences in teaching, learning and examining Econometric Theory in a computer laboratory in the last two years within the four-semester international postgraduate studies “Statistical Methods for Business and Economics” at the Faculty of Economics-Skopje of the University “Ss. Cyril and Methodius” financed with support from the European Commission. Teaching and learning econometrics in a computer lab has advantages and disadvantages for both, teachers and professors. However, the benefits of the computer laboratory for seem to outweigh its drawbacks. Based on our two years' experience and the online survey of the SMEBE students, we conclude that the computer laboratory at the Faculty of Economics-Skopje has been successfully used both for teaching and learning of Econometric Theory.

## 1. Introduction

An important change that has had a significant impact on teaching and learning statistics and econometrics over the past few decades has been the increased application of microcomputers and of user-friendly computer packages, particularly at university level. Today more and more university professors of econometrics worldwide have access to modern computer classrooms. Only two decades ago we would have thought that this was an impossible luxury. With the penetration of computers and econometric computer packages, the teaching and learning scene of econometrics has changed for the better. With current tools – a PC and a user-friendly econometric software – it is now possible to solve econometric problems without spending inordinate amounts of time calculating the solution. However, to teach students how to deal with different econometric problems successfully, it is necessary to integrate today's new technology into the computer classrooms. “Teaching in such classrooms is both exiting and daunting: exciting because the new technologies promise the possibility of better teaching, daunting because the technology and its promise pose new challenges and create new pitfalls for teachers of economics.”<sup>1</sup> With this integration it is possible to concentrate on teaching the assumptions and theoretical issues of econometrics, instead of teaching mathematical calculations. The tutorials and the examples made during the classroom and lab hours enable the computer to become more than a simple computation tool; it can be a learning tool.

With the increased use of computers and software in instruction and learning the increased use of computer technology and software in econometrics instruction and learning, additional research and discussion is needed on the appropriate ways to apply computers and software in econometric classroom in order to get the students interested in econometrics. Although there are many articles examining the effect of the use of computers and software in teaching econometrics, only a few of them are empirically based. The purpose of this paper is to bridge this gap by describing how the use of computer technology and software (particularly EViews 6), have influenced the teaching, learning and examination of econometrics taught at the three-semester international postgraduate studies “Statistical Methods for Business and Economics”<sup>2</sup> at the Faculty of Economics-Skopje of the University “Ss. Cyril and Methodius” and to share my experience with computer laboratory during the

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<sup>1</sup> Murray, M.P.: Econometrics Lectures in a Computer Classroom, *Journal of Economic Education*, Summer, 20, 1999, pp. 308-21.

<sup>2</sup> SMEBE postgraduate studies have been developed with the financial support of the European Commission within the framework of the three years' TEMPUS CD\_JEP “Statistical Methods for Business and Economics” (SMEBE).

last two years combining teachers and students points of view. We assert that only by adopting a lecture/laboratory format econometric theory and its application in economics and business can be brought together to improve student learning.

## 2. Problems and challenges in teaching econometrics

Sowey<sup>3</sup> (1983, p. 257) defined econometrics as “[...] the discipline in which one studies theoretical and practical aspects of applying statistical methods to economic data for the purpose of testing economic theories (represented by carefully structured models) and of forecasting and controlling the future path of economic variables.” Thus, it is not enough to provide students with the theoretical concepts, but also with appropriate practical examples based on real data so that they can use the theoretical knowledge for their own analyses. However, at the time when Sowey wrote his article, the students and their professors did not have access to computer laboratories. Data were provided by professors and the hand entry was made by students in the university computer center. Therefore Sowey downplayed “the practical aspects of applying statistical methods to economic data”. Becker<sup>4</sup> provided an alternative method of teaching and learning econometrics involving the use of computer labs stocked with microcomputers. Becker and Greene<sup>5</sup> analyzed the essential topics to be taught to undergraduates in statistics and econometrics and additionally point out the following main problems in the traditional instruction: (i) abstract and dry textbooks and (ii) use of problem sets<sup>2</sup> of made up data and unrealistic numerical examples. Although an immense supply of textbooks in econometrics exists, there is little attention paid on the applications of concepts and procedures. To engage students more in class it is necessary to use examples, exercises and problems based on real data.

## 3. Features of the postgraduate studies “Statistical Methods for Business and Economics” (SMEBE)

The key feature of the postgraduate studies "Statistical Methods for Business and Economics", which makes them unique not only in Macedonia, but also in the region is its strong focus on application of statistical and econometric methodology on real-world data in economics and business, with the ultimate aim to develop skills for solving new and non-standard problems either individually or in teams. This more realistic approach requires use of computer-based lectures, sessions and tutorials. Therefore in the first Project year (2007) we established a state of the art statistical laboratory i.e. a multimedia center at the Faculty of Economics-Skopje. It is equipped with 29 rotating office chairs and 29 computer desks. The following equipment has been installed: 29 PCs model HP Compag dx2200 Micro Tower Business (25 PCs financed with support from the European Commission and the 4 PC financed by the Faculty of Economics-Skopje), 1 lap top, 1 colour network laser printer, 1 laser printer, 1 LCD projector, 1 projection screen and 1 blackboard, 1 server and 1 scanner. All computers have Internet connection. The following statistical software packages were installed: STATGRAPHICS Centurion, E-VIEWS 6.0, MINITAB 14 and SAS. In addition to them, one teaching software package NetOp School, v.5.0 was installed. As a further method of facilitating application of the techniques, we have provided students with the Reuters Ecowin Pro software and database.

Since the multimedia centre is intended to be used only by teachers and professors of SMEBE and in order to prevent any damage, the entrance into the centre is possible only with electronic card. There is also a video camera for surveillance installed at the entrance of the multimedia center.

The computer laboratory is heavily used by all nine subjects of the postgraduate studies SMEBE and also by the subject Econometric Theory which is taught to undergraduate students.

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<sup>3</sup> Sowey, E.R.: University Teaching of Econometrics: A Personal View, *Econometrics Review*, May, 2, 1983, pp. 255-89.

<sup>4</sup> Becker, W.E.: Teaching Statistical Methods to Undergraduate Economic Students, *American Economic Review*, May, 77, 1987, pp.18-24.

<sup>5</sup> Becker, W.E. and Greene, W.H.: Teaching Statistics and Econometrics to Undergraduates, *Journal of Economic Perspectives*, Vol. 15, No. 4, Fall 2001, pp.169-82.

**Image 2: TEMPUS SMEBE multimedia centre at the Faculty of Economics-Skopje**



#### **4. Concept and structure of “Statistical methods for business and economics” (SMEBE)**

The international four-semester postgraduate programme SMEBE was introduced in October 2007. Six courses (Mathematical Statistics, Computational Statistics, Time Series Analysis, Advanced Econometrics, Econometrics for Finance and Simulation Methods) of the total nine courses were taught by professors of EU university consortium members (University Roma Tre from Rome, Italy and University Carlos III from Madrid, Spain) and three courses (Multivariate Statistical Methods, Econometric Theory and Statistical Quality Control) by professors of the Faculty of Economics-Skopje. In the last, fourth semester, students worked full time on their master thesis with the help of an assigned supervisor.

The SMEBE programme was delivered through a flexible combination of lectures in the multimedia centre of TEMPUS SMEBE, computer lab sessions and tutorials and projects. Lectures were used to introduce key theories, concepts and economic models. In classes the student had the opportunity to solve problems and numerical exercises, to analyse case studies, to make presentations of research published in academic journals. The computer labs provided students with the practical experience of using computer software to perform calculations and conduct realistic simulations. In addition, econometric methods were taught in lab sessions, thus students have had the opportunity to apply econometric software to empirical research. One month intensive teaching was devoted to each course, out of which the first two weeks were dedicated to lectures and laboratory sessions, the third week was foreseen only for laboratory sessions and the last week for the exams. Each course consists of 40 hours of lectures and 20 lab hours. Thus the postgraduate studies provide 30 ECTS for

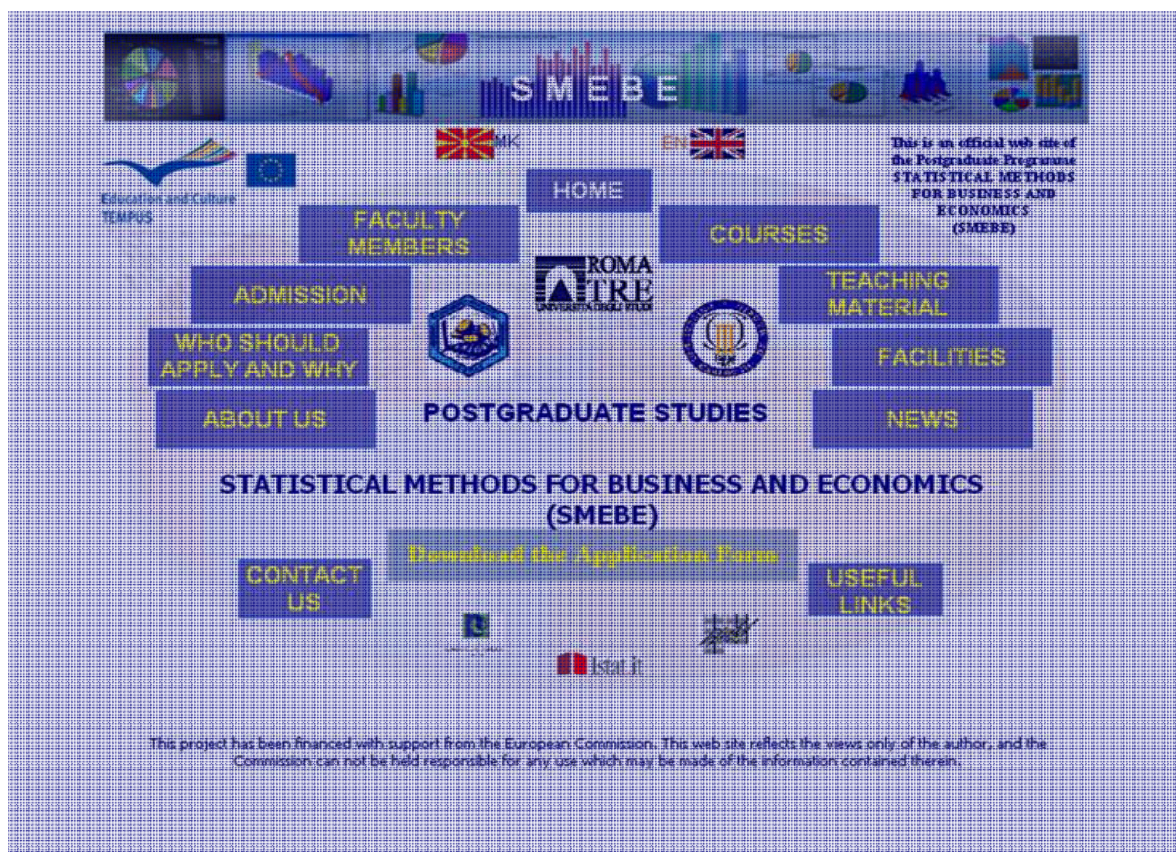
each semester Each taught course has been assessed through a combination of assigned project, the nature of which will vary according to the module, and one final exam. All final exams are computer based and have been taken in the TEMPUS SMEBE multimedia center.

## 5. Teaching Econometric Theory in the SMEBE multimedia center

Below I will provide more detail on how I have integrated the computer laboratory i.e. the TEMPUS SMEBE multimedia center in my classes on Econometric Theory at the postgraduate studies “Statistical methods for Bisness and Economics”.

My approach in teaching econometrics in the SMEBE multimedia centre has been to prepare in advance (one month prior to the start of the course) a complete set of lecture notes, exercises notes and lab manual for the computer package EViews 6, and to make them available not only to SMEBE students, but also to the wider public, by uploading them on the web site of the postgraduate programme SMEBE [http://www.eccf.ukim.edu.mk/smebe/Smst\\_en.html](http://www.eccf.ukim.edu.mk/smebe/Smst_en.html) in two languages (English and Macedonian). In that way students have been encouraged to download and study them after classes. The teaching material has been completely adapted to the need of the postgraduate studies SMEBE and complemented standard textbooks.

**Image 2: The official web site of the postgraduate programme SMEBE [http://www.eccf.ukim.edu.mk/smebe/Smst\\_en.html](http://www.eccf.ukim.edu.mk/smebe/Smst_en.html)**



After presenting material on a certain topic and in order to reinforce the concepts just presented, I prepare an in-class lab session for the students to perform it with their PCs using the econometrics software package EViews 6. These lab sessions are designed to allow students to become familiar with the software EViews 6 while at the same time learn how to apply the techniques learned in the course to real data. In that way lectures and labs in the first two weeks are complementary rather than the lectures being given priority and the labs being just adds-on. In addition to that, the third week has

been completely dedicated to lab sessions in which students, supervised by the teaching assistant, are asked to solve problems using EView6

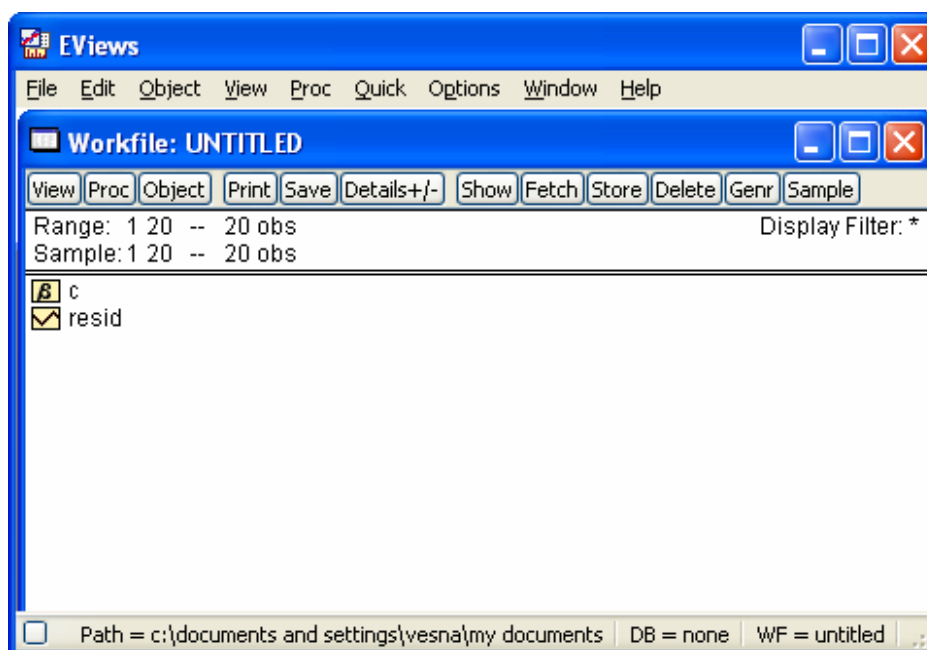
Nevertheless, the most powerful teaching tool of Econometric Theory is the project work which provides the students with the opportunity to work with real information allowing them to get familiar with the main problems of the econometric modelling. This work is also developed with EViews 6.

There is one written exam held in the forth week which is computer-based and is held in the TEMPUS SMEBE multimedia centre, For technical reasons, only 12 students may use the computers at any given time, thus some students are asked to come outside of regular course hours.

My two years' experience in teaching Econometric Theory in a computer lab shows that the choice of suitable computer package is a very important issue for teaching econometrics in a computer laboratory. Among the available econometric software, EViews 6 has been chosen due to the following reasons:

- It is intuitive and easy to use both for the instructors and the students. Instructors can employ a wide range of statistical and graphical techniques without having to learn complicated command syntax, and students can concentrate on the substance of the course, instead on the complexities of the computer package.

### Image 3: EViews workfile



- EViews 6 provides a wide variety of menu options including least squares estimators, maximum likelihood, generalized method of moments, single-equation and system methods, also offering a "console" option where users can type commands which are recorded as a batch file.
- The flexible character of EViews 6 offer teachers a possibility to combine the quick point-and-click menu options with the use of some commands and console facilities in order to re-build specific results, improving the autonomous work and the comprehension of the main econometric concepts and techniques.
- EViews 6 allows analysing datasets whose size is limited only by an available computer memory. This is a precondition for implementation of the realistic approach of teaching and learning econometrics.
- Allows using data sets in their current format These data can be automatically converted into the EViews 6 work file format.



- EViews 6 has a session concept, which provides an iconic space containing several objects such as data sets, model tables, scalars, graphs etc. that allow users to save a complete file of the whole developed work.

A very important issue when lecturing econometrics in a computer lab, is the issue of controlling what students are using their PCs for during classes. In the last two years of teaching econometrics in the TEMPUS SMEBE multimedia centre I have found out that the software NetOp School, is one of the best tutorial software package for teaching, which gives a powerful tool for virtual and networked teaching. With this tutorial software it is possible to share any screen with the class, follow students as they work and give them help where and when it's needed. Teachers can effectively control what students are doing with their computers, to monitor and take control of a student's computer, as well as project the screen of a student's PC so that everyone in class can see it. Use of such software discourages students from using their computers for anything that is nonclass related. NetOp School allows to monitor all students at once or individually from teacher's own desk, and take over a student's computer easily to provide assistance. Teacher can follow all students activities in real-time and allow or deny automatically specific programs and web addresses. It is also possible to control what applications have been used, distribute and collect documents from students and create and perform regular tests with immediate individual feedback. With D NetOp School instructor can distribute a test to all students simultaneously at the touch of a button, correct and score tests automatically. Teaching starts before class. NetOp School enables the teacher to prepare lessons and tests faster and easier than ever before. From individual help and chat functionality it is possible to manage students' progress, as if the teacher is right next to the student – wherever he is. It makes easy to monitor and evaluate students' learning progress through a powerful Test- Centre facility.

## **6. Benefits and shortcomings of teaching and learning Econometric Theory in a computer laboratory**

It is quite obvious that computers can not replace instructors and teachers can not rely only on computers during instruction of econometrics. But because computers are very sophisticated devices, and may facilitate a variety of tasks, they have enormous benefits both as teaching and learning tools.

### **6.1 Benefits of teaching Econometric Theory in a computer laboratory**

My two years' experience has shown that teaching Econometric Theory in a computer lab i.e. TEMPUS SMEBE multimedia centre has the following advantages:

1. The computer lab creates learner-centred environment where the teacher takes role of an advisor and helper, and students can work at their own pace.
2. The computer laboratory offers more possibilities to instructors in preparing the lectures and in the process of lecturing. Teachers who can see computers as a pedagogical tool can use a computer lab creatively without having to be computer experts. Indeed, teachers who have never used a computer before may take it up after they have seen the way it changes their students' work.
3. The computer lab provides teacher of econometrics with greater flexibility in activities, which check students' comprehension and progress.
4. Instructors have direct feedback from students.
5. Computers can help teachers keep records of students' works and their own materials.

### **6.2. Shortcomings of teaching Econometric Theory in a computer laboratory**

Unfortunately, computers are not free from weaknesses. During my two years' practice of teaching econometrics in a computer laboratory, I have come across that the computer lab poses a number of challenges and pitfalls for the instructors:

1. Computers can not replace teachers. Although very powerful, they cannot communicate meaningfully with the user. They can only respond to certain commands given in a specific computer language.
2. Teaching econometrics in computer lab requires more resources (smaller student to faculty ratio and reliable hardware and computer packages).

3. Maintenance and updating the computer lab is expensive.
4. Teachers need to have competence in computer laboratory use. Although the current generation of instructors of econometrics has been more exposed to use of computers, this does not translate into higher level of computer use in the process of lecturing econometrics. Teacher-training programs should be offered to provide teachers of econometrics with the necessary skills that prepare them to effectively use the hardware and software in the computer laboratories.
5. It takes much time to spend learning and exploring with computer lab technology. Clouse and Alexander<sup>6</sup> state that it might take as long as six years to learn to integrate technology into the classroom environment. This can draw back teachers of econometrics from using the computer lab for teaching econometrics.
6. In order to take advantage of the computer lab, econometrics must be revised.<sup>7</sup> I have shifted the focus of the subject Econometric Theory, from mathematical explanation to statistical reasoning and have placed additional emphasis on the use of the computer package EViews 6. Consequently, I had to write a completely new textbook "Econometrics with Application in EViews 6", Exercise Notes in Econometric Theory and Lab Manual for EViews 6. Such efforts could be a barrier for experienced teachers to adopt the computer classroom in teaching econometrics.
7. High cost in time dedicated to creation of computer slide shows for the material presented.<sup>8</sup>
8. Teachers have to handle the large heterogeneity among the students regarding their prior knowledge of statistics and computer skills. Many of the students were having difficulty with statistics. They tended to follow the lectures without understanding what was going on. Many of the students had also difficulty using the computer.
9. Increased dependence of instructors on technical facilities. In case network is down, the computers do not operate, the overhead projector is broken etc.<sup>9</sup>
10. As a result of upgrade of hardware and software, at the beginning of each semester and before each exam teachers should rerun the software in order to check for new glitches.<sup>10</sup>
11. In order to avoid computer glitches during lectures, the computer material should be very carefully prepared.<sup>11</sup>
12. Instructors must monitor both the students and the technology.<sup>12</sup> In our case we have done that with the educational software NetOp School 5.
13. In a computer lab, where the computer draws student's attention, instructors have to make greater efforts to keep students focused on content and not on technology.
14. Teachers must help students in managing the mental transition between listening and performing computing with their computers.<sup>13</sup>
15. Instructors should enable both strong and weak students to learn. However they should not allow the weakest student to dictate their pace of lecturing.<sup>14</sup>
16. Instructors have to take measures to encounter "technical cheating" during examinations. This is time consuming and requires utmost care.
17. Manual collection of examination files is also time consuming.

### 6.3 Benefits and shortcomings of learning Econometric Theory in a computer laboratory

Since the TEMPUS SMEBE multimedia centre allows an easy implementation of online questionnaires, after the end of the first semester of SMEBE in which Econometric Theory was taught (January 2008), 25 students have been asked to provide information about their personal opinion of

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<sup>6</sup> Clouse, R.W. and Alexander, E.: Classrooms of the 21<sup>st</sup> century; Teacher competence, confidence and collaboration, *Journal of Educational Technology Systems* 26(2), 1998, pp. 97-111.

<sup>7</sup> See 1, p. 315

<sup>8</sup> See 1, p. 316

<sup>9</sup> See 1, p. 316

<sup>10</sup> See 1, p. 316

<sup>11</sup> See 1, p. 316

<sup>12</sup> See 1, p. 316

<sup>13</sup> See 1, p. 316

<sup>14</sup> See 1, p. 316

the computer laboratory. Sixteen students answered to that questionnaire stating the following advantages as the biggest benefits from learning econometrics in a computer laboratory:

- Personal approach to students. In a small group of 25 students, all students, and especially weaker students receive increased attention.
- Focus on substance and not on writing down what the professor presents. Helps students pay attention and be more engaged.
- Having the screen directly in front of students made the material much more easier to follow.
- Students can download free of charge lecture and exercise notes and lab manuals from anywhere with any computer with Internet connection.
- Having the lecture and exercise notes as well as the lab manuals on any computer on the internet results in more effective study.
- Through lab sessions students can actually use the various techniques they learn in Econometric Theory
- Lab sessions give an opportunity to students to demonstrate their knowledge in another way (not only through exams);
- The empirical understanding of the concepts through labs is better than one gained by reading a textbook.
- Working with real data sets favours understanding of statistical and econometric methods and helps to develop students' interest in the course
- Current and easy to access information through Internet resources
- More information flow between students and instructors.
- Students are more motivated and empowered by computers and software.

On the other hand, slow server and wireless problems in the computer lab have been considered as the biggest disadvantage by the majority of the students.

## 7. Concluding remarks

There is no doubt that a computer laboratory poses new opportunities as well as challenges in the teaching-learning process of econometrics that require modifications in teaching style and approach. However, the effort expended to cope with these challenges is more than compensated by the opportunities that such laboratories present to utilize both hardware and software as teaching and learning tools. Since the establishment of the TEMPUS SMEBE multimedia centre at the Faculty of Economics-Skopje in 2007 which was financed with support from the European Commission, we have experienced the potential and have seen the drawbacks of the computer laboratory in teaching and learning of Econometrics. The benefits of the computer laboratory for both teachers and students seem to outweigh its drawbacks. Based on my experience and the results on the online survey of the SMEBE students, we can conclude that TEMPUS SMEBE multimedia centre was successfully used both for teaching and learning of Econometric Theory.

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