**KTH Industrial Engineering
and Management**

Essays on
University Efficiency Analysis
and
Entrepreneurship among University Graduates

Zara Daghbashyan

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Division of Economics

Department of Industrial Economics and Management

Royal Institute of Technology

SE-100 44 Stockholm

Abstract

The thesis consists of five papers: three deal with the efficiency of higher education institutions (HEI) and two with entrepreneurship among university graduates. The efficiency of HEIs is analyzed at three different levels: units of one university, universities of one country and universities of a group of European countries.

Using data envelopment analysis (DEA) the first paper compares technical efficiency among university units at the Royal Institute of Technology (Stockholm). An interesting result is that there seems to be a complementary relationship between efficiency of resource utilization in teaching and in research.

The second paper applies stochastic frontier analysis (SFA) to estimate the cost efficiency of Swedish higher education institutions. According to the estimates, half of the Swedish HEIs have an above average efficiency of 85 percent. The efficiency differences are mainly influenced by the source of funding, HEI size, the number of students per faculty as well as faculty and student compositions.

The third paper analyses the cost efficiency of universities among a set of public higher education institutions from six European countries by means of stochastic frontier techniques. The results suggest small variation in the mean economic efficiency of higher education institutions from UK, Norway, Sweden, Finland and Switzerland, implying that the efficiency differences are not explained by country effects. Instead the variations in efficiency are related to organizational differences.

The two essays on entrepreneurship among university graduates are based on a unique dataset encompassing individual level data on all employees registered in the Swedish labor market. The first paper explores the differences in entrepreneurial choice of graduates from different universities. The main finding from this paper is that the entrepreneurial choice of graduates from internationally ranked Swedish universities systematically differs from others with the difference varying by the area of education.

The second paper on entrepreneurship aims at explaining the high interest in entrepreneurship among arts graduates and finds that the need for self-expression is among the main motivations for their high interest in entrepreneurship.

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Zara Daghbashyan

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List of Appended Essays

1. Daghbashyan Z. "Do University Units Differ in Efficiency of Resource Utilization? Case Study for the Royal Institute of Technology (KTH), Stockholm*"*
2. Daghbashyan Z. "The Economic Efficiency of Swedish Higher Education Institutions"
3. Daghbashyan Z., Deiaco E., McKelvey M. "How and why does cost efficiency of universities differ across European countries? An explorative attempt using new micro data*"*
4. Daghbashyan Z., Hårsman B. "University choice and entrepreneurship"
5. Daghbashyan Z., Hårsman B. "Entrepreneurship and Arts Related Education"

Introduction

In today's knowledge economy more and more attention is paid to the higher education sector as a main producer of human capital and knowledge. Whether discussing ways of furthering economic growth, curbing CO_2 emissions or stabilizing financial markets, politicians and policy-makers increasingly refer to the important role played by universities. This interest has resulted in a growing number of studies trying to define and assess the economic and social importance of the various outputs produced by universities.

The thesis deals with two aspects of this kind: the efficiency of higher education institutions (HEI) and entrepreneurship among university graduates. In the following I will briefly discuss the importance of each question and our contribution to the existing literature.

1.1.University efficiency analysis

Aspiring to contribute to the production of human capital and knowledge, which is deemed the "driving force" of economic growth (Romer, 1986, Lucas, 1988), governments allocate public financing to higher education institutions. They use the financing for teaching and research as well as for realising their third mission, i.e. dissemination of knowledge and interaction with the society. Given the size of HEI sector and public funding it seems relevant to ask if higher education institutions are using their resources productively. As noted by Robst (2001, p.733), the activity of higher education institutions may be driven by "the pursuit of excellence" and "prestige maximization", which does not necessarily imply economic efficiency traditionally assumed for profit-maximizing business establishments.

The economic theories of non-profit behavior[1] postulate that organizations like higher education institutions have little incentive to engage in efficient production practices (James, 1990). Some authors (James and Neuberger, 1981) argue that this happens due to different optimization strategies. In contrast to firms and organizations operating for profit, non-profit organizations have other objectives[2] and profit maximization, usually assumed for efficient operation, does not seem to be is a reasonable goal for them. Another line of behavioral theory argues that whatever objectives non-profit organizations pursue, they are inherently subject to productive inefficiency due to absence of ownership claims to residual earnings or

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[1] Hansmann (1996) divides the economic theories of non-profit organizations into the role and behaviour theories.
[2] For example instead of maximizing profits they aim to maximize the quality and quantity of services produced (James and Neuberger, 1981). Another explanation is suggested by Niskanen (1971), who argues that non-profit organizations are budget maximizers because it enhances the apparent importance of the organization or alternatively provides the preferred trade-off between quantity and quality maximization.

profits, due to relatively slow response to demand changes or additionally due to specifics of income generating processes (Hansmann, 1996).

In this respect the measurement of university performance in terms of economic efficiency becomes an important issue. As mentioned in Bogetoft et al. (2011) the comparison of economic performance or benchmarking can facilitate incentive provision and limit both the pre-contractual asymmetric information or adverse selection problem and post-contractual moral-hazard problem. Asymmetric information problem can be limited by extracting information about similar organizations' past behavior and the moral hazard problem by relative performance evaluations. In addition, efficiency studies can be used to help policy-makers and university administrations identify and implement intelligent policies for enhancing productivity and efficiency.

The first three papers of this thesis are focused on the analysis of economic performance of higher education institutions. The purpose is to identify and assess the importance of factors and institutions that influence their efficiency. This is done by comparing efficiency variations within a Swedish university, between Swedish HEIs and between a sample of European HEIs.

A traditional way to compare the performance of firms or organizations is to use the so called key performance indicators (KPI), which is usually measured as a ratio of an output to an input. However, as explained in Bogetoft et al. (2011), KPI approach has serious limitations. In particular these indicators can be misleading due to different production technologies used. In addition, this approach involves only partial evaluations, whereas one indicator cannot reflect the purpose of a multiple-output and multi-input firm. Different KPIs may not identify the same firm as the most productive. The third limitation is known as the Fox's Pardox. It shows that even if one firm have high partial productivity measures, it might have lower total productivity than another firm. To do well in total it is not enough to do well in different sub-processes - it is also important to make use of the sub-processes that have relatively higher productivities than others.

Given the limitations of KPI approach, modern benchmarking analyses increasingly use the so called best practice or frontier analysis methods. The idea is to model the frontier of the production technology and measure the capacity of firms and organizations to achieve the identified frontier. The introduction of efficiency concepts by Farrel (1957) provided a conceptual framework for analyzing the capacity of a firm to achieve the idealised frontier.

He has particularly defined the concept of cost efficiency[3] as the ability to obtain maximum output from the resources available (technical efficiency) and to choose the best package of inputs given their prices and marginal productivities (allocative efficiency). The closer the firm or organization to the frontier the more efficient it is, whereas those operating on the frontier are defined as 100 percent efficient (Coelli et al.,2005).

Two methods that are most often used in the frontier analysis are data envelopment analysis (DEA) and stochastic frontier analysis (SFA). Both are frontier methods aimed at the estimation of production frontier and efficiency, but they differ in the underlying assumptions. The advantages and disadvantages of both methods are now well recognized: in SFA the functional form of the frontier is pre-defined or imposed a priori, whereas in DEA no functional form is pre-established but is estimated from the sample of observations in an empirical way. DEA is a deterministic method and assumes that all deviations from the frontier are due to inefficiency, whereas in SFA the divergence from the frontier occurs due to the inefficiency and some random shocks out of agents' control. Because each method possesses its own strengths and limitations no method is strictly preferable to the other[4]. The previous literature focused on estimation of higher education efficiency has used both methods. Thus, several studies have applied DEA to investigate the relative efficiency of higher education institutions (Johnes & Johnes, 1993, Johnes, 2006, Glass, McKillop & Hyndman, 1995, Abbot & Doucouliagos, 2003 etc). The results indicate that there are various degrees of technical and/or cost efficiency in higher education institutions and that universities are not homogenous in their performance. The studies that employ SFA as a method to estimate the economic efficiency of higher education institutions are more diverse in a sense that they aim at estimating efficiency variation but also at finding factors causing efficiency differences. For instance, Robst (2001) investigates the impact of state appropriations on the cost efficiency of public universities and suggests that those having smaller state shares of public funding are not more efficient than universities having higher shares of public funding. Stevens (2005) estimates the cost efficiency for a group of English and Welsh universities and finds that there is inefficiency in higher education sector, which among other things is explained by faculty and student compositions. Arguing that efficiency estimates maybe sensitive to the choice of methodology McMillan & Chan (2006) compare the results from applying both DEA and SFA methods for a sample of 45 Canadian

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[3] Also called economic efficiency
[4] The choice is mainly motivated by the sample size and the amount of noise in the data.

universities. They report consistency in the relative ranking of individual universities for high efficiency and low efficiency groups.

Previous efficiency studies of higher education institutions cover either universities of one country or units within the same university, very few deal with cross-country comparisons. A general finding is that the performance differs between universities. However it is not clear if the efficiency varies more among units within one university or between universities in the same country. In addition, very few studies analyze possible reasons for efficiency differences and their findings in this respect are rather ambiguous and in many cases need further investigation.

1.2. Our contribution to university efficiency analysis

The three papers on university efficiency analysis included in this thesis contribute to the existing literature by

- making a three-level analysis comparing efficiency variation within units of one university, universities of one country, and universities in a group of countries
- shedding more light upon possible reasons of efficiency variation in higher education sector and hence suggesting improvement possibilities

The first paper uses the Royal Institute of Technology (KTH, Stockholm) as a case study to analyze the variation in the technical efficiency among 47 units. Data envelopment analysis is used to measure the efficiency of KTH units in teaching and research both separately and jointly. The rich dataset, from the Research Assessment Exercise (RAE) conducted by KTH in 2008, allows the analysis to cope with some of the difficulties in measuring research output mentioned in other studies. According to the results[5] about three quarters of KTH units operate on the frontier, i.e. they have similar high efficiency in utilization of their resources for teaching and research activities. The average performance of inefficient units is estimated to be 83 percet. The inefficient operation seems to be related to both poor management and scale inefficiency. The results also indicate that there is a strong positive correlation between the efficiency of resource utilization in teaching and research, suggesting that efficiency in research affects the efficiency in teaching and vice versa.

The second paper is focused on the estimation of cost efficiency of higher education institutions in Sweden. The question asked is to what extent, if any, HEIs operating in the same national market and being regulated by the same legislation exhibit different level of

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[5] The results of this analysis have been used by KTH administration for comparison of resource utilization among KTH units.

efficiency and if the observed differences can be explained by potential efficiency determinants. The study is conducted for 30 HEIs of Sweden using stochastic frontier methodology. We particularly apply the Battese and Coelli (1995) model which allows estimating both economic efficiency and its determinants. According to our results the average efficiency estimate is 85 percent with half of HEIs having above mean efficiency. Big universities as well as those having higher number of students per faculty are found to be more efficient. Furthermore the results indicate that the source of funding matters for economic behavior of institutions, i.e. HEIs having a high share of government financing in total revenues are less efficient. Another interesting finding is that HEIs employing higher proportions of young professors are more efficient ceteris paribus. The results also suggest that the efficiency might be increased by enrolling more foreign students. Students' pre-enrolment quality, measured by median grade point average score from secondary school (GPA), turns out to have no statistically significant effect on HEI's cost efficiency.

The third paper analyses the cost efficiency of universities among a set of public higher education institutions from six European countries by means of stochastic frontier techniques. Using new cross-national set of university input and output variables as well as series of university related environmental variables we explore cross-country variation in cost efficiency as well as the impact of institutional factors on efficiency variation. The results suggest small variation in the mean economic efficiency of higher education institutions (HEI) from UK, Norway, Sweden, Finland and Switzerland, implying that the efficiency differences found are not explained by country effects. Austrian HEIs are an exception, in this respect. They are found to be less efficient with statistically significant difference from HEIs in other European countries included in the analysis. Our results further suggest that big universities as well as those hiring a higher proportion of teaching and research personnel are more efficient everything else equal.

The general conclusions from these three papers are the following:

- the within university variation is lower than between university variation. About 75 percent of KTH units have similar efficiency, whereas the variation in economic performance is higher at national level.

- The efficiency estimate based on university's own frontier differs from the efficiency estimate based on the national frontier. Though the average efficiency for KTH suggests that KTH units are rather efficient compared to the own frontier, the overall performance of KTH seems to be low compared to the national frontier.

- the cross-country comparison indicates that the differences in economic performance are less likely to happen due to institutional differences specific to each country but rather due to organizational and other differences.
- among other things efficiency variations are effected by organizational differences such as university size, source of funding, faculty and student composition.

1.3. What do we really capture by efficiency estimates?

The reliability of any analysis is closely related to the ability to model the reality in the best possible way. However modeling of complex processes is not an easy task and is always associated with certain assumptions. The frontier analysis approach applied in these papers assumes that we are able to describe the operation of higher education institutions in terms of inputs and outputs as well as in terms of environmental variables affecting the overall production process.

Our analysis is based on the assumption that public universities are non-profit organizations that use government and external funding to produce different outputs, collectively described as research, education and interaction with the society. For production of these outputs universities use different inputs such as faculty, students and facilities. The process is described in the figure below.
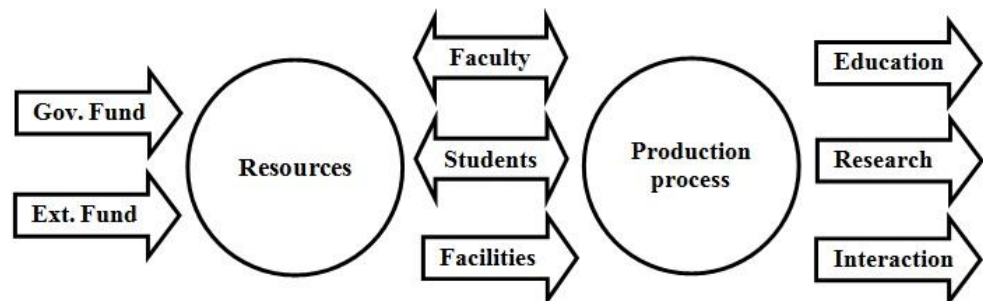

Figure 1: The operation of HEI

Efficiency differences among universities or university units might be related to the resource allocation process, i.e. mix of faculty, students and facilities, or to the production process, which transforms inputs into outputs. The former, for example, can cause efficiency variation because of differences in the faculty size and composition or due to differences in student composition, which result in differences in the original supply of knowledge and skills in terms of quantity and quality. Differences caused by the production process can be related to

organizational differences, in particular to differences in the content, size and design of courses and study programmes, the distribution of research and teaching activities etc.

The approach outlined in the figure simplifies the reality in several aspects. First of all using this approach we compare short-run efficiency, i.e. we relate annual input and output indicators, which does not take into account long-run goals. It might be that a HEI makes inefficient use of resources in the short-run, however it is justified if the long-run objectives are considered.

Furthermore, the quality of inputs and outputs is another important aspect that can affect the results of efficiency analysis. The validity of estimated efficiency indicators might be dependent on the possibility to control for quality differences. This is because frontier methods classify any university with above frontier costs as inefficient; however if extra costs are directed to ensuring a superior quality of outputs, and the quality aspects are not properly captured by the model, such classification might be misleading. Though we have tried to control for differences in university outputs in terms of quality of graduates and research, our quality measures are far from being ideal. In our cross-country analysis we have to assume that the universities are homogeneous in terms of output quality due to lack of appropriate quality proxies at cross-country level.

Next, in our analysis we could not find a good proxy for measuring the output of HEIs in terms of the interaction with society. If universities differ from each other in this respect then our results should be considered with some caution.

In addition, efficiency estimates can be influenced by the possibility to capture the specifics of environment within which HEI operates as well as organizational differences. This is especially important for cross-country comparisons since the failure to appropriately account for differences in higher education sectors, national educational objectives and internal labor market conditions can result in misleading estimates. However we hope that the data used for our cross-country analysis circumvents these pitfalls due to the centralization of the data collection process.

Finally, we would like to mention that the estimation of cost efficiency is based on the assumption that HEIs are cost minimizers; however, if their operation is driven by other objectives they can be less concerned about their economic performance. Nevertheless, as mentioned in Farsi & Filippini (2008), even if some institutions do not fully minimize their costs, the cost function approach is still meaningful and can be used as a "behavioral" approach for comparing the performance of units and marginal effects of various factors.

2.1. Entrepreneurship and graduates

One of the motivations for acquiring higher education is the prospect of better future careers, which are usually measured in terms of wages earned, over-education or employment possibilities after graduation. Obviously, these dimensions do not account for the career outcome in terms of entrepreneurial choice. Nonetheless, people exposed to entrepreneurship frequently express that they have more opportunity to exercise creative freedoms, higher self-esteem, and an overall greater sense of control over their own lives, which means that entrepreneurship should be regarded as a rather successful career outcome for the most people (Parker, 2009). Furthermore, wealth and a high majority of jobs created by small businesses started by entrepreneurially minded individuals makes entrepreneurship important not only from personal but also national prospective (Acs, 2006).

Given the importance of entrepreneurship as a career choice the two papers included in this thesis focus on the analysis of graduate entrepreneurship. As noted in Nabi and Holden (2008, p.548) graduate entrepreneurship is rapidly increasing and should be given more attention due to its importance "as a source of competitiveness and the engine for economic growth and development".

2.2. University choice and entrepreneurship

In the first paper on the career choice of graduates we particularly focus on the impact of universities on graduates' entrepreneurial choice. Previous research has mainly studied the relationship between university choice and the subsequent labor market outcome of graduates in terms of wages, over-education, employability (Dale and Krueger, 2011, Brand and Halaby, 2006, Eliasson, 2006). Little is known about the difference in the career choice of graduates from different universities. However, as mentioned in Nabi and Holden (2008), higher education is crucial to students' career-related choices and their perceptions of the attractiveness and feasibility of business-start-ups. HEIs may enhance students' entrepreneurial efficacy by providing them with attitudes and skills to cope with complexities embedded in entrepreneurial tasks and activities (Wilson et al., 2007). Recognizing the importance of education for enhancing graduates' entrepreneurial perceptions, the ambition of providing an education that stimulates ideas and entrepreneurship is currently included in the agenda of many HEIs[6]. The question addressed in our paper is whether universities are equally successful in enhancing graduates entrepreneurial perceptions and attitudes. If

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[6] See for example Högskoleverket Report 2004:38 R for Swedish HEIs and Herrmann et al. (2008) for UK universities.

graduates of some universities are more successful in the labor market due to a higher quality of their education[7], which is the finding of a number of studies (Lindahl and Regner, 2005, Lundin, 2006), then they might be less interested in entrepreneurial occupations. However using a 10-year panel data for graduates from internationally-ranked and non-ranked Swedish universities and colleges we have found an opposite pattern, implying a positive relationship between the quality of education and the frequency of entrepreneurial choice of graduates.

The results of our econometric analysis suggest that there is a systematic difference in the entrepreneurial choice of graduates from internationally ranked and non-ranked Swedish universities. In particular, graduates of ranked universities with degrees in the social, natural and medical sciences, as well as those educated as teachers, are found to be more interested in entrepreneurial occupations than graduates from non-ranked universities. Nonetheless, we found no significant difference in the entrepreneurial choice of graduates with a degree in technical sciences from ranked and non-ranked universities.

We conclude that the systematic difference in the career choice of graduates from ranked and non-ranked universities indicates that they either have different entrepreneurial preferences or different employment possibilities. If graduation from internationally ranked universities means higher productivity and better employment possibilities ceteris paribus, then graduates from ranked universities should exhibit a lower frequency of entrepreneurial choices, as compared to graduates from non-ranked universities. This pattern emerges for arts and humanities graduates, suggesting that, among other things, their entrepreneurial attitude might be driven by lower possibilities of wage employment. However, for graduates of other disciplines, the difference in entrepreneurial choice should be attributed to their entrepreneurial preferences rather than employment possibilities.

Hence, this study suggests that the quality of education matters for graduates' career choice, implying that the ambition to boost the interest in entrepreneurship among graduates should be focused on improving the quality of education.

2.3. Entrepreneurship and arts related education

The second paper on graduate entrepreneurship aims at understanding the observed high level of entrepreneurship among arts graduates. According to the Swedish data the rate of self-employment[8] for arts and media graduates was about 22% in 2007 which is about three times the rate for social and technical science graduates. A similar observation is reported for US.

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[7] Or signalling effects
[8] The ratio of self-employed to self-employed + wage employed

According to a field test questionnaire 6 out 10 arts graduates in the US are self-employed (Strategic Arts Alumni Project, 2010). This observation seems to be contradictory to the prediction of Lazear's jack-of-all-trades model of entrepreneurial choice (Lazear 2005), according to which arts graduates are expected to have low interest in entrepreneurship.

We argue that one reason might be that the utility art graduates gain from their occupational choice does not depend on generated income only but also on non-monetary considerations, not considered in Lazear's setup. Referring to pecuniary and non-pecuniary incentives literature Parker (2009) argues that money is not the only or even necessarily the most important incentive for entrepreneurs. Likewise Croson and Minniti (2012) show that self-employed are willing to accept lower earnings in exchange for psychic benefits from self-employment. This might be especially true for arts graduates due to both a strong desire to make use of their special artistic talent and due to a relatively low labor market demand for education in arts.

To explain arts graduates' high interest in entrepreneurship we outline an occupational choice model, which includes three options: wage employment, owning and combination of the two. The utility function governing the choice includes income as well as an indicator of the disutility supposed to result from differences between the skills required and the skills supplied. The model implies that an alternative providing a better match might be preferred to one providing a higher income. Using Swedish data we show that the possibility of using artistic skills has stronger impact on the choice of occupation than income considerations.

This paper contributes to the existing literature by underlining the importance of educational differences in making career decisions, by providing a formal and empirical analysis of the need of arts graduates for self-expression and by extending carrier alternatives traditionally used in previous literature. Our analysis also sheds light upon the relationship between the occupational choice and education specific unemployment rates as well as the relationship between occupational choice and past experience.

References

Abbot, M., Doucouliagos, C. (2003). The efficiency of Australian universities: a data envelopment analysis. *Economics of Education Review* 22 (1) 89–97.

Acs, Z. (2006). How is entrepreneurship good for economic growth? *Innovations: Technology, Governance, Globalization, 1(1), 97-107.*

Battese, G., Coelli, T. (1995). A model for technical inefficiency effects in a stochastic frontier production function for panel data. *Empirical Economics* 20: 325-332.

Bogetoft, P., Otto, L. (2011). Benchmarking with DEA, SFA, and R (International series in Operations Research and Management Science).

Brand, J., Halaby, C. (2006). Regression and matching estimates of the effects of elite college attendance on educational and career achievement. *Social Science Research* 35 , pp 749–770.

Coelli, J., O'Donneli, J., Battese, G. (2005). An Introduction to efficiency and productivity Analysis. Springer.

Croson, D., Minniti, M.(2012). Slipping the surly bonds: The value of autonomy in self-employment. *Journal of Economic Psychology*, 33 (2), pages 355–365.

Dale, S., Krueger, A. (2011). Estimating the return to college selectivity over the career using administrative earnings data. National Bureau of Economic Research, WP No 17159.

De Carolis, D., Saparito, P. (2006). Social capital, cognition, and entrepreneurial opportunities: A theoretical framework. *Entrepreneurship Theory and Practice*, 30(1), 41-56.

Eliasson, K. (2006). College choice and earnings among university graduates in Sweden (Doctoral dissertation, Umeå University).

Farrel, M. (1957). The measurement of productive efficiency. *Journal of the Royal Statistical Society*, A (General), 120, 253-281.

Farsi, M., Filippini, M. (2009). An analysis of cost efficiency in Swiss multi-utilities. *Energy Economics*, Elsevier, vol. 31(2), pages 306-315.

Glass, J., McKillop, D., Hyndman, N. (1995). Efficiency in the provision of university teaching and research: an empirical analysis of UK universities. *Journal of Applied Econometrics* 10, 61-72.

Hansmann, H., Hansmann, H. (2000). The ownership of enterprise. Harvard University Press

Herrmann, K., Hannon, P., Cox, J., Ternouth, P., & Crowley, T. (2008). Developing entrepreneurial graduates: putting entrepreneurship at the centre of higher education. Council for Industry and Higher Education (CIHE), National Council for Graduate Entrepreneurship (NCGE) and National Endowment for Science, Technology and the Arts (NESTA), London.

Högskoleverket Report (2004: 38 R).Cooperation with the surrounding community in higher education.

James, E. (1990). Decision processes and priorities in higher education. In the Economics of American Universities, ed. S.A. Hoenack and E.I. Collins. Buffalo, NY: State University of New York Press.

James, E., Neuberger, E. (1981). The university department as a non-profit labor cooperative. *Public Choice*, 36(3), 585-612.

Johnes, G., Johnes, J. (1993). Measuring the research performance of UK economics departments: An application of data envelopment analysis. *Oxford Economic Papers* 45.

Johnes, J. (2006a). Data Envelopment Analysis and its applications to the measurement of efficiency in higher education. *Economics of Education Review* 25(3) 273-288.

Johnes, J. (2006b). Measuring teaching efficiency in higher education: An application to data envelopment analysis to economics graduates from UK Universities, 1993. *European Journal of Operations Research* 174(1), 443-456.

Lazear, E. (2004). Balanced skills and entrepreneurship. *The American Economic Review*, Vol 94, No 2, pp 208-211.

Lazear, E. (2005). Entrepreneurship. *Journal of Labor Economics*, Vol 23, No 4, pp 649-680.

Lindahl, L., Regner, H.(2005). College Choice and Subsequent Earnings: Results Using Swedish Sibling Data. *The Scandinavian Journal of Economics*, Volume 107, Issue 3, pages 437–457.

Lucas R. (1988). On the mechanics of economic development. *Journal of Monetary Economics* 22 (1), 3-42.

Lundin, M. (2006). Effects of college choice on incomes in Sweden. Swedish Institute for Growth Policy Studies, Working paper R2007:016.

McMillan, M., Chan, W. (2006). University efficiency: A comparison and consolidation of results from stochastic and non-stochastic methods. *Education Economics*, 14(1) 1-30.

Nabi, G., Holden, R.(2008). Graduate entrepreneurship: intentions, education and training. *Education+ Training*, 50(7), 545-551

Niskansen, W. (1971). Bureaucracy and Representative Government. Chicago; Aldine Press

Parker S. (2009*). The Economics of Entrepreneurship*. Cambridge University Press.

Robst, J. (2001). Cost efficiency in public higher education institutions, *Journal of Higher Education* 72(6).

Romer, P. (1986). Increasing returns and long-run growth. *Journal of Political Economy* 94, 1002–1037.

Stevens, P. (2005). A stochastic frontier analysis of English and Welsh universities. *Education Economics*, 13, 355-74.

Strategic National Arts Alumni Project (SNAAP). (2010). Forks in the Road: The Many Paths of Arts Alumni. Bloomington: Center for Postsecondary Research, School of Education, Indiana University. http://snaap.indiana.edu.

Wilson, F., Kickul, J., Marlino, D. (2007). Gender, Entrepreneurial Self-Efficacy, and Entrepreneurial Career Intentions: Implications for Entrepreneurship Education. *Entrepreneurship Theory and Practice,* 31(3), 387-406.