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Faculty of Social Sciences
Institute of Economic Studies

MASTER'S THESIS

The Price Elasticity of the Demand for Higher Education: A Meta-Analysis

Author: **Bc. Olesia Kiiashko**

Supervisor: **Doc. Tomas Havranek, Ph.D.**

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Declaration of Authorship

The author hereby declares that she compiled this thesis independently, using only the listed resources and literature, and the thesis has not been used to obtain a different or the same degree.

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Prague, July 20, 2016

Signature

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Abstract

The main question of this study is whether the demand for higher education is relatively sensitive to tuition fee changes or is price inelastic. There is no definite answer in the literature. Approximately 52% of the estimates show it to be insignificant, 43% rate it as statistically negative, and approximately 5% are statistically positive. In a quantitative survey of 562 estimates reported in 48 studies, it has been found that large increases in tuition fees have a disproportionately negative impact on enrollment when potential publication bias and method heterogeneity are taken into account. The publication bias tests show that negative results are more preferable among researchers, because it is well supported by theory (when prices increase demand decreases). The results also suggest that four aspects of study design are especially effective in explaining the differences across primary studies: (1) the longer time period negatively associated with the price c of demand for higher education, (2) while the cross sectional estimations have reported more negative results, panel data estimations have reported fewer negative results, (3) controlling for endogeneity is crucial, (4) while controlling for unemployment rate has no clear conclusive impact, controlling for income is not significantly associated with the price elasticity of the demand for higher education.

JEL Classification	I21, D70, C51
Keywords	higher education, enrollment, tuition fee, meta-analysis

Author's e-mail	`lesya.fox89@gmail.com`
Supervisor's e-mail	`tomas.havranek@ies-prague.org`

Abstrakt

Hlavní otázkou tohoto šetrení je, zda požadavek na vysokoškolské vzdelávání je pomerne citlivý na zmeny školného nebo je cena nepružný. Neexistuje žádná jednoznacná odpoved v literature. Približne 52% z odhadu jsou zanedbatelné, 43% jsou statisticky negativní a približne 5% jsou statisticky pozitivní. V kvantitativním pruzkumu 562 odhadech vykázaných v 48 studiích bylo zjišteno, že velká zvyšování školného mají neprimerene negativní dopad na zápis když potenciální zaujatost publikace a zpusob heterogenita jsou brány v úvahu. Tyto publikace zkreslení testy ukazují, že negativní výsledky jsou výhodnejší mezi výzkumnými pracovníky, protože jsou dobre podporovány teorii (kdy se ceny zvyšují je pokles poptávky). Výsledky také ukazují, že ctyri aspekty návrhu studie jsou zvlášte úcinné pri vysvetlování rozdílu mezi primárními studií: (1) delší casový horizont negativne spojen s cenovou pružnosti poptávky po vysokoškolském vzdelávání, (2) když prurezová odhady hlásy více negativní výsledky, panelové odhady mají méne negativní výsledky, (3) kontrola endogenity je velmi duležité, (4) kontrola míry nezamestnanosti nemá jasný prukazný vliv, kontrola výdeleku není významne spojena s cenové elasticity poptávky po vysokoškolském vzdelávání.

Klasifikace JEL	I21, D70, C51
Klíčová slova	vysokoskolske vzdelani, zapis do studia, skolne, meta-analyza

E-mail autora	`lesya.fox89@gmail.com`
E-mail vedoucího práce	`tomas.havranek@ies-prague.org`

Contents

List of Tables

List of Figures

Acronyms

2SLS Two Stage Least Squares

3SLS Tree Stage Least Squares

EPR Enrollment Participation Rate

GLS Generalized Least Squares

MLE Maximum Likelihood Estimation

OLS Ordinary Least Squares

PCC Partial Correlation Coefficient

SE Standard Error

SPRC Student Price Response Coefficient

SUR Seemingly Unrelated Regressions

TSTAT T-Statistics

US United States

WLS Weighted Least Squares

Master's Thesis Proposal

Author	Bc. Olesia Kiiashko
Supervisor	Doc. Tomas Havranek, Ph.D.
Proposed topic	The Price Elasticity of the Demand for Higher Education: A Meta-Analysis

Motivation The main aim of this thesis is to analysis studies concerning demand for higher education elasticities. The main motivation is to enhance whether demand for higher education to be relatively sensitive to tuition (e.g., Hight, 1975; Heller, 1997; Chang & Hsing, 1996; Allen & Shen, 1999) or it is insensitive (Levine et al., 1988; Paulsen & Pogue, 1988; Quinn & Price, 1998; Shin & Milton, 2008; Craft et al. 2012).

A single study measure is a less precise. That is why the main goal of this work is to aggregate information from different studies in order to achieve a higher statistical power for the measure of elasticity. This method is so-called meta-analysis and for the first time was introduced by Stanley and Jarrell (1989). Meta-analysis uses a statistical approach to unite the results from different studies (effect size and weighted average) with a goal to increase statistical power over individual studies. Recent applications of meta-analysis in economics include, among others, Havranek (2015) on measuring intertemporal substitution, and Valickova et al. (2014) on financial development and economic growth.

To date, only one meta-analysis of demand for higher education elasticities is known (Gallet, 2007). The Author in his work considers two cases: tuition and income elasticity. His results reveal that demand is least responsive to tuition and

income in the United States, and he emphasizes that the measure of quantity and price, as well as estimation method have important effects on the tuition elasticity. However, it is important to notice that this study did not correct the estimates for publication bias. This is a severe problem, because this bias can seriously distort the results of meta-analysis (Stanley, 2005). This thesis will examine publication bias for higher education demand elasticities in the literature.

Hypotheses

Hypothesis #1: The estimated higher education demand elasticities is affected by publication bias in literature.

Hypothesis #2: The true effect-size of higher education demand elasticities sensitive to tuition.

Hypothesis #3: Whether research design, publication characteristics, and method and time choice explain heterogeneity across empirical studies in this literature.

Methodology I will conduct a search of the relevant literature in databases such as RePEc, Scopus and Google Scholar, search for the following keywords: "higher education elasticity", "demand for higher education" and "higher education expenditure". I will identify journal articles and working papers, including econometric studies examining the demand for higher education elasticities.

Following previous studies (Doucouliagos, 2005; Valickova et al., 2014), fistly, I will start with partial correlation coeffient (PCC). I will calculate the PCC because primary studies differ in terms of higher education elacticities measurement and I need some standardization for comparability across studies.

Importantly, some primary studies include the interaction effect of tuition with as the explanatory variable along with the percapita real income itself (Jackson and Weatherby, 1975; Leslie and Brinkman, 1987). For these studies, I will consider the average marginal effect of higher education elasticities and use Delta method to

approximate the standard errors. Doing so, I will receive the t-statistic to calculate PCC.

The simple meta-regression model examines the effect of standard error of PCC (SEpcc) on standardized effect size-PCC itself, following Valickova et al.(2014). To reduce heteroskedasticity and obtain more efficient estimates, Stanley (2008) purposes weighting with the standard error of the PCC. Therefore, weighted least squared (WLS) version is obtained with divided each variable to SEpcc.

Afterwards, the bivariate regression may provide bias estimate results if important moderator variables were omitted (Doucouliagos, 2011). Adding moderator variable, will develop the detection of the source of heterogeneity across primary studies (Doucouliagos & Stanley, 2008). The moderator variables also will add with weighted least squared values.

Expected Contribution Main contribution will introduce publication selection bias using different estimation methods in demand for higher education elasticities literature. Investigation on the demand for higher education has a principal importance for policymakers, because the major public policy goal is develop efficiency on student access to higher education, and tuition plays a pivot role as a part of policy instrument. Therefore, policymakers can be better informed about higher education elasticities and detect what is the main impact of tuition and income on higher education.

Outline

1. Introduction: This part will explain the main idea of the topic and motivation.

2. Literature review: In this part, it will be briefly described how different authors estimate the elasticity of demand for higher education in the literature.

3. Meta-analysis methodology (publication bias, heterogeneity) and data: This part will present meta-analysis methodology and will explain how effect sizes

and their standard error, as well as research characteristics have been collected from studies.

4. Empirical results: The main findings and interpretation will be discussed in this part.

5. Concluding remarks: All findings will be summarized, the policy implication will be provided for policymakers.

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Author

Supervisor

Chapter 1

Introduction

Investigation into the demand for higher education is of principal importance for policymakers. One major public policy goal is developing efficiency on student's access to higher education. Tuition fees play a pivot role as a policy instrument. Due to reductions of subsidies to higher education by many governments (which can be observed across numerous countries over recent decades), many universities have been compelled to rase tuition fees in an effort to maintain revenues to cover budgetary expenses.

In addition, each university aims to increase the quality of their education or at least to maintain it at the same level as a priority, usually implying increasing costs over the long term. Therefore, the main goals of institution financial offices may be in opposition to some degree. On the one hand, expenditures should be covered by revenues, which can lead to increase in the cost of education. On the other hand, such increases should not be such that students decide not to enter the university. Thus, universities are highly interested in enrollment information when setting an optimum level of tuition fees.

Price elasticity of the demand for higher education carries information about students' response to tuition increase and can define whether institutions will meet their revenue targets. University revenues from tuition fees will be greater

than their target values if the price elasticity is lower than expected value and vice versa; if price elasticity is much higher than expected value, the university will not meat its revenue targets and may experience budget shortfalls.

Many studies are devoted to this topic because it is relevant to policymakers. Many researchers attempted to determine the true effects of tuition on student enrollment over the last century. Recently the question has become even more pressing due to the increases in availability of education. Nevertheless, results are different across studies and there is no benchmark magnitude of the price elasticity of the demand for higher education.

The main aim of this thesis is to analyze studies concerning the demand for higher education elasticities. The main motivation is to find whether demand for higher education is relatively sensitive to tuition (e.g., Hight, 1975; Heller, 1997; Chang and Hsing, 1996; Allen and Shen, 1999) or it is insensitive (Levine et al., 1988; Paulsen and Pogue, 1988; Quinn and Price, 1998; Shin and Milton, 2008; Craft et al. 2012). Thus, policymakers may be better informed about higher education elasticities and detect the main impact of tuition fees on higher education.

A single study measure is a less precise. That is why the main goal of this work is to aggregate information from different studies in order to achieve a higher statistical power for the measure of elasticity. This method is so-called meta-analysis, which uses a statistical approach to unite the results from different studies (effect size and weighted average) with the aim to increase statistical power over individual studies. However, while conducting research, there is a severe problem known as publication bias or the file-drawer problem. Publication selection occurs when researchers, referees, or editors prefer certain types of estimates, typically statistically significant results or those that are in line with the prevailing theory (Stanley, 2005).

From the traditional point of view, when the tuition increases, the demand

for higher education decreases. Therefore, we expect a strong negative relationship between the price of higher education and enrollment. However, recent decades show that the role of education changed significantly. Until the middle of the Twentieth Century, education was a luxury and very few people could dispute its value. Nowadays it has become widespread, a large number of educational institutions now exist, and the role of the knowledge increases with increase in job competition.

Young people understand that their future highly depends not only on knowledge, but also on degrees in order to be competitive in the job market. So now the main question: does tuition much influence student's decision to pursue and degrees and how much tuition fees are students willing to pay? The traditional intuitive way of understanding the relationship between tuition and enrollment is still relevant, however, it might be that researchers unintentionally discard positive estimates (results become underrepresented) and we can observe bias in the literature.

To date, only one meta-analysis of demand for higher education elasticities is known (Gallet, 2007). Gallet considers two cases: tuition and income elasticity. His results reveal that demand is least responsive to tuition and income in the United States, and he emphasizes that the measure of quantity and price, as well as estimation method have important effects on the tuition elasticity. However, it is important to notice that this study did not correct the estimates for publication bias. This is a severe problem, because this bias can seriously distort the results of meta-analysis (Stanley, 2005).

The thesis is structured as follows: Chapter 2 includes a literature review, which briefly describes how different authors estimate the elasticity of demand for higher education in the literature. Chapter 3 presents meta-analysis methodology and data. This part details the data collected for the meta-analysis, explains how effect sizes and their standard error, as well as research

characteristics have been collected from studies, and presents meta-analysis methodology. Chapter 4 discusses the empirical results, main findings and interpretations. The Chapter 5 summarizes and explains policy implications.

Chapter 2

Literature Review

The substantial variation in estimates of elasticity of the demand for higher education can be observed in the literature. Differences in study attributes can be consider as the main explanation factor in understanding of such variation. The very intuitive approach to explain applicant's enrollment decision is to look at the cost of education and asses how it can influence their decision making.

Traditional point of view states that if tuition fees increase than the demand for higher education decreases. Therefore, as it is predicted by the theory, strongly negative relationship between price for higher education and enrollment is expected. However, the relationship between tuition fee changes and applicant's decision to enroll is not so straightforward. The effect of the cost of education on enrollment is very important for the policymakers. That is why a number of works was conducted in this field. Researches made an attempt to answer for such important questions as: (1) Are tuition fees the main factor for the applicants in their decision making? (2) Whether it is significantly influence their decision?

Some researchers show that the demand for higher education is relatively sensitive to tuition fees (e.g., Hight, 1975; Heller, 1997; Chang and Hsing, 1996; Allen and Shen, 1999). However, there is a number of works, which results are

opposite and says that the demand for higher education is relatively insensitive to the cost of education (Levine et al., 1988; Paulsen and Pogue, 1988; Quinn and Price, 1998; Shin and Milton, 2008; Craft et al. 2012).

Recent decades, a shift has observed in the empirical researches to the opinion that tuition fees do not play so important role in students' decision as it predicted by the theory. Taking into account all the investigations, the main question now is: what is the truly effect of increasing or decreasing in the costs of education? The meta-analysis approach can help to shed light on this question by combining all results. However, this method is not absolute substitution for the literature review and good consideration of previous studies is still important. A brief review of several works, considering the effect of the tuition fees on students' enrollment, is presented below.

Hight (1975) emphasizes that the increase in tuition fees in private universities comparing to public had enormous negative impact on the private to public enrollment ratio. He also showed that increase in family income leads to expansion of private share of higher education market. Leslie and Brinkman (1987) made a comprehensive work on a literature review, collected 25 studies from 1967 to 1982 to investigate the relationship between price changes for higher education and the demand for higher education. They described the importance of student's demand investigation as "expanding and equalizing student access long has been a major public policy goal, and manipulation of price has been seen as the major policy instrument for achieving this goal" (Leslie and Brinkman, 1987, p. 182).

This statement is still relevant nowadays. It can be consider as a benchmark in answering for the question why it is crucial to study students' demand for education. The authors applied to their work the methodology offered by Jackson and Weathersby (1975), who did a three-step process of standardization to calculate SPRC (student price response coefficient) and investigated differ-

ent types of institutions. Following the demand theory, they expected SPRC to be negative. Leslie and Brinkman (1987) found that SPRC vary from -0.2 to -2.4 and the modal price response from 25 studies is equal to -0.6, which they called their "best estimate for public policy purposes" (Leslie&Brinkman, 1987, p. 189). However, the authors found that despite of tuition fee increases last two decades, the enrollment rate also increased in the United States. They explained this phenomenon as prices increased in nominal terms, but not in real terms.

In addition, they found a positive effect of financial aid on the enrollment, which is stronger for students with law income. Moreover, the author made a crucial notice that not only prices affect student's decision, but also disposable income, their preferences and tastes, the value of knowledge and investment prospective. This statement also did not lose its value and even became more relevant today. Leslie and Brinkman (1987) made a big contribution to the economics by investigation the demand for higher education and their study is one of the landmark works in this field.

Heller (1997) updated the Leslie and Brinkman's (1987) work. The author says that since Leslie and Brinkman published their work, many student demand studies appeared. That brought a lot of new information according to this topic. His goal was to extend the previous work rather than simple repeating with studies that are more recent. The author in his paper concentrated his attention on answering questions, concerning tuition and financial aid changes, and how this changes affect later cohort of students, students with different incomes, races or in different college sector, are this effects the same or differ. The Author pointed that "Knowing the answers to these questions, or at least some possible answers, can help policymakers determine the likely impacts of changes in tuition and financial aid policies at the federal, state, and institutional levels" (Heller, 1997, p. 626). This statement is also relevant and even

sharper nowadays. The author concluded that the magnitude of the effect on tuition fee changes varies across studies and depends on such factors as statistical techniques, differences in population, type of cost component. However, Heller confirms the fundamental relationship between price of education and enrollment that has been confirmed by earlier researches.

According to Heller (1997) every increase in tuition fees by $100 leads to decrease in enrollment from 0.5 to 1.0 percent points across all types of institutions. In addition, the author has got some specific findings on aid sensitivity, differences among income groups, differences among races, differences between sectors. Namely decrease in financial aid leads to decrease in enrollment. In addition, lower-income students, black students and students in community colleges are more sensitive to tuition and aid changes.

Chang and Hsing (1996) conducted a study used time-series annual data to investigate how do tuition and other factors affects student enrollment to private colleges and universities in the United States. They also used general functional form coupled with dynamic specification in their investigation. The authors statistically rejected at the 5% level the log-linear, linear functional forms and the static model, which were widely used in earlier studies. They found that tuition fees and other costs connected with university participation have significant effect on the enrollment. In addition, the author show very slow adjustment of actual enrolment to the desire one.

Allen and Shen (1999) also confirmed the fundamental relationship between tuition and enrollment by empirical results. They applied simple enrollment demand model to their investigation of the regional market environment. They looked at a private, church-related, comprehensive institution that offer undergraduate, graduate and professional education. The authors found a significant negative effect of gross (or net) tuition fees on the demand for higher education. In addition, a positive income elasticity of the demand was found, which says

that private education is a normal good. However, it is interesting to notice that this conclusion is also debatable across the literature. For example, 13 years later, Craft et.al (2012) investigated the enrollment at Southern Utah University and found that the higher education is inferior good.

Allen and Shen (1999) also showed that the opportunity cost of college attendance has significant effect on the enrollment. They extended these general findings with two more conclusions. First, significant competitive threat associated with public sector. Second, the role of scholarships and grants significantly increasing in student's decision making if the competitor institution exists. The authors found that the net price elasticity of demand is equal to -1.53, which says that tuition subsidies play an important role to enrollment decision.

Levine et.al (1998) investigated the students' decisions to enroll across three Mid-Atlantic States (New York, New Jersey, and Pennsylvania). They considered these decisions an investment decisions including human capital. The authors took Enrollment Participation Rates (EPR's) as a measure of demand for higher education and estimated individual equations for demand in each of states. In addition, they applied pooled data from the states to two regional equations to investigate demand for higher education separately for public and private universities. They found EPR's to be income elastic and price inelastic for both public and private sectors across all the states. Moreover, one of the finding confirms that public and private higher education are substitute goods. However, according to the cross-price elasticities (less than 0.3), this substitution is weak.

Quinn and Price (1998) examined the demand for medical education over the 1948 to 1994 years. Their results shows that the major determinants of medical university participation are income and return to medical education, while price does not play an important role in student's decision. Shin and

Milton (2008) examined the effects of increase in price for education on enrollment in such academic fields as engineering, physics, biology, mathematics, business, and education. The authors made a big contribution for policymakers by extending the existing researches on tuition elasticity of demand for higher education by analyzing it not only by student's characteristic, but also considering discipline level. They found that price elasticity differ across disciplines. Demand is elastic to price level in Physics, Biology, and Business, but it is inelastic in Engineering field, which has the highest expenditure and rate of return. However, the authors warn readers and emphasize that they should be careful with interpreting the results as far as meaning can be different for different conditions of each individual country.

Curs and Singell (2009) conducted a study, where they for the first time assessed differences in net price responsiveness across needs and abilities for the University of Oregon. They showed the decreasing in price responsiveness with need and ability. This investigation should help to policymakers and institution managers in setting the prices and predicting future enrollment.

Craft et.al (2012) showed the experience of increasing the tuition at Southern Utah University. They found that despite the significant tuition increase over 30 years, enrollment growth is still strong as well as increase in revenues. They emphasize that "the university has consequently expanded funding for vital needs including new faculty, advanced accreditation, increased computer lab space, academic advising, and student employment" (Craft et.al, 2012, p. 13) and this influence student's decision more than tuition fees.

The same idea about stronger relationship between the enrollment rate and the quality of education at university, can be found in other works. For example, McDuff (2006) in his work, investigated enrollment to in-state public universities and colleges tn the US. He came to the same conclusion that students are willing to pay more for the increasing quality of university. This can

be very intuitive: young people consider the higher education as an investment into the future which will help to pay back current investments. Universities that have better programs, better equipment, better professorial team can give more opportunity for the students to be more competitive on the labor market. This expected future benefits can influence more the applicants decisions rather than the current level of the tuition fees. In addition, the author found the positive correlation (0.30) between quality and tuition fees at the state level. This proofs a very natural idea that the higher quality is connecting with additional expenditures which lead to the higher prices for education. However, McDuff (2006, p. 445) made a crucial notice that "students seem to be attracted to quality to such a large degree that tuition effects are tiny in comparison".

Hemelt and Marcotte in both their studies in 2008 and 2011 did not find a significant response of enrollment to the large increase in the tuition real rate. They found that a 100 dollar increase in tuition leads to only about 0.25% decrease in enrollment rate, which almost nothing compering with price increasing.

Several studies include tuition fees in the regression as a dummy variable investigating whether the tuition fees by itself play the role in student's decisions rather than the amount of this tuition. It is especially characteristic for the number of researches in Germany. Dwenger et.al (2011) test mobility of university applicants taking into account influence of tuition fees. Bruckmeier and Wigger (2013) investigated public universities enrollment in some German states to answer the question whether the recent introduction of tuition fees had a negative effect on enrollment and they did not find significant effect on aggregate enrollment rates. They extended their work in the same year cooperating with Georg-Benedikt Fischer by considering the location of universities in their model. Hubner (2012) uses dummy variable indicating residence in a fee state to investigate the effects of tuition on enrollment probabilities. He found

negative effect of tuition fees on enrollment, which is similar by its magnitude to the U.S. and much larger than in other countries in Europe.

Gallet (2007) attempted to apply the meta-analysis method to investigation of demand for higher education. As it was mentioned before, this is the first work on this field and the only one known up to now. Numerous studies on investigation of higher education demand exist. Each of them has different and sometimes contradictory to each other estimation results of the tuition and income elasticities. The author conducted a pooled estimate of conceptually similar studies to determine which characteristics are the main determinants of college enrollment. This work is focusing on several specific questions such as short and long run differences in elasticity estimates and sensitivity of these elasticity estimates to the chosen functional form of the demand.

In addition, the Gallet (2007) tried to reveal whether data differences, method of estimation and different corrections significantly influence the estimates of elasticity. Moreover, whether the type of journal, where the single study was published, and the year of publication affect elasticity estimates. The meta-analyses of the demand for other products were taken as a base for this work.

First, the author collected price and income elasticities of higher education from 60 existing studies that were conducted in the period from 1953 to 2007. Then they were regressed as dependent variables on different study attributes as independent variables. These studies attributes are presented in the regression in form of dummy variables and capture particular characteristics, such as country, type of university, gender of applicants etc. The interpretation as follow: a positive estimated coefficient of a dummy variable says that study characteristic increases the elasticity estimate ceteris paribus and otherwise, a negative estimated coefficient of a dummy variable says that study characteristic decreases the elasticity estimate ceteris paribus.

Gallet (2007) also provides the review of the main differences across studies, such as specifications of the dependent variable, type and source of the data, demographic or an institutional characteristic, estimation techniques, different aspects of the publication.

In both cases, tuition and income elasticities, coefficient estimates for many study attribute's variables are significantly different from zero. The income effect on enrollment are less investigated than price effect in the literature. Significance of coefficients on many individual study characteristics shows the little impact on income elasticity comparing with the price elasticity. However, some study attributes affect the income elasticity.

The estimation results revealed the demand for higher education to be more price inelastic in the short-run rather than in the long run due to the significantly positive coefficient of the dummy variable, that capture the period. The same effect was detected in case of the income elasticity. In addition, demand is more tuition and income inelastic in the United States rather than other countries. Also the results shows that the measure of quantity and price, as well as estimation method have important effects on the tuition elasticity. For example, 3SLS, MLE or SUR estimation increase the tuition elasticity, while 2SLS and GLS decrease it. Estimation method also has important effects on the income elasticity. Particularly, using MLE decreases income elasticity, while GLS estimation has the opposite effect. However, the measurement of quantity and price affect the income elasticity very little. Besides, the type of the data (cross-sectional, time series, or panel) do not have significant effect neither on price elasticity nor income.

The results are different across the studies and there is no benchmark magnitude of the price elasticity of the demand for higher education. The main aim of this thesis is to analysis primary studies to shed light on whether demand for higher education is relatively sensitive or insensitive to tuition fees.

Chapter 3

Methodology and Data

3.1 Methodology

This section provides the background for the methodology used in this thesis. The question about the true relationship between price for higher education and enrollment has been debatable across the literature and became even more interesting last decades. It is interesting why researches find such a various results by investigation the same topic. Why despite of theoretical background, many findings show that enrollment inelastic to increases in the tuition fees or there is even positive relationship?

Narrative literature review is be not sufficient in this situation. The main disadvantage of such unsystematic reviews is that reviewer includes only a portion of reports in her work (perhaps more preferable ones from his point of view). This could bring bias, because conclusions of such review might be seriously affected by beliefs and expectations of the reviewer.

Meta-regression analysis (MRA) can overcome this disadvantage due to the systematic review of all relevant studies, included in this analysis. It helps very strongly in understanding of heterogeneity among the studies. The statistician Karl Pearson published the first paper on meta-analysis in 1904 in the

British Medical Journal. This method became widely used and developed in the medical field to aggregate the results of multiple clinical trials. More recently, meta-analysis have extended from medical research to other fields. For the first time in economics Stanley and Jarrell introduced meta-analysis in 1989. Recent applications of meta-analysis in economics include, among others, Nelson and Kennedy (2009) on environmental and natural resource economics, Havranek (2015) on measuring intertemporal substitution, and Valickova et al. (2015) on financial development and economic growth. (Stanley&Jarrell, 1989, p. 300) stated in their work that this is "the method that allows us to look over our own shoulders".

In a few words, it is a quantitative approach or statistical technique which combines the findings from various individual studies with the aim to cover all relevant literature according to some topic. The main idea behind this approach is to investigate and identify different factors that could be potential drivers of the researches results. This systematic aggregation of different findings brings more explicit picture and draws more independent from human factor conclusions. Stanley (2001, p. 132) has very precisely noticed that "the most important strength of meta-analysis is that it moves literature reviews away from casual judgements about "good" studies that deserve attention and "poor" studies that should be set aside, and instead provides a replicable statistical framework for summarizing and interpreting the full range of evidence."

Systematic aggregation of data from individual studies can improve statistical power. However, as any other statistical method, meta-analysis has its own weaknesses. The main requirement for MRA is a comprehensive search strategy. The validity of the approach is strongly depends on selection criteria for the studies and quality of their methodology. In addition, heterogeneity, publication and reporting biases can be named through the problems of meta-analysis. Despite it, this approach is a powerful statistical instrument in

understanding the differences among the studies.

Meta-analysis approach doesn't replace or cancel literature review. Good survey of the different articles is still relevant and important for investigation. However, meta-analysis helps to look more deep and more unbias at the differences across this studies and to make an attempt to understand the answers to such questions as "Why there is so much variation among the reported empirical results of economic research? Why do researchers come to such different findings when they are purportedly investigating the same phenomenon? Does the reason lie in the idiosyncratic choices of statistical methods? Or, is it a result of the biases induced by model misspecifications? Perhaps, it is the unique character of different data sets". Stanley and Jarrell (1989, p. 299-300). These two methods, unsystematic and systematic reviews, are complement to each other. Together they can provide additional information and avoid different sources of bias that can be observed in the literature.

MRA identifies how a particular choice of different characteristics (such as datasets, estimation methods, control variables, samples and others) can affect reported results. In addition, it helps to detect publication bias, which can arise when some of the results are strongly supported by the theory and more preferable among the researches. This information is crucial for universities and policymakers in their decision making concerning the prices on education. The wrong information can bring reduction in enrollment rate or money losses to university. That is why meta-analysis was chosen as a tool for the investigation of price elasticity of the demand for higher education.

3.1.1 Publication bias

A severe problem can be meet during the conducting meta-analysis research. This problem is well known as publication bias or the file-drawer problem. Pub-

lication bias appears because of the difference between the number of empirical findings that are likely to be published and these ones that are available to be published. That leads some of the estimates to be unpublished and brings serious bias to the investigation. For example, researchers may be confused by finding results that are contrary to these ones that are strongly predicted by the theory. In addition, such results are often not easy to publish. Because of this bias, the true effect can be overestimated or underestimated, therefore it can lead to wrong conclusions and serious consequences. Moreover, statistically significant results are more likely to be published than insignificant results, because they are more attractive. According to Borenstein et. al (2009) "studies that report relatively high effect sizes are more likely to be published than studies that report lower effect sizes". It might discourage researcher to show insignificant results. This is the most frequent case of publication bias following Stanley (2005). It moves the empirical effects to be larger than they are. Therefore, this tendency to prefer some results rather than others may lead researchers to hide findings that are not in the line with theory or insignificant, leading to a bias in the published literature.

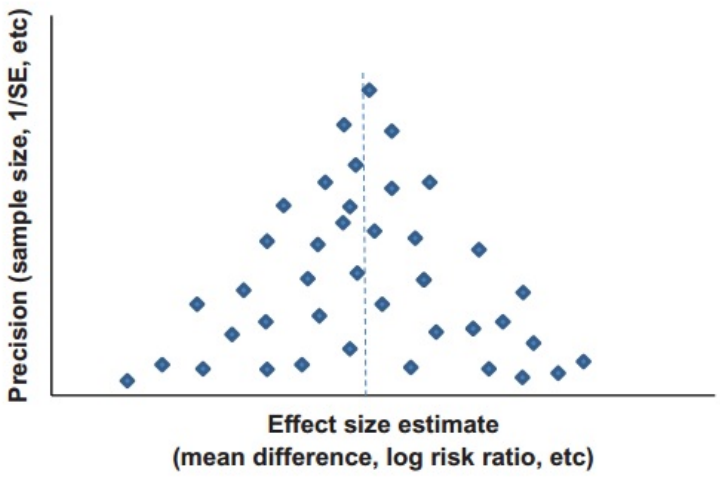
3.1.2 Graphical Approach

The examination of funnel plot is a simplest visual way to detect publication bias. It shows the studies included in the meta-analysis with an non-standardized effect (for example, regression, correlation coefficients, estimated elasticities, or PCC) on horizontal axes and precision on vertical axis. Precision can be any measure of the extent to which the results can be affected by the play of chance. Following Stanley 2005 (p. 314), "precision can be measured in a variety of ways, the most common and precise of which is the inverse of the standard error (1/SE)." The sample size, as well as its square root, the number

of degrees of freedom also can serve as a measure of precession.

The studies with small number of observations has more widely spread around the average estimated results rather than the results with large number of observations due larger random random errors. If scatter plot looks like funnel plot, it means that there is no publication bias. Figure 3.1 represents funnel-plot illustration with sufficient number of unbiased primary studies. Each point represents an estimated effect size in primary study.

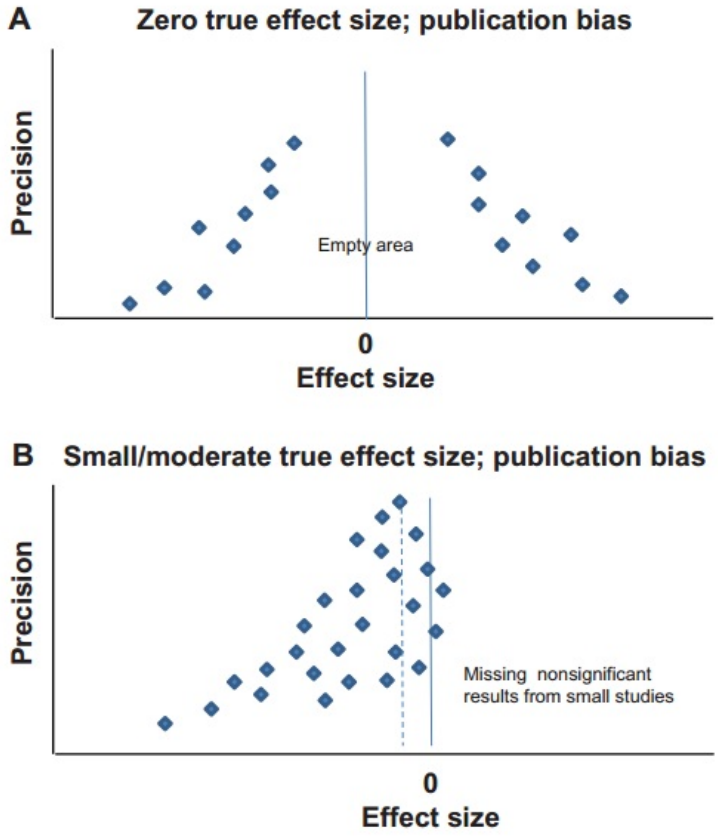
Figure 3.1: Funnel-plot illustration with sufficient number of unbiased studies



Source: Song et. al. (2013).
Notes: The figure shows funnel-plot illustration with sufficient number of unbiased primary studies.

When the true reported-effect size equals zero, the biased selection of studies looks like a funnel plot with an empty area around zero (Figure 3.2A). When the reported effect-size is small or moderate, the funnel plot may become asymmetric because of publication bias towards to negative or positive. Figure 3.2B shows funnel-plot illustration with negative publication bias.

Figure 3.2: The possible impact of publication bias on the shape of funnel plots



Source: Song et. al. (2013).

Notes: Figure 3.2A shows funnel-plot illustration with zero true effect-size publication bias. Figure 3.2B shows funnel-plot illustration with negative publication bias.

3.1.3 Partial correlation coefficient

The selected studies used different types of higher education tuition that include different units, scales and components. The partial correlation coefficient is estimated between tuition and dependent variable for each reported results to standardized measure of the estimated effect of tuition on higher education demand (Greene, 2008; Doucouliagos and Stanley, 2009; Valickova et al., 2015). This standardize allows to analyze different studies with direct comparison. However, before standardize effect size, it is needed to consider the average marginal effect of tuition on higher education demand.

Following previous studies (Doucouliagos, 2005; Valickova et al., 2015), the partial correlation coefficient derived as:

$$PCC_{is} = \frac{t_{is}}{\sqrt{t_{is}^2 + df_{is}}} \tag{3.1}$$

where i indexes the primary studies, s indexes the different reported result for each primary studies. t_{is} is the associated t-statistics; and df_{is} is the corresponding number of degree of freedom. PCC_{is} represents partial correlation coefficient between tuition and higher education demand.

The simple meta-regression model examines the effect of standard error of PCC_{is} ($SEpcc_{is}$) on standardized effect size of effect size - PCC_{is} itself:

$$PCC_{is} = \beta_0 + \beta_1 * SEpcc_{is} + \epsilon_{is} \tag{3.2}$$

where $SEpcc(SEpcc_{is} = \frac{PCC_{is}}{TSTAT_{is}})$ is the conventional measure of precision, which estimated as a standard error of partial correlation coefficient, ϵ is the regression error term.

3.1.4 Heterogeneity

To reduce heteroskedasticity and obtain more efficient estimates, Stanley (2008) purposes that Eq.(3.2) can weight with the standard error of the PCC_{is}. Therefore, weighted least squared (WLS) version of Eq.(3.2) is obtained with divided each variable to $SEpcc_{is}$:

$$TSTAT_{is} = \beta_0 \frac{1}{SEpcc_{is}} + \beta_1 + \epsilon_{is} \frac{1}{SEpcc_{is}} \tag{3.3}$$

where $TSTAT_{is} = \frac{PCC_{is}}{SEpcc_{is}}$ measures the significance of partial correlation coefficient of interest. The β_0 provide true effect size of tuition on higher education demand in terms of partial correlation coefficient: as a coefficient of the inverse of the standard error of the partial correlation coefficient, it measures the underlying effect of tuition on higher education demand. The coefficient β_1 measures publication bias and indicates the direction of the bias.

The bivariate regression may provide bias estimate results if important moderator variables were omitted (Doucouliagos, 2011). Adding moderator variable to Eq.(3.3), will develop the detection of the source of heterogeneity across primary studies (Doucouliagos and Stanley, 2009). The moderator variables added with weighted least squared values:

$$TSTAT_{is} = \beta_0 \frac{1}{SEpcc_{is}} + \beta_1 + \sum_{k=1}^{N} \lambda_k * \frac{1}{SEpcc_{is}} X_{kis} + u_{is} \frac{1}{SEpcc_{is}} \tag{3.4}$$

where k represents number of moderator variables with weighted by $(1/SEpcc_{is})$, λ_k are the coefficient of moderator variables, which each of them measure the impact of corresponding moderator variable on the underlying effect of tuition on higher education demand, and u_{is} is the error term with standard assumption.

3.2 Data

Following the methodology applied by Stanley (2013), the survey conducted a search of the relevant literature on the elasticities of the demand for higher education. Moreover, this research is focused on the influence of tuition on enrollment, therefore only those studies were used as a data base that investigated the causality between tuition and enrollment.

The data contains in total 48 studies (these are listed in Table 3.1): 39 of these are published in refereed journals, 9 are working papers. The number of outcomes reported per study ranges from one (Campbell & Siegel, 1967; Tannen, 1978; Sulock, 1982; Savoca, 1990; Toutkoushian & Hollis, 1998; Berger & Koshtal, 2002) to 106 (Hemelt & Marcotte, 2011), with mean of 23.

Collecting of the studies went through several steps. Firstly, the studies were identified by searching in such searching systems as Google Scholar, Scopus and RePEc. Key words used in the search were "higher education elasticity", "demand for higher education", "price elasticity of higher education" and "higher education expenditure". The abstracts of all of these studies are carefully reviewed and only those, that showed containing the empirical estimates, have been downloaded for the further investigation. Additionally, other studies have been revealed by examining the reference section and literature reviews of some of these studies (Campell & Siegel (1967); Jackson & Weathersby (1975), Heller(1997). The search was conducted using English keywords and stopped on March 23, 2016.

The studies were taken into further analysis according to the following criteria. First, the model of the study should include tuition as an explanatory variable and enrollment (or probability of enrollment) as a dependent variable. Studies that contain another model specification were excluded from the analysis. Second, tuition should not be dummy variable. Studies that include tuition

Table 3.1: **Primary studies included in Meta-analysis**

Author(s)	**Year**	**Author(s)**	**Year**
Agarwal and Winkler	1985	Hoenack and Weiler	1975
Alexander and Frey	1984	Hsing and Chang	1996
Allen and Shen	1999	Huijsman et al.	1986
Berger and Koshal	2002	Kane	2007
Bezmen and Depken	1998	King	1993
Bruckmeier et al.	2013	Knudsen and Servelle	1978
Buss et al.	2004	Koshal et al.	1976
Campbell and Siegel	1967	McDuff	2006
Canton and de Jong	2002	McPerson and Schapiro	1991
Chen	2016	Mueller and Rockerbie	2005
Cheslock	2001	Murphy and Trandel	1994
Chressanthis	1986	Neill	2009
Coelli	2009	Noorbakhsh and Culp	2002
Corman and Davidson	1984	Ordovensky	1995
Craft et.al.	2012	Parker and Summers	1993
Curs and Singell	2009	Paulsen and Pogue	1998
Dearden et al.	2011	Quigley and Rubinfeld	1993
Doyle and Cicarelli	1980	Quinn and Price	1998
Elliott and Soo	2013	Savoca	1990
Grubb	1988	Shin and Milton	2008
Hemelt and Marcotte	2008	Sulock	1982
Hemelt and Marcotte	2011	Tannen	1978
Hight	1975	Toutkoushian, Hollis	1998
Hoenack and Pierro	1990	Tuckman	1970

Notes: A complete list of studies is available in the Appendix A.

as a dummy variable were also excluded from the analysis (for example, Bruckmeier & Wigger, 2013). Third, it is not possible to control for publication bias in the literature without estimates of standard errors. Therefore, only studies that provide standard errors or t-statistics for their estimates were included in the analysis.

In contrast of product demands, there might be differences in measuring of enrollment. Therefore there are some differences across studies about the estimation of the demand function for higher education. Most of the researchers use total enrollment as a dependent variable. However, there is some variations. For example, Hemelt and Marcotte (2008) use total headcount, total number of credits taken, and the number of first-time, full-time freshman (FTFT) as a measures of enrollment. Mueller and Rockerbie (2005) have come to a conclusion that the number of applications is a better measure of the demand for Canadian universities rather than enrollment. Also different authors uses such a measurements as total number of applications received by an institution, the number of students registered at institution, the percentage of all students enrolled at a particular university etc.

As it was mentioned before, one meta-analysis of demand for higher education elasticities was already conducted by Gallet (2007). The Author in his work considers two cases: tuition and income elasticity. The main interest for this thesis is only tuition elasticity. Therefore, the data until 2007 is mostly based on the list of the studies by Gallet. All of the 60 studies were revised. The only those of them that contains tuition elasticity, and were available for the moment of searching, and confirm to the selection criteria were taken for the further investigation. Some additional studies that were published before 2007 were found by methodology described above.

In total, the data base for this research contains 48 studies that give 562 estimates of the tuition elasticity of the demand for higher education. Ap-

proximately 52 % of these estimates are insignificant and 43 % are statistically negative, and approximately 5 % are statistically positive (based on the conventional 5 % significance level). These studies are listed in the Appendix Table 1A. For more information, see Appendix A.

Table 3.2 provides the list, description and statistics of collected variables used in the meta-analysis. This table divides main attributes of studies into several groups that reveal the source of heterogeneity in the literature.

Authors preferred their specification to different measurement of higher education tuition, different methods, different samples, different time periods, different control variables and different endogeneity assumption. Therefore, it values to analyze heterogeneity regarding to different groups.

Table 3.2: **Description and summary statistics of collected variables**

Variable	Definition	Mean	St.Dev.	Min	Max
Tuition	Tuition on higher education	-0.24	0.73	-11.10	2.35
SE tution	Estimated standard error of tuition	0.13	0.23	0.00	3.15
TSTAT	The estimated t-statistics of the effect size	-2.31	9.11	-190.00	13.80
PCC	The partial correlation coefficient	-0.14	0.25	-0.99	0.71
SEpcc	The standard error of PCC	0.08	0.07	0.00	0.31
Estimation					
NO.OBS	The logarithm number of observation	6.06	2.37	2.48	13.26
NO.EXP.VAR	The number o explanatory variable	7.59	4.11	1.00	24.00
NO.COUNTRY	The number of country	5.99	13.99	1.00	53.00
NO.TIME	The number of time	12.15	11.82	1.00	50.00
Publication					
YEAR	Publication year	2000	11.55	1967	2016
CITATIONS	Google Scholar citation number	43.11	37.32	0	293
PUBLISHED	Dummy, 1 if published in journal, 0 otherwise	0.54	0.50	0.00	1.00
Control variables					

Continued on next page

Table 3.2: **Description and summary statistics of collected variables (continued)**

Variable	Definition	Mean	St.Dev	Min	Max
UNEMP	Dummy, 1 if unemployment is included, 0 otherwise	0.57	0.50	0.00	1.00
INCOME	Dummy, 1 if income is included, 0 otherwise	0.70	0.46	0.00	1.00
Dataset					
CROSS	Dummy, 1 if dataset type is cross-sectioanl is included, 0 otherwise	0.22	0.41	0.00	1.00
PANEL	Dummy, 1 if dataset type is panel is included, 0 otherwise	0.59	0.49	0.00	1.00
TIME-SERIES	Dummy, 1 if dataset type is time-series is included, 0 otherwise	0.19	0.39	0.00	1.00
Estimation Methods					
OLS	Dummy, 1 if method type is OLS, 0 otherwise	0.37	0.48	0.00	1.00
FE	Dummy, 1 if method type is FE, 0 otherwise	0.51	0.50	0.00	1.00
ENDOGENEITY	Dummy, 1 if endogeneity has been conducted, 0 otherwise	0.09	0.28	0.00	1.00
Sample					
MALE	Dummy, 1 if used only male participation	0.10	0.30	0.00	1.00
FEMALE	Dummy, 1 if used only female participation	0.10	0.30	0.00	1.00
PRIVATE	Dummy, 1 if used only private institutions	0.06	0.25	0.00	1.00
PUBLIC	Dummy, 1 if used only public institutions	0.05	0.21	0.00	1.00

Notes: Method characteristics are collected from studies estimating the effect of tuition on enrollment. The list of studies is available in the Appendix.

We can observe a substantial variation in the elasticity estimates among the studies with mean tuition elasticity of -0.24 and standard deviation of 0.73 which is range from -11.10 to 2.35. Therefore, the average effect of tuition on enrollment is negative and the standard error of this estimate is small (0.13). In addition, it is worth to look at the partial correlation coefficient as far as strictly comparability cannot observe between estimates. According to the

Doucouliagos (2011) the mean of partial correlation coefficient is small with the value -0.14.

The estimation characteristics show that studies include approximately 8 explanatory variables. The mean number of countries (or regions in the country) is about 6 and the mean number of a time periods is 12. It should be noted that many studies use the country-level data and mostly for the United States (Allen & Shen, 1999; Shin & Milton, 2008). However, several datasets are based on state-level or region-level data (Koshal, et. al., 1976; Tuckman, 1970; Toutkoushias & Hollis, 1998; Quigley & Rubinfeld, 1993). Some studies are analyzed on institutional level (Hemelt & Marcotte, 2008, Hemelt & Marcotte, 2011, Craft et. al 2012), some is interested in different fields of study (Shin & Milton, 2008).

First paper has been published in 1967 in this literature, and latest one that included to this thesis has been published in 2016. The top 5 most cited papers are Campell & Siegel (1967) - 293, McPerson & Schapiro (1991) - 290, Kane (2007) - 108, Agarwal & Winkler (1985) - 107, and Tuckman (1970) - 89 (Citation numbers based on Google scholar).

Most of the authors control for unemployment (57 %) and/or income (70 %) in their regression analysis. The unemployment rate plays important role on enrollment decision of applicants. One might argue that higher unemployment rate discourages applicants due to lower economic performance and/or lower expected private returns. However higher unemployment across less educated rather that more educated people. Additionally, lower economic conditions stimulates education to be more valuable.

According to the type of the dataset it can be observed that panel data dominates cross-sectional and time-series (59 % of studies are based on panel data). The cross-sectional data is observed only 22 % across primary studies, and it mostly was chose by the old papers. Remaining studies were examined

with time-series data. The researcher preferred panel data due to its advantages comparing to cross-sectional and time-series. Panel data contain observations of multiple individuals obtained over multiple time periods, it has advantages advantage to control for individual heterogeneity and heterskedasticity issues. Estimation techniques are also differing across the studies. As far as panel data dominates other types of data, fixed effect models are found more preferable (51 % of studies use this technique). Ordinary Least Squares (OLS) meets in 37 % of cases and the rest are other methods such as modified OLS, 2SLS (Two Stage Least Squares), 3SLS (Three Stage Least Squares), SUR (Seemingly Unrelated Regressions) method, GLS (Generalized Least Squares), MLE (Maximum Likelihood Estimation), Zenner estimates, and Probit and Logit models.

Additional four dummy variables have been included to control for the choice of sample. Primary studies has different sample choice, regarding to the gender participation. Mostly studies prefer include all students, however some research differentiated males and females. The 80 % of sample have been include all participants, 10 % of samples included only male, 10 % only used female students. Next two dummy variable are control whether primary study included only private or public institutions. The sample of this research contains 6 % of private and 5 % of public initiations.

Table 3.3 presents the main analysis of the higher education elasticity across primary studies. The arithmetic mean of partial correlation coefficient of higher education elasticity is -0.144 with a 95% confidence interval [-0.165, -0.122]. The fixed effect estimator has been weighted by the inverse variance, it yields -0.202 with a 95% confidence interval [-0.208, -0.196]. The random-effects estimator measures random differences across primary studies, it shows similar to fixed effect estimator: the higher education elasticity is statistically negative with a 95% confidence interval [-0.227, -0.177]. According to Doucouliagos

(2011) it is negligible small value. It might not confirm potential publication selection and method choice like fixed and/or random effect, it might related to misspeciffications that have systematic effects on the results.

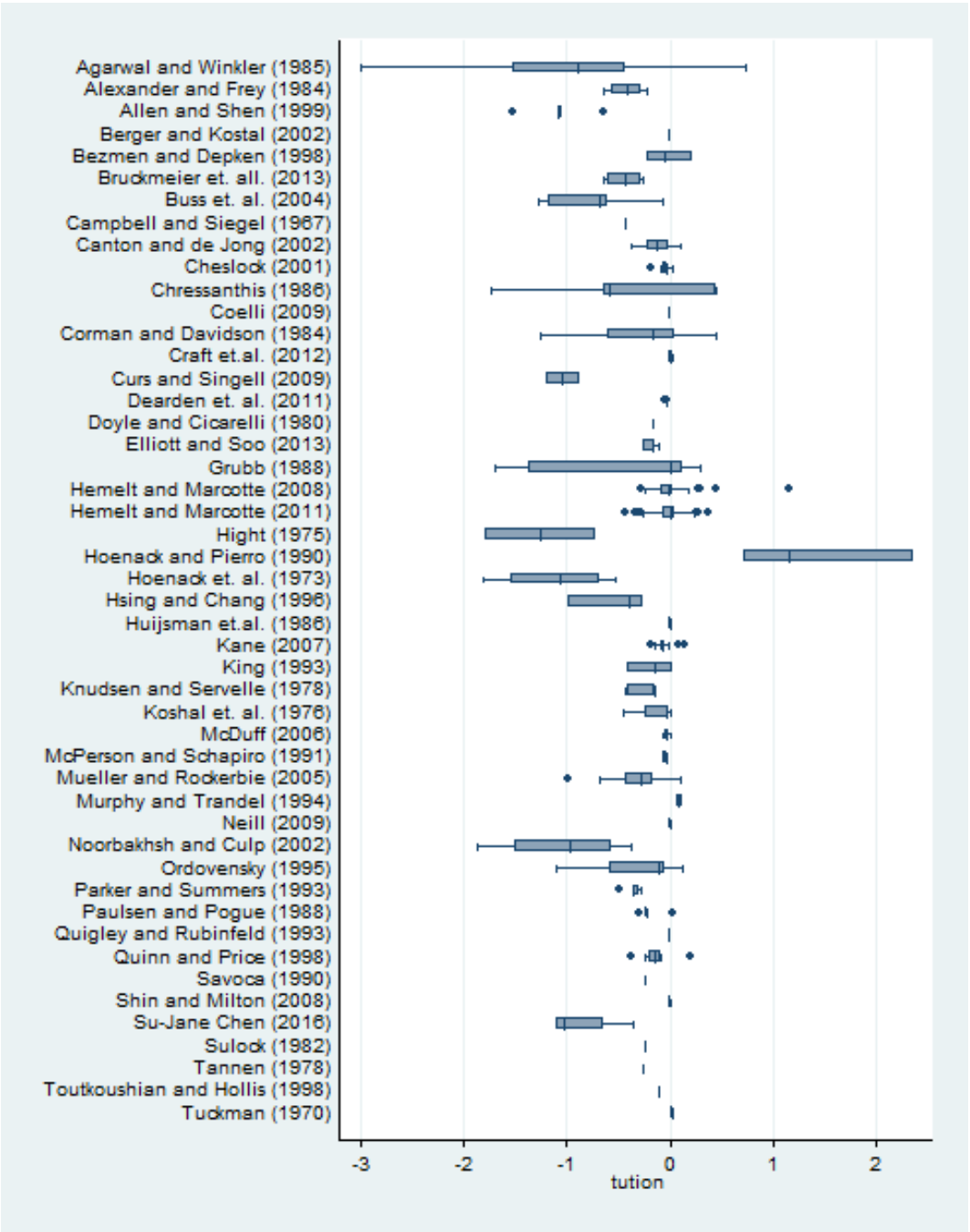
Table 3.3: **Estimates of the overall partial correlation coefficient**

Explanation	**N**	**Mean**	**SE**	**95% conf. int.**	
Simple average of PCC	562	-0.144	0.011	-0.165	-0.122
Fixed-effects average PCC	562	-0.202	0.003	-0.208	-0.196
Random-effects average PCC	562	-0.202	0.012	-0.227	-0.177

Notes: Simple average represents the arithmetic mean. The fixed-effects estimator uses the inverse of the variance as the weight for the PCC. The random-effects specification additionally considers between-study heterogeneity.

Figure 3.3 shows a box plot of the mean estimate values across primary studies. It shows that most primary studies reported negative results and it range -1 to 0. The heterogeneity across studies may be due to difference in dataset, estimation methods, sample choice, choice of control variables and/or it might related to publication characteristics. Table 3.2 provides the mean estimates for the participants and primary studies.

Figure 3.3: The higher education elasticity by study



Source: Author's computations.

Notes: The figure shows a box plot of the estimates of the higher educational elasticities across primary. The higher educational elasticities measured the impact changes on tuition on enrolment. Full reference list can be found in Appendix A.

Chapter 4

Empirical Results

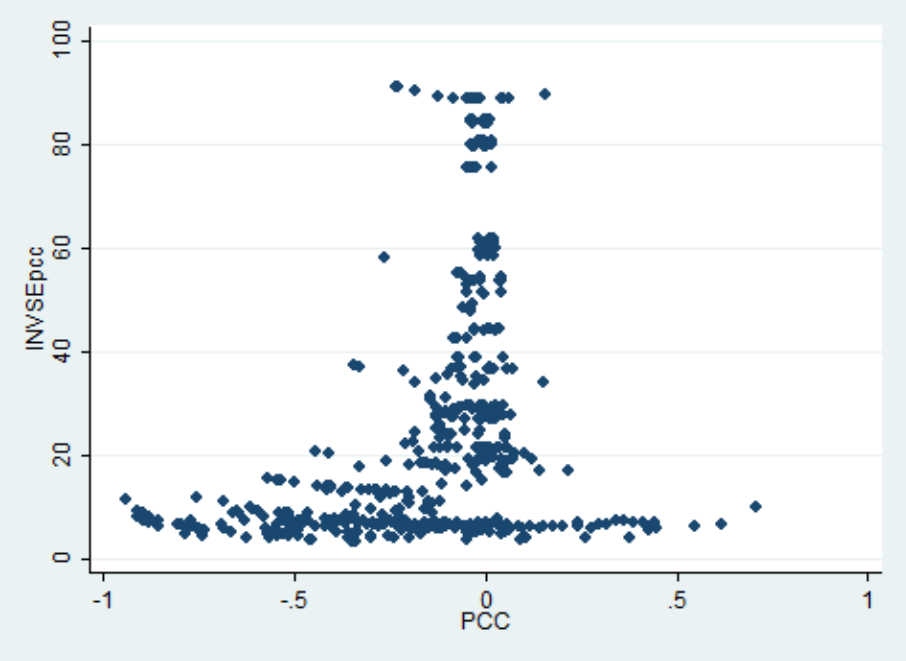
4.1 Publication Bias

Publication selection occurs when researchers, referees, or editors prefer certain types of estimates, typically statistically significant results or those that are in line with the prevailing theory (Stanley, 2005). Publication bias has been analyzed by many researcher (DeLong & Lang, 1992; Card & Krueger, 1995; Ashenfelter et. al, 1999 etc.), and found that most reported study results has been affected by publication selection (Doucoiliagos and Stanley, 2013). Therefore before analyzing the heterogeneity between primary studies, it worths to check whether literature has publication bias towards common expectation across studies.

If researcher prefer report of higher eduction elasticity statistically significant and negatively correlated with the turion, then higher education elasticity literature mislead readers. The presence of publication bias in higher education elasticity can be examined visually in Figure 4.1. This visual explanation is called inverse funnel plot (Egger et. al, 1997). Figure 4.1 presents correlation between estimated results with the inverse of the estimated standard error. Partial correlation coefficient has been used to standardize estimated

results. Horizontal axis represents the inverse of the estimated standard error and vertical axis shows estimated effect of higher educational tuition in primary studies. The presence of asymmetrical form signalling the publication bias. Figure 4.1 shows that negative results are preferable among researcher. It might related to the theoretical expectation on the impacts of higher education tuition on enrollment. Funnel plot is not follow where it confirms that even higher standard errors have been reported despite that they have insignificant results. However, most estimated results are negative, where make funnel plot asymmetric toward negative values. Therefore, it signals that negative results are preferable in the literature.

Figure 4.1: Funnel plot of the effect of higher education elasticity



Source: Author's computations.
The funnel plot is asymmetric toward to negative values. It signals that negative results are preferable in the literature.

The funnel plot show only visual description of publication bias. It can be confirmed by more formally. Table 4.1 represents the test of funnel asymmetry. The dependent variable is partial correlation coefficient of estimated results (PCC), the estimated equation is $PCC_{is} = \beta_0 + \beta_1 * SE + \epsilon_{is}$.

Table 4.1: **Tests of the true effect and publication selection**

	Clustered OLS		IV estimation		Fixed-effects	
	Precision	Study	Precision	Study	Precision	Study
	(1)	(2)	(3)	(4)	(5)	(6)
SE (publication selection)	-2.101***	-1.003***	-5.198*	-1.672***	-0.233	-0.688**
	(0.26)	(0.23)	(3.01)	(0.53)	(0.22)	(0.29)
Constant (true effect)	-0.004	-0.092***	0.004	-0.025	10.190	3.068**
	(0.00)	(0.02)	(0.00)	(0.04)	(11.56)	(1.44)
N.Observations	562	562	562	562	562	562
N.Groups	48	48	48	48	48	48
R^2	0.44	0.63	0.31	0.35	0.20	0.12
F(1,47)	67.83	18.82	2.98	10.07	1.17	5.49

Source: Author's computations. The dependent variable is PCC; the estimated equation is $PCC_{is} = \beta_0 + \beta_1 * SE + \epsilon_{is}$. All results are weighted by the inverse variance and the number of studies. The standard errors of the regression parameters are clustered at the study level. Columns (1), (3) and (5) represent results weighted by the inverse variance, columns (2), (4) and (6) represent results weighted by the number of studies. Columns (1) and (2) represent OLS with cluster-robust standard errors at the study level; columns (3) and (4) represent IV estimation, where the instrumental variable is the inverse of the square root of the number of degrees of freedom; columns (5) and (6) represent fixed-effects estimation at the study level. The reported t-statistics are based on heteroskedasticity cluster-robust standard errors.

All results are weighted by the inverse variance and the number of studies. The standard errors of the regression parameters are clustered at the study level.

Columns (1), (3) and (5) represent results weighted by the inverse variance, columns (2), (4) and (6) represent results weighted by the number of studies. Columns (1) and (2) represent OLS with cluster-robust standard errors at the study level. OLS estimates confirm that literature has negative publication bias. IV estimations (Columns (3) and (4)) instrumented *estimated standard error* variable with the inverse of the square root of the number of degrees of freedom, has similar results OLS. Fixed-effects estimations (Columns (5) and (6) represent) at the study level confirms publication bias towards negative estimated higher education elasticities.

The main evidence that especially large increases on tuition fee have a disproportionately negative impact on enrollment. On the one hand, Sa (2014) shows that applications decrease in response to higher fees in UK during 2012, especially for courses with lower salaries and lower employment rates after graduation. On the other hand, Hemelt & Marcotte (2011) has showed that increase on tuition from one year to the next year do does not have significant negative effect on enrollment.

4.2 The Differences in Primary Studies

The previous section emphasized that the reported standard errors are correlated with the reported effect size. However, it is not enough to explanation the different results in primary studies. The difluence might related to the publication characteristics and study design like the choice of control variables, dataset choice, estimation method and subsample choices.

Table 4.2 presents the results of multivariate meta-regression, for which

employed three different estimation methods to explain the heterogeneity of the estimated effects of tuition fee on higher education reported in primary studies. Columns (1), (3) and (5) represent results weighted by the inverse variance, columns (2), (4) and (6) represent results weighted by the number of studies. Columns (1) and (2) represent OLS with cluster-robust standard errors at the study level; columns (3) and (4) represent IV estimation, where the instrumental variable is the inverse of the square root of the number of degrees of freedom; columns (5) and (6) represent fixed-effects estimation at the study level. The reported t-statistics are based on heteroskedasticity cluster-robust standard errors. All three different estimation method and two different weighting strategies comparable with each other. The main findings are similar for total six different specifications. The more explanatory variables have significant improvement on regression; when explanatory variables included to the regression the additional R^2 increased 0.34.

Regarding to the study design, Table 4.2 shows that higher number of observation reports less negative results among primary studies. The study design have a strong impact on the reported results, so the underlying conclusion about the tuition and enrollment nexus depends on how study has been designed. Authors those used less than 1000 observations, found effect sizes varying from -0.287 to -1.102 (Agarwal & Winkler, 1985; Buss et. al, 2004; Muller & Rockerbie, 2005; Chen, 2016, and etc.). However, McDuff (2006) and Neil (2009) used over than 500000 and 350000 observations respectively, and found less negative results comparing to the previous group in the literature.

McDuff (2006) examines college quality - tuition fee nexus, found that applicants prefer to apply to the high quality public colleges despite of higher tuition fee of institutions. It is still questionable whether higher education fee has negative impact on the enrollment. There is a simultaneous effect that higher demand tends higher tuition fee, and better conditions leads higher

quality, therefore higher quality attracts more applicants enroll to the college. However development on the college quality from student's points of view is expecting higher that increase on the tuition fee.

Results show that the longer time period negatively associated with the price elasticity of demand for higher education. This finding suggests that it might be worthful concentrate on longer time dimension when examine the impact of higher tuition fee on enrollment. Craft et. al. (2012) emphasize that when longer period is taking account, the impact of tuition fee on enrollment is larger. It takes time for students in their decision making after changes in tuition fee.

It has been found that more recent published studies confirm significant negative tuition fee - enrollment nexus. The studies published in journals are more likely reported higher negative price elasticity of demand for higher education. Surprisingly, higher cited studies are less likely report negative correlation between enrollment and tuition fee.

Concerning the controls for tuition fee, the dummy variables for unemployment rate and income indicate whether study take account unemployment rate and income into its regressions. The unemployment rate and income as an economic and social factors affects to the enrollment willingness and possible opportunity cost for return on higher education. While unemployment rate has positive and significant effect on higher education elasticity from clustered OLS and IV results, it gives significant and negative results with fixed-effect results. The role of unemployment is questionable. It might encourage young people to get higher education for to be more competitive on the labor market in the future. It might discourage lower return of higher education.

The results suggest that the primary studies overestimate the importance of controlling for income; approximately 70% of primary studies condition for family income, but controlling for income does not have significant effect on

decision making. Craft et. al. (2012) shows that personal income has not strong impact on freshman's enrollment choice.

Next, the data choice of studies has has a systematic effect on the reported results. While the cross sectional estimations have reported more negative results, panel data estimations have report less negative the price elasticity of demand for higher education. The panel data effect is positive, which means that studies that included individual and time dimension tend to find less negative results. Concerning choice of estimation methods, results suggest that studies with OLS estimations has reported more negative like cross sectional choice, fixed effects reported less negative results, some has report positive like panel data choice.

Table 4.2: **What drives the heterogeneity in the results?**

Variable	**Clustered OLS**		**IV regression**		**Fixed effects**	
	(1)	(2)	(3)	(4)	(5)	(6)
NO.OBS	0.095***	0.036**	0.067***	-0.016	0.113***	0.194***
	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.05)
NO.EXP.VAR	0.009	0.155***	-0.014	0.103**	-0.097**	-0.045
	(0.01)	(0.05)	(0.01)	(0.05)	(0.04)	(0.06)
NO.COUNTRY	0.047*	-0.001	0.048	-0.017	-0.000	-0.015
	(0.02)	(0.04)	(0.04)	(0.04)	(0.06)	(0.01)
NO.TIME	-0.085***	0.028	-0.087***	0.042	-0.044**	-0.110**
	(0.01)	(0.04)	(0.02)	(0.04)	(0.02)	(0.04)
Publication						
YEAR	-22.398***	-11.652**	-26.766***	-10.545*		
	(4.04)	(5.08)	(6.14)	(5.74)		
CITATIONS	0.010	0.033*	0.011	0.038*		
	(0.01)	(0.02)	(0.01)	(0.02)		
PUBLISHED	0.036	-0.136	0.050	-0.145*		
	(0.05)	(0.09)	(0.07)	(0.08)		
Control variables						
UNEMPLOYMENT	0.343***	-0.025	0.338***	0.000	-0.059	-0.264**
	(0.07)	(0.06)	(0.10)	(0.06)	(0.07)	(0.13)
INCOME	-0.005	-0.079	0.011	-0.021	-0.016	0.003
	(0.01)	(0.05)	(0.01)	(0.05)	(0.04)	(0.05)
Dataset						
CROSS	-0.206***	0.088	-0.299**	0.087		
	(0.08)	(0.11)	(0.12)	(0.11)		
PANEL	0.099**	0.124*	-0.000	0.049		
	(0.05)	(0.07)	(0.06)	(0.07)		
Estimation Methods						
OLS	0.002	-0.128**	-0.000	-0.114**	-0.045	0.011

Continued on next page

Table 4.2: **What drives the heterogeneity in the results? (continued)**

Variable	**Clustered OLS**		**IV regression**		**Fixed effects**	
	(1)	(2)	(3)	(4)	(5)	(6)
	(0.00)	(0.05)	(0.00)	(0.06)	(0.05)	(0.09)
FE	0.119**	-0.014	0.158*	-0.079	-0.095	-0.011
	(0.05)	(0.10)	(0.09)	(0.10)	(0.08)	(0.09)
ENDOGENEITY	0.123***	-0.015	0.211***	0.046	-0.029	0.069
	(0.04)	(0.07)	(0.07)	(0.08)	(0.08)	(0.09)
Sample						
MALE	-0.297***	0.004	-0.337***	0.019	-0.081	-0.079*
	(0.09)	(0.05)	(0.12)	(0.05)	(0.06)	(0.05)
FEMALE	-0.306***	0.041	-0.346***	0.061	-0.042	-0.046
	(0.08)	(0.05)	(0.12)	(0.05)	(0.06)	(0.04)
PRIVATE	0.391***	0.041	0.347***	0.050	0.427***	0.180
	(0.08)	(0.11)	(0.10)	(0.12)	(0.05)	(0.20)
PUBLIC	0.406***	-0.031	0.364***	-0.026	0.301***	0.151
	(0.08)	(0.08)	(0.10)	(0.08)	(0.06)	(0.13)
SE (publication selection)	4.572***	0.708	0.988	-1.602***	4.817***	5.546***
	(1.22)	(0.50)	(1.05)	(0.55)	(0.34)	(0.80)
Constant	168.848***	87.861**	202.671***	79.930*	-1.106***	-1.841***
	(30.57)	(38.65)	(46.52)	(43.57)	(0.17)	(0.29)
N	562	562	562	562	562	562
R^2	0.784	0.268	0.750	0.202	0.375	0.322

Notes: The dependent variable is PCC; the estimated equation is $PCC_{is} = \beta_0 + \beta_1 * SE + \sum_{k=1}^{N} \lambda_k * X_{kis} + \epsilon_{is}$. All results are weighted by the inverse variance and the number of studies. The standard errors of the regression parameters are clustered at the study level. Columns (1), (3) and (5) represent results weighted by the inverse variance, columns (2), (4) and (6) represent results weighted by the number of studies. Columns (1) and (2) represent OLS with cluster-robust standard errors at the study level; columns (3) and (4) represent IV estimation, where the instrumental variable is the inverse of the square root of the number of degrees of freedom; columns (5) and (6) represent fixed-effects estimation at the study level. The reported t-statistics are based on heteroskedasticity cluster-robust standard errors.

Studies those considered endogeneity in their estimation, have reported less negative results. McDuff (2006) emphasizes that possible endogeneity in the enrollment of resident students. Author controls endogeneity with including land are and travel cost, found lower tuition elasticity. Dearden et. al. (2011) construct panel data included different regions, genders, the level of parental eduction and different time periods dealing with multicollinearity and endogeneity. They found that there was an important negative effect of higher tuition on enrollment in UK during 1992-2007. Neill (2009) shows that due to endogeneity of tuition fee, single equations models give incorrect results. There

is simultaneity between tuition fee and enrollment: demand-side equations are not enough for clear conclusion, therefore supply-side equations needed to be considered to get correct results.

Moreover, studies those concentrated only males and females, not all sample, found more negative results. Bruckmeier et. al. (2013) confirms negative turion fee - enrollment relationship for both males and female, and show that enrollment to the technical university positively associate with mae and negatively with females. The number of high school graduates in the same region has positive impact of first-year student for only female, but it does not play important role on male's decisions (Bruckmeier et. al., 2013). Mueller and Rockerbie (2005) show that female applicants are less sensitive to the tuition change comparing to male, but more sensitive to the quality of universities. Higher unemployment rate discourages females more than male to apply to medical and comprehensive universities, however economic and social condition do not play an important role for both males and females decision make. Controlling income is associated with turion fee - enrollment nexus only for males.

The studies those concentrated on more private and public institutions has reported less negative results. Hemelt and Marcotte (2011) estimated the price elasticity of enrollment in public institutions and analyze how sensitive enrollment is to tuition increases. Families with higher income prefer to send their child either to more affordable private intuitions in same country or send to aborad, however students from lower income families prefer stay in public in-state universities.

Chapter 5

Concluding remarks

The main aim of this thesis is to analysis studies concerning demand for higher education elasticities. The motivation is to determine whether demand for higher education is relatively sensitive to tuition fee or insensitive to tuition fees. The study analyzes primary studies in the higher education elasticity literature.

After reviewing the apparently mixed results reported in 48 studies that give 562 estimates of the tuition elasticity of the demand for higher education, approximately 52 % of these estimates are insignificant and 43 % are statistically negative, and approximately 5 % are statistically positive. This study asks two principle questions. First, whether there is publication bias in the price elasticity of the demand for higher education literature. The study finds that large increases in tuition fees have a disproportionately negative impact on enrollment when potential publication bias and method heterogeneity are taken into account. The publication bias tests show that negative results are preferable among researchers. Secondly, the work examines why different studies report such different results. Meta-analysis allows formal examination of the sources of heterogeneity to the publication characteristics and study design, including the choice of control variables, dataset choice, estimation method and

subsample choices.

To summarize the literature quantitatively, meta-analysis method has been used and results suggest that following aspects of study design are especially effective in explaining the differences in reported effect-size across primary studies:

- the longer time period negatively associated with the price elasticity of demand for higher education,
- while the cross-sectional estimations have reported more negative results, panel data estimations have reported less negative results,
- controlling for endogeneity plays a crucial role, and has a detractive effect on negative reported results.
- while controlling for the unemployment rate has no clear conclusive impact, controlling for income is not significantly associated with the price elasticity of the demand for higher education.
- differentiating estimation methods changes impact: while OLS estimations have reported more negative such as cross sectional choice, fixed effects have reported less negative results like panel data choice.
- more recent published studies confirm significant negative tuition fee - enrollment nexus, while the studies published in journals are more likely to report higher negative price elasticity.

In terms of policy implications, the decision to increase tuition fees or not is hard task for policy makers. They must balance the quality of higher education and yet maintain the lowest possible costs to support affordable public education opportunities. On the one hand, higher expenditures are required to support university performance. On the other hand, lower costs leads to lower higher educational quality. Policy makers need to balance two opposite goals for higher education.

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Appendix A

Appendix A.1

Studies Included in the Meta-Analysis (Alphabetical Order)

1. Agarwal, V.B. & Winkler, D.R. (1985). Foreign demand for United States higher education: a study of developing countries in the eastern hemisphere. *Economic Development and Cultural Change*, 33(3), 623-644.

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