Beliefs, Access Constraints and Voluntary Education Decisions

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April 28, 2012

Abstract

I present a model that explores the effect of release of constraints in access to education on education outcomes. Contrary to general intuition, I show that improved access may be harmful for all parties, if sufficiently high quality of education is not provided. In a theoretical model, I focus on universities as certification devices, that at a (an opportunity) cost rather than enhancing students’ human capital, transmit (imperfect) information about the abilities of their graduates to potential employers. In a world with two privately informed types, I will show the existence of perverse incentives, for a part of the society with low innate abilities, to enrol university only when the education quality is low. Due to those incentives, increased access to voluntary education is beneficial for high types only if the certification quality is sufficiently high. Otherwise, general access to education may negatively affect the payoffs of only high types or all students. The effect is even stronger when the supply of academic resources is inelastic. In such a case, an increase in output, for a fixed investment per student, has to lead to a decrease in quality. This deterioration of certification precision means an increase of probability of wrong assessment of true abilities. Taking advantage of this process, the low ability students increase their enrolment rate leading to even further deterioration of the certification system. The final outcomes may depend on agents’ initial beliefs. Depending on those beliefs the education system will offer either low quality certification and large enrolment or high quality and low enrolment.

The proposed mechanism highlights the importance of quality in transition to mass education. It also contributes to explaining the rapid growth of enrolment rates despite growing concerns about the quality in Central and Eastern Europe over the last 20 years.

*I thank Massimo Morelli, Piero Gottardi, Elisabeth Schulte, Hinnerk Gnutzmann, Jan Peter Siedlarek and participants of EUI Micro Working Group seminars for useful comments and discussions.
1 Introduction

The last 50 years can be considered as the age of university education. The enrolment rates at tertiary education institutions have increased from around 5% in the early 1950s in most developed countries to 50% and more nowadays [2]. This change has various grounds. Undoubtedly, the technological progress in the last decades has increased the demand for skilled labour (the so called skill-biased technology change). The population growth in the western world has significantly decreased (in some countries it is even negative) and the resulting increase in the relative scarcity of labour in relation to capital justifies higher investment in human capital. Also societal perception of higher education has changed. It is no longer a consumption good enjoyed by the elite but an investment in human and social capital. The access to universities has become more universal and reduction of entrance constraints for the socially impaired groups is one of an important issues of social and political debate. The quote by Nicolas Barr [4] gives an idea of the current perception. “The expansion of higher education throughout the OECD and beyond is both necessary and desirable.”

However, mass university education does not necessarily imply mass success on the labour market. Recent studies show an increase in overeducation rates. An increasing number of graduates take jobs that do not utilise their acquired qualifications [15]. There is no clear explanation for this phenomenon, and numerous hypotheses can be stated. Education quality may be insufficient and not lead to accumulation of human capital level, which is supported by evidence on credential inflation (see e.g. [20]). Also in high school final exams grade inflation is common [17]. Another possible explanation of limited success of mass education is the change in relative innate abilities compared to non-graduates. If there exists unobserved heterogeneity in the students population, past estimates of returns to higher education, calculated when only a small proportion of population enrolled at universities, may not be valid under mass enrolment.

The introduction so far applies mostly to the developed countries, but in many developing countries the change in enrolment is even more rapid. Figure 1 depicts the relative growth of population of students in Central and Eastern Europe (CEE) and Western Europe in the last decade. [1]

In some countries like e.g. Romania or Poland the annual changes in many years exceeded 10%. The average increase in the number of enrolled students in CEE in years 1999-2007 has increased by 69%, compared to only 13% increase in Western Europe (the EU15). CEE countries are catching up with their more developed neighbours and bridging the education attainment gap. Thanks to the growth in the last two decades the proportion of population with higher education has reached the level of the developed countries or even exceeded it. This sudden growth certainly raises questions about the potential causes, consequences and capacity constraints of education system.

This radical change was possible due to partial liberalisation of the higher education market which lead to foundation of numerous private universities. Private institutions, offering education at a fee, moved the burden of financing education from governments towards the users and increased the capacity of the education systems.

The high demand in this period can be attributed to the following facts. First of all, there was a demand overhang. Those who were denied education before the fall of communism or those who were willing to study on faculties non existing before the transition entered the education market. The rapid economic transition lead to a huge increase in unemployment in the region, therefore university education was a way to delay entering the labour market. The opening of the EU labour markets was the driving force of the university enrolment rates growth in the later years, at least for the new member states. Even though many graduates (e.g. 70% in Lithuania [3]) could not find the jobs in their fields of training, they hope to capitalize on their education on emigration [24]. E.g. 25.9% of university students in Romania expressed their will to emigrate in a Eurobarometer survey in 2002. [18] Finally, the growth is caused also by the increase in the gross number of students that study at more than one faculty. [2]

The enrolment rates in CEE have increased despite general concerns about the higher education quality. Although the empirical evidence is very scarce [19], the press reports supported by reports commissioned by national

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1 Figure 1 is based on gross enrolment data, therefore it double-counts students enrolled at more than one faculty.
2 Gross number of students double counts individuals who are registered at more than one faculty, however, this measure is the most relevant for a study in context of capacity constraints.
authorities (e.g. [14]) raise those issues. This position is also backed by the World Bank [3], which recommends undertaking substantial changes needed in tertiary education to shift the focus from quantity to quality. As a study for Lithuania states the "poor quality education system is blamed for the country’s failure to produce educated young people with skills and knowledge suited to Lithuania’s labour market needs, thus contributing to emigration motivations and recent labour shortages in certain sectors" [24].

This study has three objectives. First of all, to analyse, from a theoretical perspective, the effects of improving access to university education. Furthermore, I want to present a plausible mechanism that would contribute to understanding of the enormous growth of tertiary education enrolment rates in CEE. Answering the empirical question I contribute to theoretical literature on certification by analysing, to my knowledge, an unexplored aspect of administrative restrictions on the certification provision. I will show that release of admission restrictions for higher education can be beneficial only if the certification quality is sufficiently high. Otherwise, despite the unlimited access, the informativeness of a certificate may decrease due to increased enrolment of the low types. Finally, I would like to explain cross-country differences in the region. The possible explanation for differences of growth rates between the CEE countries may come equilibrium multiplicity driven by short term inelasticities of supply (e.g. of university teaching staff). The supply of academic teachers becomes a "quasi-bottleneck" and a constraint in short run. Hence, the higher the growth of enrolment rates, the lower the education quality for a given level of per student expenditure.

In the model, I assume that agents differing in their innate abilities are privately informed about their types
(innate abilities). They may, at a cost, voluntarily undergo a certification process which is the only mechanism of information transition of their abilities to the competitive employers. The employers offer one type of a job in which the productivity of the worker is defined by the type. The certification is assumed to be imperfect and the parameter defining the precision is of the key interest here. The higher the imperfections the higher the chances of those of low innate abilities to receive the high ability certificate.

The model is designed to analyse the effects of release of constraints on access to education. To understand the transition two stages are presented. In the first stage, referred to as pre-transition regime, restrictions to access are modelled through exogenous limits on university supply. Disregard of the demand the number of university places is fixed. In the second phase, referred to as transition regime, the exogenous capacity constraints are lifted. The access to education is given to all who enrol and the effect of the release of the constraints is analysed.

In the extension of the model I assume also the existence of short term capacity constraints, given by a convex short term certification quality provision cost function. I assume that agents make their educational decisions based on, rather vague, prior beliefs on the return to education. The process of belief formation is very complex and not a primary subject of the analysis. I will show, however, that those beliefs can be self-confirming. Economies with the same fundamentals may end up with different levels of enrolment and hence education quality.

The key mechanism in this paper is as follows. If agents believe that the certificates are highly imperfect more low innate ability students take their chances and register. Since the certification is imperfect it automatically increases the proportion of low types in the pool of positively certified. As a result the expected productivity and hence wage of those with a certificate is decreasing. The effect of the low types enrolment is magnified the certification quality cost function is convex.

The imperfection of certification is interpreted as the role of luck and connections in determining education outcomes. Note that due to the nature of certification the notions, education quality, certification quality and the role of luck in determining outcomes are equivalent. In the extended model with convex cost function, enrolment rates above the capacity constraints push the education/certification quality down increasing the role of luck in the process. If, in contrary, agents initially believe that education is more precise in revealing the true type, low skill agents abstain from education. The differences in prior beliefs in the population of agents would lead to differences in educational outcomes due to existence of multiple equilibria in the model. I abstain from modelling human capital formation, which is a big simplification. The qualitative results presented in the paper would still hold in the extended model. The magnitude of the effect would be, however, decreased.

This paper is a contribution to literature on quality disclosure very thoroughly reviewed by Dranove and Jin [13]. My work draws mostly on a short note on imperfect certification and its implications on the market size. De and Nabar [11] present a simple model with two risk neutral, privately informed sellers of different types, a single buyer and an exogenous certification technology (imperfect and at a fixed cost). The authors present a disturbing result, that the higher the certification accuracy the lower the demand for certification services. Unless certification costs are too high, all high quality and some low quality sellers desire certification. As accuracy increases, the high types continue to demand certification - if anything, they will be better off. At the same time the chances of low type sellers securing a high ranking decrease, thus reducing their demand for certification. As a result, the total demand decreases. The same mechanism is, obviously, present also in my model.

A few authors have shown possible negative effects of information disclosure on buyers. Lizzeri and Gavazza [16] show how information can harm the buyers when sellers’ incentive scheme is not aligned with the buyers evaluation of the good. Bouton and Kirchsteiger [8] show that when different groups of buyers impose negative externalities or when there are capacity constraints additional information about quality of the goods may reduce the overall welfare. It is the case when the group that has a lower valuation of the good or produces negative externalities is less informed before the arrival of new information. Those models show the negative effect of additional information.

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The initial idea in this paper was to model the changes in higher education in CEE in the last 20 years, the paper is only currently being adjusted to a more general concept of access restrictions through e.g. economic constraints. However, other than names no other changes are required.

Alternative mechanism that fit into the framework is corruption. As described by Rothstein et al. [23] in some countries "parents buy their childrens way into good schools, especially universities, and then pay even more for good grades."
on the buyers, while in my model the possibility to transmit more information about the quality of the good offered may harm the sellers.

A more sophisticated and more general model of imperfect certification is presented in a recent working paper of Daley and Green [10]. The authors incorporate certification into a standard signalling model. In their work a stochastic grade is an additional source of information supplementing a costly signal. Moreover, the authors endogenise the certification quality by relating directly the resources spent on signalling to the certification quality. Considering individuals as certification quality setters is bit unrealistic, however, it could be interpreted as a result of university competition that is ignored in my model.

Another recent approach to the issues related to certification is a work by Rosar and Schulte [21]. The authors explore the tradeoff between the quality of the generated information and the participation level. They analyse the optimal certification device from a perspective of an information-loving receiver. In their setting, contrary to the papers mentioned before, the agents are risk averse and imperfectly informed about their own type. The optimal device has to compromise the information quality provided by the test and self-revelation through differences in participation rates between the types. Therefore the optimal device is often imperfect. If the test is too accurate, an information-averse individual may refrain from taking the test. The authors consider only costless technology, which significantly affects the results.

The relation between costs of education and enrolment rates has been approached by Blankenau and Camera [6], [7]. In their model they supplement the signalling role of education with human capital investments and describe education as a two stage process. The agents choose whether to enrol at a university (at a cost) and subsequently whether to invest in human capital (at additional cost). While enrolment is a public knowledge, the skill level is revealed to the employers only with a certain probability. In equilibrium there is a proportion of agents who invest in signalling (enrolment) without increasing the human capital. Using dynamic programming approach, they show that low tuition fees increase enrolment rates, however, it does not necessarily increase the human capital accumulation. Their analysis suggests that when incentives to student performance are weak some policies that are successful in raising enrolment may have negative consequences on educational outcomes and aggregate productivity. Improving the quality of education (the rate of transformation of effort into human capital) is a more effective policy.

Finally, the last source of inspiration for this paper is the recent interest in explaining numerous aspects of policy preferences through self confirming beliefs based on World Value Survey (WVS) results. In that fashion Alesina and Angeletos [1] and Benabou and Tirole [5] have found a correlation between one item of the questionnaire - a belief that it is luck rather than hard work that determines economic outcomes - and the share of social expenditure as a part of GDP. The authors have, independently, created causal mechanisms creating self-confirmation of the beliefs. As a result both models show that in countries where the belief in the role of luck is high the public social spendings are high.

The paper is organised as follows, the next section presents some evidence on the relation between beliefs in the role of luck in determining economic outcomes in CEE enrolment rates. Section 3 presents the key modelling assumptions. Section 4 describes the effect of release of exogenous capacity constraints on education system. More specifically, in section 4.1, I show the equilibrium with fixed enrolment quotas (administrative capacity constraints), where the supply of tertiary education services is lower the quantity of agents willing to undertake certification. In section 4.2 the effect of release of capacity constraints is shown. Welfare comparison of the two cases is presented in Section 4.3. Section 5 examines the effect of endogenous capacity constraints in form of supply inelasticities affecting the economy following the steps taken in the previous section. The inelasticities magnify the effect of the transition. Finally, Section 6 concludes.

2 Beliefs and tertiary education data

In this section I present some empirical evidence on the relation between beliefs in the role of luck and data on tertiary education in central and Eastern Europe. I use an item from World Value Survey, which corresponds to a question "In the long run, hard work usually brings a better life. Or, hard work does not generally bring success;
it’s more a matter of luck and connections.” The answers are coded 1 to 10, where 10 implies the highest belief in the role of luck and connections. As stated earlier in this paper, universities serve solely certification purposes, therefore these beliefs coincide with the beliefs on the education quality. The higher the role of luck, the higher the probability of the low type of being certified as a high type.

The Figure 2 shows positive correlation between belief in the role of luck and total tertiary education enrolment rates in 20 countries. As it can be seen, the higher the role of luck the higher the enrolment rates.

The correlations are robust to controlling for a number of socio-economic variables, i.e. GDP per capita and a measure of social inequality, and as political science literature suggests some variables related to religious fractionalisation [25].

All CEE countries for which the data was available

The enrolment rate is defined here as number of students registered at university relatively to the population in age group 20-24.
Table 1. Dependent variable - Average Enrolment Rate in Tertiary Education in 2002-2008 Central and Eastern Europe

<table>
<thead>
<tr>
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<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<tbody>
<tr>
<td>Mean belief that luck determines outcomes</td>
<td>11.556*</td>
<td>10.060**</td>
<td>9.670*</td>
<td>10.834*</td>
</tr>
<tr>
<td></td>
<td>(2.03)</td>
<td>(2.11)</td>
<td>(1.95)</td>
<td>(1.93)</td>
</tr>
<tr>
<td>GDP per capita</td>
<td>1.586***</td>
<td>1.635***</td>
<td>1.730**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.99)</td>
<td>(2.95)</td>
<td>(2.14)</td>
<td></td>
</tr>
<tr>
<td>Gini Coefficient</td>
<td>0.280</td>
<td>0.129</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.46)</td>
<td>(0.19)</td>
<td></td>
<td></td>
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<tr>
<td>Share Catholics</td>
<td>-7.070</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-0.49)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share Protestants</td>
<td>7.440</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>(0.29)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>2.296</td>
<td>-10.987</td>
<td>-18.750</td>
<td>-19.0156</td>
</tr>
<tr>
<td></td>
<td>(0.09)</td>
<td>(-0.50)</td>
<td>(-0.67)</td>
<td>(-0.61)</td>
</tr>
<tr>
<td>Observations</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.141</td>
<td>0.043</td>
<td>0.374</td>
<td>0.310</td>
</tr>
</tbody>
</table>

Sources: Total expenditure on tertiary educational institutions and administration as a % of GDP, average over years 2004-2008 and share of population enrolled in tertiary education from UIS UNESCO database. Data on religion fractionalisation is from International Religious Freedom Report 2004 and belief that luck determines income from World Value Survey data for 1981–1997 from the Institute for Social Research, University of Michigan. I report OLS estimates, with t statistics in parentheses (* significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent).

3 The model

3.1 Agents

I assume a continuum of privately informed risk neutral agents of mass 1. The agents differ in productivity, and they can be of type $\theta \in \Theta = \{\theta_H, \theta_L\}$. I standardise the values to $\theta_H = 1$ and $\theta_L = 0$. The proportion of high types is a public information and is set to $\lambda \in [0, 1]$. The agents will be sometimes referred to as students and test takers throughout the text.

The agents can disclose their type only through voluntary enrolment at a certification institution. Throughout the text a word university will be used as a synonym, but the range of applications stretches to other forms of certification. The certification institution serves only testing purposes and provides no human or social capital gains. The agents make a strategic decision $d_i \in D = [0, 1]$, where 1 is to apply for a certification at a private cost $s$ if accepted, 0 otherwise. In-between values of $d_i$ are interpreted as mixed strategies. The private cost is not a transfer to the certifier and independent of certification precision. Due to access constraints if the number of applications exceeds the certifiers’ capacity applications are randomly selected for certification. If the agents apply and get accepted, they undergo a noisy test procedure which with certain probability $p \in [0.5, 1]$ reveals their true type. I assume transparent testing procedure with voluntary participation, hence both the enrolment decision and test results are observable by the employer.\(^9\)

\(^9\)This cost could be interpreted as an opportunity cost or the living costs while at university, for other applications one could think e.g. of costs of preparing product documentation.

\(^{10}\)One could think of different testing procedures. The possible variations are mandatory (as opposed to voluntary) testing, which would be appropriate for analysis of compulsory education. Another possibility is opaque (as opposed to transparent) testing, i.e. strategic individual decisions on disclosure of test taking decision (possibility of hiding the negative test result). See [22] for a discussion in a world with costless certification technology. Note that their results do not always hold when agents bear certification costs.
The number of agents in the economy implies that a decision of an individual $i$ has only infinitesimal effect on the aggregate application rate. Therefore, I define $q$ as an aggregate application rate of low type agents and $m$ as the aggregate application rate of the high type. I also define the total application rate $M \equiv m \ast \lambda + q \ast (1 - \lambda)$. 

3.2 Certifiers (Universities)

I assume a single, non-strategic certification institution, which offers certification to all applicants subject to capacity constraints. The certification technology is binary i.e. the certifier issues only pass and fail certificates. The probabilities of false positive and false negative results are equal and exogenous\(^{11}\), as presented in Table 2.

<table>
<thead>
<tr>
<th>Table 2. Certification Probabilities</th>
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<tbody>
<tr>
<td>High Type</td>
</tr>
<tr>
<td>Pr(Pass)</td>
</tr>
<tr>
<td>Pr(Fail)</td>
</tr>
</tbody>
</table>

The certifier’s capacity is fixed to $\phi$. If the number of applications exceeds the number of places offered the university randomly draws a proportion $\delta(m, q)$ to be accepted at the university.\(^{12}\) Formally the acceptance rate is defined as:

$$\delta(q, m) = \begin{cases} 
1 & \text{if } q = 0 \text{ and } m = 0 \\
\min\left(\frac{\phi}{M}, 1\right) & \text{otherwise}
\end{cases}$$

The capacity constraints are lifted in Section 4.2. In Section 5 the certification quality is endogenised.

3.3 Employers

I assume perfectly competitive employers that observe aggregate enrolment decisions and individual test results and make wage offers to individual agents upon observing or not a certificate (both fail and pass) in a Bertrand fashion.

3.4 Timing

I consider the following timing of the game. First nature allocates the productivity levels among agents and the certification quality $p$ and the private costs $s$ is set. Subsequently, agents make their application decisions. Once the decisions are made and the quality of the test decided employers perfectly observe the test results and make a take-it-or-leave offer to the workers on a competitive labour market. Agents’ decisions and their consequences from the employers perspective are presented on Figure 3. On the left hand side the two disks represent the pools of agents of different type (black for the high types and white for the low types). In the first stage the agents make a decision whether to apply for the certificate or not. Proportion $m$ of high types and proportion $q$ of low types decides to do so. Those who choose certification enter a stage in which a random selection for certification takes place. The level of gray of the disk, represents the relative proportion of high types in a given pool (the darker the disk the higher proportion of high types). With probability $\delta$ agents undertake a test which with probability $p$ reveals their true type. With probability $1 - \delta$ agents are not allowed to take the test and end up in a pool of uncertified agents together with those who did not apply for certification. In a scenario in which the capacity constraints are lifted $\delta = 1$.

\(^{11}\)The exogeneity assumption may sound strict, however, e.g. university are exogenously financed from public purse and the level of expenditure indirectly defines the certification quality. The direct link between quality and financing is explored in Section 5

\(^{12}\)This assumption on lack of screening technology is strong, however, it fits the CEE before 1990s. Positive discriminations of working class was a part of social policy. Applicants from low income farming and working class background had their admission requirements lowered, compared to other social classes. At the same time the admission restrictions, in particular on non-technical faculties were a part of social engineering.
3.5 Equilibrium concept

In the analysis, I employ a D1 refinement of Nash equilibrium to solve the game, such that the following sequence of action holds. University commits to invest all the tuition fees in certification quality. Students map from their beliefs on other students actions into education decisions. Belief-strategy combination satisfies Bayes rule whenever possible, and sequential rationality always. D1 refinement restricts the out-of-equilibrium beliefs. It requires that if the set of As responses for which one type of B gains from deviating is larger than the set for which a second type gains then As beliefs must assign zero probability to the second type [9]. I solve the game by backward induction and therefore start with the strategies of the employers. For simplicity, I focus only on symmetric equilibria, in which all agents of the same type act in the same way.

4 Effect of Exogenous Certification Access Constraints

In this section, I will analyse the effect of lifting the exogenous certification access constraints. In the next subsection I present an equilibrium under the constraints, in section 4.2 an equilibrium with no constraints and subsequently the welfare comparison of the two effects.

4.1 Exogenous Access Constraints

Solving the game by backward induction I start with the employers and their wage offers. Knowing the the total application rate $M$, the quantity of certified and uncertified agents the employers can easily calculate the expected productivity in a given pool of workers. The competition drives the wage offers to the expected productivity level. Wages of agents who are accepted for certification and pass (subscript $P$) or fail ($F$) university and those who decide
not to take the test \((U)\) are given by the following:

\[
\begin{align*}
\text{\(w_P(p, q, m) = \frac{pm\lambda}{(1-p)q(1-\lambda) + pm\lambda}\)}
\end{align*}
\]

\[
\begin{align*}
\text{\(w_F(p, q, m) = \frac{(1-p)m\lambda}{pq(1-\lambda) + (1-p)m\lambda}\)}
\end{align*}
\]

\[
\begin{align*}
\text{\(w_U(p, q, m) = \frac{\lambda(1 - m\delta(q, m))}{(1-\lambda)(1-q\delta(q, m)) + \lambda(1-m\delta(q, m))}\)}
\end{align*}
\]

\(w_P\) and \(w_F\) are, respectively, equal to the proportion of high types in the pool of students who passed and failed the test. The acceptance rate \(\delta(q, m)\) is defined in eq. 1. Note that \(\delta\) does not affect the wages. The proportion of low and high type accepted at the university is equal the proportions of applicants. \(w_U\) is the proportion of high types in the pool of agents that did not take any test. The employer can not distinguish between agents who were not accepted and those who did not apply.

To perform the analysis it is useful to define the expected payoffs conditional on being certified for both types, given by:

\[
\begin{align*}
\text{\(Ew_H(q, m, p) = p \ast w_P(\cdot) + (1-p) \ast w_F(\cdot) - s\)}
\end{align*}
\]

\[
\begin{align*}
\text{\(Ew_L(q, m, p) = (1-p) \ast w_P(\cdot) + p \ast w_F(\cdot) - s\)}
\end{align*}
\]

Agents making their certification decisions weigh the probability of getting the pass or fail certificate (and the respective wages) with the certain cost \(s\) and compare it to their outside option, refraining from education. When the agents are indifferent between the two options they choose \(d_i \in (0, 1)\). We can write students expected utilities in the following way:

\[
\begin{align*}
\text{\(U_H(q, m, p, d_i) = d_i \ast \delta(\cdot) \ast Ew_H(q, m, p) + (1-d_i \ast \delta(\cdot))w_U(\cdot)\)}
\end{align*}
\]

\[
\begin{align*}
\text{\(U_L(q, m, p, d_i) = d_i \ast \delta(\cdot) \ast Ew_L(q, m, p) + (1-d_i \ast \delta(\cdot))w_U(\cdot)\)}
\end{align*}
\]

In words, whenever an agent makes a decision whether to enter the university, with probability \(\delta(q, m)\) she is admitted and gets the expected wage for a university graduate for a given type and pays the cost \(s\). With probability \(1 - \delta(q, m)\) she is not accepted by the university and remains uncertified. If the agent decides not to apply for the certification, she gets the wage of an uncertified worker with certainty.

I impose the following assumptions:

\[\text{\(A1 : s < 1 - \lambda\)}\]

\[\text{\(A2 : \phi < \lambda\)}\]

A1 assures that a high type prefers perfect certification to pooling on no certification. A2 assures that access constraints assure that not all high types can be certified under the capacity constraints.

**Proposition 1** Whenever Assumptions 1 and 2 are fulfilled and \(p > 0\) all good students \((m = 1)\) and some, but not all, bad students \((q \in (0, 1))\) apply. For \(p = 1\), \(m = 1\) and \(q = 0\).

**Proof.**

The agents optimisation problem can be written as the following

\[
\begin{align*}
\text{\(\max_{d_i \in [0, 1]} U_i(p, \mu_i(q), \mu_i(m), d_i)\)}
\end{align*}
\]

where \(\mu_i(q)\) and \(\mu_i(m)\) are the beliefs of an agent \(i\) on the total application rates of high and low types (an aggregate measure of strategies of all other agents). Agents of a given type choose to apply whenever the expected wage of a university graduate net of costs exceeds the wage of the uncertified agents.
It is immediate that, whenever certification is perfect \((p = 1)\), all high types who apply and get accepted receive \(1 − s\). Assumption 1 ensures that the enrolment decision in such a case, dominates the possible coordination on \(m = 0\). Low types, if apply and get accepted, receive \(-s\) for sure, therefore \(m = 1\) and \(q = 0\) must be the equilibrium.

For lower levels of certification precision, the situation is more complex. Firstly, I will show that \(m = 1\) and \(q^* ∈ (0, 1)\) and consistent beliefs form an equilibrium and subsequently I will rule out all other possibilities.

Suppose \(m = 1\). Since all good students apply, given the Assumption 2, the acceptance rate \(δ(q, m) < 1\) assures that some of the good students enter the pool of untested workers driving the uncertified wage above 0. To determine the optimal application rate of low types note that if both \(m = 1\) and \(q = 1\), the proportions of high types and low types in the pool of certified and uncertified students are the same, hence \(U_L(d_i = 0, q = 1, m = 1) = λ\). Since for any level of \(p > 0.5\) the test is informative, \(U_L(d_i = 1, q = 1, m = 1) > λ\). So it can’t be that all the low types apply. At the same time \(U_L(d_i = 1, q = 0, m = 1) = 1\), therefore it can’t be that none of the low types applies. From continuity of \(w_L, w_P\) and \(w_F\) there must exist \(0 < q^* < 1\) such that \(U_L(d_i = 1, q = q^*, m = 1) = U_L(d_i = 0, q = q^*, m = 1)\). Assumption 2 guarantees that this value is strictly positive. In such a case an action \(d_L = q^*\) and consistent beliefs \(μ_i(q) = q^*\) form the best response. For any level of \(μ_i(q)\) high types holding beliefs \(μ_i(m) = 1\) find it optimal to apply, therefore the belief system \(μ_i(q) = q^*\) and \(μ_i(m) = 1\) and individual strategies \(d_L = q^*\) and \(d_H = 1\) form an equilibrium. The closed form solution of the equilibrium value of \(q^*\) exists but the degree of polynomial solving the indifference condition makes it impossible to present the result. From inspection of the respective expected wages, it is immediate that an increase in \(λ\) increases while the increase in \(s\) and \(φ\) decreases the equilibrium \(q^*\). Since for any level of \(m\) and \(q\) \(U_H(·) > U_L(·)\) the inequality must hold for \(q^*\) therefore \(d_H = 1\) is indeed the best response.

To see that any level of beliefs consistent with \(m ∈ [0, 1)\) can’t be supported in equilibrium note the following. \(∀_{p > 0.5} U_H(·) > U_L(·)\), while the outside option yield the same outcome for both types, therefore it can’t be that both high and low type are mixing at the same time. To rule out \(m = 0\), note that if \(μ_L(m) = 0\) the anticipated wage of the low type taking the test is \(U_L(d_i = 1, ·) = 0 < U_L(d_i = 0, ·) = w_L(m = 0, ·) ≥ λ\) hence the optimal response of a low type is \(d_L = 0\). At the same time it can’t be that \(q = 0\) and \(m = 0\) since then \(Ew_H(·) = 1\) and \(d_H = 1\) is the best response.

The equilibrium in which no-one enrols and high types hold beliefs \(μ_H(m) = 0\) and \(μ_H(q) > 0\) while \(μ_L(m) = 0\) and \(μ_L(q) > 0\) is ruled out by the D1 refinement. The refinement makes the employers put 0 weight on such the out-of-equilibrium beliefs system.

The argument seizes to be valid for \(p = 0.5\) and the resulting non-informativeness of the test.

In summary, in the described regime, the demand for education exceeds the supply. The agents that were not admitted to the test are mixed with those who voluntary did not take it. The certification capacity constraints lead to a loss of information that could be acquired from voluntary decisions with no constraints. In the only D1-robust equilibrium of this game all high types always apply. The application rate of the low types (denoted as \(q_{pre}^*\)) for a certain range of parameters for this regime, together with application rates for the case with no capacity constraints \((q_{post}^*)\) are presented graphically on Figure 4.

The informational flow from workers to employers is negatively affected by the constraints. However, as it will be shown in the next section the release of the constraints, does not necessary lead to an increase in utility of the high type agents.

### 4.2 Release of Constraints

Now I will describe the economy after a release of the certification constraints. Suppose that the authorities have decided to provide certification to everyone who requests it. Under constraints, the demand significantly exceeded the supply. Release of the student’s quotas sets \(δ(m, q) = 1\) disregard of the application rate. All the remaining assumptions remain the same.

From the employers perspective the problem stays the same, at the stage they enter the game all the parameters
are known, therefore the pass and fail wages are given by equations 2 and 3. The wage of uncertified workers is given by equation 4 with $\delta(q,m) = 1$.

From the students’ perspective the regime change does not change the economic problem faced by them, however it significantly affects the possible set of outcomes. First of all, since all students can be accepted, if the results from the previous section hold, i.e. $m = 1$ the uncertified wage would decrease, lowering the low types outside option. Lowered outside option increases the pressure on the low types to apply. Keeping in mind Assumption 1 I establish the following results.

**Proposition 2** When there are no constraints all the good students enrol ($m = 1$) and $q \in [0, 1]$. Equilibrium low type application rate is higher than under certification constraints.

**Proof.** The logic behind the proof that $m = 1$ is exactly the same as in the case with constraints. However, since now all the high types that want to take the certification are accepted, the expected wage of non-certified workers is 0. This decreases the value of the outside option of the low type. As a result, the low types equilibrium application rate is strictly higher than in the previous case. It’s clear that for sufficiently low level of private education costs $s$ (and sufficiently low $p$) all low types apply. If the costs exceed the value $p$ such that $U_L(p(\cdot), q = 1, m = 1, d^H_L = 1, \delta) = 0$ the full application rate can not be an equilibrium any more. Low types are better off by staying out of certification, in which case they receive 0 utility. However, as in the previous case, from continuity, there exist such $\mu_i(q)$ that $U_L(\cdot, q, d^H_L = 1) = U_L(\cdot, q, d^H_L = 0) = 0$. Only such level of beliefs can be supported in equilibrium. If the payoff from enrolment is higher the individually rational decision is to enrol. The equilibrium $q^*_\text{post}$ in this case can be obtained analytically and is given by:

$$q^*_\text{post} = \min(1, \frac{(-s - (1 + p)p(1 + 2s) + \sqrt{(-1 + p)^2p^2 + 2(1 - 2p)^2(-1 + p)ps + (1 - 2p)^2s^2}) \lambda}{2(-1 + p)p(1 + 2s)}).$$

Interestingly, for high enough $s$ and low enough $p$ an equilibrium with the high type payoffs $< \lambda$ can be supported in equilibrium. ■

Figure 4 shows the equilibrium application rates of the low types in the two regimes for different values of $s$. As it can be seen the application rate before transition is always lower than after and both rates are weakly decreasing in certification precision. The two coincide and converge to zero only when the certificate is perfectly precise. In such a case none of the low types applies. It can also be seen that for low values of $p$ and $s$ full participation of the low types can be achieved in the regime without administrative constraints. This happens only for $s < \lambda$ and sufficiently low $p$.

![Figure 4](image-url)  
(a) $s = 0.05$  
(b) $s = 0.1$  
(c) $s = 0.3$

Figure 4: Low type equilibrium enrolment rate $q^*$ as a function of $p$ for different levels of $s$ and $\lambda = 0.25$ and $\phi = 0.15$ for both cases.
4.3 Welfare comparison

The total welfare analysis in this model is extremely simple. It’s a standard characteristic of a certification model,\textsuperscript{13} that from the welfare point of view the high certification rate equilibrium is strictly dominated by the low certification rate equilibrium. Given the assumptions, the total output and total workers’ remunerations in both cases are equal to \( \lambda \), but the total level of wasteful investment in certification is lower with low certification rate. The certification cost is, by construction, a pure social waste. It is more interesting to compare the utility of both types between the two regimes. The release of exogenous capacity constraints clearly has an ambiguous effect. Although it allows everyone to undergo the certification, it increases the proportion of the low types in the pool of certified agents lowering the wages. The analytical solution for the comparison is not computationally feasible, however we can make some simple observations.

**Proposition 3** When the access constraints are lifted high types are better off only if \( p \) is sufficiently high. Low types, for \( 0.5 < p < 1 \), are always worse off.

**Proof.** I have shown that for \( p > 0.5 \) the high types always fully enrol. To see that there exists a parameter space where high types lose on release of constraints note the following. When the certification is perfect \( (p = 1) \), under no constraints all high types undertake certification in equilibrium and their type is truly revealed, hence \( U_H = 1 - s \). When there are constraints all the high types (and none of the low types) apply, but only \( \delta = \theta/\lambda \) of them gets accepted and receives a payoff \( 1 - s \) and the rest remains uncertified receiving a strictly lower payoff \( \frac{(\lambda - \phi)^2}{\lambda(1 - \phi)} < \lambda < 1 - s \).

Now suppose the certification is infinitesimally informative. All the high types apply and the proportion of the low types applying is such that their expected wage from applying and staying uncertified is the same. Informative-ness of the test implies that in the limit \( \lim_{p \to 0} U_H = \lim_{p \to 0} Ew_H = \lim_{p \to 0} Ew_L = \lim_{p \to 0} w_U = \lim_{p \to 0} U_L \).

Since high and low types split the available payoff equally their expected wages are determined by the total waste due to certification costs. These costs are strictly higher when the constraints are lifted, therefore both high and low types are better off under constraints. Since high type utility is continuous there exist an open set of values \( p \) under which the high type is better off under constraints. Low types are always worse off since the release of capacity constraints implies that none of the high types remains uncertified. At the same time higher proportion of low types undertakes the test. Since the test is informative, more information on the true types is revealed which clearly negatively affects the low types. Moreover, since \( m = 1 \), whenever the low type’s enrolment rate in post-transition regime \( q_{\text{post}}^* \) is less than 1 she receives utility of 0.

The release of the constraints implies higher number of students and hence higher amount of private resources spent on education. As a result the total pool divided between the agents decreases. Figure 5 presents the range of parameters for which high type benefits from the change of the regime (white area) for our numerical example. This happens only if the level of \( f \) and the resulting low levels of \( p \) are sufficiently high. At the same time there is, surprisingly a wide range of parameters where high types only lose on release of constraints (black area). In this range of parameters the crowding effect of low types entering education because of the decrease of their outside option has a dominant role. As it can be seen, as \( \alpha \) increases the range of values of \( s \) and \( f \) for which the high type is worse off is better off also decreases. In other words the expansion of tertiary education can be beneficial only if sufficiently high quality level is assured.

4.4 Licensing

Licensure although similar to professional certification is characterized by one key difference. Contrary to certification, license is a legal requirement for practising a profession. Therefore a failure of being granted a license is much more than just a bad signal about quality. To analyse the effects of access constraints on licensing process note that those who not receive a license are not allowed to practice and therefore in the simple modelling framework\textsuperscript{14}

\textsuperscript{13}At least in a simple standard with no modularities in a production / matching function.
presented above \( w_F = w_U = 0 \). This equality holds disregard of the constraints. As a result the release of access constraints does not change the expected wage of those who fail a certification therefore it does not change the low type incentives to apply. The low type application rates before and after the release of the constraints remain the same. Therefore improved access to certification is purely beneficial for both high and low types.

5 Effect of Exogenous and Endogenous Certification Access Constraints

In this section I analyse the case where, in addition to administrative access constraints, there exist endogenous constraints in form of supply inelasticities. As discussed in the introduction, it’s natural to think of quasi-bottlenecks in response to a huge change in demand, at least in the short run.

Suppose now, that, rather than assuring quality, the authorities offer the certification institution a fixed fee \( f \) per certificate issued.\(^\text{14}\) The non-profit certification institution spends the entire fee on certification provision. To reflect the possibilities of short term inelasticities I assume the cost of a single certificate to depend not only on the quality provision but also on the supply.

Inelasticities of supply are defined through the unit cost function \( c(M\delta(q,m),p) \) per certificate issued. The cost function is assumed to meet the following:

\[
\begin{align*}
A3 : & \quad c(M\delta(q,m),p = 0.5) = 0 \\
A4 : & \quad c_1(M\delta(q,m),p) > 0 \\
A5 : & \quad c_2(M\delta(q,m),p) > 0 \\
A6 : & \quad c(M\delta(q,m),p) \text{ is bounded}
\end{align*}
\]

\(^\text{14}\)Alternatively, one could think of lump sum financing and the certification institute setting the optimal certification quality and quantity. However, such an approach would blur the key findings of this paper.

\(^\text{15}\)In this case an exogenous fee \( f \) uniquely defines \( p \)

\[c(p, M) = \alpha \left(\frac{M\delta(q,m)}{\phi}\right)^\gamma (p - 0.5)^2\] 

where \( \gamma \geq 0 \) is interpreted as a measure of short term supply inelasticities. When \( \gamma = 0 \) there are only exogenous access constraints, i.e. the situation is analogous to the previous section. The higher \( \gamma \) the lower the quality
level for a given education subsidy \( f \) and given raise in the enrolment rate. To highlight the short term inelasticities I assume, in the numerical examples, that the certification cost depend on the enrolment rate relative to the initial capacity (before the release of the constraint). Before the transition, the total number of students \( (M\delta(q, m)) \) never exceeds \( \phi \). In the post transition regime, when the administrative constraints are lifted \( (\delta(m, q) = 1) \) the cost depends on the growth of number of delivered certificates relatively to initial capacity constraints. This assumption is aimed at capturing the costs of adjusting from one equilibrium to another, and can be interpreted as a short term supply curve.

Supply inelasticities play a significant role in determining the outcomes of this game. Contrary to the previous case, certification quality depends not only directly on \( f \) but also on the total number of registered agents. As a result the enrolment rates of the two types affect the individual decision in two ways. First effect is as in the previous case, through a proportion of types in different pools of students. Second channel is through certification quality. Since the enrolment decisions are made only after the fee \( f \) is announced, the certification quality is not known ex ante by the agents. Due to inelasticities, the higher the number of registered students, the lower the quality. As an example, the effect of change in low types’ application rate on low types expected utility after the release of access constraints is given by equation (9). Analogical analysis can be performed for the the changes in \( m \) and for the effect on \( U_H \).

\[
\frac{\partial U_L}{\partial q} = (w_F - w_P) \frac{\partial p}{\partial q} \quad \frac{\partial w_P}{\partial q} + \frac{\partial w_F}{\partial p} \frac{\partial p}{\partial q} + (1 - p) \left( p \frac{\partial w_P}{\partial q} + \frac{\partial w_P}{\partial p} \frac{\partial p}{\partial q} \right) > 0
\]

(9)

The change of the enrolment rate of the low types has two effects for those who enrol. The first one is the effect of the quality change due to change in enrolment rates on the expected wage of the low type. For a given fee, an increase in enrolment decreases the certification quality, which leads to an increase in the expected wage. The second effect is the impact of enrolment rate on receiving the fail wage, which is ambiguous. On the one hand an increase in \( q \) decreases the expected wage. At the same time a decrease in \( p \) leads to an increase in \( w_F \). The third effect, of change in \( q \) on the pass wage, is clearly negative, both through the higher number of low types attempting the test and the lowered quality of the test. Similar reasoning has to be undertaken for the high type and for the the high types participation.

The analysis is performed in a similar fashion to the previous section. First I describe an equilibrium in a scenario when both endogenous and exogenous constraints coexist. In the second scenario, the administrative capacity constraints are lifted and only the supply inelasticities exist. This scenario will be referred to as the transition regime.

### 5.1 Both Constraints

In this case, as I will show, the introduction of endogenous capacity constraints in a form described above does not change the outcomes from the scenario without endogenous constraints. The results are still valid (given Assumptions 1 and 2).

**Proposition 4** Endogenous capacity constraints do not affect the equilibria when exogenous constraints hold.

**Proof.**

To see the result note that, similarly to the previous case for any value of \( p(\cdot) U_H(\cdot) > U_L(\cdot) \), therefore it can’t be that in equilibrium both types mix at the same time. Suppose now that \( m = 1 \), then the exogenous capacity constraint is reached. \( M\delta(q, m) = \phi \) disregard of the low types enrolment decisions. Therefore the fee \( f \) uniquely pins down the certification precision \( p \). The analysis from the previous section remains valid. All the equilibria with \( m = 1 \) from the previous scenario apply also here.
The certification quality changes only for the total number of applications \( M < \phi \), which, given that high and low types can’t mix at the same time may happen only if \( q = 0 \) and \( m < \frac{\phi}{\lambda} \). but this can not be an equilibrium since for \( q = 0 \) the high types utility from enrolment is \( 1 - s \) disregard of the test precision, so all high types would decide to enrol.

The certification system always works, in equilibrium, at it’s full capacity \( \phi \), therefore agents can perfectly infer the quality. As a result the change of the cost function has no effect on the outcomes. However, once the exogenous constraints are lifted, the results will change, as shown in the next section.

5.2 Release of Exogenous Constraints

In this section I analyse the effect of endogenous capacity constraints once the exogenous constraints are lifted. In such a case they truly affect the economy. Contrary to the previous case, here, the low types can coordinate and change the outcomes thanks to which new equilibria emerge. It’s clear that the endogenous capacity constraints negatively affect the welfare of the high types. For any level of tuition subsidy \( f \) and \( M > \phi \) the resulting certification quality is lower than in the case without constraints. The possibility of the low types to affect the education quality leads to an interesting result, a multiplicity of equilibria.

**Corollary 1** For a certain parameter range multiple equilibria with different education quality and enrolment rate exist. The final outcome depends on the prior beliefs on the education quality.

**Proof.** A clear analytical proof of the proposition is not possible, therefore a numerical analysis will be presented instead. The result follows directly from Equation (9) presenting a differentiation of \( U_L \) with respect to \( q \). The ambiguous effect may lead to multiple equilibria depending on the initial beliefs on the enrolment rates. It does not, however change the result achieved in the previous regimes that \( m = 1 \). For some parameters high types receive in equilibrium less than \( \lambda \).

**Numerical Example**

I will present a numerical analysis and fully characterise equilibria for the cost function defined in Equation(8). I will present, in details, all equilibria for a special case with \((\lambda = 0.25, \phi = 0.15, \alpha = 0.3 \text{ and } \gamma = 1)\).\(^{16}\)

Analysing the change of \( U_L \), we can identify 6 types of equilibria in which the high types always enrol and the low types optimal decision depends on the values of parameters. The graphical representation of the equilibria types can be found on Figures 6 and 7. The blue line on Figure 6 depicts the expected utility of the low type as a function of \( \mu_i(q) \) conditional on \( m = 1 \) (the solid line) and the certification quality for a given low types’ enrolment (dashed line). The values of \( f \) and \( s \) differ between the equilibrium types. Depending on the values at \( \mu_i(q) = 0, \mu_i(q) = 1 \) and the number of zero points different equilibria arise. The Figure 6 presents the area of existence of different equilibrium types on \( f-s \) space for different values of \( \alpha \).

The short description is presented below.

1. For low values \( f \) and \( s \) (the bottom left dark gray and light gray area next to it on Figure 7\(^{17}\)) the utility of the low type is decreasing in \( \mu_i(q) \) but always positive (Figure 6(a)). Of the two effects discussed earlier, the effect of the change in the proportions of the low types in the pool of graduates is dominant. The optimal decision is to always enrol disregard of the beliefs held. Increase in the low type enrolment rate decreases the low type’s utility, but it always stays positive. In the light gray area the high types’ equilibrium utility is lower than \( \lambda \).

2. For moderate values of \( f \) and low values of \( s \) (dark gray and white areas in the top left corner) there exist two stable equilibria with \( q = 0 \) and \( q = 1 \) (Figure 6(b)). In addition, there is one unstable equilibrium such that

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\(^{16}\)This set of parameters implies realistic results. Perfect certification under exogenous capacity constraints costs 7.5% of future product (throughout the life, after graduation) of a high type. Under full enrolment, perfect certification is almost prohibitively high and would require the input of \( f = 0.5 \).

\(^{17}\)The described areas are easiest to identify on the third plot, for \( \alpha = 0.5 \).
Figure 6: Low type utility as a function of $\mu_i(q)$ for $\lambda = 0.25$ and $\phi = 0.15$ and $\alpha = 0.3$

$U_L(\mu_i(q), \cdot) = 0$. In this case, perfect certification is attainable for low levels of low type enrolment. Hence, the expected wage is zero (the flat part of the blue curve). If agents believe that the enrolment rate is low, they don’t enrol themselves. For higher enrolment levels the effect of the decrease in certification quality is very strong, leading to positive utility for higher values of beliefs. Therefore for high enough $\mu_i(q)$ the optimal decision is to enrol. If the low types coordinate on $q = 1$ and the values of $f$ and $s$ are in the white area on the plot the high types receive in equilibrium utility lower than $\lambda$.

3. For moderate values of $f$ and $s$ (black and small very light grey area east of it) 3 equilibria exist with $q = 0$ and with two values of $q \in (0, 1)$ (Figure 6(c)). The utility function is initially increasing in the beliefs $\mu_i(q)$ and becomes positive for moderate values, but it starts to decrease becoming negative for high values. The two equilibria with positive enrolment are defined by the intersections of $U_L$ curve and the horizontal axis. For the highest low type equilibrium enrolment rate the high types receive less than $\lambda$ for $f$ and $s$ in the light gray area.

4. For low values of $f$ and high values of $s$ (light grey and gray areas in the bottom right corner) there exist one equilibrium with $q \in (0, 1)$ (Figure 6(d)). The case is analogous to the one on Figure 6(a). The utility is strictly decreasing in $\mu_i(q)$. However the higher value of $s$ causes that the utility is positive for low values of $\mu_i(q)$ and negative for high values. Therefore the only equilibrium is the intersection of the $U_L$ curve and the horizontal axis. In the light gray area the equilibrium payoff of the high type is smaller than $\lambda$.

5. For high values of $f$ and $s$ (gray area in the top right corner) there exist one equilibrium with $q = 0$ (Figure 6(e)). Low types utility from enrolment is always negative disregard of the enrolment rate. The inverted U-shape indicates that the effect of certification quality is strong, but due to high costs $s$ insufficient to make the utility positive.

6. For moderate values of $f$ and $s$ (very small gray area at the bottom tip of the black area) three equilibria with
\( q \in (0, 1) \) exist (Figure 6(f)). This case clearly shows the interplay of the two effects. Even or very low values of \( \mu_i(q) \) the certification is imperfect. Therefore, for \( \mu_i(q) \) close to zero even the fail wage is high, therefore the low types may expect high utility. However as the enrolment increases the fail wage goes significantly down bringing the \( U_L \) below zero. At this point the certification quality decrease effect comes into play moving the curve in the positive range again. Finally for high values of \( \mu_i(q) \) the quantity effect dominates. The three equilibria are given by the intersections of the \( U_L \) curve and the horizontal axis.

The analysis so far shows that supply inelasticities may result in multiplicity of equilibria. This model shows that the change of the enrolment rate may be an effect of differences in beliefs in the role of luck in determining the educational outcomes. If such beliefs are held by the society, the low types coordinate and drive the quality of education down, fulfilling their beliefs.

The welfare analysis will be skipped, the effect of \( \gamma > 0 \) is clear. The higher the cost of certification provision the lower the certification precision which results in decreased utility of the high types and increase in low types wasteful participation.

6 Conclusions

The key message of this study is that release of certification access constraints can be harmful for all parties if the certification quality is not sufficiently high. The mechanism leading to those results is based on a trade-off between self-revelation through a certification decision and information revealed in the certificate itself. Improved access, assuming the independence of constraints and ability distributions, decreases the pool of uncertified agents with high abilities and hence the expected wage of the uncertified. As a result, low types mimic the high types and to enrol at higher rates hence informativeness of self-revelation is decreased. The negative affect of improving access under low quality is aggregated when there exist supply inelasticities and the certification quality decreases with the number of certificates issued. This can start a self enhancing mechanism in which the chances of low ability agents to receive a certificate increase, which increases the demand and drives the quality further down.

One of the possible applications of the results is the changes in higher education in Central and Eastern Europe after the collapse of the communism and subsequent rapid growth of enrolment rates. In that region years of under-supply (due to exogenous capacity constraints) of university education created a high demand which the existing and new-established education institutions were trying to accommodate for. It gives also an explanation for requirement inflation for lower-middle class office jobs.

Another issue tackled in this paper is the differences in the level of enrolment rates between the countries in CEE. I claim that cross country differences in the beliefs in the role of luck in determining economic outcomes can be one of the determinants. In certification context, the beliefs on the role of luck in determining outcomes and the beliefs on the quality of education are, by construction, identical. Given the assumptions used in this model,
they are inseparable from the individual beliefs over enrolment rates. This model shows that those beliefs can be a driving force behind the differences between, otherwise similar, countries in the growth of the higher education enrolment rates in the transition period.

The presented model maybe considered an oversimplified description of education system in transition. A dynamic model, in which agents base their beliefs on education quality on the past observations and capacity adjustments, would be more suitable for this purpose. The current model completely ignores the human capital formation during the education process, which, surely, biases the results. Therefore adding a form of productivity enhancement is another natural extension. Furthermore, the issue of modularities in job - employer matching is completely ignored. However, if they exist, it would increase the need of high education which would bring not only fair but also efficient allocation of labour.

Another possible criticism would touch unrealism of assumption that the authorities set no limits on overall university financing. More realistically, particularly in context of CEE countries, free public education should be supplemented with private costly education. This more realistic approach would add additional complexity, without, however, changing the key results.

The results lead to some policy recommendations. First of all, when improving access to education the authorities should focus on assuring high quality. General availability or freedom to choose education are definitely desirable but, as the model shows, can be even detrimental for the society if the sufficient quality level is not assured. Another finding is that private education costs help agents self-select and partially improve information revelation. The model, does not, however, bring a message that higher education should not be provided free of charge. Alternative, and widely supported model of education financing, mean-tested loan system, would assure free education at the point of use (see [4] and [17] and would not be pure tax-financing. However, given the economic instability in the region, aversion towards financial institutions caused by the economic turmoil in the transition, general risk aversion, there are serious risk regarding the applicability of the idea.

Another possible solution for controlling the huge increase in demand is regulation of admission. Rather than complete release of admission caps, a smooth transition by an increase by an \textit{ex ante} fixed number of places at universities would be recommended. Similar measures are currently under discussion in CEE countries. The Polish parliament discusses recently a bill imposing a requirement of an acceptance of Ministry of Education for an increase in enrolment at a university exceeding 2%. The model pools all the disciplines together, however, it’s natural to think that not all fields undergo similar quality deterioration process. In fact, the rate of growth at technical universities in CEE is much lower than in social sciences and the humanities. Therefore price differentiation between the fields of study seems reasonable. The results of this highly stylised analysis also may be treated as an argument against the recent change in the definition of Human Development Index, which from 2010 includes the years of schooling as one of the development indicators. If education is used by employers as a test of students quality high values of average schooling may be a result of a bad equilibrium rather than a societal progress.

References


