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Universities' competition under dual tuition system

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Abstract

The paper proposes a model of strategic interaction of universities under dual tuition system used in Russia, where universities combine the state-financed enrollment provided for free with the enrollment in excess of state quota provided at paid basis. It is demonstrated that the impact of state-financed higher education expenditures on the education quality and tuition depends on the choice of the policy instrument: an increase in per student subsidy under the same total quota improves education quality and raises tuition fee while an increase in quota under the same per student allotment reduces both education quality and tuition fees. It is also demonstrated that both policies have positive impact on total enrollment but do not necessarily result in social welfare improvement.

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1. Introduction

The trade-off between the quality of education, mass enrollment, and the cost of public spending on higher education is still a central question in the area of higher education finance both in developed and developing economies (Barr 2009). The problem of quality in higher education and its relationship to the university funding has been approached both from the empirical and theoretical grounds. Contrasting free education in US public schools with the paid education in private schools Epple and Romano (1998) demonstrate that in the equilibrium private schools should provide higher quality to attract students as otherwise they would choose free public schools.

Conclusions concerning the impact of funding on the quality of higher education are quite sensitive to the approach used to define the quality. It might be quite misleading to use peer effect as a proxy for the quality of education as it depends not only on the quality of students but is largely affected by the quality of teaching. By separating the two effects and assuming that quality of teaching is determined before the admission, Romero and Del Ray (2004) demonstrated that, in the presence of liquidity constraint, there is a unique equilibrium where public universities provide higher quality than the private ones.

There are few empirical papers that trace the impact of funding sources on the performance of higher education institutions (HEIs). Most of the studies focus on the tuition and enrollment and demonstrate that reduction of government support brings an increase in tuition fee both for public and private institutions (Rizzo, Ehrenberg 2003) and has negative impact on enrollment (Berger, Kostal 2002). There are even fewer empirical papers that look at the quality implications of the higher education funding sources. Frederick et al. (2012) proposed and estimated a model where the quality of education is a function of the amount of per student funding. Their simulation suggests that federal funding drives up the quality of education; but if these funds are used for students' aid, then the result is the opposite with significant increase in enrolment but deterioration of education quality.

All the studies discussed above deal with HEIs of developed economies. However, the state support mechanisms as well as the constraints faced by decision makers might be quite different in developing and transition economies. We look at the case of higher education in post-soviet transition economies, where dual tuition system is used: either a student is admitted within the state-financed quota and studies for free or he/she is admitted on commercial basis with tuition fully financed by private sources. Moreover, the number of students that should be admitted on free basis is determined by the government: this total quota is allocated between universities by the government. Thus, the total subsidy received by each university depends on the level of per student allocation (the same for all universities) and particular quota of state-financed enrollment specific for each university. We demonstrate that it is not the total government funding of HEIs but the particular structure of this funding, i.e. its decomposition into the level of per student allocation and the state-financed enrollment quota, that are important for the choice of education quality by universities.

The game-theoretical model presented in the next section is inspired by the framework of Fethke (2005, 2006) used to analyze the strategic interaction between state-subsidized universities.

2. The model

We consider a game with three groups of players: government represented by the ministry of education, two state universities, and students. We assume that the total government funding of higher education (M) as well as the level of per student subsidy (τ) for a given period are exogenously fixed. These parameters uniquely identify the state-financed total enrollment $X \equiv M/\tau$, which is allocated between the two universities on a competitive basis so that $\bar{x}_1 + \bar{x}_2 = X$, where $\bar{x}_i$ is state-financed quota allocated to university i ($i = 1, 2$).

The education services provided by the two universities are treated by students as imperfect substitutes with demand functions derived from representative agent utility maximization. Following Fethke (2005), we assume quadratic utility function

$$u(x_1, x_2, m) = a_1 x_1 + a_2 x_2 - 0{,}5\left(x_1^2 + 2bx_1x_2 + x_2^2\right) + m,$$

where x_i stays for the services (enrollment) provided by university i and m represents the consumption of all other goods. Parameter $b \in (0, 1)$ reflects the degree of substitutability of the education services provided by the two universities. Coefficients a_1 and a_2 are treated as quality parameters. Denoting by θ_i the initial level of education quality provided by university i, the final quality level is given by $a_i = \theta_i + s_i$, where s_i $(s_i \geq 0)$ stays for the education investment chosen by the university. Utility maximization brings the following demand functions:

$$x_i(p_i, p_j) = \frac{1}{1-b^2}\left(a_i - ba_j - p_i + bp_j\right),$$

where p_i is the tuition charged by the university i.

We assume that each university maximizes net revenue which could be used to finance the staff research activities. The gross revenue of HEI comes from tuition and the state financed quota with exogenously fixed per student payment τ: $p_i\left(x_i(p_i, p_j) - \bar{x}_i\right) + \tau\bar{x}_i$. It should be noted that due to the presence of dual tuition system, where some students are admitted to HEI on tuition-free basis while others pay full tuition, we need some rationing rule. We are not going to model the admission process explicitly but just assume efficient rationing, that is, consumers with the highest valuation of education services of the university are admitted on a free bases to this university.

The cost function of university i includes quadratic costs of education quality investment and enrollment costs with constant marginal cost c_i: $C_i(s_i, x_i) = s_i^2 + c_i x_i$. The level of per student subsidy is set to cover per student enrollment cost for each HEI: $\tau \geq c_i$. To guarantee positive demand we assume that marginal enrollment cost is less than the maximum willingness to pay in the absence of investment: $c_i < \theta_i$ for every i.

Initially, the two universities simultaneously and independently choose their investment in education quality, then the ministry of education allocates the total state-financed enrollment quota between the universities taking into account the education quality investment. The resulting quota allocation as well as quality investment is publicly announced. Finally, universities simultaneously decide on the tuition fee for the enrollment in excess of the state-financed quota.

3. Equilibrium

As the game is sequential we will look for the subgame perfect Nash equilibrium and derive it via backward induction.

3.1. Tuition competition

Taking the state-funded quota and the education quality investment as given, each university i decides on the tuition charged by maximizing its net revenue $R_i^{net}(p_i, p_j) = p_i(x_i(p_i, p_j) - \bar{x}_i) + \tau\bar{x}_i - c_i x_i(p_i, p_j) - s_i^2$. Under the given specification of demand this function is strictly concave in the own price so that the best response is given by the first order condition:

$$p_i(p_j) = (c_i - (1-b^2)\bar{x}_i + a_i - ba_j + bp_j)/2. \tag{1}$$

Solving the system we get the equilibrium tuition levels for the given quota allocation:

$$p_i = \frac{(2-b^2)a_i - ba_j - (1-b^2)(b\bar{x}_j + 2\bar{x}_i) + bc_j + 2c_i}{4-b^2}. \tag{2}$$

Plugging these prices back into the demand functions, we get the resulting enrollment:

$$x_i(\bar{x}_i, \bar{x}_j) = \frac{(2-b^2)(a_i - c_i + (1-b^2)\bar{x}_i) - b(a_j - c_j + (1-b^2)\bar{x}_j)}{(4-b^2)(1-b^2)}. \tag{3}$$

3.2. Quota allocation

The total enrolment quota X financed by the government is allocated between the two universities $\bar{x}_1 + \bar{x}_2 = X$ [1] in the way that maximizes social welfare (TS):

$$TS = a_1x_1 + a_2x_2 - 0.5(x_1^2 + 2bx_1x_2 + x_2^2) - c_1x_1 - c_2x_2 - (s_1)^2 - (s_2)^2,$$

where x_1 and x_2 correspond to the equilibrium enrolment levels which depend on the quota allocation as it is indicated by (1). As the objective function is concave and the constraints are linear, we may restrict our analysis to first order conditions. We restrict our analysis to the case of interior solution, when both universities get some finance from the government. The first order condition then takes the form:

$$a_1 - x_1 - bx_2 - c_1 = a_2 - x_2 - bx_1 - c_2.$$

It means that quota allocation should equalize net marginal benefits for the two products. Plugging the expressions for equilibrium enrollment (3) and taking into account the total quota, we get the following solution for the quota allocation problem:

$$\bar{x}_i = \frac{X}{2} + \frac{(a_i - c_i) - (a_j - c_j)}{2(1-b)}. \tag{4}$$

[1] We assume that the total state-financed enrollment is less than the efficient one in the absence of investment in quality, i.e. $X < (\theta_j - c_j + \theta_i - c_i)/(1+b)$.

To guarantee interior solution, the two universities should not differ much, i.e. the following condition should take place: $\max((a_1-c_1)-(a_2-c_2),(a_2-c_2)-(a_1-c_1))<(1-b)X$. If we compare the equilibrium quotas, we can see that the university with the higher value of net marginal benefit (the higher difference between a and c) gets the larger quota.

Plugging (4) in the equilibrium enrollment function (3), we find the paid-basis enrollment

$$x_i-\bar{x}_i=\frac{(a_1-c_1)+(a_2-c_2)-X(1+b)}{2(2-b)(1+b)}, \tag{5}$$

which appears to be the same for both HEI even if the quotas are different. To explain this fact first we should note that price competition results in best response function (1) that could be restated as $(1-b^2)(x_i-\bar{x}_i)=p_i-c_i$, that is, paid enrollment is proportional to the difference between the tuition fee and the marginal enrollment cost. Quota allocation rule derived above equalizes the net social benefit for both universities, which results in equality of the price-cost margin and explains the resulting symmetry of the paid enrollment.

3.3 Quality investment competition

Finally, we proceed to the first stage of the game, where the two universities simultaneously decide on the education quality investment. We rewrite the total net revenue of a university by separating the net revenue from state-financed enrollment and the net revenue from privately paid enrollment: $R_i^{net}=(\tau-c_i)\bar{x}_i+(p_i-c_i)(x_i-\bar{x}_i)-s_i^2$. Taking into account the best response tuition function (1) and demand for enrollment, we get $p_i-c_i=(1-b^2)(x_i-\bar{x}_i)$. Plugging back, we obtain the following expression for the net revenue: $R_i^{net}=(\tau-c_i)\bar{x}_i+(1-b^2)(x_i-\bar{x}_i)^2-s_i^2$. If we substitute (4) and (5) into this net revenue function and take into account that $a_i=\theta_i+s_i$, we can see that the objective function is strictly concave in s_i so we can look at the first order condition only:

$$\frac{\tau-c_i}{2(1-b)}+\frac{(1-b)(x_i-\bar{x}_i)}{(1+b)(2-b)}=2s_i. \tag{6}$$

As $x_i-\bar{x}_i=x_j-\bar{x}_j$ then $s_i-s_j=0{,}25(c_j-c_i)/(1-b)$, that is, the university with lower marginal cost will invest more in education quality. This happens because an increase in the willingness to pay brings the same benefit to both universities but the benefit from the state financed quota is higher for the university with lower marginal cost.

The level of per student subsidy that was irrelevant at previous stages has direct impact on the benefit from quality investment. We can trace this impact directly by solving system (6):

$$s_i=4\gamma\left((\tau-c_i)(1+b)(2-b)^2+(1-b)^2\left(\theta_j-c_j+\theta_i-c_i-(1+b)X\right)\right)+\gamma(1-b)(c_i-c_j), \tag{7}$$

where $\gamma=\left(2(1-b^2)(2-b)^2-(1-b)^2\right)^{-1}/8>0$. Plugging this quality investment in the quota allocation rule (4) and the paid enrollment function (5), we get the equilibrium quota:

$$\bar{x}_i=\frac{X}{2}+\frac{(\theta_i-c_i)-(\theta_j-c_j)}{2(1-b)}-\frac{(c_i-c_j)}{8(1-b)^2}, \qquad . \tag{8}$$

and the equilibrium enrollment in excess of the state-financed quota:

$$x_i - \bar{x}_i = \frac{(\theta_1 - c_1) + (\theta_2 - c_2) - X(1+b)}{2(2-b)(1+b)}\left(1 + 8\gamma(1-b)^2\right) + 2\gamma(2\tau - c_i - c_j)(2-b). \tag{9}$$

4. Policy analysis

Now we will look at the impact of an increase in the government finance of higher education implemented via (i) an increase in per-student subsidy under the same total quota or (ii) an increase in total quota under the same rate of per-student finance.

4.1. Quality, quotas, tuition, and enrollment

Proposition 1. An increase in per student subsidy under the same state-financed quota increases education quality, tuition levels, and paid enrollment while the allocation of universities' quotas is unaffected.

Proof. By differentiating (7)-(9) with respect to per student subsidy τ we get:

$$\frac{ds_i}{d\tau} = 4\gamma(1+b)(2-b)^2 > 0, \ \frac{d\bar{x}_i}{d\tau} = 0,$$

$$\frac{d(x_i - \bar{x}_i)}{d\tau} = 4\gamma(2-b) > 0 \text{ and } \frac{dp_i}{d\tau} = (1-b^2)\frac{d(x_i - \bar{x}_i)}{d\tau} > 0, \ i = 1, 2. \ \square$$

It should be pointed out that although the per student subsidy is included in the fixed component $\tau\bar{x}_i$ of university net revenue function, its impact is quite different from the lump-sum subsidy. The reason is that the university quota $\bar{x}_i$ isn't exogenously given but is allocated by the government and this allocation depends on the university quality investment. The incentive for quality investment comes from two sources (indicated by the two terms in the LHS of (6)): better quality increases the quota allocated to the university and as a result raises revenue from state-financed tuition; and better quality increases the willingness to pay that directly affects the revenue from paid enrollment.

If per student subsidy increases then the revenue from state-financed enrollment increases that intensifies competition for this enrollment. According to quota allocation rule (4), higher quality investment increases the share of state-financed enrollment allocated to the university. Thus, increased competition for state-financed enrollment provides an incentive for additional quality investment by raising the LHS of (6). The higher is per student subsidy rate, the higher is the increase in the net revenue of the university. Thus, with the increased marginal benefit from investment and the same marginal cost we observe an increase in education quality investment. As the increase in per student subsidy is identical for both universities and quality investment cost functions are also the same, we observe symmetric impact of the policy on the quality investment.

As both universities have exactly the same incentive to increase the investment but the total quota stays the same, the resulting quota allocation is not affected. The total enrollment for each HEI goes up due to the increased willingness to pay resulting from the education quality improvement. It increases both the equilibrium tuition and paid enrollment. As quality investments are raised by the same amount for both universities, this results in identical increase in willingness to pay, which explains the symmetric increase in paid enrollment and tuition fees.

An increase in the government higher education expenditures will have the opposite impact on the education quality and tuition if it is implemented via an increase in state-financed quota instead of per student subsidy. The reason is that tuition subsidy has no direct impact on demand for paid enrollment but affects the equilibrium only indirectly via its impact on quality investment. In case of increased state-financed quota we observe both direct effect via the reduction of the residual demand for paid enrollment and indirect effect that works through quality adjustment. Moreover, in case of a rise in per student subsidy the marginal benefit from quality investment goes up due to increased profitability of the state-financed quota and intensified quota competition that drives up the quality investment. If, instead, the quota is increased then the profitability of state-financed enrollment is unaffected while the profitability of paid enrollment is reduced due to the reduction in residual demand. Thus, we observe a reduction rather than an increase in the marginal benefit from quality investment that explains the opposite change in the quality investment. This opposite indirect effect that comes from the reduced quality together with direct effect from reduced residual demand brings a reduction of tuition fees. These results are summarized in proposition 2.

Proposition 2. An increase in the state-financed quota under the same per student allotment has symmetric impact on equilibrium parameters of both universities, resulting in the reduction of quality investment, equal increase in HEI quotas with partial crowding out of paid enrollment, and reduction of tuition fees.

Proof. Differentiate (7)-(9) with respect to total quota X:

$$\frac{ds_i}{dX} = -4\gamma(1-b)^2(1+b) < 0,\ \frac{d\bar{x}_i}{dX} = \frac{1}{2},\ \frac{d(x_i-\bar{x}_i)}{dX} = -\frac{1+8\gamma(1-b)^2}{2(2-b)} < 0,$$

$$\frac{dp_i}{dX} = (1-b^2)\frac{d(x_i-\bar{x}_i)}{\partial X} < 0,\ \frac{dx_i}{dX} = \frac{1-b}{2}\frac{2(1+b)(2-b)-1}{\left(2(1+b)(2-b)^2-(1-b)\right)} > 0,\ i=1,2.\ \square$$

As we can see from proposition 2, an increase in state-financed quota has symmetric impact on the two universities. The explanation for this result comes from the symmetric allocation of the increased quota, which follows from the quota allocation rule (8). As it was explained in section 3.2 the total quota is allocated in the way that equalizes the social marginal benefit for both HEIs. This initial allocation, according to the rule (8), is not necessarily equal. But when the equality of the marginal benefit is restored via the initially asymmetric quota allocation then any additional quota is split equally in order to avoid any distortions of the achieved balance.

With the same additional quota both universities observe the same reduction in private benefit from quality investment due to reduced paid tuition, indicated by the second term in the LHS of (6), and given the same cost functions for the quality investment this results in a symmetric reduction of quality. In its turn, the same reduction in quality results in identical fall of willingness to pay, which together with the symmetric reduction in quota finally results in the same fall in tuition fees and paid enrollment.

4.2. Welfare analysis

In the considered model, an increase in per student subsidy increases both quality and enrollment but does not necessarily improve the social welfare. The reason is that universities may overinvest in the education quality as this investment is used in strategic competition for state appropriations and for the revenues from the paid tuition. The incentive motivated by quota competition comes from the quota allocation rule (4) which suggests positive impact of education quality on the state-financed enrollment. The second argument comes from the positive impact of education quality on the willingness to pay and the resulting net revenue from the paid enrollment.

To perform welfare analysis we should look at the policy impact on the total surplus (TS). Per student subsidy rate affects the value of TS due to the changes in enrollment (enrollment effect) and the changes in education quality (quality effect):

$$\frac{dTS}{d\tau} = \underbrace{MB_x \frac{dx_i}{d\tau}}_{enrollment\ effect} + \underbrace{MB_s \frac{ds_i}{d\tau}}_{quality effect},$$

where $MB_x = \partial TS / \partial x_1 + \partial TS / \partial x_2$ stays for the net social marginal benefit from enrollment and $MB_s = \partial TS / \partial s_1 + \partial TS / \partial s_2$ stays for the net marginal benefit from education quality.

Proposition 3. An increase in per student subsidy rate results in positive enrollment effect. If initially $c_1 = c_2 = c$ and initially $\tau = c$ then quality effect is also positive and $\left.\frac{dTS}{d\tau}\right|_{\tau=c} > 0$.

Proof. Enrollment effect is positive as: $MB_x = (p_1 - c) + (p_2 - c) > 0$ and $dx_i / d\tau > 0$ due to proposition 1.

From proposition 1 we get $ds_i / d\tau > 0$. Calculating the net marginal benefit from quality and substituting (6) we get:

$$MB_s = x_1 + x_2 - 2(s_1 + s_2) = (x_1 + x_2 - X)\frac{1 + b(2-b)}{(1+b)(2-b)} + X - \frac{\tau - c}{1-b}. \tag{10}$$

It is definitely positive if $\tau = c$, and as a result quality effect is positive in this case. Thus if $\tau = c$ then both quality and enrollment effects are positive, that is, a small increase in the subsidy rate raises total surplus $\left.\frac{dTS}{d\tau}\right|_{\tau=c} > 0$. □

The result of proposition 3 suggests that the normative cost approach is not socially desirable as a small increase in the subsidy rate necessarily increases total surplus. This is because HEI gets zero net return from allocated quota if per unit subsidy just covers the cost of education. Thus university's marginal benefit from quality investment represented by the LHS of (6) is given by the second term only. As a result the level of quality investment is rather low. When the per-student subsidy is raised above the unit costs it makes the state-financed quota profitable and the intensified quota competition increases quality investment and results in positive quality effect that, together with increased enrollment, raises the social welfare.

But with further increase in the subsidy rate the profitability of state-financed quota might become so large that HEIs overinvests in quality making the social marginal benefit from quality negative. In this case the quality effect has the sign opposite to the enrollment effect and as indicated in Fig.1 under high τ, the negative quality effect might dominate the social welfare. We should treat this example as theoretical reasoning for the upper bound on the level of per student appropriation.

High per student allotment intensifies strategic competition that creates an incentive for quality overinvestment which in its turn drives up the expenditure of HEI and reduces the net revenue used by universities for research. This possibility is illustrated by the downward sloping part of producers' surplus (PS) curve at Figure 1.

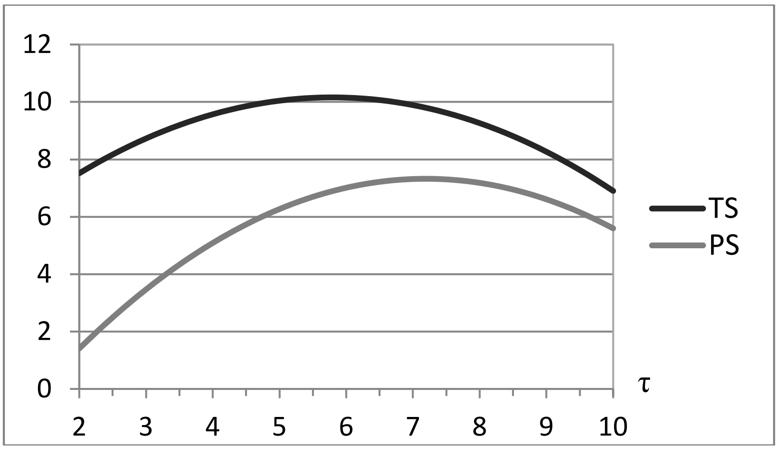

Figure 1. Impact of per student subsidy rate on producers' surplus (PS) and social welfare (TS) (parameters: $\theta_i = 5, c_i = 2, b = 1/4, X = 2$).

Although per student subsidy rate has no direct impact on utility, the students are definitely better off as it is demonstrated in proposition 4.

Proposition 4. An increase in the per student subsidy increases the students welfare.

Proof. By differentiating consumers' surplus we find

$$\frac{dCS}{d\tau} = (a_1 - x_1 - bx_2)\frac{dx_1}{d\tau} + (a_2 - x_2 - bx_1)\frac{dx_2}{d\tau} + \sum_{i=1}^{2}\left(x_i \frac{ds_i}{d\tau} - (x_i - \bar{x}_i)\frac{dp_i}{d\tau} - p_i \frac{d(x_i - \bar{x}_i)}{d\tau} \right) =$$

$$= \sum_{i=1}^{2}\left(x_i \frac{ds_i}{d\tau} - (x_i - \bar{x}_i)\frac{dp_i}{d\tau} \right) = 4\gamma(2-b)(1+b)[x_1 + x_2 + (1-b)X] > 0 . \square$$

The result of proposition 4 could be explained by the fact that the increase in education quality and enrollment provides benefits which exceed the loss from increased tuition for paid enrollment.

Now, let us move to the analysis of the welfare impact of the total state-financed quota X:

$$\frac{dTS}{dX} = \underbrace{MB_x \frac{dx_i}{dX}}_{enrollment\ effect} + \underbrace{MB_s \frac{ds_i}{dX}}_{quality effect} .$$

Proposition 5. An increase in the state-financed quota results in positive enrollment effect but ambiguous quality effect. If $\tau = c_1 = c_2$ then the quality effect is negative.

Proof. Enrollment effect is positive as: $MB_x = (p_1 - c_1) + (p_2 - c_2) > 0$ and according to proposition 2, an increase in quota brings only partial crowding out of paid enrollment so that total enrollment increases: $\frac{dx_i}{dX} > 0$.

If $\tau = c_1 = c_2$ then according to (10) social marginal benefit from quality is positive:

$$MB_s = x_1 + x_2 - 2(s_1 + s_2) = (x_1 + x_2 - X)\frac{1 + b(2 - b)}{(1 + b)(2 - b)} + X > 0.$$

Since $\frac{ds_i}{dX} < 0$ due to proposition 2, the quality effect is negative. □

As it follows from proposition 5 under normative cost approach the quality effect and the enrollment effect have opposite impacts on the social welfare. Even if initially the positive enrollment effect overweighs the negative quality effect, further increase in the quota might result in the decrease of the total surplus. An increase in total quota raises the overall enrollment and reduces quality investment. The first change increases marginal benefit from the quality investment and the second one reduces marginal investment cost so that the net marginal benefit from quality increases. As a result, the society suffers more from quality reduction. It might happen that starting from some level of the total state-financed quota[2], the negative quality effect will overweight the positive enrollment effect and the total surplus goes down as it is demonstrated by Figure 2.

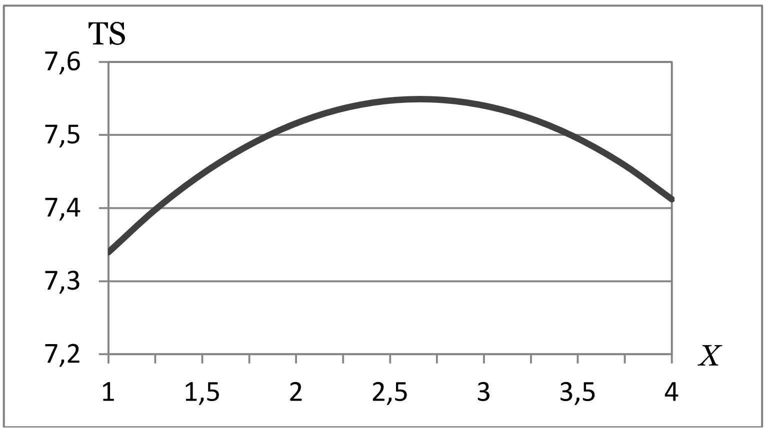

Figure 2. Welfare impact of state-financed enrollment quota $(\theta_i = 5, c_i = 2, b = 1/4, \tau = 2)$.

Contrary to the policy of an increase in per student subsidy, an increase in the state-financed quota is not necessarily welfare-improving for the students as it is demonstrated in Figure 3. On the one hand, an increased state-financed quota raises total enrollment and reduces the tuition fees that definitely increases consumers' surplus but, on the other hand, it reduces incentive for quality investment and the latter effect might become dominant as it is indicated by the downward sloping part of the CS illustrated in Figure 3

[2] This level is less than socially efficient one as throughout the paper we keep the assumption on the upper bound of total quota specified in the footnote 1.

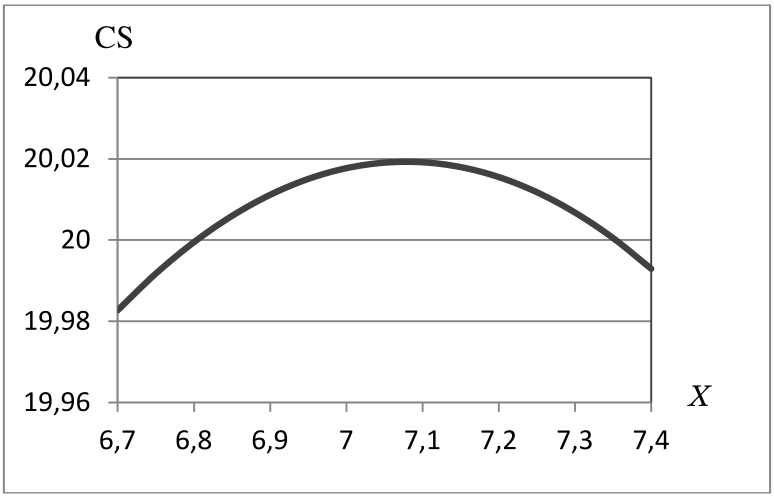

Figure 3. Impact of state-financed enrollment quota on CS $\left(\theta_i = 5, c_i = 1/4, b = 1/4, \tau = 1/4\right)$.

5. Conclusions

This paper develops a model for HEIs strategic interaction to analyze the impact of state appropriation used in post-soviet economies. The two parameters of the government funding policy, per-student allotment and the total enrollment quota, not only affect the level of higher education funding but also affect the strategic education quality and tuition competition between the universities.

If an increase in state funding of higher education takes the form of increased state-financed enrollment under the same per student subsidy, the resulting effect is deterioration of the education quality and partial crowding out of paid enrollment followed by reduced tuition. If instead the per student subsidy is increased under the same size of state-financed quota, the education quality and tuition go up together with an increase in paid enrollment. These findings suggest that it is particular structure, not just the total size of state appropriations, that is important for the policy impact. The immediate implication is that the level of per student subsidy and the total state-financed enrollment quota should be treated separately in empirical analysis.

Another practical implication comes from the welfare analysis. It was demonstrated that the normative cost principle for the determination of per student subsidy is not socially desirable as a small increase in per-student allotment in this case necessarily increases total surplus. On the other hand, a very high level of per student subsidy might result in overinvestment in education quality and have undesirable effect for the net revenue of universities used for research and thus for the overall social welfare.

Finally, it was demonstrated that not only the high per-student allotment but also the high level of state-financed enrollment quota could be undesirable for the society due to partial crowding out of paid enrollment and underinvestment in the education quality.

The model could be extended to take into account the heterogeneity of students in terms of their abilities and the resulting peer effect in education.

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