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Resource dependence theory analysis of higher education institutions in Uzbekistan

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Abstract In this paper, resource dependence theory (RDT) is used to guide an empirical analysis of the higher education system in Uzbekistan. Regression analysis is applied to a panel dataset consisting of 62 Uzbek higher education institutions, covering the period 2000–2013, to examine the determinants of the expenditure decisions made by institutions. The key hypothesis is concerned with the relationship between the share of revenue from tuition fees and the share of expenditure spent on teaching. The analysis attempts to control for unobserved heterogeneity through the inclusion of fixed effects. Instrumental variables estimation is used to address the potential endogeneity of the relationship between these two variables. The main finding is that there is a positive and statistically significant relationship between the share of revenue from tuition fees and the share of expenditure spent on teaching, even after other factors are held constant, which is consistent with a core premise of RDT.

Keywords Resource dependence theory · Higher education finance · Uzbekistan

Introduction

Following the breakup of the Soviet Union, Uzbekistan declared independence on August 31, 1991. Before independence, and like all other republics of the Soviet Union, almost all aspects of higher education were "centrally planned" in Moscow through the Ministry of Education. For example, decisions about subjects taught, student numbers, course content, staff salaries and student stipends were made by "Moscow Central". There was little, if any, serious

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consideration of any regional requirements or input from those working at higher education institutions. The inefficiencies inherent to central planning, which were the main factors behind the breakup of the Soviet Union, are well known, and such inefficiencies were present in the way resources were allocated to higher education. At the time of independence, Uzbekistan inherited a higher education system on the verge of collapse (see Ruziev and Rustamov 2016).

The restructuring of the failed higher education system inherited from the Soviet Union has been a slow and expensive process for the Uzbek Government. Like most countries, the Government also had to considerably reduce expenditure on public services, including education, as a consequence of the most recent "financial crisis" (see Albrecht and Ziderman 1995; Johnstone and Marcucci 2010; Sanyal and Johnstone 2011). One institutional response to reductions in government funding is to introduce some form of "user fee", such as tuition fees. If user fees are already in place, another response is to increase the amount charged (Barr 2010; Johnstone 2004; Muscio et al. 2013; Salmi and Hauptman 2006; Sanyal and Johnstone 2011). Most research on the consequences of introducing or increasing tuition fees has largely focussed on the "demand side", which is mainly the impact on the behaviour of students, such as participation and drop-out rates (Canning et al. 2007; Johnstone and Marcucci 2010; Paulsen and Smart 2001; Psacharopoulos and Patrinos 2004; Sam 2011; Tilak 2004). There has been little research on the "supply side", which is the impact on the behaviour of institutions in terms of, for example, how revenue is partitioned between teaching, research and other activities.

With this brief background in mind, this paper has two main aims. The first is to use resource dependence theory (RDT) to guide an empirical analysis concerned with how becoming more dependent on tuition fees as a source of revenue affects expenditure decisions about how this revenue is spent. We agree with Nienhüser (2008, p. 18) that "it is not possible to test such a complex theory like RDT in its entirety because it consists of many hypotheses". However, it does suggest the key (for our purpose) hypothesis that, if the relative share of one type of revenue increases, then the relative share of expenditure relevant to this source should also increase. Given the growing dependency of higher education institutions in some countries on tuition fee income, RDT is a useful starting point before moving on to more elaborate theoretical explanations of institutional behaviour. The second aim is to provide what we believe is the first empirical analysis of this type for a former Soviet republic. In addition, we believe Uzbekistan makes an interesting case study since it has had to restructure a centrally planned higher education system concurrently with the rolling out of market economy.

The remainder of this paper is organised as follows. The next section is a historical overview of the higher education system in Uzbekistan since independence. A key trend since around the year 2000 is that the share of public funding has declined considerably with the share of private funding, increasing considerably against a backdrop of increasing student numbers. After that is a brief review of RDT. The small number of studies that have used RDT to guide empirical research concerned with the behaviour of higher education institutions are reviewed. Following this, the methodological approach is presented. Regression analysis applied to a panel dataset consisting of 62 Uzbek higher education institutions, covering the period 2000–2013, is used to examine the possible determinants of the share of expenditure spent on teaching. The main hypothesis is that this share should be highly dependent on the share of revenue from tuition fees. The analysis attempts to control for unobserved heterogeneity through the inclusion of fixed effects. Instrumental variables estimation is used to address the potential endogeneity of the relationship between the share of revenue from tuition fees and

the share of expenditure spent on teaching. The results are then presented, followed by the conclusions. The main finding is that there is a positive relationship and it is statistically significant, even after other factors are held constant, which is consistent with a core premise of RDT.

An overview of the Uzbek higher education system

In 1991, Uzbekistan inherited a higher education system consisting of 42 institutions. There were three "state universities", nine engineering polytechnics, 14 teaching and language colleges, three agricultural colleges, three cultural and arts institutes, seven medical, nursing and pharmaceutical schools and one sports and physical education institute (SCS 2013). Since independence, the number of higher educational institutions has increased to 64. "New" institutions were created by opening, reclassifying, renaming and merging institutions. There are currently two "academies", 21 universities and 41 "institutes". Academies are research-intensive institutions that offer mainly postgraduate programmes of study. Most of the universities teach a wide range of subjects at both the undergraduate and postgraduate levels. "Institutes" tend to be more specialised institutions. The key point is that, in the 25 years since independence, there has been considerable change in the Uzbek higher education system. Not only has the number of institutions increased by 50%, there has also been considerable restructuring.

The Uzbek higher education system is the responsibility of the Ministry of Higher and Secondary Specialized Education (MHSSE). All the physical assets of higher education institutions (e.g. buildings and land) are state-owned. It is important to note that, at the time of independence, the Government committed the country to free-market principles. Despite this pledge, the higher education system remains partially controlled by the Government. However, compared to the Soviet Union higher education system, institutions are much more self-determining, having scientific and management boards that make operational decisions. Institutions are permitted to manage their physical assets. For example, they are allowed to keep income generated from the rental of property, such as student accommodation. They are also allowed to keep income generated from commercial activities, such as consulting and contract research.

The Government, through the MHSSE, sets the maximum number of students that an institution can enroll through a set of subject-specific quotas. Figure 1 shows the number of students enrolled in the academic years 2000/2001 to 2016/2017. The figure also shows the numbers separately for undergraduate and postgraduate study. Note that the postgraduate numbers are for masters-level students and do not include doctoral/PhD students. In this 17-year period, the number of students increased from 183,600 in 2000/2001 to 268,300 in 2016/2017. This is an increase of 84,700 students, which, in percentage terms, represents an increase of nearly 50%, and an average growth rate of around 3% per year. The majority of this growth has been in undergraduate study rather than postgraduate study. In the academic year 2016/2017, 96.5% were undergraduate students and 3.5% were postgraduate students. In this period, the share of postgraduate students has never exceeded 5.2%. It is clear that, in this period, there has been a sizeable expansion in the number of students enrolled at Uzbekistan higher education institutions.

Figure 2 shows the numbers of students admitted in the academic years 2000/2001 to 2016/2017. Again, the numbers are shown separately for undergraduate and postgraduate
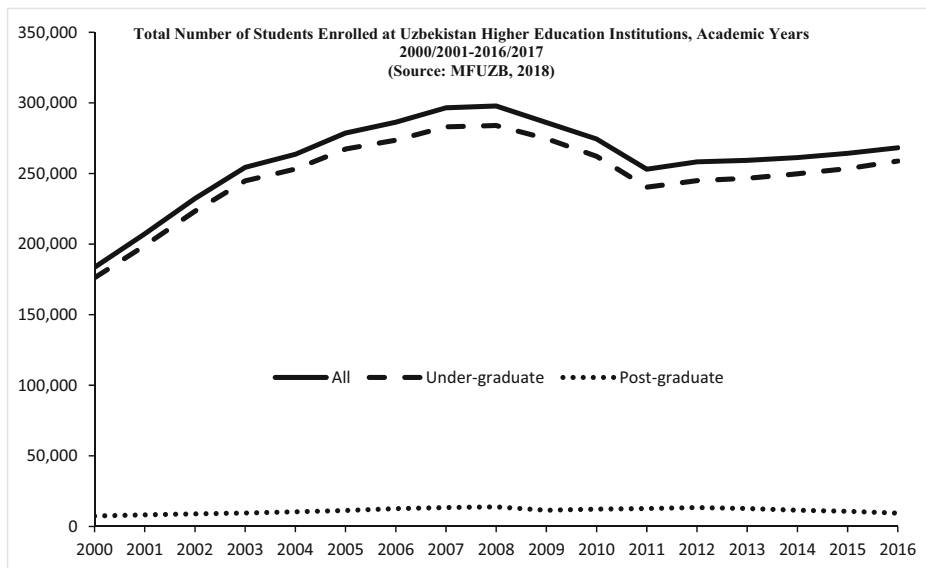
Fig. 1 Total number of students enrolled at Uzbekistan higher education institutions, academic years 2000/2001 to 2016/2017 (source: Ministry of Finance of the Republic of Uzbekistan 2018)

study. The pattern is similar to what is observed for enrolment, noting that enrolment is a "stock", while admission is a "flow", so in absolute numbers, the former is considerably larger than the latter. In the academic year 2000/2001, 44,700 students were admitted, of which 90.8% were undergraduate admissions and 9.2% were postgraduate admissions. In the academic year 2016/2017, 61,200 students were admitted, of which 94.3% were undergraduate admissions and 5.7% were postgraduate admissions. In other words, about 40% more students were admitted in 2016/2017 compared to 2000/2001. Postgraduate admissions, as a share of the total admissions, have almost halved. It is important to note that admissions peaked at almost 70,000 in 2007/2008. Since then, admissions declined slightly, stabilising at around 63,000 per year in the period 2008/2009 to 2016/2017.

Figure 3 shows the numbers of students graduating in the academic years 2000/2001 to 2016/2017. The numbers graduating is also a "flow". There has been a large increase in the number of graduates in this 17-year period. In the academic year 2000/2001, there were 31,600 graduates, of whom 89.2% were undergraduate graduates and 10.8% were postgraduate graduates. In the academic year 2016/2017, there were 64,100 graduates, of whom 91.6% were undergraduate graduates and 8.4% were postgraduate graduates. This indicates that the numbers graduating in 2016/2017 is about double that of 2000/2001. More specifically, undergraduate graduates increased from 28,200 in 2000/2001 to 58,733 in 2016/2017, which, in percentage terms, is a difference of 108%. Likewise, postgraduate graduates increased from 3400 in 2000/2001 to 5367 in 2016/2017, which, in percentage terms, is a difference of 58%.

Beginning in the mid-2000s, institutions were allowed to set their own tuition fees subject to a "cap" set by the MHSSE. Currently, 70% of undergraduate students and 80% of postgraduate students are required to pay tuition fees. The remainder have their tuition fees paid by the Government. These students are mainly from disadvantaged backgrounds and certain ethnic groups. Table 1 shows the annual average tuition fees for undergraduate and postgraduate study for selected subjects in the academic year 2016/2017. There is not much
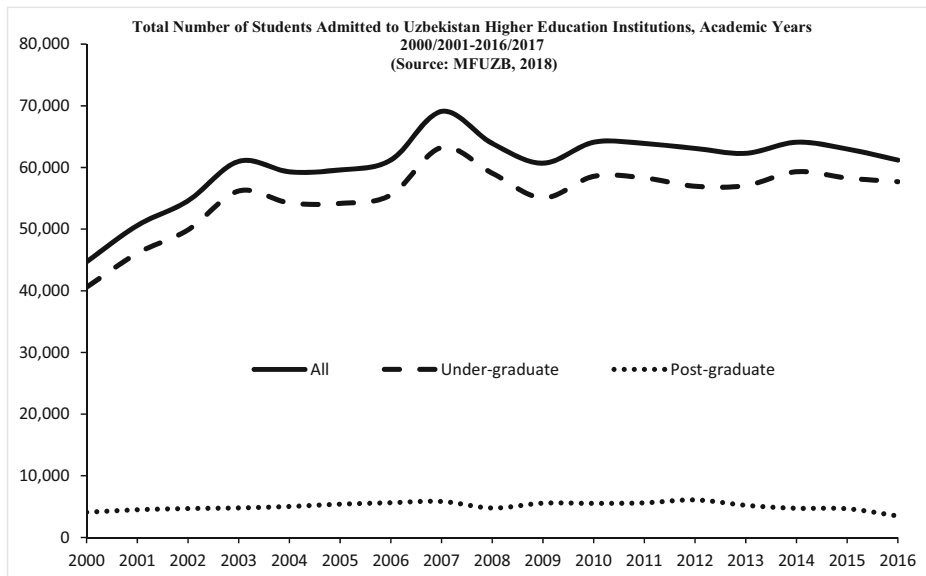
Fig. 2 Total number of students admitted to Uzbekistan higher education institutions, academic years 2000/2001 to 2016/2017 (source: Ministry of Finance of the Republic of Uzbekistan 2018)

variation in tuition fees between undergraduate and postgraduate study. The average tuition fee paid for undergraduate study is (US) $2606 per year and for postgraduate study $2852 per year. Likewise, there is not much variation by subject studied. The standard deviation for undergraduate study is $400 and for postgraduate study $450. Tuition fees of around $2800 do not seem excessive when compared to the United States or the United Kingdom. However, Uzbekistan is classified by the World Bank as a "lower middle income" country. In 2016, the average individual earnings in Uzbekistan was $1625 per year. Therefore, tuition fees
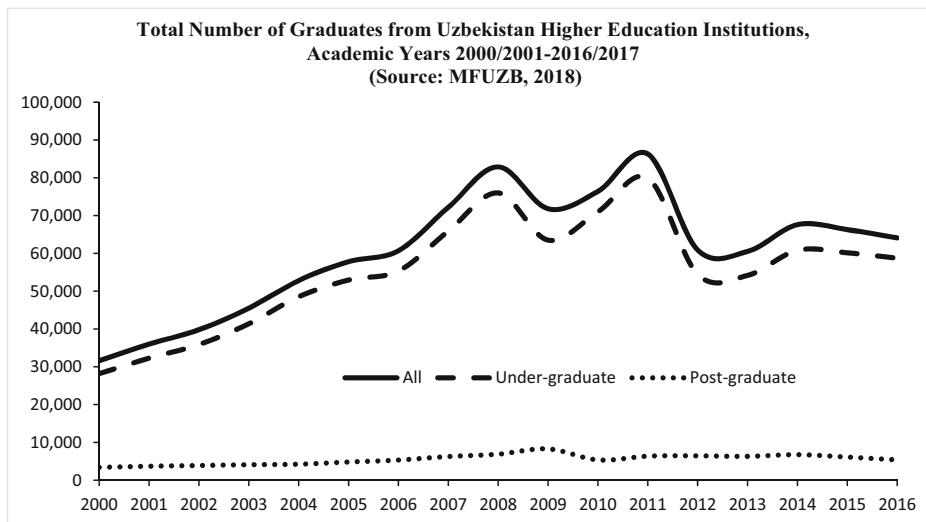
Fig. 3 Total number of graduates from Uzbekistan higher education institutions, academic years 2000/2001 to 2016/2017. (source: Ministry of Finance of the Republic of Uzbekistan 2018)
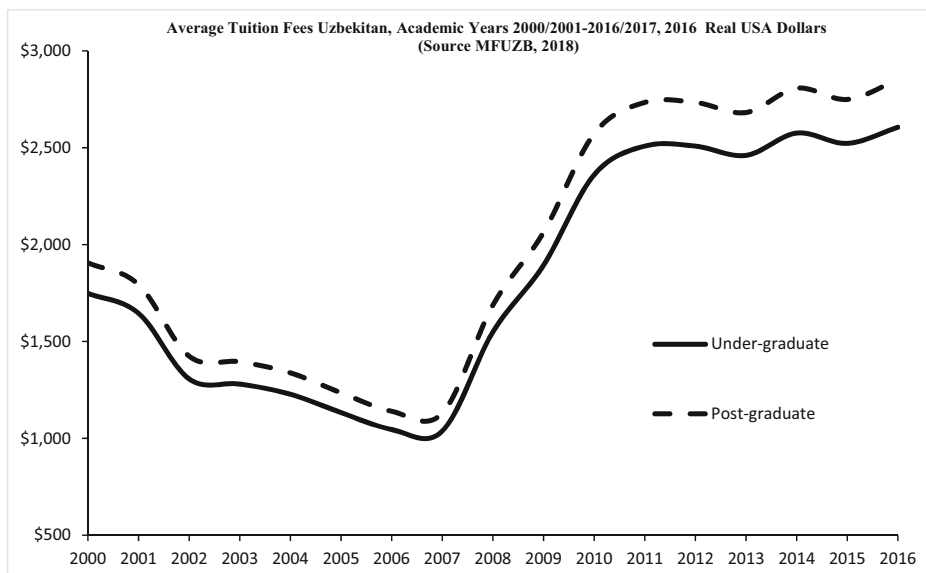
Table 1 Average annual tuition fees at Uzbekistan higher education institutions, academic year 2016/2017, 2016 US dollars

Subject	Undergraduate	Postgraduate
Teaching	$2220	$2407
Arts	$2638	$2915
Humanities	$2220	$2407
Social sciences	$2220	$2407
Journalism	$2421	$2654
Business and management (economics)	$2938	$3225
International economic relations	$3289	$3616
Law	$3289	$3616
Natural sciences	$2579	$2771
Engineering	$2528	$2816
All subjects	$2606	$2852

Source: Ministry of Finance of the Republic of Uzbekistan (2018)

averaging over $2800 per year represent a considerable expense. Higher education is very expensive in Uzbekistan and is a serious financial burden for the majority of students and their families.

Not only are tuition fees high in Uzbekistan, but they have increased considerably in real terms, particularly in the past decade. Figure 4 shows the average tuition fees paid for undergraduate and postgraduate study in the period 2000/2001 to 2016/2017 in real 2016 US dollars. In this same period, there was considerable inflation, with the consumer price index (CPI) increasing around seven-fold (i.e. in 2017, 7 Uzbekistani so'm had the same purchasing power as 1 so'm in 2000). Inflation was rarely less than 10% per year and was over 25% per year in 2000 and 2001. As Fig. 4 shows, tuition fees actually decreased in real terms from 2000/2001 to 2007/2008. However, since then, tuition fees have risen steadily from

Fig. 4 Average tuition fees in Uzbekistan, academic years 2000/2001 to 2016/2017, 2016 real US dollars (source: Ministry of Finance of the Republic of Uzbekistan 2018)
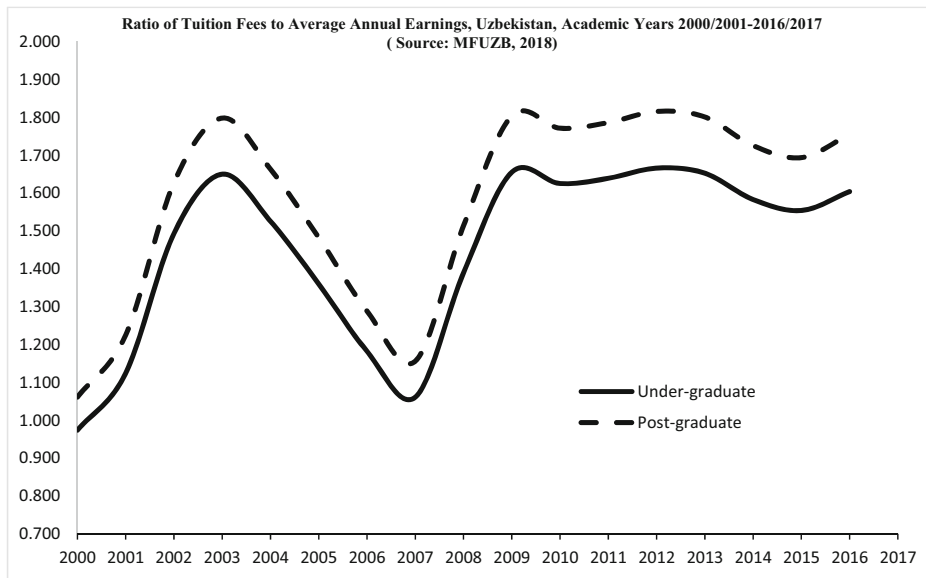
Ratio of Tuition Fees to Average Annual Earnings, Uzbekistan, Academic Years 2000/2001-2016/2017 (Source: MFUZB, 2018)

Fig. 5 Ratio of tuition fees to average annual earnings, Uzbekistan, academic years 2000/2001 to 2016/2017 (source: Ministry of Finance of the Republic of Uzbekistan 2018)

around $1000 for undergraduate study and $1100 for postgraduate study to $2600 and $2850, respectively. This represents an average annual increase in both undergraduate and postgraduate tuition fees of around 12% per year.

Expenditure Per Higher Education Student, Uzbekistan, 2016 Real US Dollars Selective Years Acaemic Years Between 2000/2001-2016/2017 (Source: MFUZB, 2018)
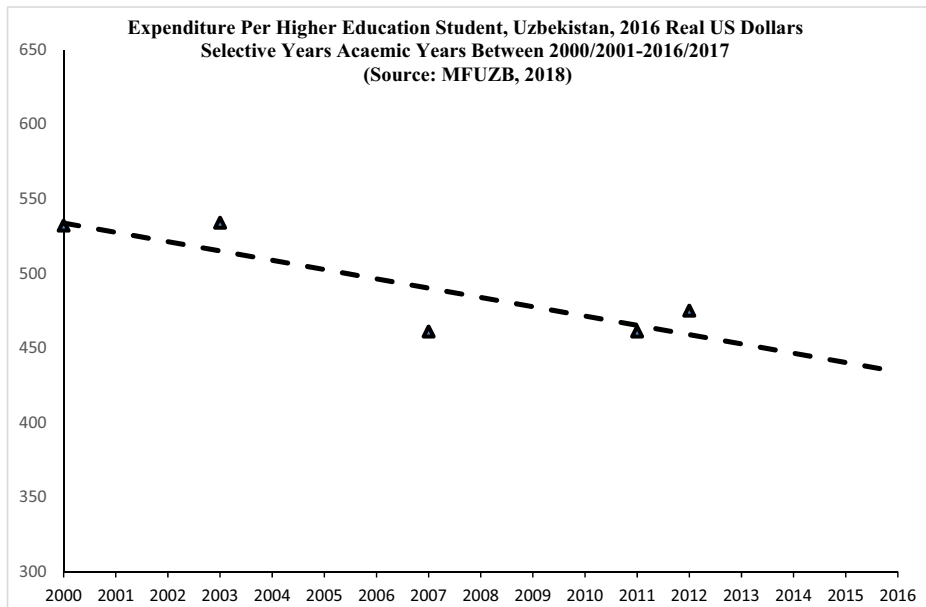
Fig. 6 Expenditure per higher education student, Uzbekistan, 2016 real US dollars, selective years, academic years 2000/2001 to 2016/2017 (source: Ministry of Finance of the Republic of Uzbekistan 2018)
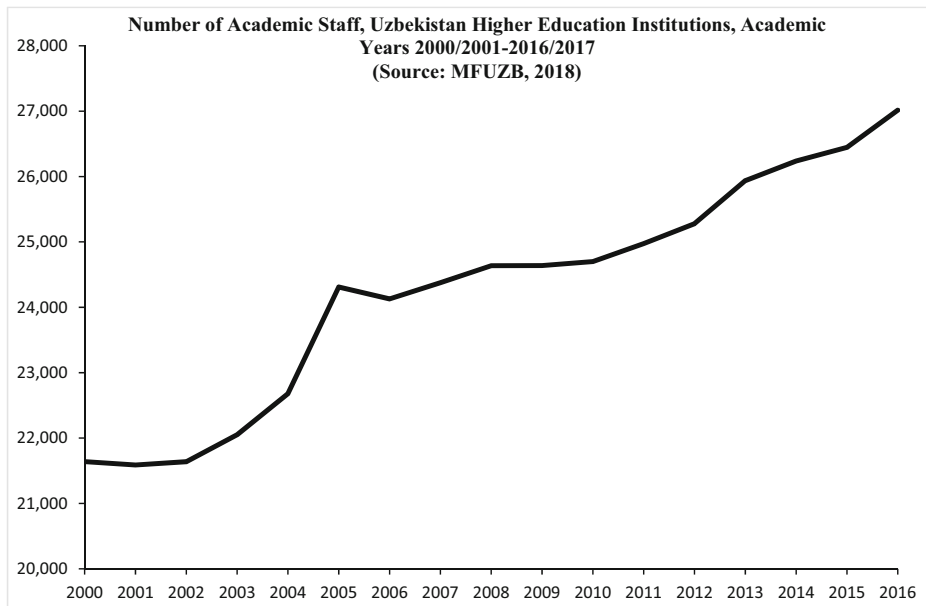
Fig. 7 Number of academic staff, Uzbekistan higher education institutions, academic years 2000/2001 to 2016/2017 (source: Ministry of Finance of the Republic of Uzbekistan 2018)

Considering changes in real tuition fees removes the problem associated with inflation. However, real values say little about the Uzbekistan population's "ability to pay" these fees. In order to understand this better, Fig. 5 shows the ratio of tuition fees to average annual individual earnings. Even in 2000/2001, higher education in Uzbekistan was expensive, with tuition fees being equivalent to around a year's average individual earnings. In the earlier years of this period, this ratio increased, suggesting that tuition fees increased more than average earnings. However, after this period, the opposite occurred, with the ratio decreasing to the equivalent of around a year's average individual earnings by 2007/2008. Since then, it increased and has been relatively constant in recent years at around 1.6 times the average earnings for undergraduate study and 1.8 times the average earnings for postgraduate study.

One might expect that, with such increases in tuition fees and student numbers, expenditure per student would have increased. Figure 6 shows the expenditure per student for five academic years: 2000/2001, 2003/2004, 2007/2008, 2011/2012 and 2012/2013. Such information is regarded as being sensitive by the Government and we were unable to find estimates for any other years. However, fitting a trend line (shown in Fig. 6) through these five observations for the period 2000/2001 to 2016/2017 provides some evidence that expenditure per student has decreased in this period. In the academic year 2000/2001, the expenditure per student was $532. In the academic year 2012/2013, it was $475. This represents a reduction of around 10%.

As a partial response to the increasing tuition fees, in 2001, the Government introduced a stipend system for all students, regardless of whether they were paying tuition fees themselves or having the fees paid by the Government (National Human Development Report, NHDR 2011). The Government justified their "stipends-for-all" policy on equity grounds, in the sense that it resulted in all students having a minimum income to pay the costs of at least a part of

Table 2 Average monthly academic salary, Uzbekistan, academic year 2013/2014

Position	Monthly salary
Head of department	$682–715
Professor	$649–682
Associate professor	$583–616
Senior teacher	$528–550
Assistant	$462–495

Source: author's calculations, based on data from the Ministry of Finance of the Republic of Uzbekistan (2013) and the Central Bank of Uzbekistan (2013)

their study. However, the amount of the stipend received depends on academic performance, with better performance translating into a larger stipend. In the academic year 2016/2017, there were three stipend levels based on grades received: (1) "excellent" = $188 per month, (2) "good" = $141 and (3) "satisfactory" = $94 (Ministry of Finance of the Republic of Uzbekistan 2018). Since the stipend for "excellent" is double that for "satisfactory", the stipend system is also an incentive system aimed at improving academic performance. It is worth noting that 12 months of the top stipend is only two-thirds of the average tuition fee. There is a considerable shortfall between the cost of a year's study and what the stipend system pays. We know of no research that has explored whether this stipend system is actually working.

Figure 7 shows the number of academic staff in the period 2000/2001 to 2016/2017. It is clear that the number of academic staff has steadily increased, noting that, in the same period, the number of higher education institutions also increased. In 2000/2001, the number of academic staff was 21,640. By 2016/2017, this had increased to 27,014 academic staff. This is an increase of almost 5500 people or 25%. About 8% of current academic staff are professors and doctors of science, around 38% are assistant professors and candidates of science, and around 54% are lecturers (Ministry of Finance of the Republic of Uzbekistan 2018). Table 2 shows the average monthly salaries of different academic staff in the academic year 2013/2014. The maximum salary for a head of department is $715 per month. The minimum salary for an assistant is $462 per month. This is a salary gap between the "top and bottom" of around 50%, which is very small compared to what is observed in most Western countries (EC Tempus 2010). However, as Fig. 8 shows, the increase in academic staff has not resulted in an increase in the staff:student ratio. This ratio actually decreased from 2000/2001 to 2007/20008. Since then, it has increased from around 80 to 100 students per staff member.

Institutions in the Uzbek higher education system receive funding from both public and private sources. Before the start of the academic year, each institution prepares a budget, which is largely based on the previous academic year's funding plus any additional funding requests. The budget is then vetted by the MHSSE. After deliberation, the overall budget for the higher education sector is set and forwarded to the Ministry of Finance, who decide on the amount that will be allocated (which is usually less than what is asked for). Therefore, public funding is essentially a "block grant", with the institutions being able to spend this money in the ways they desire. The main source of private funding is from tuition fees, along with rental income, consultancy, contract research and the provision of short courses and training to groups in both the public and private sectors. It is important to note that there is no direct "clawback", in the sense that private funding does not crowd out public funding. More specifically, if an institution raised an additional $1 million in private funding, its public funding through its block grant is not reduced by this amount or some fraction of it.
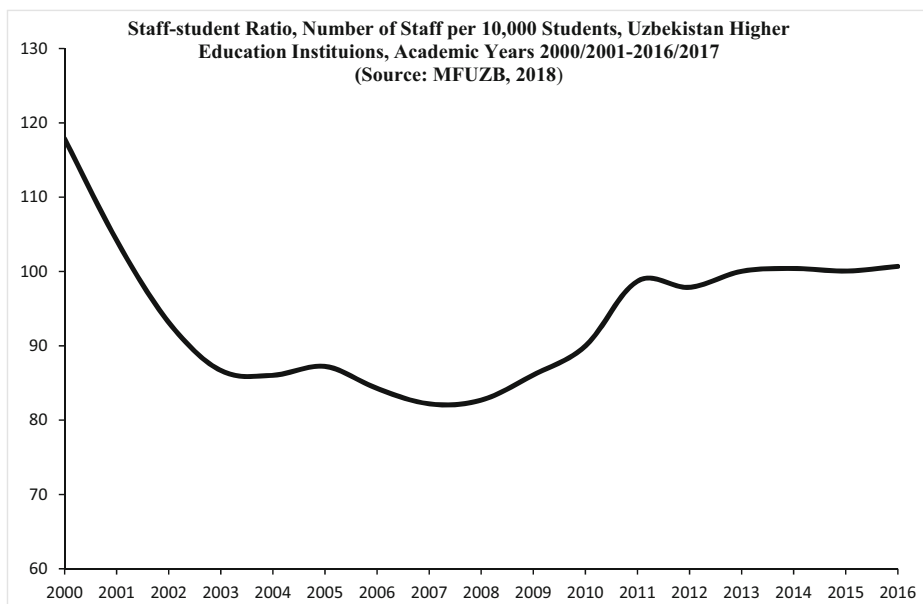
Fig. 8 Staff:student ratio, number of staff per 10,000 students, Uzbekistan higher education institutions, academic years 2000/2001 to 2016/2017 (source: Ministry of Finance of the Republic of Uzbekistan 2018)

Figure 9 shows the funding shares of Uzbek higher education institutions for each academic year in the period 2000/2001 to 2016/2017. Three funding sources are included in this figure. The first is the share of income from tuition fee income. The second is the share of income from the Government. The third is the share of income from other private activities, such as consultancy, contract research and commercial activates. It is clear that the share from the Government has decreased in this period. In 2001/2001, 58.4% of income was from the Government. By 2016/2017, this share had dropped to 28.5%. On the other hand, in the same period, the share of income from tuition fees has increased from 38.1% to 68.4%. However, Uzbekistan higher education institutions have not been very successful at increasing their share of income from non-government/non-tuition fee sources. In 2000/2001, the share of income from other private activities was 3.4%. In 2016/2017, it was 3.1%. It has never exceeded 4.1% in any academic year. Income from tuition fees is now the principal source of funding, making up over two-thirds of the total income.

Previous research

Resource dependence theory (RDT) is primarily concerned with how the behaviour of an organisation is affected by the external resources that the organisation uses. The first comprehensive statement of RDT is by Pfeffer and Salancik (1978). Central to their interpretation is the idea that the control over the allocation of resources is an important source of power in organisations. Pfeffer and Salancik (1978, p. 39) state: "…the behaviors of organizations will respond to demand made by external organizations upon whose resources they are heavily dependent." This simple idea makes intuitive sense in competitive markets, where a group of firms are producing a similar product using similar inputs and competing for the same
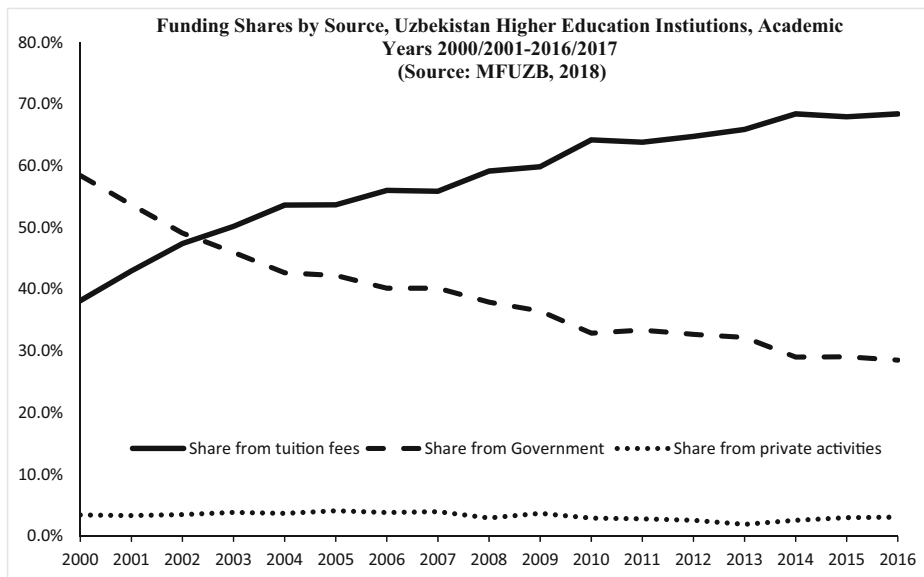
Funding Shares by Source, Uzbekistan Higher Education Instiutions, Academic Years 2000/2001-2016/2017 (Source: MFUZB, 2018)

Fig. 9 Funding shares by source, Uzbekistan higher education institutions, academic years 2000/2001 to 2016/ 2017 (source: Ministry of Finance of the Republic of Uzbekistan 2018)

customers. In such markets, a firm's ability to obtain, change and exploit resources is fundamental to their success, if not their survival, in the market.

Organisations depend on resources, and some (if not all) of these resources are produced by other organisations. However, resources produced by one organisation are only of value if they are used by another organisation. This leads to a dependency between organisations, with the access to and control of resources becoming the basis of power. It is the distribution of power across organisations that is fundamental in explaining their behaviour. Despite its simplicity, RDT has stood the test of time well and remains a very influential theoretical framework in organisational behaviour, industrial economics, supply chain management, managerial economics and other business-related subjects (see Hillman et al. 2009).

One of the first studies that analyses the resource dependence of one organisation on another is by Provan et al. (1980). They investigate the relationship between non-profit organisations and their umbrella organisations. Their main conclusion, which supports RDT, is that: "…power over an individual organization is larger the more resources it controls" (p. 18). Since this seminal empirical work, there have been a large number of studies that have attempted to understand the behaviour of a wide range of organisations testing hypotheses derived from RDT. Studies that represent this diversity well include: Casciaro and Piskorski (2005), Davis and Cobb (2010), Freel (2000), Frooman (1999), Hillman et al. (2007), Ozcan and Eisenhardt (2009) and Saidel (1991). There is also a small number of studies that have used RDT to understand the behaviour of institutions in the higher education sector. Since the focus of this paper is the higher education sector in Uzbekistan, the remainder of this section focuses on these studies.

We believe that the first empirical application of RDT-derived hypotheses to the higher education sector is by Tolbert (1985). She constructed a sample of 167 public and 114 private universities in the United States. She finds that universities with a higher share of income from public sources have a larger number of offices that manage public funding. Likewise she found

that universities with a higher share of income from private sources have a large number of offices that manage private funding. Both findings are supportive of RDT. Her analysis suggests that the more dependent a university becomes on a specific source of funding, the larger the share of resources devoted to obtaining such funding and the lower the share devoted to other activities.

In our view, the most comprehensive application of RDT to the higher education sector is by Fowles (2013). He examines the relationship between a university's dependence on tuition fee income and their expenditure on teaching (and teaching-related activities). He constructed an 11-year panel of 419 "4-year" public universities in the United States. The main outcome variable of interest is "teaching expenditure as share of total expenditure". A key explanatory variable is the "share of total operating revenues derived from net tuition". The net tuition revenue is the total income received from tuition fees paid minus any scholarships, stipends or "fee deals", which effectively reduce the fees paid by students. RDT hypothesises a "strong" positive association between these two variables. Regression analysis confirms such an association, even after other variables thought to impact on the outcome variable are "held constant".

One issue left unexplored, but of considerable policy importance, concerns whether increased expenditure on teaching actually has a positive impact on student performance, as measured by, for example, grades or drop-out rates. Coupet (2013) addressed this issue more directly, by employing a statistical approach similar to Fowles (2013). A notable finding is that an increasing share of administrative expenditure in the total expenditure is associated with higher drop-out rates in Afro-American universities in the United States. He argues that there is a need to reduce the administrative costs to reduce drop-out rates of students studying at these universities.

Pilbeam (2012) tests features of RDT by considering the roles of "pro-vice-chancellors" (PVCs) in the United Kingdom higher education sector. Their approach is considerably different to the studies discussed above. A PVC is similar to a "vice-president" in the American higher education system. A web-based survey was used to collect information from 16 universities. In each of these universities, the questionnaire was completed by the PVC responsible for teaching and the PVC responsible for research. The main findings show that PVCs responsible for research had formed cross-institution communication networks to collectively lobby for public research funding controlled by the Funding Council. The PVCs responsible for teaching had not formed such networks, the likely reason being that, unlike research funding, there is no similar "pot" of teaching funding available to lobby or compete for.

It is difficult to precisely test specific hypotheses derived from RDT. With respect to higher education, the theory implies that, if the share of funding from one source of revenue increases in its relative importance, then the share of expenditure relevant to this source should also increase. With respect to the Uzbek higher education system, there has been a large increase in the last 15 years in the share of revenue from tuition fees. Since it is believed that tuition fees are mainly a payment for teaching services, if RDT is an accurate explanation, then the share of expenditure spent on teaching should also have increased in this period.

Methodology

Data

In order to explore the relevance of RDT, a panel dataset of individual Uzbek higher education institutions was constructed covering the 14-year period 2000–2013. The main data sources

were the annual financial reports of each higher education institution provided by the MHSSE. Most of this information is not in the public domain. It is an unbalanced panel because, in the study period, "new" institutions were created by opening, reclassifying, renaming and merging institutions. In total, 62 institutions generated 857 institutions-year observations, with an average of 13.8 observations per institution.

Regression model

In an attempt to address hypotheses consistent with RDT, variants of the following two-way fixed-effects regression model are estimated:

$$ShareTeach_{it} = \alpha + \beta ShareFee_{it} + \gamma Controls_{it} + \theta_i + \theta_t + \varepsilon_{it} \qquad (1)$$

where the subscript i ($i = 1, 2,...,. 62$) denotes institution and the subscript t denotes year ($2000 = 1, 2001 = 2,..., 2013 = 14$). *ShareTeach* is the share of the total expenditure of institution i in year t spent on teaching. *ShareFee* is the share of the total revenue of institution i in year t from tuition fees. *Controls* is a set of variables for institution i in year t that capture factors thought to impact on expenditure decisions in addition to *ShareFee* (discussed below). θ_i is an institution-specific fixed effect, which is included to capture unobserved factors specific to institutions that persistently impact on the expenditure decisions and do not change over time (i.e. unmeasured factors that affect individual institutions that do not change over time). θ_t is a time-specific fixed effect, which is included to capture unobserved factors that persistently impact on the expenditure decisions of all institutions over time (i.e. unmeasured factors that affect all institutions in the same way through time). ε_{it} is a random error term. α, β and γ are the parameters to be estimated. The inclusion of both institution and time fixed effects is a way of attempting to control for unmeasured factors that should be included as variables in the regression. Although fixed effects do not provide any information about what these factors are, their inclusion does allow one to interpret the effects of the variables included in the equation with greater confidence (see Baltagi 2014).

If RDT is relevant, then you would expect $\beta > 0$. This would imply that the higher the share of revenue from tuition fees, the higher the share of expenditure spent on teaching, after other factors are held constant. In addition, since both *ShareTeach* and *ShareFee* are proportions, β has a straightforward interpretation. To illustrate, if $\beta = 1$, then a one percentage point increase in *ShareFee* is associated with a one percentage point increase in *ShareTeach*. If $\beta > 1$, then a one percentage point increase in *ShareFee* is associated with more than a one percentage point increase in *ShareTeach*. If $\beta < 1$, then a one percentage point increase in *ShareFee* is associated with less than a one percentage point increase in *ShareTeach*. Therefore, β is effectively an "elasticity", which is the standard way in which economists summarise the strength of the association between two variables. The larger the value of β, the more responsive changes in the share of resources devoted to teaching are to changes in the share of revenue from tuition fees.

Variables

The dependent variable in the regression model is the share of total expenditure spent on teaching (*ShareTeach*). This variable is the amount of money spent on instruction, student services, as well as the spending on maintaining of the library and classroom facilities, as a

proportion of the total expenditure. The largest components are salaries paid to academic and administrative staff, who do the teaching and carry out teaching-related administration. Unfortunately, we do not have information about how academic staff split their time between research, teaching and other activities. Therefore, we cannot be more detailed in the way "education expenditure" is measured. However, since all staff do not spend all their time teaching, *ShareTeach* contains a certain amount of measurement error. Another important component of this variable is student stipends that all students receive based on their previous semester's grades.

The main independent variable of interest is the share of the total revenue from tuition fees (*ShareFee*). This variable is the tuition fee share of the total operating revenue for public and private funding sources. Public funding is mainly from the block grant that each institution receives from the Government. Private income, other than tuition fees, includes rental income, campus services (such as catering), consultancy, contract research, short courses, training programmes and the sale of other educational products, such as books and teaching materials.

The regression also includes four additional control variables. The first is institutional size (*NumStud*). Institutional size is a student-based measure, equal to the number of full-time equivalent students enrolled at each institute in each year. The majority of students at Uzbek higher education institutions are full-time students. In the construction of this variable, part-time students were allocated a weight of one-half (0.5) of full-time students.

The second control variable is the average tuition fee charged at each institution in each time period (*AveFee*), corrected for inflation. As discussed above, tuition fees vary across institutions and by subject. It is argued that tuition fees are, in part, a signal of institutional quality. Institutions that charge higher fees are often perceived to be higher quality institutions. For example, it is believed that individuals who attend such institutions received a better education. In turn, upon graduation, these individuals are likely to have more success in the labour market.

The third control variable takes into consideration that there are differences in tuition fees between undergraduate and postgraduate study, with tuition fees being higher at most institutions for postgraduate study (see Table 3). In an attempt to control for this difference, a variable was constructed for each institution for each year, consisting of the average duration (in weeks) of postgraduate programmes (*LengthPG*). Albrecht and Ziderman (1995), Koshal and Koshal (1999) and Barr (2009), amongst others, have argued that the higher cost of postgraduate education can be partially offset by economies of scope in postgraduate and undergraduate education.

The fourth and final control variable is the number of staff at each institution in each year (*NumStaff*). This includes both academic and administrative staff. Since staff salaries is the largest item of expenditure for most institutions, you would expect expenditure decisions to be affected by staff numbers. It is important to note that, since student numbers (*NumStud*) is also included as a variable in the regression, the empirical model is implicitly controlling for differences in the "staff:student ratio". Therefore, if institutions decide to increase the number of staff in order to increase the staff:student ratio, then those institutions with a larger number of staff are more likely to have higher teaching-related expenditure.

Endogeneity

The empirical model presented above explicitly assumes that the direction of causation is from the share of total revenue from tuition fees to the share of total expenditure spent on teaching.

Table 3 Summary statistics of regression variables

Variable	Observations	Mean	Std. dev.	Min.	Max.
ShareTeach	857	0.80	0.094	0.16	0.98
ShareFee	857	0.541	0.161	0.06	0.95
NumStud	857	3231	2424	60	12,648
NumStaff	857	783	507	34	2950
AveFee (000)	857	2265	1589	393	6050
LengthPG	857	63	26	0	102
DevFund (millions)	857	1995	2420	0	13,209
AdAdmin	857	0.891	–	0	1

That is, changes in the share of total revenue from tuition fees <u>cause</u> changes in the share of total expenditure spent on teaching (i.e. $\Delta ShareFee \rightarrow \Delta ShareTeach$). This is the causal direction implied by RDT. However, the reverse casual direction is also plausible. For example, an institution may increase its share of expenditure devoted to teaching in order to send a signal to potential students that they provide high-quality teaching. If they are successful, then the institution could charge higher tuition fees, resulting in a large share of tuition fees in the total revenue. The idea of potential two-way causation raises the possibility that the share of total revenue from tuition fees is "endogenous" (see Bowden and Turkington 2008). Therefore, in our empirical model, the variable *ShareFee* is potentially endogenous. If this is the case, then not only will the estimated parameter of *ShareFee* (β) be biassed, but likely also the estimated parameters (γ) of the other included variables. It is important to stress that the inclusion of fixed effects is not a solution to the endogeneity problem.

In an attempt to address the potential endogeneity of the share of tuition fees in the total revenue, an "instrumental variables" (IV) estimation approach is adopted (see Bowden and Turkington 2008). In order apply IV estimation, at least one variable—the so-called "instrumental variable"—that generates exogenous variation in *ShareFee* is needed. In a strict sense, what is needed is a variable Z that is correlated with *ShareFee* and not correlated with *ShareTeach*. If this condition is met, then the relationship between *ShareFee* and *ShareTeach* can be purged of potential endogeneity, with the resulting estimated parameter of *ShareFee* being the causal effect of *ShareFee* on *ShareTeach*. From a statistical point of view, the technique is a form of two-stage least squares regression. From a practical point of view, the IV estimation requires replacing *ShareFee* in Eq. (1) with its predicted value based on a regression that includes all the other variables (*Controls*) and at least one addition variable (i.e. the "instrument") that is not included in Eq. (1). As discussed below, there are formal statistical tests that provide information on the validity of the underlying assumptions of this estimation technique.

Two IVs are used. The first, *DevFund* is related to the so-called "development fund" (CMUZB 1997). Starting in 1997 (i.e. before the time period used in our analysis), a policy was introduced where, at the beginning of each academic year, each higher education institution is required to deposit 5% of their previous year's revenue to a central fund controlled by MHSSE. In most years, most institutions bid for money on a competitive basis from this fund, with a wide variation in the amounts awarded. The second instrumental variable, *AdAllow* is related to the "additional admission allowance". This is essentially money received by institutions for enrolling students above their original quota at the request of the MHSSE. We do not know how much each institution received. All we know is whether some money was received. Therefore, *AdAdim* is a dummy variable coded "1" if the institution
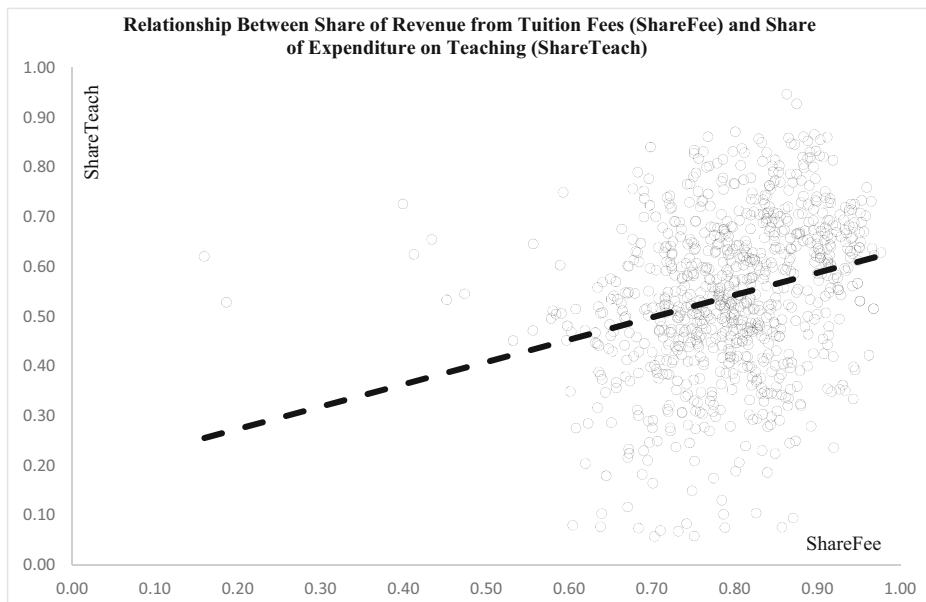
Fig. 10 Relationship between share of revenue from tuition fees (*ShareFee*) and share of expenditure on teaching (*ShareTeach*)

received some money and "0" if they did not. This money is in addition to the tuition fees paid by these above-quota students.

It is clear that receiving money from these two sources increases the total revenue of an institution in the academic year it is received. However, it is not clear whether it increases expenditure on teaching, since expenditure decisions are made in the previous academic year for the next academic year (e.g. the hiring of new staff). Therefore, we expect that, a priori, both should be good instruments. In order to explore the validity of this assumption further, two Durbin–Wu–Hausman test statistics were calculated. Both are tests for the exogeneity of *ShareFee* based on *DevFund* and *AdAdmin* as instruments. These tests are discussed in detail by Baltagi (2014) and Bowden and Turkington (2008). The first is the Durbin–Wu–Hausman χ^2 statistic. The value of this test statistic is 8.4, which is highly statistically significant at a *p*-value of 0.004. The second is the Durbin–Wu–Hausman *F* statistic. The value of this test statistic is 7.7, which is highly statistically significant at a *p*-value of 0.006. Both versions of the test clearly reject the hypothesis that *ShareFee* is exogenous. These tests indicate that ordinary least squares regression is not the appropriate estimator for Eq. (1) and IVs should be used.

Results

Table 3 reports the means, standard deviations and minimum/maximum values of all the variables used in the statistical analysis. The values are for all 62 institutions during the period 2000–2013. About 80% of expenditure is on teaching. Around 55% of total revenue comes from tuition fees. The average institutional size is around 3200 full-time equivalent students. The average number of staff per institution is 783. The average tuition fees paid is over 2 million Uzbekistani so m per year. The average length of a postgraduate course is 63 weeks.

Table 4 Regression estimates: share of total expenditure spent on teaching (*ShareTeach*)

Estimator	(1) OLS	(2) Fixed effects	(3) IV	(4) Fixed effects IV
ShareFee	0.010 [0.4]	0.108*** [3.3]	0.375* [1.7]	0.343** [2.3]
NumStud (000)	0.007** [3.0]	− 0.010*** [3.0]	− 0.004 [0.6]	− 0.012*** [3.0]
NumStaff	− 0.00001 [1.2]	0.00007*** [3.4]	0.00004 [0.5]	0.0009*** [3.0]
AveFee (000)	0.00002*** [8.7]	− 0.00003** [2.5]	0.00005 [0.3]	− 0.00001 [0.6]
LengthPG	0.0003** [2.3]	0.0004* [1.9]	− 0.0002 [0.6]	0.0003 [1.7]
Constant	0.717*** [61.8]	− 0.767*** [17.9]	0.606*** [8.5]	0.589*** [2.9]
R^2 (%)	16.0	55.9	16.3	55.4
Institution fixed effects?	No	Yes	No	Yes
Time fixed effects?	No	Yes	No	Yes
No. observations	857	857	857	857
No. of institutions	62	62	62	62

The absolute value of the ratio of the parameter to its standard error is given in parentheses

*Significant at the 10% level

**Significant at the 5% level

***Significant at the 1% level

Eighty-nine percent of institutions received "additional admission allowance" funding. The average amount of funding per institution received for the "development fund" was nearly 2 billion Uzbekistani so m. The standard deviation and minimum/maximum values shown in Table 5 suggest that there is considerable variation in all these variables.

Figure 10 is a plot of the relationship between the share of revenue from tuition fees (*ShareFee*) and the share of expenditure on teaching (*ShareTeach*). Given that there are 857 points observed in this figure, there is not a large number of outliers. In addition, the majority of the observations are bunched quite tightly to the predicted relationship shown by the dashed line. The zero-order correlation is +0.26, which is statistically significant at below the 1% level (*p*-value <0.01). This positive and significant statistical correlation is consistent with RDT in

Table 5 Additional regression estimates: share of total expenditure on teaching (*ShareTeach*)

Estimator	(1) OLS	(2) Fixed effects
ShareFee	0.034 [0.7]	0.153*** [2.9]
NumStud (000)	0.009*** [3.3]	− 0.006* [1.7]
NumStaff	− 0.00004 [1.4]	0.0005*** [2.6]
AveFee (000)	0.00003*** [5.0]	0.0003 [5.3]
LengthPG	0.0003** [2.3]	0.0003 [0.9]
ShareFee × *Year*	− 0.002 [0.4]	− 0.003 [0.7]
Year	− 0.003 [1.0]	− 0.004 [1.4]
Constant	0.713*** [31.3]	–
R^2 (%)	16.3	51.5
Institution fixed effects?	No	Yes
Time fixed effects?	No	No
No. of observations	857	857
No. of institutions	62	62

The absolute value of the ratio of the parameter to its standard error is given in parentheses

*Significant at the 10% level

**Significant at the 5% level

***Significant at the 1% level

the sense that a larger share of revenue from tuition fees is associated with a larger share of expenditure being spent on teaching. While this is encouraging, there are other factors that affect expenditure decisions, and these need to be "held constant" in order to more confidently comment on the relative strength of this relationship.

It is important to note that the minimum and maximum values for *ShareTeach* and *ShareFee* suggest that there are some institutions in the dataset are specialist institutions, in the sense that they concentrate on research or teaching. The range in *ShareTeach* is wide, from 16% to 98%, while the standard deviation is only 9.4%. Likewise, the range in *ShareFee* is even wider, from 6% to 95%, with a larger standard of 16.1%. Such institutions may be outliers, which could bias coefficient estimates. However, this is less likely to be the case when fixed-effects regression is used. An outlier in our analysis is, by definition, an institution that has a large residual, i.e. the difference between its actual values and the value "predicted" by the regression is large. Institutions that are outliers will have a large fixed effect. In fixed effects, outliers are, in a sense, "controlled for" and coefficient estimates should not be biassed.

Table 4 reports the regression estimates. Column 1 shows the ordinary least squares (OLS) estimates. The parameter of *ShareFee* is positive but very small in magnitude and is not statistically significant at the 10% level. Column 2 shows the fixed-effects estimates, where both institution-specific and time-specific fixed effects are added. In this specification, the parameter of *ShareFee* is positive. It is also about ten times larger than in the OLS specification and statistically significant at the 1% level. Column 3 shows the instrumental variable estimates. In this specification, the parameter *ShareFee* is almost four times larger than in the fixed-effects specification. However, it is only statistically significant at the 10% level. Finally, column 4 shows the fixed-effects instrumental variable estimates. In this specification, the parameter *ShareFee* is very similar in magnitude to the estimate from the IV specification (column 3), but is statistically significant at the 5% level.

Before turning to a discussion of the other variables included in the models, it is important to note that the inclusion of fixed effects leads to a large increase in the proportion explained. The R^2 value for the OLS specification is 16.0%. Once institution-specific and time-specific fixed effects are added, the R^2 value increases to 55.9%. Likewise, when fixed effects are added to the IVs specification, the R^2 value increases from 16.3% to 55.4%. This suggests that there are key factors that impact on the share of total expenditure spent on teaching not included in the specification. While these fixed effects "stand in" for these omitted variables, the estimator does not provide information about what these missing variables are. However, future research will need to seriously consider including other factors beyond those included in our specification.

The Durbin–Wu–Hausman tests reported above suggest that *ShareFee* is endogenous and that instrumental variable estimates should be used to estimate the model. Given that it is also important to include institution-specific and time-specific fixed effects, our preferred specification is what is reported in column 4 of Table 4. Therefore, we have more confidence in the parameters of the control variables based on this specification compared to the other specifications. In this specification, three of the four included control variables are statistically significant at the 1% level. However, the magnitudes of the effects are very small. The parameter of the number of students variable, *NumStud*, is negative. The parameter of the number of staff variable, *NumStaff*, is positive. The parameter of the average tuition fee paid, *AveFee*, is positive. Finally, the parameter of the average length of postgraduate courses, *LengthPG*, is positive but not statistically significant. While there are various interpretations of the effects, the small estimated effects suggest that they are not important. For example, an additional 1000 students is only associated with a 0.012 reduction in the share of expenditure spent on teaching.

The key finding is the parameter of *ShareFee*. The point estimate of +0.343 suggests that a 10% increase in the share of revenue from tuition fees is associated with a 3.4% increase in the share of expenditure spent on teaching. This implies that a 10% increase in the share of revenue from tuition fees is associated with a 6.6% increase in the share of expenditure spent on other activities. In other words, revenue for tuition fees is heavily subsidising these other activities. It is not clear if this is sustainable.

One problem with the point estimate of 0.343 is that it is for the whole time period of 14 years. It is clear that fixed-effects estimation with panel data is a useful estimator since it uses both cross-sectional and temporal variance. We believe that this is preferred to estimators that are based only on cross-sectional variance or temporal variance. In order to explore if the parameter of *ShareFee* varies over time, two additional specifications are estimated. The estimates are shown in Table 5. In both specifications, an interaction between the share of revenue from tuition fees, *ShareFee*, and a linear time trend, *Year* (2000 = 0, 2001 = 1,…, 2013 = 13), is added. Column 1 shows the OLS estimates and column 2 shows the fixed-effects estimates. Strictly speaking, in both specifications, the interaction is not statistically significant. However, the parameter of interaction is negative. Ignoring statistical significance, and taking the point values as given, the parameter value for the year 2000 is 0.153 and that for the year 2013 is 0.111. In other words, the magnitude of the relationship is considerably smaller at the end of the period compared to at the beginning of the period. However, it is not possible to perform a similar calculation based on a specification that takes into consideration the potential endogeneity of *ShareFee*. If *ShareFee* is potentially endogenous, then so is *ShareFee × Year*. In order to explore the potential endogeneity of both, more instruments are required than what we have in our dataset. Nonetheless, despite the very speculative nature of this finding, future research will need to examine carefully if the relationship between *ShareFee* and *ShareTeach* is time-varying, with it becoming less "elastic" through time.

Conclusions

This paper used resource dependence theory (RDT) to guide an empirical analysis concerned with how the expenditure decisions of higher education institutions are affected when they become more reliant on tuition fees. This analysis focussed on the experience of Uzbekistan. We believe that Uzbekistan makes an interesting case study since it has had to restructure a centrally planned higher education system concurrently with the rolling out of market economy. In addition, the Uzbek higher education system had to adapt, like many other countries, to a sharp reduction in public funding related to the recent global economic recession. The main finding is that there is a positive and statistically significant relationship between the share of revenue from tuition fees and the share of expenditure spent on teaching, even after other factors are held constant. Over the period 2001–2013, the Uzbek higher education system has become much more dependent on tuition fees as a source of revenue. This trend is similar to what, for example, Fowles (2013), Slaughter and Leslie (1997) and Tolbert (1985) report for the United States. In this sense, the financial decisions made by Uzbek higher education institutions are similar to those made by public higher education institutions in the United States. This convergences is quite remarkable when it is remembered that, at independence in 1991, Uzbekistan inherited a system riddled with the inefficiencies and dysfunctionalities associated with the collapse of central planning and the disintegration of the Soviet Union.

To a certain extent, it is not surprising that, when students pay higher tuition fees, higher education institutions spend more on activities related to teaching. However, the analysis carried out in this paper suggests that this outcome in Uzbekistan is far from a "one-to-one match". Our best estimate of the relationship between the share of revenue from tuition fees and the share of expenditure spent on teaching is +0.34. This is considerably below the value of 1, which suggests that the majority share of tuition fee revenue is spent on non-teaching activities, such as research and administration. It is clear that Uzbek students (and likely their families) are heavily subsidising activities at higher education institutions that have little (if any) direct impact on the quality of the education experience they receive. This raises a serious value-for-money issue that cannot be ignored indefinitely by a government that periodically needs to democratically elected. Perhaps more importantly, given that the average tuition fee paid by Uzbek students is not drastically lower than the average earnings of the Uzbek population, higher education is very expensive. Given average earnings, there seems to be little scope for making it even more expensive in the future, without sizeable reductions in participation rates and considerable political backlash.

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