The Effect of Market Integration on Public Higher Education

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Abstract

This paper assesses the relationship between prices and market integration in public higher education. The analysis focuses on the effect of Tuition Reciprocity Agreements (TRAs) on in-state resident tuition and fees of 4-year public institutions. Those agreements, which lower tuition for out-of-state students, can be understood as market integration devices. Market integration through TRAs is analyzed under the framework of an in-state subsidized market where demand has now access to a bigger choice set of partially subsidized institutions, changing decisions towards higher expenditure and quality. Using longitudinal data, I present strong evidence that the market integration of TRAs sparked an increase in 4-year public institution in-state prices. The result holds for both selective and non-selective institutions. In the same line, the TRAs have also increased the faculty/student ratio among selective institutions. These findings reaffirm the idea that part of the increase of prices in higher education is explained by market integration, as suggested by Hoxby (1997).

Keywords: Higher education, market integration, reciprocity agreements, tuition levels.

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1 Introduction

One of the main concerns in higher education has been the evolution of tuition and fees, which have increased continuously since the 1980s (Ehrenberg, 2000). Figure 1 shows the evolution of public institutions' published and net tuition and fees (for in-state students) between the academic years 1990-91 and 2012-13. We can see that the published prices increased monotonically, more than doubling themselves over this period. Meanwhile, the net price (published tuition and fees minus grants) has also increased, but to a lower extent.

[Figure 1 about here]

Part of the reason net prices have not increased as rapidly as published prices is due to the increase in federal and state grants. As Table 1 shows, the federal and state grant aid has almost doubled in the last decade for undergraduate studies. This suggests that public higher education funding per student has increased simultaneously with the increasing sticker prices.[1] In short, the increase in published prices has increased pressure for families (higher net prices) and to the public budget (demand for more generous grants).

[Table 1 about here]

In this setting, it is important to determine what factors are behind the increase in the published tuition and fees. As the problem has become evident, different hypotheses have emerged. One popular explanation is the "Bennett Hypothesis",[2] which suggests that an increase in grants does not generate lower prices; instead, colleges increase prices to capture part of the new resources available in grants. Therefore, the increase in grants (resources) would be the reason behind the increase in prices. A second popular hypothesis is the "Baumol cost-disease Hypothesis", suggested by Baumol (1967). In his classic article, William Baumol suggests that sectors that are labor intensive and do not have space for technological advance in their production processes will increase their cost of production, since they need to prevent workers from leaving to the technologically improved sectors. Higher education would fit in this setting, as Baumol (1967) stated: "[...] (the model) suggests that, as productivity in the remainder of the economy continues to increase, costs of running the education organizations will mount correspondingly, so that whatever the magnitude of the funds they need today, it can be reasonably certain that they will require more tomorrow, and even more on the day after that." Therefore, his hypothesis is that the productive nature of higher education explains the rise in prices.

However, the hypothesis that this paper will try to test, and that is not mutually exclusive with the "Bennett" and "Baumol" hypotheses, is the one maintained by Hoxby (1997), who suggests that market integration has changed the market structure of higher education, so "[...] tuition is rising

[1] Despite the increase in real prices, the level of enrollment has also thrived because of increasing returns to education (Heckman and Vytlacil, 2001). This also means that the total higher education funding has increased as a consequence of more people studying.

[2] The name is due to William Bennett, former Secretary of Education.

because the open market has ignited quality competition." The idea is that the US market for higher education was a geographically separated market. However, it has become more integrated over time, which would have augmented quality competition and increased prices. Therefore, here it is the quality competition nature of higher education markets that explains rising prices. In particular, the idea is that if price elasticities are relatively lower than the quality elasticities, then institutions might rather increase prices and quality, than decreasing prices (as a typical economic model would suggest). This would be referred here on as the "Ignition Hypothesis".

In this paper, I will test whether the "Ignition Hypothesis" is correct. In particular, I will check market integration through Tuition Reciprocity Agreements (TRAs). TRAs are treaties between states agreeing that institutions will charge a lower tuition (by at least $4,000 dollars) to out-of-state students from within the agreement compact. If we think of market integration through TRAs as equivalent to the introduction of a larger choice set with partial in-kind subsidies, then the Peltzman (1973) model of in-kind subsidies can help us to understand why we should expect an increase in price and quality among the public higher education institutions. From this, we can test the hypothesis that increased competition (larger choice set) leads to increasing prices. Therefore, analysing the effects of TRAs can help us to understand current market integration phenomenons in higher education. In particular, the increase in federal student grants and the introduction of student loans might have similar effects: an increase in the choice set for students might increase competition and, as a consequence, prices.[3]

In the empirical analysis, I take advantage of the long yearly panel data of published tuition and fees at the institution level to test the Hoxby (1997) hypothesis. In particular, I check whether market integration through TRAs led to an increase in prices. Next, I look at the effects that TRAs have on selective and non-selective institutions. If the ignition hypothesis is correct, then we would expect that higher-quality institutions increased their prices more than lower-quality institutions, which would be the case if market integration increases differentiation between institutions. As a way to look whether the increase in prices has implied higher quality, as suggested by Peltzman (1973), I also look at the effects of TRAs on the faculty/student ratio of institutions.

Using a difference-in-differences and event study methodologies, I find that TRA 4-year public institutions increased in-state published prices by 10% more than non-TRA 4-year public institutions. Furthermore, price increases appear to be slightly higher in selective institutions, which also increase their faculty/student ratio. The results seem credible and indicate that the TRAs acted as a spark: increases in prices happen just after institutions were affected by a TRA. Therefore, it seems that across state competition increased in-state prices, which might have negative consequences on the access to higher education and on the pressure on public finances to provide more generous student aid.

In the next section, I review the literature about higher education market integration. In section 3, I describe the TRAs. Next, section 4 unfolds the analytical framework using the Peltzman (1973) model. The empirical models are explained in section 5. Section 6 gives details about the data used

[3] Grants and loans have increased competition across states (Hoxby, 1997) and produced the entrance of new for-profit institutions (Deming et al., 2011).

in the analysis, while the results are in section 7. In section 8, I discuss the results and give economic meaning to them. Section 9 concludes.

2 Literature Review

The issue of tuition levels and evolution in higher education has been the subject of study of labor and public finance economists. The two main studies in this area are Hoxby (1997) and Rizzo and Ehrenberg (2003), both focusing on 4-year higher education institutions. Hoxby (1997) tries to explain how the structure of higher education markets has changed through time and how that could explain the tuition rising phenomenon. In particular, her hypothesis is that market integration would increase quality competition, generating increases in tuition.

For the empirical analysis, Hoxby (1997) generates a Herfindahl-Hirschman Index (HHI) for each institution, with the concentration of students' enrollment across states. As we would expect a positive correlation between the HHI and the prestige of the institutions, Hoxby (1997) uses an instrumental variables fixed effects model,[4] to check whether market integration has an effect on prices, grants, enrollment and quality. The estimation results suggest a negative coefficient for the HHI on prices (students coming from different states mean higher prices), a negative coefficient for the interaction of HHI with high selectivity institutions and a positive coefficient of the interaction with low selectivity institutions. Therefore, Hoxby (1997) finds some empirical support for her market integration hypothesis.

The second important paper in the area is Rizzo and Ehrenberg (2003). They focus on the strategic enrollment and tuition decisions that flagship universities undertake as a response to lower state appropriations. Given that institutions could have more freedom to set out-of-state tuition levels, that variable would be an alternative to deal with lower state appropriations. In order to explore those possibilities, the authors estimate a reduced form equation on tuition for in-state students, tuition for out-of-state students, share of non-resident enrollment and grant aid. Rizzo and Ehrenberg (2003) results indicate that flagship institutions do not enroll out-of-state students in order to collect more revenue. Instead, they offer enrollment and grant aid to them as a form of raising the quality of the institution.

Another area where border costs, as those set up by a in-state and out-of-state pricing structure, are relevant is trade economics. For example, Hunt and Mueller (2004) study the effects of border costs in the migration decision between Canada and the US. Using an indirect utility model, the authors find that there are important border costs. However, more interesting to us is the research that looks at intranational border costs. Wolf (2000) studies the transaction patterns of commodities and finds a home-state bias, suggesting the existence of border costs related to interstate trade. Such result, later estimated to be lower by Millimet and Osang (2007), is surprising given the fact that in

[4]The instrumental variables used are the price of interstate flights, the price of a long distance calls, the standardized admission test adoption, the number of National Merit Scholarships in the College's Region and an indicator of a TRA in the state. Hoxby (1997) uses a panel data with years 1940, 1950, 1960, 1966, 1971, 1976, 1981, 1986 and 1991.

the US there are no intranational tariff barriers.

Finally, it is worth highlighting that there has not been a study that looks exclusively to the educational market changes that TRAs implied or that takes advantage of event study methodologies. In our case, the combination of a fall in border costs with yearly panel data allows us to test directly whether market integration ignites a rise in tuition.[5]

3 The Tuition Reciprocity Agreements

In the US, the existence of different states generates a segmentation of the higher education market. First, students already have large transportation costs to change their residence in order to attend an out-of-state higher education institution. Second, differentiation in the tuition across in-state and out-of-state students introduce a border cost that increases the cost of attending an out-of-state institution. For example, in the academic year 2010-11 the public 4-year institutions had on average a sticker price (tuition and fees) for in-state students of $6,721 dollars, while the sticker price for out-of-state students was $15,648 dollars.[6] Therefore, we can see that prices for out-of-state students are more than to 2 times the prices for in-state students.

In this context, Tuition Reciprocity Agreements (TRAs) are treaties between states agreeing that, under some conditions, institutions will charge a lower tuition to out-of-state students from within the agreement compact. Therefore, TRAs decrease the border costs related to studying out of state. As it is cheaper to study out of state, out-of-state institutions become closer substitutes to in-state institutions. In consequence, this is similar to a market integration process where border tariffs are lowered.

The main TRAs have taken place under different higher education compacts (the compacts are older than the TRAs), which perform different cooperation policies and actions across states. Some time after the creation of each compact, member states agreed on creating TRAs. There were two main reasons for the creation of TRAs.[7] One reason was to provide resident students with a broader access to opportunities, by lowering out-of-state tuition costs. The second reason was to avoid the duplication of certain departments and programs. In particular, thar idea focused on professional programs, but also applied to "uncommon baccalaureate programs in allied health fields" (SREB, 1979).[8] However, time would expand the TRAs to include undergraduates in general.[9]

The TRAs always include public institutions,[10] might include some voluntary private institutions[11]

[5] As I explained before, Hoxby (1997) has a panel data with observations in every 5-10 years, which does not allow her to check for short term changes using event study methodologies. The reason for that is that the students' state-of-origin data is not available every year.

[6] Source IPEDS database.

[7] For more details, see WICHE (2012, 2005); MOHE (2013); Abbott (2004); MHEC (2011); SREB (1979).

[8] The focus on avoiding the duplication in the health field, is related to the large investments required in that area.

[9] I focus my analysis on undergraduate TRAs.

[10] An important exception to the rule is the University of California System, which is not included. However, the California State University system is included.

[11] However, private institutions could always just charge the same tuition for in-state and out-of-state students, so it should not matter whether they subscribe a TRA or not.

and, in some cases, include a certain number of "spots" for TRA students. The four most important compacts are the following:

- **WICHE:** The Western Interstate Commission for Higher Education consists of Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington and Wyoming. In 1953, WICHE created the Professional Student Exchange Program (PESP) to include reciprocity in certain health professions. Given the success of PESP, the possibility of creating a similar program for undergraduates was always under analysis. Finally, in 1988 WICHE created the program Western Undergraduate Exchange (WUE), which allows residents of the compact states to access a reduced tuition of 150 percent of the regular resident tuition. The majority of the participant states got into the TRA in 1988. In the fall 2011, WUE helped 29,077 students.

- **MHEC:** The Midwestern Higher Education Compact consists of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota and Wisconsin. The compact established the Midwestern Student Exchange Program (MSEP), which imposes 150 percent of the resident tuition as the maximum tuition that public institutions can charge to a student resident in a compact state. The majority of the states subscribed the agreement in the years 1990 and 1991.[12] In the academic year 2010-2011, the MSEP covered 3,276 students.

- **SREB:** The Southern Regional Education Board consists of Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia and West Virginia. Around 1976, the compact created the Academic Common Market (ACM) for some specific graduate programs. In 1981, ACM expanded towards undergraduate students.[13] Presently, it gives compact resident students access to 1,900 undergraduate and graduate programs, not available in the home state, at in-state tuition rates.

- **NEBHE:** The New England Board of Higher Education includes Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont. That board created the Tuition Break Program in 1957, which enables out-of-state students inside the compact to enroll a major not available at their home state, at a tuition that is at most 175 percent of the in-state tuition. Currently, more than 700 undergraduate and graduate programs offer the Tuition Break discount, which has benefited 9,000 students in the year 2011-2012.

As explained in the descriptions above, the TRAs have some restrictions. For example, in the case of SREB and NEBHE not all programs are available. To get an idea of how much is the discount in each compact, in Figure 2 we can observe the tuition that out-of-state students would have to pay

[12] MHEC members Illinois, Iowa, South Dakota and Ohio do not participate in MSEP.

[13] At that time, Delaware, Oklahoma and North Carolina did not integrate the ACM. Currently, Florida, North Carolina and Texas only participate with programs at the graduate level.

with and without the different TRAs, under the assumption that the institutions discount prices the least possible.[14] From the data, it comes to evidence that the discounts can be very large.

[Figure 2 about here]

It is worth noticing that there are also other minor TRAs. For example, Minnesota has bilateral TRAs with Wisconsin (since 1968), North Dakota (since 1975) and South Dakota (since 1978). Also, Kentucky and Tennessee have a TRA since 2000. Those agreements are usually undertaken within a compact and imply an increase in the spots for students and lower tuitions than the compact TRA.

Another type of TRAs are the ones that only apply to a certain study area. For example, the WWAMI (Washington, Wyoming, Alaska, Montana and Idaho) agreement only covers Medical Schools. Finally, some states have created TRAs with the border counties. In these agreements, only students near the border will have access to lower tuition rates. In particular, Kentucky, Washington and Texas have created such TRAs. As a sample restriction, none of the TRAs particular to areas or counties are included in our analysis.

In Table 2, I show the number of institutions that got into a TRA during the period of analysis. The NEBHE is the oldest in the system. However, the MHEC and SREB agreements are much more important in size. Finally, it is worth to notice that the TRAs where mainly undertaken between 1980 and 2000.

[Table 2 about here]

4 Analytical Framework

It is necessary to set up some theoretical framework that explains why tuition would increase after TRA-based market integration. Noticing that subsidies to higher education are subsidies in-kind, I can use the Peltzman (1973) model to understand why TRAs would generate an increase in tuition among public institutions.[15]

Peltzman (1973) shows that in-kind subsidies can generate lower consumption of a good (higher education quality) than if the good was not subsidized. The idea is that people who were likely to consume a lot of the good (go to high quality institutions) might not do so if the public provision of the good is subsidized up to a maximum level (the best public university in the state). To illustrate Peltzman's point, we can look at Figure 3, which graphs the traditional problem of an individual choosing between higher education quality and other goods given a budget constraint.

In a world without subsidies, the budget constraint would be the straight line that starts from D (only consumption of other goods) and crosses A. As in a traditional utility maximization problem, the individual would choose the point where her utility curve is tangent to the budget constraint.

[14] This means that if they are mandated to at maximum charge x percent of the in-state tuition, I assume that the institution will charge that amount.

[15] I thank Caroline Hoxby for a helpful discussion on this subject.

In the case of no-subsidies in higher education, that is point A in Figure 3 (with utility U_A). Now, suppose that state introduces in-kind subsidies of higher education, until some maximum level, for in-state students. In-kind subsidies generate a budget constraint that is a rotation of the budget constraint of non-subsidized higher education. Meanwhile, the maximum level of subsidized higher education constraint implies that the budget constraint only applies until a certain level of quality in higher education. Therefore, the budget constraint for in-state subsidized education would be the line that links points D and B in Figure 3. If the point B of consumption of the maximum subsidized higher education is above the utility curve U_A, then the individual will prefer the in-state subsidized education to the non-subsidized higher education. As Figure 3 shows, that could even imply that they end up choosing a lower quality higher education than what they would if higher education was not subsidized.

[Figure 3 about here]

[Figure 4 about here]

Now, we need to understand what would be the effect of a TRA in this framework. An individual that now has access to TRA institutions has a new budget constraint. First, the TRA institutions are partially subsidized, as we saw in section 3, so the budget constraint line goes between the in-state subsidized and the non-subsidized budget constraints. Second, now the individual has access to a richer set of higher education institutions (which includes all the universities within the TRA compact), so he will have access to some partially subsidized institutions of higher quality than the best institution in-state (point B). Both features of the TRA budget constraint are captured by the line that links D and C in Figure 4. We can see that if the point C is above the utility curve U_B, then the student would choose C instead of B, thereby, choosing a higher quality education under the TRA. This suggests that students that would like to achieve a higher quality higher education would migrate out of the state.

So far, we have only discussed the choices that students have made and disregarded how the pricing behavior of higher education institutions would be affected. If we look at the Figure 4, it is clear that if in-state subsidized institutions want to get back the students that migrated out-of-state, from point B to point C, then they should offer a higher quality of education, implying a movement of the point B to the right until it is above the utility curve U_C. Unless such movement is completely subsidized in-kind, such movement requires an increase in tuition levels. Therefore, I can say that if the institutions want to retain high quality students, then the Peltzman (1973) model suggests that instituions should rise price and quality. In consequence, under this framework TRAs generate increases in the tuition of public institutions, particularly among the institutions which are the most interested in retaining high quality students.

5 Empirical Model

One difficulty of doing research about higher education institutions, is that it is unclear what exactly institutions are maximizing (Winston, 1999). Consequently, several problems arise when trying to model the behaviour of higher education institutions, as the maximization function of the institutions is unknown. As a result, the usual Industrial Organization models (for example, Cournot competition) do not apply directly. Therefore, in this section I will provide an empirical model that tries to generate relevant predictions without making many assumptions.

5.1 Simple Reduced Form

In this first part, I will follow the reduced form approach by Rizzo and Ehrenberg (2003) and try to understand its meaning. I can start from simple structural supply-demand model for the higher education market (independently of whether we are talking about in-state or out-of-state markets), which has the form:

$$P_i = f(Q_i, x_i, \mathbb{1}_i^R, \epsilon_i^p) \tag{1}$$

$$Q_i = g(P_i, x_i, \mathbb{1}_i^R, \epsilon_i^q) \tag{2}$$

Where $\mathbb{1}_i^R$ is a dummy indicating whether the institution is in a TRA state, P_i is price, Q_i is enrollment, x_i is a series of covariates (such as employment rate and population) and ϵ_i^p and ϵ_i^q are the error terms. Usually, it is assumed that f and g are multiplicative functions of the variables[16] and errors, so the price and demand would follow the equations:

$$P_i = Q_i^{\gamma} \cdot e^{x_i'\beta + \mathbb{1}_i^R \delta_R + \epsilon_i^p} \tag{3}$$

$$Q_i = P_i^{\theta} \cdot e^{x_i'\phi + \mathbb{1}_i^R \rho_R + \epsilon_i^q} \tag{4}$$

Taking logarithm of both equations gets us to the type of equations that were estimated by Rizzo and Ehrenberg (2003):

$$\log P_i = \log Q_i \cdot \gamma + x_i\beta + \mathbb{1}_i^R \delta_R + \epsilon_i^p \tag{5}$$

$$\log Q_i = \log P_i \cdot \theta + x_i\phi + \mathbb{1}_i^R \rho_R + \epsilon_i^q \tag{6}$$

Before going forward, I will state what the signs of the different coefficients should be. As price increases with the demand, we expect γ to be positive. Meanwhile, as the demand should be decreasing with price, we expect θ to be negative. Also, note that the TRA coefficients would be different for in-state and out-of-state dependent variables. In the case of in-state demand, we would expect $\rho_R < 0$,

[16] For example, if profits are defined by $\pi = q \cdot p - C(q)$, then the FOC with respect to p would be $q = (C'(q) - p) \cdot \frac{\partial q}{\partial p}$. In that case, I would model the conduct $(p - C'(q))$ and $\frac{\partial q}{\partial p}$ as dependent on a set of observable variables.

as now the state students are more likely to migrate. Meanwhile, for the out-of-state demand we would have $\rho_R > 0$, as there is more migration across states. With respect to δ_R, it is not easy to predict its sign. However, Hoxby (1997) hypothesis suggests that $\delta_R > 0$ for the in-state price.

As I need credible restrictions on the parameters to deal with the simultaneous equations problem and estimate the full structural model, I instead focus on estimating a reduced form and understand what the coefficients represent. If I replace equation (6) in equation (5), and rearrange terms, I obtain the following equation:

$$\log P_i = x_i \cdot \frac{\beta + \gamma\phi}{1 - \gamma\theta} + \mathbb{1}_i^R \cdot \frac{\delta_R + \gamma\rho_R}{1 - \gamma\theta} + \frac{\epsilon_i^p + \gamma\epsilon_i^q}{1 - \gamma\theta} \tag{7}$$

First, notice that the numerator in each of the coefficients is the total effect of the independent variable on the dependent variable. In the case of the TRA dummy, the effect is composed of the direct effect (δ_R) plus the indirect effect through quantities ($\gamma\rho_R$). Second, given that $\gamma > 0$ and $\theta < 0$, we should have $(1 - \gamma\theta) > 1$. That implies that the reduced form analysis will have the correct sign, but it will underestimate the absolute value of the effects. Finally, note that $\eta_i = \frac{\epsilon_p + \gamma\epsilon_q}{1-\gamma\theta}$ has a mean zero and, under independence of the errors, variance $\sigma_\eta^2 = \frac{\sigma_p^2 + \gamma^2\sigma_q^2}{(1-\gamma\theta)^2}$. This means that when I use a Wald or t-student test for the null hypothesis on some coefficient λ ($H_0 : \lambda = 0$), where λ was estimated in the reduced form, the common term $(1 - \gamma\theta)$ goes away, implying that the test indeed tests whether the total effect of a particular variable of interest is zero. Therefore, our reduced form regressions will get the correct sign of the total effects, the coefficients will be biased towards zero and the tests for the null hypothesis that a coefficient is zero is equivalent to the test that a particular variable has no effect.

As I said before, in the in-state market we expect that $\rho_R < 0$. Given $\gamma > 0$, that means that $\delta_R > \delta_R + \gamma\rho_R$, so the total effect effect of TRAs on in-state prices would be smaller than the direct effect. Meanwhile, for the out-of-state we should have $\rho_R > 0$, so $\delta_R < \delta_R + \gamma\rho_R$. Therefore, the total effect of TRAs on out-of-state prices would be bigger than the direct effect.

Although so far we have explained our estimation as a cross-sectional difference regression, it is worth to say that a panel data difference-in-differences approach has a similar interpretation, since it simply adds institution and time dummy variables. Therefore, my preferred specification is:

$$\log P_{it} = \alpha_i + \mu_t + x_{it} \cdot \tilde{\beta} + \mathbb{1}_{it}^R \cdot \tilde{\delta} + \tilde{\epsilon}_{it} \tag{8}$$

The $\mathbb{1}_i^{R,t}$ indicates if the institution is under a reciprocity agreement at time t. Meanwhile, $\tilde{\beta}$, $\tilde{\delta}$ and $\tilde{\epsilon}$ have the interpretation suggested in equation (7) and α_i and μ_t are the institutional and time fixed effects, respectively. The advantage of this panel data approach is that it allows us to capture institutional and time fixed effects. In this manner, I can avoid problems related to initial tuition levels or system-wide time shocks. The identification will capture changes that happen after the TRAs take place and that are particular to TRA institutions. However, the difference-in-differences approach also has shortcomings, which will be reviewed in the next subsection.

5.2 Before and after TRA differences

There are several reasons to look at the periods just before and after a TRA affected an institution using event studies methodologies. The most important reason is that we are interested in checking whether TRAs ignited a tuition rising phenomena. This suggests that I should look at the change in behavior just after a TRA takes place, instead of looking at what was the effect on the long run. In that sense, an analysis of periods just before and after a TRA affects an institution would give us better information to understand whether Hoxby (1997) hypothesis is correct.

In the methodological side, one common problem with difference-in-differences (DID) analysis is that the results could be driven by differences in trends among groups. One way to check whether that is true or not is by using interaction dummies of the TRA indicator with the periods just before and after a TRA starts for a particular institution. Such strategy allows us to see how the differences between "treatment" and "control" groups were evolving at the time that the treatment began.

A second problem of DID is particular to our paper. It is possible that non-TRA institutions eventually get their higher education market integrated due to other reasons.[17] That means that in the long run, non-TRA institutions will catch up with the TRA institutions as the market becomes integrated for everyone, so DID will estimate a zero effect of TRAs. Therefore, it makes sense to look at the short-term changes instead of the long-run ones.

Using an event-study approach for the short-term changes provoked by TRAs, I analyse the coefficients in a window of time $[\underline{t}_i, \bar{t}_i]$ around the period when the TRA takes place for institution i. The following regression enables such analysis:

$$\log P_{it} = \alpha_i + \mu_t + x_i \cdot \tilde{\beta} + \sum_{k=\underline{t}_i}^{\bar{t}_i} \mathbb{1}_i^{R,T} \cdot \mathbb{1}_i^{t=k} \cdot \tilde{\delta}_k + \mathbb{1}_i^{R,T} \cdot \mathbb{1}_i^{t>\bar{t}_i} \cdot \tilde{\delta}_{t>\bar{t}_i} + \tilde{\epsilon}_{it} \tag{9}$$

In this equation, we have two groups: those that end up in a TRA in the final period T ($\mathbb{1}_i^{R,T} = 1$) and those who never enter a TRA ($\mathbb{1}_i^{R,T} = 0$). Then, $\tilde{\delta}_{t>\bar{t}}$ will be the mean difference between TRA and non-TRA institutions in periods after $\bar{t}$. Meanwhile, $\tilde{\delta}_k$ will be the difference between TRA and non-TRA institutions in the period $k \in [\underline{t}_i, \bar{t}_i]$.[18] If I call t_i^R the period in which the institution enters a TRA ($t_i^R = \infty$ for institutions that never enter), then I can define the symmetric period of analysis as $[t_i^R - c, t_i^R + c]$. In our case, I will use $c = 4$, since that gives as a window that is neither too long nor too short. Then, the δ_ks will help us to see the evolution of the differences between TRA and non-TRA institutions around the period when a TRA starts to apply to each institution. The result would be interesting if I see a different pattern between $\delta_{k<t_i^R}$ and $\delta_{k>t_i^R}$. Ideally, $\delta_{k<t_i^R}$ should be close to zero and have a flat evolution, while $\delta_{k>t_i^R}$ could jump to values higher than zero or have a non-flat evolution.

Finally, it is worth noticing that this methodology is not without shortcomings. The main one is that my estimations will be inconsistent if there are shocks that affect TRA institutions and that

[17] For example, cheaper flights, cheaper phone calls and a more uniform application process.

[18] Notice that $\underline{t}_i$ and $\bar{t}_i$ have i as a subscript. That is because the timing of the different TRAs differ.

happen at the same time that TRAs take place. However, the fact that TRAs take place at different points of time make those shocks unlikely.

6 Data

Ideally, I would like to carry an analysis on multiple variables, such as published prices, net of institutional aid prices, in-state and out-of-state enrollment, faculty per student, average SAT of students and others. Sadly, the published prices and the total enrollment are the only variables of interest available on a consistent yearly basis (faculty per student data is available for most years). There are two concerns about the published sticker price. The first one is that there is a lot of public funding that will help students to deal with higher prices.[19] However, then it is the case that increases in published prices are paid by public funds. In consequence, increases in published prices set higher pressure on the public finances. A second shortcoming of published prices, is that they do not take into account increases in institutional student aid. However, in public 4-year institutions the private and institutional sources of funding are not important. For example, in the academic year 2009-10 the private gifts, grants, contracts; the investment returns and other revenues represented just 16% of the total core revenue in public 4-year institutions.[20] That suggests that it is unlikely that increases in prices were nullified by institutional student aid. Summing up, in public institutions the published price increases will set pressure on the student or in the public finances. Therefore, published prices still are a good indicator of how much is being paid for higher education in public institutions.

The data used comes from the Integrated Postsecondary Education Data System (IPEDS) database, which includes surveys about different topics for all higher education institutions in the United States. That database starts in 1969. However, I use data since 1977[21] and provided by the National Science Foundation (NSF), since NSF standardized the IPEDS surveys across time.[22] This should not be a problem, since WICHE, MHEC and SREB agreements took place after 1977, while the NEBHE took place before 1969.[23] From IPEDS, I obtain published tuition, fees, total enrollment,[24] and the number of faculty for higher education institutions. The analysis is restricted to 4-year public institutions, since they are the ones affected by TRAs. Finally, I also use some state longitudinal data obtained from the U.S. Census (population data) and the U.S. Bureau of Labor Statistics (unemployment) for the purpose of generating state covariates. The control variables are the log of state tax collection per capita (state funding), the state unemployment rate (opportunity cost of going to college), the share of state population between 18 and 24 years old (demand), the population density of the state (geographical concentration of colleges) and log of total state population (state size). I avoid using

[19] This might take the form of federal, state or local grants and appropriations that are used to provide student aid.
[20] Source: Integrated Postsecondary Education Data System.
[21] I chose that year because the data is consistent thereafter.
[22] Available at https://webcaspar.nsf.gov.
[23] In the case other entire state agreements, two of them took place before 1977.
[24] I would like to use in-state and out-of-state enrollment separately. However, that data is not available for all the period under study. I have a similar problem with data about grants and scholarships.

institutional variables, since those might be affected by the presence of TRAs.

Given the geographical nature of the US, I leave some states out of the sample. First, I do not take into account Hawaii and Alaska, since they are too far apart to consider TRA market integration as a possibility. I also omit from the data the states of Kentucky, Texas and Washington, since those states have TRAs that only apply to the border counties, making it difficult to assess whether the type of market integration that they went through.[25] In the same line, I restrict myself to institutions that have data for the whole 1977-2009 period, which excludes California, Florida, Idaho, New Hampshire.

Next, I present some basic summary statistics for the used sample of 4-year public institutions in the academic year 2009-10 (Table 3). We can see that published in-state prices are around $5,300 dollars, being lower for institutions under a TRA. Similarly, the percentage of in-state students is lower for TRA institutions.[26] Meanwhile, no statistical difference shows up in the out-of-state prices or in the total fall enrollment. Finally, it is worth to check state level variables. It seems that larger and more dense states were the ones less likely to undertake a TRA. A apossible reason is that their higher education markets might already have enough opportunities within a big state and that the duplication costs might not be a major concern in big states. Nevertheless, the descriptive statistics suggest that a panel data analysis, which allows to control for institutional and state fixed effects, is more appropriate.

[Table 3 about here]

7 Results

In this section, I present the estimates of the effect of TRAs on prices that are obtained from the two estimation procedures described in section 5.[27] First, I will present cross-sectional correlations to see if some pattern emerges from the data. Then, I use panel data and add control variables in order to estimate regressions with fixed effects. Next, I will look to the event study approach results, which contain important information and more credible results than the simple difference-in-differences (DID) approach. Finally, I show results that differentiate by selectivity of the institution and that use the faculty/student ratio as the dependent variable.

Finally, it must be clarified that all the standard errors are clustered at the state level, in order to deal with the possible autocorrelation problems related to DID methodologies, as suggested by Bertrand et al. (2004).

[25] The inclusion of those states lowers difference-in-differences coefficients, making them non-significant. However, the results for the before and after TRA differences remain similar.

[26] Although I would like to analyse that variable, it is not available on a yearly basis for the period under study.

[27] Given that I do not have a clear interpretation for the total enrollment, I do not include it in the main results. However, the results are in the Appendix section.

7.1 Reduced form results

First, I will present the results related to the reduced form analysis in a simple cross section. Table 4 presents the results of an OLS analysis on the 2009 cross section of institutions. Columns (1) and (2) are the results for published in-state tuition and fees, while (3) and (4) are the results for out-of-state price. At first glance, market integration is correlated with lower prices. However, the size of the errors do not allow us to reject the null hypothesis of no differences in prices.

[Table 4 about here]

Next, Table 5 shows the results obtained by including institution and time fixed effects.[28] The DID approach tells us that the TRA has a positive an significant effect on the in-state price among public 4-year institutions. The effect seems to be robust to the inclusion of state variables. That suggests that TRAs market integration has increased in-state prices. Meanwhile, I find zero effect of TRA on out-of-state price. Therefore, I could say that higher education market integration does not affect out-of-state published prices. These results agree with the argument that market integration would increase in-state prices.

[Table 5 about here]

7.2 Before and after TRA differences results

Here I will analyse the short term effects of TRAs using an event study approach. As it was explained before, there are three reasons to carry this analysis: (i) check whether institutions under TRAs would be diverging from non-TRA institutions anyway; (ii) deal with the fact that TRA institutions would be in a more integrated market in the short term, but non-TRA institutions will also be in an integrated market in the long term; and (iii) by checking the short term changes in the variables, I can see check whether the TRAs worked as an ignition spark for the increase in prices. In order to do that, I present in Table 6 the results when I include dummies for 4 periods before and after an institution becomes part of a TRA.

[Table 6 about here]

The results for in-state price are columns (1) and (2) of Table 6. The coefficients before the TRA applies are similar and around 0.04.[29] However, in the periods after the TRA was activated, the price starts to diverge systematically. The coefficients of the third period post-TRA, which are statistically significant at the 10%, show that the divergence would be about 12%. Meanwhile, in the fourth post-TRA period the difference grows to 14%, significant at the 5%.[30] In periods after that, the price

[28] Given the low variation in prices within a state, an equivalent regression using state fixed effects obtains almost identical results.

[29] I cannot reject the null hypothesis that the coefficients of the first 4 periods are zero (p-value for the Wald test is 0.75). The average year that the institutions in the regression entered a TRA is 1983.

[30] The Wald test for the null hypothesis that the coefficient for the fourth post-TRA period is equal to the coefficient in the TRA period is also rejected.

ended up diverging by more than 16%. Therefore, this seems to suggest that in 4-year institutions the positive coefficients relating TRAs with in-state prices have a causal interpretation, since the observed divergence happened right after an institution joined a TRA. In short, I do find evidence that TRAs market integration sparked an increase in in-state prices of about 10%.

The evidence seems to be different for out-of-state prices (columns 3 and 4 of Table 6). All the coefficients are not statistically different from zero, especially after I include state covariates. In short, I find that there is no effect of TRAs on out-of-state prices, neither as a jump in levels or in the growth rates.

7.3 Heterogeneity on TRA effects

In this subsection, I present the results that emerge when I try to take into account the selectivity of the institutions. As the analytic framework suggested, it is possible that more selective institutions will be the ones that would increase their prices the most in order to reach higher levels of quality and retain students. Therefore, looking at the impact of the TRAs across institutions of different selectivity will provide useful information.

For building a selectivity measure, I used the Carnegie Classification from 1976[31] and defined as selective the Research Institutions (18% of institutions), the Doctoral Granting Institutions (10% of institutions), and the elite professional schools (3% of the institutions). Then, I interact selectivity with the TRA dummy in order to estimate fixed-effects regressions similar to those in Table 5.

[Table 7 about here]

The results are presented in Table 7. In columns (1) and (2), the results indicate that both selective and non-selective 4-year public institutions increased their in-state prices after a TRA. Also, the selective institutions seem to have increased them more (however, the difference is not statistically significant). Meanwhile, columns (3) and (4) suggest us that neither type of institution changed their out-of-state prices as a result of TRA.

7.4 Effects on Faculty

Until now, I have shown that public 4-year institutions increased their published tuition after the state entered a TRA. However, It is also worth knowing if there are changes on quality. In particular, the Peltzman model suggests that competition would increase cost in order to increase quality. In order to understand if changes in quality took place, I use as a proxy the faculty per student ratio. Because the data has some missing years (1984, 1987, 1988, 1989), it is not possible to carry an event study approach, it is still worth looking at the difference-in-differences estimators.[32]

The result of the DID analysis of the effect of TRAs on the faculty-per-student ratio are shown in Table 8. The results on the first two columns suggest that there is no effect on the average institution

[31] Carnegie (1976).

[32] Other quality measures, such as selectivity, are not available yearly in the 1977-2009 period.

in the sample. However, the Peltzman (1973) model emphasizes that high-quality institutions might be more affected by TRAs. Therefore, columns 3 and 4 show estimations with interactions of TRA on the selectivity of the institution. The estimates for the selective institutions are significant at 10% with and without covariates. This suggests that for every thousand students, selective institutions have 3 more faculty members. Given that enrollment is over 10,000 for the average institution, that suggests about 30 more faculty members.

[Table 8 about here]

In synthesis, I have found that TRA seem to have increased the faculty-per-student in the selective institutions. The results are aligned with the prediction of the Peltzman (1973) model, since the selective institutions were the most likely to increase quality.

8 Discussion

This paper provides three important findings. First, the paper confirms Hoxby (1997) hypothesis about the role of market integration, suggesting that market integration increased the in-state price and also the faculty/student ratio among selective institutions. Second, I find that TRA market integration sparks a continuous increase of prices in the 4 years after a TRA takes place, confirming the idea of market integration as an "ignition device". Third, the results are in-line of the predictions that of Peltzman (1973). In particular, the introduction of a bigger choice set of institutions with partially subsidized tuitions increases the prices and the quality of the institutions, particularly among the most selective ones.

The estimates suggest that TRAs produce an increase in 10% on in-state prices for public 4-year institutions. That effect can be interpreted as more than just correlations, since the increase takes place in the periods right after a TRA takes hold. To have a better glance at that, I present in Figure 5 the coefficients estimated previously in Table 6. We can see that "before TRA", the coefficients are close to 0.04 and have a flat evolution. Quite differently, the "after TRA" estimates suggest an increase of in-state prices of at least 10% in only 4 years. The result is robust to the separation between selective (increase 12%) and non-selective institutions (increase 10%). That can be explained by the traditional vertical competition model, where the increase in price of the high price state institution creates an opportunity to the low price state institution to also increase prices. Meanwhile, in the case of out-of-state prices I do not find much effects, which is in-line with the predictions of our analytical framework if we assume that one of the main objectives of the public institutions is to retain in-state students, rather than out-of-state students.

[Figure 5 about here]

All of these results are in line with Hoxby (1997), who finds that tuition in public institutions would increase as a result of market integration. However, there are important differences with her

results. One difference is that because of the binary nature of TRA variables and the yearly nature of the data, I can check whether the rise in prices happened contemporaneously with the market integration. This gives us an idea of whether the estimated effects are causal and whether TRAs acted as an ignition device for the price increase. The other difference is that I do find that market integration had a big effect on public institutions.[33]

As we know, this paper considers previous market integration in higher education. However, market integration has not stopped. Communication and transportation costs are still decreasing, implying that the market is getting even more geographically integrated. Also, the higher education market is becoming increasingly integrated across the globe. For example, Asian students are entering in large numbers into the US higher education system[34] and US students are being attracted to colleges outside the US.[35] That could imply that the tuition rising phenomena will continue to increase and become global.

Finally, my analysis has focused on published tuition and fees. As I explained before, a part of the increase is absorbed by the students. However, a substantial portion is also absorbed by the state and federal governments. Therefore, market integration also puts more pressure on the public budget. One way to deal with that is to increase the state grants instead of the federal grants, since the latter increases market integration (Hoxby, 1997) and, therefore, might result in even higher published prices.

9 Conclusions and Further Research

This paper studies the effect higher education market integration on prices. Using interstate Tuition Reciprocity Agreements (TRAs) and institutional panel data (1977-2009), I find that public 4-year institutions increased their prices by at least a 10% just after a TRA included them. That confirms Hoxby (1997) hypothesis of market integration as an ignition device of price increases in higher education. Therefore, we can state that market integration would have played a big part of the increase in higher education prices in the last 30 years. This sets concern on future market integration processes that might take place. If they produce higher published tuition and fees, as our results suggest, this would set higher economical pressure on families and the public finances. Therefore, finding ways to avoid the relation between market integration and price increases is needed.

As we have seen, TRAs are mechanisms for market integration that ignited price increases. The findings suggest that market integration increase tuition, setting a setting a red light for public policies that look to increase tuition by increasing competition in higher education. Given that we also find some evidence that TRAs increase quality, the results reinforce the idea that higher education is an odd market where traditional market policies, such as market integration, do not work as supposed,

[33] Hoxby (1997) suggested that it would take a 20% decrease of the in-state students enrollment share, in order to rise tuition by 11.6%

[34] http://thechoice.blogs.nytimes.com/category/study-abroad/.

[35] http://www.nytimes.com/2008/12/01/education/01scotland.html?pagewanted=all.

but instead reinforce quality competition.

Nevertheless, more research is needed to test other possible hypotheses that explain increasing tuition prices. Although the findings on the effect of market integration on tuition are very important, those effects do not exclude the possibility that the "Bennett Hypothesis" or the "Baumol cost-disease Hypothesis" also explain a fair share of the tuition rising phenomena. For example, Long (2004) provides important evidence for the "Bennett Hypothesis" by analysing the Georgia HOPE scholarship program. Therefore, more research on those hypothesis is needed. Such research is of particular importance, as grants keep increasing and important technology improvements are still taking place.

Finally, further research might be required to get a better understanding of integration in higher education markets. In particular, analysis using contemporary market integration processes (for example, internet penetration) and richer data sets could provide an interesting research agenda and better predictive power of future phenomenons.

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Table 1: Evolution of Federal and State Grants Aid by Institution Type

Institutions	Year	Federal and State Grant Aid
Public Doctoral	99-00	$1,090
	04-05	$1,330
	09-10	$1,910
Public Master's	99-00	$1,470
	04-05	$1,800
	09-10	$2,620
Public Bachelor's	99-00	$1,480
	04-05	$1,980
	09-10	$2,690

Source: College Board.

Table 2: Number of 4-year Public Institutions who got into a Tuition Reciprocity Agreement, by year

Year	**WICHE**	**MHEC**	**SREB**	**NEBHE**	**Other**[a]
1957	-	-	-	24	-
1968	-	-	-	-	22
1975	-	-	-	-	4
1978	-	-	-	-	6
1980	-	-	148	-	-
1985	-	-	-	-	-
1986	-	-	8	-	-
1988	31	-	-	-	-
1989	14	-	-	-	-
1990	-	40	-	-	-
1991	-	21	-	-	-
1994	-	19	-	-	-
1996	-	12	-	-	-
1997	33	-	-	-	-
1998	3	-	2	-	-
1999	-	4	-	-	-
2000	-	-	15	-	16
2005	-	3	-	-	-
Total	81	99	173	24	42

a: Only statewide agreements and not bordering counties agreements.

Source: Author's calculation based on IPEDS and TRA agencies reports.

Table 3: Summary statistics for 4-year Public Institutions (2009), by TRA status

Variable	**Mean no TRA**	**Mean TRA**	**SD sample**	**t-test Δ**
Undergraduate tuition and fees, in-state	5,839	5,132	302.3	2.34
Undergraduate tuition and fees, out-of-state	13,990	13,661	532.8	0.62
Faculty	532.8	435.4	58.32	1.67
Fall enrollment	13,007	11,179	1,242.9	1.47
% of in-state enrollment	89.59	80.93	1.73	4.98
Unemployment rate	8.84	8.67	.18	.94
Tax revenue per capita	2,727	2,306	65.8	6.40
Percentage of population 18-24 years old	9.82	9.94	0.006	-1.98
Population density state (people/mi sq)	401.43	163.99	34.67	6.85
Total population in state (millions)	13.606	4.975	.521	16.56
Number of observations	86	238		

Table 4: OLS cross-section regression on log-price (tuition and fees) for in-state and out-of-state students, 4-year Public Institutions, 2009

VARIABLES	(1) 4-year Instit. log price in	(2) 4-year Instit. log price in	(3) 4-year Instit. log price out	(4) 4-year Instit. log price out
Under reciprocity agreement at time t	-0.148	-0.0319	-0.140	-0.00594
	(0.167)	(0.277)	(0.0923)	(0.110)
Log state tax revenue per capita		0.528**		0.175
		(0.245)		(0.253)
Unemployment rate		0.0541		0.0407
		(0.0398)		(0.0376)
% population between 18 and 24 years		-12.72		-11.18
		(8.794)		(8.510)
Population density state (people/mi sq)		-0.000120		7.17e-05
		(0.000278)		(0.000180)
Log state population		0.0223		0.0854
		(0.0929)		(0.0768)
Constant	8.581***	4.863	9.567***	7.511***
	(0.155)	(2.942)	(0.0672)	(1.986)
Observations	324	324	367	367
R-squared	0.015	0.084	0.014	0.082

Clustered standard errors at the state level in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 5: Fixed-effect regression on log-price (tuition and fees) for in-state and out-of-state students, 4-year Public Institutions, 1977-2009

VARIABLES	(1) 4-year Instit. log price in	(2) 4-year Instit. log price in	(3) 4-year Instit. log price out	(4) 4-year Instit. log price out
Under reciprocity agreement at time t	0.0997**	0.111***	-0.00404	-0.0133
	(0.0402)	(0.0406)	(0.0448)	(0.0462)
Log state tax revenue per capita		-0.0629		0.0332
		(0.138)		(0.127)
Unemployment rate		0.0223**		0.0208***
		(0.00896)		(0.00654)
% population between 18 and 24 years		0.551		4.093**
		(2.643)		(1.670)
Population density state (people/mi sq)		-9.17e-05		0.00130**
		(0.00120)		(0.000603)
Log state population		-0.456**		0.0573
		(0.175)		(0.139)
Constant	8.399***	15.73***	9.469***	7.435***
	(0.0484)	(2.795)	(0.0445)	(2.474)
Observations	10,368	10,368	11,744	11,744
R-squared	0.865	0.868	0.889	0.891
Number of unitid	324	324	367	367
Institution FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Clustered standard errors at the state level in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 6: Fixed-effect regression for the log-price for in-state and out-of-state students, using dummies for periods before and after reciprocity agreement, 4-year Public Institutions, 1977-2009

VARIABLES	(1) 4-year Instit. log price in	(2) 4-year Instit. log price in	(3) 4-year Instit. log price out	(4) 4-year Instit. log price out
4-period before reciprocity	0.0244	0.0444	0.00886	0.00710
	(0.0417)	(0.0423)	(0.0357)	(0.0314)
3-period before reciprocity	0.0245	0.0371	-0.0258	-0.0171
	(0.0510)	(0.0527)	(0.0427)	(0.0470)
2-period before reciprocity	0.0297	0.0394	-0.0411	-0.0354
	(0.0527)	(0.0534)	(0.0422)	(0.0489)
1-period before reciprocity	0.0409	0.0524	-0.0651	-0.0577
	(0.0509)	(0.0523)	(0.0428)	(0.0498)
Period reciprocity took place	0.0319	0.0488	-0.0429	-0.0390
	(0.0580)	(0.0603)	(0.0411)	(0.0497)
1-period after reciprocity	0.0589	0.0701	-0.0442	-0.0470
	(0.0569)	(0.0575)	(0.0464)	(0.0545)
2-period after reciprocity	0.0913	0.107*	-0.0409	-0.0405
	(0.0580)	(0.0589)	(0.0543)	(0.0608)
3-period after reciprocity	0.115*	0.129**	-0.0341	-0.0404
	(0.0627)	(0.0628)	(0.0641)	(0.0729)
4-period after reciprocity	0.132**	0.152**	-0.0349	-0.0404
	(0.0641)	(0.0645)	(0.0670)	(0.0759)
4-periods or more after reciprocity	0.165**	0.202***	-0.00451	-0.0128
	(0.0748)	(0.0720)	(0.0612)	(0.0677)
Log state tax revenue per capita		-0.0705		0.0270
		(0.139)		(0.127)
Unemployment rate		0.0222**		0.0206***
		(0.00922)		(0.00658)
% population between 18 and 24 years		-0.315		3.623*
		(2.550)		(1.813)
Population density state (people/mi sq)		0.000106		0.00129**
		(0.00124)		(0.000605)
Log state population		-0.540***		0.0462
		(0.182)		(0.143)
Constant	6.753***	14.99***	9.470***	5.622**
	(0.0378)	(2.825)	(0.0566)	(2.356)
Observations	10,368	10,368	11,744	11,744
R-squared	0.866	0.869	0.889	0.891
Number of unitid	324	324	367	367
Institution FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Clustered standard errors at the state level in parentheses.*** p<0.01, ** p<0.05, * p<0.1

Table 7: Fixed-effect regression on log-price (tuition and fees) for in-state and out-of-state students, 4-year Public Institutions, 1977-2009: Analysing by the selectivity of the institution

VARIABLES	(1) 4-year Instit. log price in	(2) 4-year Instit. log price in	(3) 4-year Instit. log price out	(4) 4-year Instit. log price out
Reciprocity in t * Selective	0.101**	0.122***	0.00622	-0.0122
	(0.0427)	(0.0433)	(0.0408)	(0.0388)
Reciprocity in t * Non-selective	0.0994**	0.107**	-0.0262	-0.0137
	(0.0421)	(0.0423)	(0.0617)	(0.0524)
Log state tax revenue per capita		-0.0623		0.0333
		(0.137)		(0.127)
Unemployment rate		0.0224**		0.0208***
		(0.00893)		(0.00655)
% population between 18 and 24 years		0.536		4.091**
		(2.640)		(1.659)
Population density state (people/mi sq)		-9.03e-05		0.00130**
		(0.00120)		(0.000603)
Log state population		-0.458**		0.0570
		(0.176)		(0.141)
Constant	8.399***	15.76***	9.285***	5.346**
	(0.0483)	(2.807)	(0.0405)	(2.354)
Observations	10,368	10,368	12,186	11,744
R-squared	0.865	0.868	0.886	0.891
Number of unitid	324	324	383	367
Institution FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

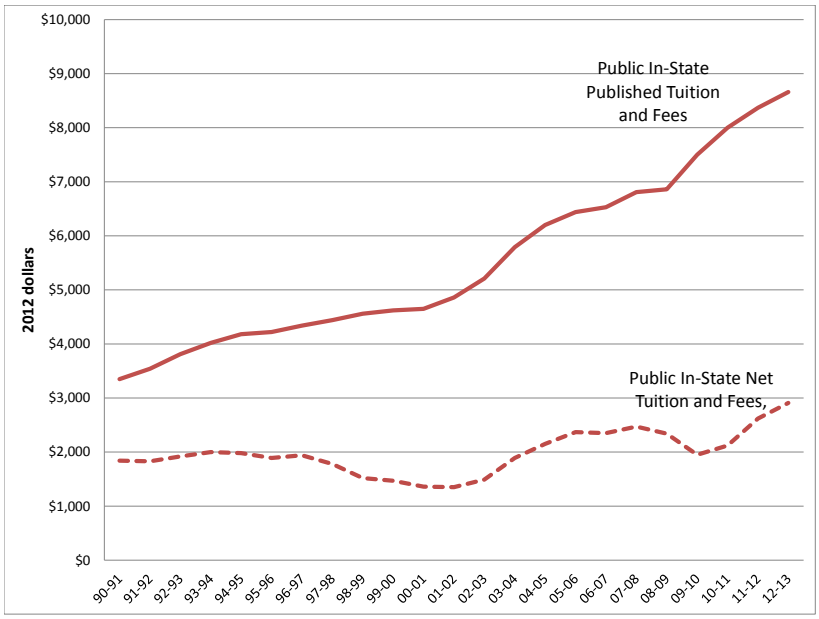
Clustered standard errors at the state level in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 8: Fixed-effect regression on the number of faculty per student, 4-year Public Institutions, 1977-2009

VARIABLES	(1) Faculty per student	(2) Faculty per student	(3) Faculty per student	(4) Faculty per student
Under reciprocity agreement at time t	0.000732	0.000910		
	(0.00117)	(0.00108)		
Reciprocity in t * Selective			0.00312*	0.00350**
			(0.00174)	(0.00157)
Reciprocity in t * Non-selective			-0.000246	-8.28e-05
			(0.00145)	(0.00139)
Log state tax revenue per capita		0.00277		0.00292
		(0.00273)		(0.00277)
Unemployment rate		5.77e-05		7.41e-05
		(0.000213)		(0.000221)
% population between 18 and 24 years		0.0261		0.0216
		(0.0704)		(0.0683)
Population density state (people/mi sq)		-1.66e-05		-1.54e-05
		(1.44e-05)		(1.37e-05)
Log state population		-0.00519		-0.00592
		(0.00452)		(0.00435)
Constant	0.0434***	0.106	0.0435***	0.116
	(0.000569)	(0.0743)	(0.000578)	(0.0714)
Observations	10,638	10,638	10,638	10,638
R-squared	0.015	0.018	0.017	0.020
Number of unitid	394	394	394	394
Institution FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

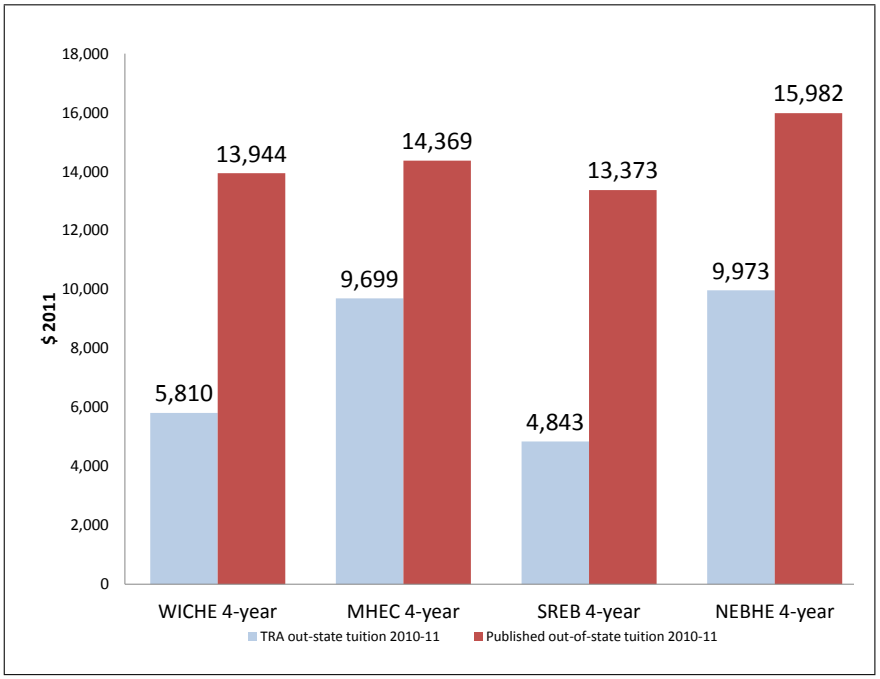
Clustered standard errors at the state level in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Figure 1: Evolution of Published and Net Tuition and Fees in 4-year Public Institutions



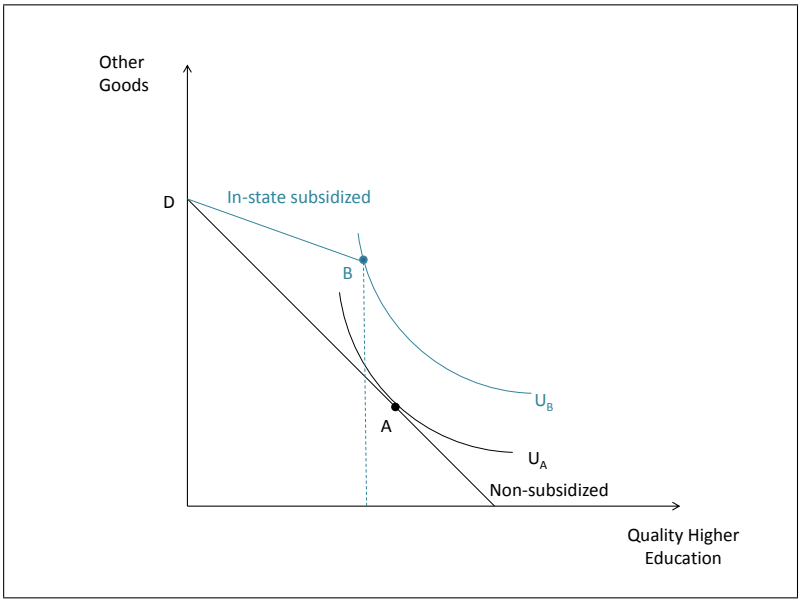
Source: Undergraduate charges data, College Board.

Figure 2: Tuition with and without TRAs minimum discounts for 4-year Public Institutions



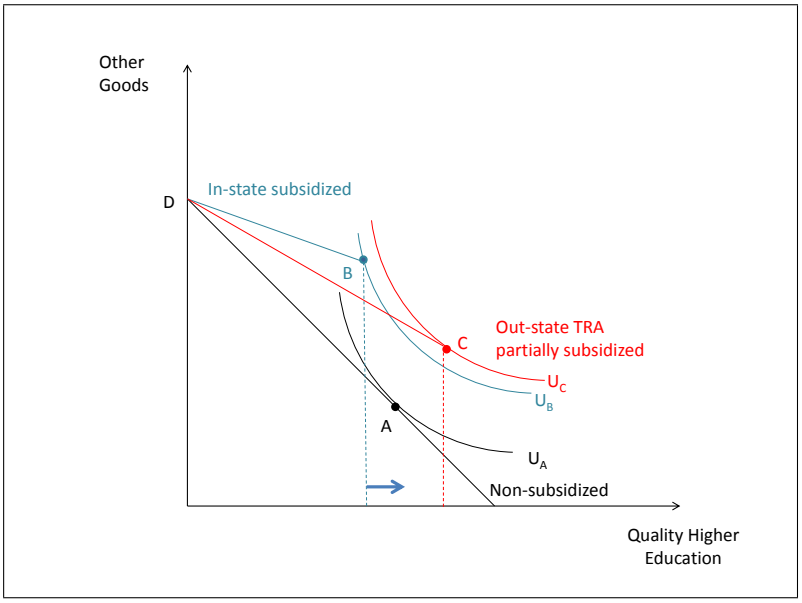
Source: IPEDS.

Figure 3: The Peltzman model with in-state subsidies



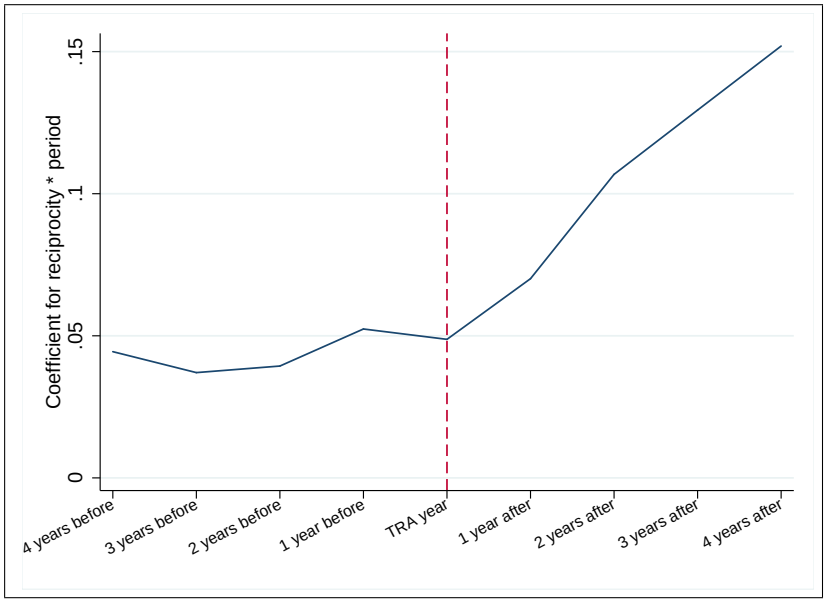
Source: IPEDS.

Figure 4: The Peltzman model with in-state subsidies and Tuition Reciprocity Agreements



Source: IPEDS.

Figure 5: In-state tuition and fees evolution, before and after a TRA takes place, 4-year Public Institutions



Appendix

Table A.1: OLS cross-section regression on log of total enrollment, 4-year Public Institutions, 2009

VARIABLES	(1) 4-year Instit. log enrollment	(2) 4-year Instit. log enrollment
Under reciprocity agreement at time t	0.256	0.356
	(0.322)	(0.276)
Log state tax revenue per capita		0.0504
		(0.291)
Unemployment rate		0.120***
		(0.0436)
% population between 18 and 24 years		4.976
		(12.35)
Population density state (people/mi sq)		0.000280
		(0.000233)
Log state population		0.145
		(0.0910)
Log student/faculty ratio		0.621***
		(0.168)
Constant	8.810***	2.426
	(0.303)	(2.353)
Observations	383	382
R-squared	0.014	0.179

Clustered standard errors at the state level in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A.2: Fixed-effect regression on log of total enrollment, 4-year Public Institutions, 1977-2009

VARIABLES	(1) 4-year Instit. log enrollment	(2) 4-year Instit. log enrollment
Under reciprocity agreement at time t	0.0480*	0.00188
	(0.0270)	(0.0199)
Log state tax revenue per capita		-0.0442
		(0.0701)
Unemployment rate		-0.00381
		(0.00449)
% population between 18 and 24 years		1.227
		(1.082)
Population density state (people/mi sq)		-0.000227
		(0.000591)
Log state population		0.776***
		(0.116)
Constant	8.630***	-3.167*
	(0.0131)	(1.782)
Observations	12,256	12,256
R-squared	0.326	0.393
Number of unitid	383	383
Institution FE	Yes	Yes
Year FE	Yes	Yes

Clustered standard errors at the state level in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A.3: Fixed-effect regression for the log of total enrollment using dummies for periods before and after reciprocity agreement, 4-year Public Institutions, 1977-2009

VARIABLES	(1) 4-year Instit. log enrollment	(2) 4-year Instit. log enrollment
4-period before reciprocity	0.0352*	0.00444
	(0.0205)	(0.0302)
3-period before reciprocity	0.0205	-0.00918
	(0.0245)	(0.0281)
2-period before reciprocity	0.0230	-0.00743
	(0.0250)	(0.0260)
1-period before reciprocity	0.0210	-0.0121
	(0.0273)	(0.0249)
Period reciprocity took place	0.0267	-0.0165
	(0.0284)	(0.0261)
1-period after reciprocity	0.0334	-0.0108
	(0.0299)	(0.0263)
2-period after reciprocity	0.0313	-0.0135
	(0.0314)	(0.0270)
3-period after reciprocity	0.0465	-0.00476
	(0.0340)	(0.0266)
4-period after reciprocity	0.0484	-0.00571
	(0.0352)	(0.0280)
4-periods or more after reciprocity	0.0872**	0.0104
	(0.0407)	(0.0316)
Log state tax revenue per capita		-0.0490
		(0.0692)
Unemployment rate		-0.00396
		(0.00454)
% population between 18 and 24 years		0.963
		(1.123)
Population density state (people/mi sq)		-0.000208
		(0.000566)
Log state population		0.765***
		(0.118)
Constant	8.668***	-2.920
	(0.0129)	(1.830)
Observations	12,256	12,256
R-squared	0.331	0.394
Number of unitid	383	383
Institution FE	Yes	Yes
Year FE	Yes	Yes

Clustered standard errors at the state level in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A.4: Fixed-effect regression on log of total enrollment, 4-year Public Institutions, 1977-2009: Analysing by the selectivity of the institution

VARIABLES	(1) 4-year Instit. log enrollment	(2) 4-year Instit. log enrollment
Reciprocity in t * Selective	0.00334	-0.0621
	(0.0491)	(0.0468)
Reciprocity in t * Non-selective	0.0664**	0.0268
	(0.0253)	(0.0186)
Log state tax revenue per capita		-0.0470
		(0.0700)
Unemployment rate		-0.00414
		(0.00439)
% population between 18 and 24 years		1.321
		(1.090)
Population density state (people/mi sq)		-0.000240
		(0.000583)
Log state population		0.792***
		(0.117)
Constant	8.629***	-3.402*
	(0.0130)	(1.783)
Observations	12,256	12,256
R-squared	0.328	0.398
Number of unitid	383	383
Institution FE	Yes	Yes
Year FE	Yes	Yes

Clustered standard errors at the state level in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Figure A.1: Total enrollment evolution before and after a TRA takes place, 4-year Public Institutions