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The economic impact of universities: empirical evidence from Turkish provinces

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ABSTRACT

Twenty-three new state universities were established in different provinces in Turkey in 1992. This study investigates universities' possible economic impacts on local economies in provinces in Turkey by comparing per capita GDP before and after the establishment of new universities. To do so, we employ difference-in-difference and matching based on entropy balancing to provide robustness against observable and time-invariant unobservable heterogeneity. Using the provincial level data between 1987 and 2000 in Turkey, we find that increases in the number of universities are positively associated with GDP per capita at the province level. Empirical results also show that unemployment rates in provinces fall with the establishment of new universities in Turkey.

KEYWORDS
University; growth; unemployment; Turkey

JEL CLASSIFICATION
H52; E62; I28

I. Introduction

The primary purpose of universities is to produce knowledge. The universities help improve technological and social fields in a country by carrying out scientific studies. However, it is also apparent that universities have substantial budgets. Thanks to this budget, they spend money on the economy or generate income by selling the goods and services they produce in the market. Besides, staff salaries are an essential item of university budgets. The spending of the personnel's income also provides vitality to the economy with its multiplier effect. Therefore, we can consider universities as a production function. Universities can contribute to the local economy, that is, to the regions where they are established or the provinces' economy. This might occur with several channels such as the university can conduce to new businesses to be established that lead to economic activity with a spillover effect.

Moreover, a university could cause new investments and explore new technologies that help local and regional economies. Twenty-three new state universities were established in Turkey in 1992. Therefore, this study investigates universities' possible economic impacts on local economies in provinces in Turkey by comparing per capita GDP in 1992 and with per capita GDP in 2000.

The long-term effect of universities on economic development is through knowledge production and transfer. Especially the strategy of establishing state universities serves primary knowledge production (Drucker and Goldstein 2007). Technology transfer programmes, university-industry partnerships, and training programmes (curricula) suitable for local companies' labour demand are examples of economic development programmes. While universities help companies with new technology demands by doing basic research, they also create regional economic demand and vitality through their budgets. Endogenous growth theories discuss its influence on economic growth through knowledge production (see Aghion and Howitt 1998; Acemoglu 2012 for detail). Universities are also important economic actors by investing in physical capital, building buildings, laboratories, research centres, transportation, and other infrastructure investments.

Studies on universities' economic impact focus on estimating direct or indirect expenditures, investment, and employment in the region. For example, Glasson (2003) calculated an output multiplier of 0.70 to 1.12 for Sunderland University in northeastern England. Arap (2010) stated that there are two fundamental factors in opening new

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universities in Turkey. One is the expected impact of establishing universities on local economic development, and the other is a political motive. One of the critical objectives for establishing new universities in Turkey since the 1950s is to ensure that they spread to Turkey's regions. By doing so, it aims to lower regional disparities in the country. The basic approach here is to provide equal opportunities and contribute to eliminating regional inequalities in Turkey.

Public investments often raise questions about the allocation and efficiency of resources. The issue of knowledge production and its contribution to the region's economies is becoming essential for universities. Although some studies on universities' economic impact exist, few of them attempt to analyse the effect in an econometric sense for the Turkish case. For instance, Görkemli (2009) investigates Selçuk University's contribution to Konya's economy by using static data such as students, personnel, and other university expenditures and argues that it is an important actor in Konya's economy. Again, according to a study on a regional basis, it was concluded that Süleyman Demirel University contributed approximately 81 million T.L. (Turkish liras) to Isparta (Akçakanat, Çarikçi, and Dulupçu 2010). According to a study using educational institutions such as universities and the number of researchers in the USA, Zucker, Darby, and Brewer (1998) found that these institutions affect biotechnology companies' settlement decisions and cause economic growth. Valero and Van Reenen (2019) explored that increases in the number of universities are positively associated with the future growth of GDP per capita. Their estimates imply that a 10% increase in a region's number of universities per capita is associated with a 0.4% higher future GDP per capita.

After a summary of the literature, this paper aims to investigate whether universities, which are science centres, contribute to the economic structure of the cities they were founded. Universities make multifaceted contributions to the cities they are located. Some of them are urban income, an improvement in the city's economic structure, and labour mobility. In order to understand whether they contribute to the economy or not, variables such as provincial income per capita and unemployment rate in dollar terms were used as dependent variables. To the best of our knowledge, this paper is one of the first papers attempting to show the causal effect of universities on economic outcomes.

This paper is organized as follows. Section 2 describes the data and econometric methodology used in the paper. Section 3 sets our empirical results. Finally, Section 4 concludes the paper.

II. Data and econometric methodology

We employ the Differences and Differences method, which has been used to uncover causality among variables in econometrics. The data covers the years 1987–2000 for provinces in Turkey. The economic data used in the study were compiled from the Ministry of Development and TURKSTAT (Turkish Statistical Institute). The data of the universities' foundation years were obtained from the Higher Education Board (YÖK). Twenty-three new universities were established in 1992, and 22 provinces welcomed new universities since two universities[1] were established in Kocaeli.

Furthermore, two newly established universities were not included in the analysis because they were established in provinces where they already have a university. Kırıkkale was not in provincial status in 1987; therefore, it is not included in the data. As a result, 19 university cities that met with new universities for the first time in 1992 constitute the study's main subject. Hence, we compare the economic growth and unemployment variables of these 19 provinces[2] with other provinces in 2000 to identify causality.

The difference in differences (Diff and Diff) is a statistical technique used in econometrics and quantitative research in social sciences that tries to imitate an experimental research design using observational data by examining the differential effect of a treatment (Angrist and Pischke 2008). For example, there is a 'treatment group' and a 'control group' in a natural experiment. Diff and Diff estimation calculates the effect of a treatment (i.e. an explanatory variable or an independent variable) on an outcome (i.e. a response variable

[1]Gebze Technical University and Kocaeli University.
[2]The list of provinces is presented in the online appendix.

or dependent variable) by comparing the mean change over time in the outcome variable for the treatment group to the mean change over time for the control group. We can write the Diff and Diff equation which provides us the average treatment effect on the treated (ATET) as follows:

$$Y_{it} = \alpha + \delta University_i * year_{2000} + \beta University_i + \gamma year_{2000} + \theta X_{it} + \in_{it} \quad (1)$$

where Y_{it} is the dependent variable representing either per capita GDP in constant US$ or unemployment rate in province i on year t.

University is a dummy variable;

which takes the value of 1 if a university was established in the city of i in 1992, 0 otherwise.

$Year_{2000}$ is also a dummy variable;

which takes the value of 1 for the year of 2000 and 0 otherwise.

X_{it} represents time-varying control variables that might affect the dependent variable and $\in_{it}$ is the error term.

The coefficient of interest (treatment group) in eq (1) is δ and its expected sign is positive for economic growth and negative for the unemployment rate. Hence, we test two hypotheses in this paper such that provinces where universities established in 1992, will have more per capita GDP and less unemployment rate in 2000 compared to other provinces. We use the cluster option since errors may be correlated within group over time in differences in differences analysis. The robust option in regression only corrects for heteroskedasticity but otherwise considers errors are independent across observations (Furquim, Corral, and Hillman 2020; Liang and Zeger 1986).

Descriptive statistics of the variables used in the econometric model are given in Table 1. As shown from the minimum and maximum value of each variable in Table 1, there are sufficient variations in each variable across provinces. For example, a province has a GDP per capita of $315, whereas Turkey's wealthiest one's GDP per capita is $7556 between 1987 and 2000. We have a balanced panel dataset for the analysis.

Table 1. Descriptive statistics.

Variables	Obs	Mean	Std. Dev.	Min	Max
GDPpc (in US dollars)	201	1973.071	1151.82	315.781	7556.283
Popgrowth	201	15.589	14.053	−35.25	55.38
Unemployment	201	5.619	2.711	1.7	14.5
Share of Industrial employees	201	8.643	6.484	.7	34.8
University	201	.284	.452	0	1
University Grad. rate	201	4.152	2.174	1.6	16.46
Public Investment pc	201	148.816	311.186	.3	2340

III. Empirical findings

Difference-in-difference estimation

Using the Difference and Differences estimation method, Table 2 reports the universities' economic effects in the provinces where they were established. The dependent variable GDPpc is shown in the first and second columns of Table 1, while the third and fourth columns display the unemployment rate. Columns (1) and (3) show the basic models, while columns (2) and (4) show models in which control variables are included in the econometric equation. The control variables we used in our study are population growth rate, city population rate, the share of industrial employees, university graduate rate and public investment per capita in province i at time t. The treatment variable is statistically significant in both basic models and models with added control variables. In other words, the statistical significance of the treatment variable's coefficient was not lost even after the control variables were added, indicating the importance of our treatment variable to explain the dependent variable. According to model (2), the provinces' per capita income in

Table 2. Effect of a university on per capita GDP and unemployment rates in provinces.

Variables	(1) GDPpc	(2) GDPpc	(3) Un	(4) Un
δ^{DID}	328.9*	408.5**	−1.445***	−1.331***
	(185.3)	(197.7)	(0.430)	(0.405)
Controls	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Observations	201	201	201	201
R-squared	0.138	0.622	0.353	0.455
Parallel-trends test	F(1, 66) = 1.71		F(1, 66) = 1.39	
	Prob > F = 0.1952		Prob > F = 0.2424	

Robust standard errors clustered at province level in parentheses. The total number of clusters is 67 in all columns. Control variables are population growth rate, the share of employees in the industrial sector, university graduate rate and public investment per capita. Test for the parallel trend is also given in Table 2, indicating the parallel trend assumption holds. ***p < 0:01, **p < 0:05, *p < 0:1.

Table 3. Entropy balancing outcomes.

	Before: Without Weighting						After: With Weighting		
	Treatment			Control			Control		
	Mean	Variance	Skewness	Mean	Variance	Skewness	Mean	Variance	Skewness
Population growth rate	12.77	113.8	0.058	13.5	232.9	0.179	12.77	113.8	0.058
Share of industrial employees	9.242	22.73	0.944	8.915	46.72	1.445	9.242	22.73	0.944
University graduate rate	5.932	2.025	0.940	4.685	5.028	2.175	5.932	2.025	0.940
Public investment per capita	240.6	2666	1.182	133.7	10,713	4.751	240.6	2666	1.182

which universities were established in 1992 is 408.5 dollars more than the provinces without new universities in 2000.

Another hypothesis of our paper to be tested is whether the unemployment rate falls in provinces where universities were first established. When we look at model (4), the provinces' unemployment rate in which universities were established in 1992 is approximately 1.33 percentage points lower than the provinces without new universities in 2000, implying that universities, directly and indirectly, play an important role in decreasing unemployment in the local economy.

Further analysis

We use the terminology matching DID to take the analysis further to emphasize that the estimator provides additional robustness against selection on unobservables. We implement a reweighting technique, entropy balancing (Hainmueller 2012), that focuses directly on the balancing of conditioning variables. It constructs a set of matching weights that, by design, forces certain balance metrics to hold. Entropy balancing requires a set of balance conditions to be provided. These are often of the form "the mean of matching variable X must be the same between treated and control observations such that;

$$\sum_{i|D_i=0} w_i X_i = \sum_{i|D_i=1} X_i$$

where X_i indicates treatment status and w_i are the matching weights, and similarly for other variables for which the mean (first moment) should match. Second, and possible higher moments of covariate distributions can also be included. Entropy balancing is more effective in reducing covariate imbalance than propensity score methods as it reweights the control group observations in such a way that the control group satisfies pre-specified balancing requirements (ie. same mean and variance of conditioning variables as in the treatment group) (Marcus 2013).

Provinces without newly established universities were weighted to meet the targets of balance on the three moments (mean, variance and skew) of the 4 independent variables shown in Table 3. Table 3 displays descriptive statistics for the 4 covariates before and after matching subsamples based on entropy balancing. The balance table includes the means, variances and skewness of covariates for both treatment and control pre and post weighting. As seen from the table, the moments of these variables across the subsamples are reasonably very similar prior to reweighting, which should also help the convergence and optimization process. In fact, the balancing algorithms only required 9 iterations to converge fully.

Therefore, in this section, we perform entropy balancing procedure. Firstly, we obtain the weights from entropy balancing, called the matching/reweighting step. In the second step, we regress the change in per capita GDP and provincial unemployment rates on the treatment indicator with the sampling weights obtained in the first step. By doing so, matching ensures that only comparable provinces are compared. Table 4 displays the results for the entropy matching DID estimator.

Table 4. Matching DiD results after entropy balancing.

	Matching DID	
Variables	GDPpc	Un
δ^{DID}	727.544*	−1.619*
	(389.907)	(0.856)

The table presents the effect of establishment of new universities on GDP per capita and unemployment rate in provinces using 'mathing DiD' results after entropy balancing. Each cell displays the ATT from a separate regression and its robust standard error in parenthesis.
* p < 0.1 **p < 0.05 ***p < 0.01

Table 5. Robustness check: per capita GDP and unemployment rates in 1990 and 2000.

Variables	Per capita GDP 1990	Per capita GDP 2000	Unemployment rate in 1990	Unemployment rate in 2000
University	122.3	302.0	0.152	−0.269
	(219.6)	(291.6)	(0.422)	(0.437)
Popgrowthrate	10.55*	−9.704	0.00580	0.114***
	(5.860)	(8.373)	(0.0153)	(0.0163)
Shareofindustrialemployees	114.9***	116.0***	−0.205***	−0.239***
	(31.47)	(23.00)	(0.0555)	(0.0444)
Unigradrate	280.5***	243.5***	−0.492***	−0.447***
	(77.88)	(37.90)	(0.143)	(0.0874)
Public investment pc	49.16	0.175	0.000150	0.00138***
	(43.69)	(0.253)	(0.0872)	(0.000380)
Constant	954.5***	1,220***	−0.356	−2.252*
	(358.4)	(445.3)	(0.802)	(1.285)
Observations	67	67	67	67
R-squared	0.632	0.660	0.486	0.740

Robust standard errors in parentheses, *** p < 0.01, ** p < 0.05, * p < 0.1

The mathing DiD results in Table 4 supports the empirical findings in basic DiD specification in Table 2 in the previous section. Although the significance levels of coefficients become lower, they are still significant at 10% and their signs are as expected. Accordingly, provinces with newly established universities have a higher GDP per capita and lower unemployment rate in 2000, when only comparable provinces are compared with the help of entropy balancing.

Table 5 indicates the analysis for the years 1990 and 2000 using a cross-sectional analysis of the university's effect on per capita income and unemployment variables in provinces for the robustness check. We explore that provinces' per capita income and unemployment rates with and without universities are not statistically different. This result proves the causality effect of universities on economic growth and unemployment, expressed in Table 2.

IV. Conclusion

The primary purpose of establishing universities is to contribute to the education level by increasing human capital. In this context, universities have three fundamental functions. These are: to train the workforce needed by the society, to direct social development, and to eliminate the wrong information that prevents development (Hatiboğlu 1995). In addition to this primary purpose, it is apparent that universities contribute to the province's economic and social life.

In order to give the estimates a causal interpretation, this study applies a combination of matching and difference-in-difference estimation that is robust against selection of observables and selection of unobservables with time-invariant effects. Econometric analysis reveals that unemployment rates fall in the provinces where universities were established in 1992. We also find that new universities statistically increased the per capita income of the province.

To conclude, in addition to generating knowledge, contributing to human capital, and raising educated individuals, which are among the primary goals of universities, they also contribute to the provinces' economy where they were established. In particular, this paper demonstrates that opening new universities in almost all provinces in Turkey has also been conducted for economic purposes.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Appendix

Table: The list of universities established in 1992 in Turkey

	University Name	Establishment year	Province
1	Afyon Kocatepe University	1992	Afyonkarahisar
2	Adnan Menderes University	1992	Aydın
3	Balıkesir University	1992	Balıkesir
4	Abant İzzet Baysal University	1992	Bolu
5	Çanakkale Onsekiz Mart University	1992	Çanakkale
6	Pamukkale University	1992	Denizli
7	Mustafa Kemal University	1992	Hatay
8	Süleyman Demirel University	1992	Isparta
9	Galatasaray University	1992	İstanbul
10	İzmir Institute of Technology	1992	İzmir
11	Kahramanmaraş Sütçü İmam University	1992	Kahramanmaraş
12	Kafkas University	1992	Kars
13	Kırıkkale University	1992	Kırıkkale
14	Gebze Technical University	1992	Kocaeli
15	Kocaeli University	1992	Kocaeli
16	Dumlupınar University	1992	Kütahya
17	Celal Bayar University	1992	Manisa
18	Mersin University	1992	Mersin
19	Muğla University	1992	Muğla
20	Niğde University	1992	Niğde
21	Harran University	1992	Şanlıurfa
22	Gaziosmanpaşa University	1992	Tokat
23	Bülent Ecevit University	1992	Zonguldak