Capturing the Economic Impact of a Public Institution: the Rovira i Virgili University[1]

By

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Abstract

This paper deals with some of the effects associated with a public institution in the territory. Specifically, I use the input-output method to estimate the economic impact of the Rovira i Virgili University (URV) in the region of Tarragona. First, I construct an input-output table for the province of Tarragona in 1999 using a non-survey method: the RAS technique. Then I calculate the amount of expenditure generated by the presence of the University, including investment by the URV, students consumption and expenditure of the staff. I use the input-output demand model with this information to evaluate income creation and employment effects of the University activity in the territory. This empirical study shows that Rovira i Virgili University plays an important role within its area of influence.

1. Introduction

Public institutions such as universities are a significant source of employment and income in a local economy. Regional economic analysis often tends to underplay the economic impact of public institutions. The main interest usually lies in determining the effects of industry and production, because these can be calculated easily.

The main functions of universities are research and teaching. In practice, however, a university develops a very large and complex set of activities. Universities today have many employees, make a significant consumption of goods and services, and transfer technology to other economic agents. Universities are therefore highly integrated within the economic structure of their regions.

This paper analyses, at the empirical level, the economic benefits to the province of Tarragona accrued by the presence of the Rovira i Virgili University (URV). The

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economic impact of this institution is defined in terms of its input and output links with the economy in the province. In this study I construct an input-ouput table for Tarragona in 1999 and use it to calculate the income generated by the URV and the effects of the University on employment.

The Rovira i Virgili University was founded just ten years ago as a public institution. The area of influence is the province of Tarragona (in the southwest of Catalonia), comprising 6.253 Km^2 and 588.499 habitants in 1999 (9.5% of Catalonia). In 1999, the University employed 998 full-time and 391 part-time persons and had 11.735 students. Today, the URV offers over 30 different degrees in ten faculties, which are located in the cities of Tarragona and Reus.

Similar studies have evaluated the effects from the income and employment of universities and other non-profit institutions. For example, Moore and Sufrin (1974) studied the economic benefits of Syracuse University through a model of macroeconomic multipliers. Also, Bleaney et alia (1992) discussed the effects of University of Nottingham by the estimation of the local multiplier effects and the calculation of output and income impacts. Armstrong (1993) studied the local income and the employment impact of Lancaster University, using keynesian multipliers.

Generally, a complete economic analysis of the impact of a regional university should incorporate both measurements of the flow of annual economic activity attributable to the existence of the institution (short-term effects) and long-term effects (Beck et alia, 1995). Long-term effects are measured in terms of the institution's contribution to the stock of human capital and technology. However, evaluating such long-term effects requires many data and these are usually very difficult to obtain. In this paper, therefore, I shall only evaluate the short-term effects of the University's activity.

The paper is organised as follows. In the next section, I present the theoretical approach used in the analysis. Section 3 describes the construction of the database for the empirical application, and section 4 illustrates the main results. At the end of the paper are some concluding remarks.

2. Capturing the Economic Impact of the University

The theoretical approach is based on the input-output framework. I have used this method to quantify the degree of URV integration in the productive system of the economy in the province. With this, I can also evaluate the income creation and employment effects generated by the University expenditure.

The demand version of the input-output model, in matrix notation, is defined as follows[2]:

$$AX + D = X, \tag{1}$$

where A is a matrix of technical input-output coefficients, X is a vector that contains the final output in every sector, and D is a vector of final demand. The sectorial output is then equal to:

[2] See, for example, Miller and Blair (1985) for an exposition of the input-output analysis.

$$X = (I - A)^{-1} D = MD, \tag{2}$$

where I is the identity matrix, and $M = (I - A)^{-1}$ is the *Leontief inverse matrix*. Expression (2) can be transformed in terms of variations, as follows:

$$\Delta X = (I - A)^{-1} \Delta D = M \Delta D, \tag{3}$$

assuming that $(I - A)^{-1}$ exists and assuming that A remains constant. Expression (3) determines the changes in the output values when there is a change in the final demand of an activity or a change in the final demand of all the activities simultaneously.

The model described in (3) captures the entire sequence activated in the production sphere caused by a modification in the final demand. In this sense, an increase in the demand of one sector will generate an increase in its production to cover the new demand and, at the same time, this sector will buy more inputs to the other sectors, and so on. Consequently, the final effect in the sectorial production is the result of the interdependence relationships in the productive sphere.

The model described in (3) assumes that all the final demand items are exogenous. The assumption that consumption demand is exogenous, however, is contrary to the basic economic theory. Consumers earn income in payments for their endowments of labour supply and capital and, in the role of consumers, spend income in final goods and services. To take into account the channel from the income increase to the increase in the final consumption, we can extend the model by moving the household from the final demand to the input-output matrix, that is, make the consumption endogenous. This extension leads to the following expression:

$$\Delta \overline{X} = (I - \overline{A})^{-1} \Delta \overline{D} = \overline{M} \Delta \overline{D}. \tag{4}$$

In expression (4), $\overline{X}$ is the vector of final output and has $n+1$ elements (n production activities and 1 household sector). Similarly, $\overline{D}$ is the vector of final demand for the $n+1$ elements (n remaining final demand for sectors and 1 final demand for the output of households). Finally, matrix $\overline{A}$ has the following structure:

$$\overline{A} = \begin{bmatrix} A & u \\ v & 0 \end{bmatrix},$$

where u is a column vector of sectorial consumption coefficients, calculated by dividing the sectorial consumption by the total value added of the economy, and v is a row vector of value added coefficients, calculated by dividing the sectorial value added by the sectorial output.

In this study, I define economic impact as the difference between the economic activity in the region given the presence of the University, and the level of economic activity there would be if the University institution did not exist. This impact can be measured by taking into account the amount of expenditure that is directly associated with the presence of the URV. This method, therefore, is in line with the accepted theory and practice in regional economic studies, which consider higher-education institutions as regional enterprises (Beck et alia, 1995).

To empirically implement the model I need to reflect the amount of URV expenditure. Specifically, I have considered investment by the University, consumption by the

University staff and consumption by the students. All these categories of expenditure define one vector (Δe) that contains all the demand for the productive activities due to the presence of the University:

$$\Delta e = \Delta i + \Delta w + \Delta s. \tag{5}$$

In expression (5), Δi is a vector that contains the sectorial destination of the University's investment; Δw is a vector that reflects the sectorial destination of the consumption of the University's employees; and Δs is a vector that contains the sectorial destination of students' consumption.

Let $\overline{M}^*$ denote the elements of matrix $\overline{M} = (I - \overline{A})^{-1}$ for the n production activities. If we combine the total expenditure defined in expression (5) with expression (3), the input-output model quantifies the sectorial production due to the presence of the University as follows:

$$\Delta X = \overline{M}^* \Delta e. \tag{6}$$

I can write expression (6) in the following way:

$$\Delta X = I\Delta e + [M - I]\ \Delta e + [\overline{M}^* - M]\ \Delta e. \tag{7}$$

Therefore, total impact in the sectorial production (ΔX) is divided into three different effects:

1. *Direct effect* ($I\Delta e$), which contains the initial increase in demand in each sector as a result of the University activity. This effect quantifies the amount of sectorial demand in investment and consumption made by the University, its employees and its students.
2. *Indirect effect* ($[M - I]\ \Delta e$). The sector that receives the final URV demand will need to increase the production and will also increase the input demand to the others sectors, and so on. The indirect effect is therefore caused by the interdependence relationships in the productive system.
3. *Induced effect* ($[\overline{M}^* - M]\ \Delta e$). This effect shows the additional impact on the production of the endogeneization of consumption. Specifically, the increase in production will lead to an increase in value added, which will rise the private income and private consumption; as a result, production increases again, and so on.

Finally, the input-output model also shows the effects on employment in the Tarragona region due to the University's activity. These employment effects are calculated as follows:

$$\Delta O = O\,\overline{M}^* \Delta e. \tag{8}$$

In expression (8), O is a diagonal matrix of the employment coefficients, calculated as the number of workers divided by the output in each sector. If the presence of the University helps to generate production, the activities will need new workers to satisfy this production. This effect is quantified in (8).

3. Database

The model described in the previous section evaluates the economic impact of the Rovira i Virgili University in the productive system of the Tarragona region. However, to empirically implement this model, the activity of the URV has to be reflected in the input-output table as a differentiated sector. I have obtained the necessary information directly from the budget and the public accounts of the University, and for several variables I have applied some indirect calculus. The reference year is 1999, the same period for which I calculate the input-output table for the province of Tarragona.

To reflect the URV activity in the input-output table, I needed to know the amount of outlays related to the University, and the components of these variables. Summing down the column in the input-output table, the outlays of sector j (X_j) are calculated as:

$$X_j = \sum_i X_{ij} + W_j + M_j. \tag{9}$$

In expression (9), the amount of outlays are equal to the intermediate inputs $\left(\sum_i X_{ij}\right)$, the value added ($W_j$) and the imports ($M_j$). The value added is defined as:

$$W_j = L_j + N_j,$$

where L_j includes the payments for labour services and N_j includes the profits of sector j.

Following expression (9), the intermediate inputs contain the purchases of raw materials and other intermediate services and products. This information was obtained directly from the URV's budget in 1999. Wages and salaries are also reflected in this budget. Profits include the income property obtained with the activity. The value for the profit variable of the URV was also obtained from the University's budget. The value of imports completes the University's outlays. For this, we have to consider that the output supplied by the URV is a final public service, which implies that there are no trade operations of equivalent products with foreign markets. Consequently, the value assigned to University imports in table 1 is zero.

To integrate URV activity into the input-output table, I also needed to compute the output of the University. Summing across the row in the input-output table, the amount

Table 1. Outlays of the URV, 1999.
(Thousand Euros)

Intermediate Inputs	13685.05
Wages and Salaries	28746.40
Profits	213.15
Final Production	42644.60
Imports	0
Total Outlays URV	**42644.60**

of output of a sector j (X_j) is equal to:

$$X_j = \sum_j X_{ij} + D_j. \tag{10}$$

The element $\sum_j X_{ij}$ is the intermediate output and contains the sales of raw materials and services, which are used in the production processes of the other activities. The University, as a higher-education institution, offers final services to the rest of the economy, which implies that the intermediate outputs are zero. However, there is an activity involving the transfer of knowledge and technology, which I consider as an intermediate output. The value of intermediate outputs is therefore equivalent to the budget value of the transfer services sold to firms and other institutions.

Also in expression (10), D_j is the final demand of the University. The input-output table defines the final demand of sector j as:

$$D_j = C_j + I_j + G_j + E_j. \tag{11}$$

Expression (11) reflects all the possible final destinations of the sectorial output: private consumption (C_j), investment (I_j), public consumption (G_j) and exports (E_j). I have obtained the private consumption in goods offered by the University directly from the budget, which incorporates the fees and public prices collected. The investment demand is zero, because there is no decision of this kind in the productive sphere materialised in goods supplied by the University. Public consumption is the amount of public services produced by the University. This value is not reflected directly in its budget. I have therefore obtained public consumption by indirect calculation, comprising the outlays of URV minus the private consumption and intermediate outputs, because the other components in the final demand variable (exports and investment) are zero. Finally, the value of exports to the foreign markets is zero, because the services produced by the URV are not traded abroad.

From the criteria described above, the final output of the University in 1999 is shown in table 2.

From the outlays and the output of the URV we can identify the University as a separate sector from the other activities in the input-output table. However, to compute the economic impact I needed more information. This information concerns the amount of expenditure generated by the presence of the URV (vector Δe in the previous section and all the components involved).

The expenditure vector is calculated as follows. The amount of investment and its sectorial destination (vector Δi) is obtained directly from the URV budget.

Table 2. Output of the URV, 1999.
(Thousand Euros)

Intermediate Outputs	1972.00
Private Consumption	9736.40
Investment	0
Public Consumption	30936.20
Exports	0
Total Output URV	**42644.60**

Table 3. Total Expenditure of the URV, 1999. (Thousand Euros)

Sector	URV Investment (Δi)	Employees' Consumption (Δw)	Student's Consumption (Δs)	Total Demand (Δe)
1. Agriculture	0	763.29	709.19	1472.48
2. Energy	0	1027.73	0	1027.73
3. Metals	0	24.04	0	24.04
4. Minerals	0	54.09	0	54.09
5. Chemistry	0	721.21	0	721.21
6. Machinery	3269.51	805.36	0	4074.86
7. Automobiles	0	775.31	0	775.31
8. Food	0	3449.81	3768.35	7218.16
9. Textile	0	1027.73	2824.76	3852.49
10. Paper	1171.97	498.84	3533.95	5204.76
11. Other industry	895.51	564.95	0	1460.46
12. Construction	13005.90	336.57	0	13342.47
13. Commerce	0	6611.13	2355.97	8961.10
14. Transportation	0	871.47	2590.36	3461.83
15. Finance	0	492.83	0	492.83
16. Private services	0	4110.92	7771.09	11882.01
17. Public services	4838.15	510.86	0	5349.01
18. Rovira i Virgili University	0.00	6.01	9712.36	9718.37
Total	**23181.04**	**22652.15**	**33266.03**	**79099.22**

To obtain the value of employees' consumption (Δw), I apply an indirect calculation. Wages and salaries is a variable in the URV budget[3] but, for an accurate evaluation, we have to bear in mind that our context for analysis is the province of Tarragona. For this reason, I have reduced wages and salaries in the proportion that corresponds to employees who live outside this area[4]. The justification for this is that the consumption of these employees has practically no impact on the local economy. Also, part of the wages and salaries is not materialised in consumption, but in savings. Therefore, to the salaries of the workers who live in the Tarragona area I apply the proportion of income that is effectively transformed into consumption[5]. The value resulting from this then has to be assigned to each activity. The sectorial destination of consumption has been obtained from the *Instituto Nacional de Estadística* (1995)[6].

In 1999 the URV had 11.735 students, 66.5% of whom lived close to the faculties[7]. For these students, I calculated expenditure related to registration fees, academic

[3] The calculation of the consumption of URV employees does not reflect the investment demand from house purchases. This item is also due to the presence of the University, but no information is available for it. The effects on the construction sector will therefore be undervalued.

[4] In 1999, 9.7% of the employees lived outside the province of Tarragona.

[5] The value is 0.8723, which indicates that the consumption is 87.23% of personal income (*Fundación BBVA*, 2000).

[6] The last available information is for 1990, and concerns all whole of the Catalan economy.

Table 4. Employment and Final Production. Tarragona, 1999. (Number of jobs and thousand Euros)

Sector	Employment (a)	Final Production (b)	(a) / (b)
1. Agriculture	23507	1244359	0.0189
2. Energy	2901	2823905	0.0010
3. Metals	703	50360	0.0140
4. Minerals	4154	331372	0.0125
5. Chemistry	5648	737037	0.0077
6. Machinery	10420	842025	0.0124
7. Automobiles	1447	43373	0.0334
8. Food	6921	1093543	0.0063
9. Textile	2969	351513	0.0084
10. Paper	3585	254501	0.0141
11. Other industry	5335	306185	0.0174
12. Construction	34858	1930275	0.0181
13. Commerce	55520	3854685	0.0144
14. Transportation	10712	721514	0.0148
15. Finance	4587	3836313	0.0012
16. Private services	30096	2010406	0.0150
17. Public services	36913	1078707	0.0342
18. Rovira i Virgili University	1327	42644	0.0311

material, public transportation and leisure services[8]. For the remaining 33.5% of students, I added living expenditure[9]. Finally, I applied a common criterion based on the demand of students that would be generated if the University did not exist and they had had to study at other universities (Lewis, 1988). Specifically, I used the information related to the higher-education students from the province of Tarragona to other universities before the foundation of the Rovira i Virgili University. The sectorial destination of the amount of students' consumption has been obtained from the *Instituto Nacional de Consumo* (1998)[10]. In this way I obtained the vector Δs.

Table 3 shows the expenditure related to the presence of the University in 1999. By sectors, construction receives the most overall demand (16.9%), followed by private services (15%) and the Rovira i Virgili University (12.3%). By components, students' expenditure is the largest value, whereas the values for employees' consumption and

[7] I include in this area the administrative division of Alt Camp, Baix Camp, Tarragonés and Baix Penedés.

[8] To make an accurate estimation of students' consumption, I did not take into account the living expenditure of the students that lived near the faculties, because this expenditure cannot be directly attributed to the URV presence.

[9] In order to capture the attraction of new students coming far away from Tarragona, this category includes all the students coming from other areas of Spain.

[10] According to the sectorial proportions in this source, in some cases the sectorial values of students' consumption is zero.

Table 5. Input-Output Transactions Matrix. Tarragona, 1999. (Thousand Euros)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	URV	Total
1	362221	0	0	212	6994	0	0	652779	10338	11112	28809	1100	229200	0	0	945	14262	0	1317972
2	59455	1235741	10637	93656	178761	73568	3144	26628	29200	32904	27462	67714	406091	100175	120153	116945	82971	4835	2670040
3	585	141	8273	812	1437	82022	2048	252	21	534	2538	30132	0	173	0	0	0	0	128968
4	112	198	179	20038	3663	10054	217	2603	49	417	472	234451	2351	29	0	1327	65	0	276225
5	38861	9347	663	10998	156982	26212	972	6550	21470	15537	42658	13242	43674	808	575	24225	23039	366	436180
6	12170	5309	349	3701	7363	75311	2976	2810	1318	1888	3665	138324	93206	2980	2762	9449	13628	275	377485
7	174	0	0	0	0	34	2422	0	0	0	0	0	9290	325	0	60	140	0	12444
8	172145	0	0	0	4466	0	0	25316	7624	221	0	0	184177	152	0	2996	8228	0	405324
9	3111	85	28	1120	3000	4294	397	634	102860	1204	7391	869	3469	375	0	1809	2194	41	132881
10	0	226	16	1183	4835	733	50	2865	724	38732	1568	1795	17192	1840	16228	31302	4474	606	124368
11	4281	452	54	1710	5108	23543	2039	4768	1705	2331	28141	30576	35926	4697	230	2895	4184	349	152988
12	1145	3247	217	1929	1157	1516	87	394	246	66	407	0	61444	7251	59885	131541	13402	2396	286329
13	101291	32898	11513	17569	44429	115997	10372	38274	20205	24582	17293	284426	210080	34719	61074	54723	54715	953	1135116
14	17334	6636	696	8496	9324	13809	935	7567	2745	2929	3637	59105	77788	34524	67826	32790	13025	832	359999
15	1506	3756	86	1498	3656	5254	427	1564	1381	1278	1987	43007	49224	5484	2783245	10273	1968	41	2915634
16	2028	12002	259	4825	13635	13523	2148	5326	2278	3571	3766	64819	134914	13572	208235	133491	92791	2992	714174
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
URV	12	424	24	86	177	370	22	33	4	8	12	58	77	43	77	362	183	0	1972
Total	776430	1310461	32995	167833	444986	446239	28256	778362	202169	137316	169807	969616	1558102	207147	3320290	555133	329270	13685	11448098

investment are similar.

To calculate the occupation effects (see expression (8) of the model), we need to know the relationship between employment and final production in each activity. This information is given in table 4. The values for employment are from the *Instituto Nacional de Estadística* (1999), and the final production is the one used to calculate the input-output table for Tarragona in 1999, which I shall explain below.

The input-output table is constructed on the basis of a non-survey method: the RAS technique (Bacharach, 1970). This technique allows us to project an input-output coefficient matrix to a future period by using a reference coefficient matrix. The table of origin is the input-output table for Catalonia in 1987 (*Cambra Oficial de Comerç, Indústria i Navegació de Barcelona and Departament de Comerç, Consum i Turisme,* 1992). So, in this exercise I calculate a spatial projection of the input-output coefficient matrix (from Catalonia to Tarragona) and a temporal projection (from 1987 to 1999).

To apply the RAS method I also need to know the sectorial value added for the Tarragona area, the intermediate inputs (the sum of columns in the unknown matrix of intermediate transactions) and the intermediate outputs (the sum of rows in the new intermediate transactions matrix).

The sectorial value added for the province of Tarragona was obtained from the *Fundación BBVA* (2000). I calculated the intermediate inputs by assuming that the relationship between these inputs and the value added in the original table of 1987 is reproduced in the new table. The amount for final output can then be calculated as the sum of the intermediate inputs and the value added in each activity. Finally, I have adapted the intermediate outputs of the original input-output table to preserve the identity between the intermediate inputs and the intermediate outputs in the projected table.

Using the criteria described above, I applied the RAS method. Table 5 shows the input-output transactions matrix for Tarragona in 1999, in which the activity of the URV is reflected as a differentiated sector. This allows us to show the interdependences of the University with the other sectors of production.

Finally, to calculate the consumption coefficients (the vector u in matrix $\overline{A}$) I need to know the sectorial values of final consumption for Tarragona in 1999. The amount of consumption was obtained from the *Fundación BBVA* (2000). The sectorial destination of this variable was obtained by using the information of the *Instituto Nacional de Estadística* (1995).

4. Results of the Economic Impact

This section summarises two types of results reported by the model: the income creation and the employment effects of the Rovira i Virgili University.

Before showing these global effects, we can use the input-output model to analyse the income multiplier for the University sector. This multiplier is equal to the sum of the elements corresponding to the URV column in the Leontief inverse matrix (matrix M). The resulting value quantifies the diffusion effect to the rest of the production sphere when the URV receives a unitary and exogenous injection. This multiplier is equal to 1.594, which means that every unit of inflows received by the University is

Table 6. Multipliers in Higher Education Studies. (Huggins and Cooke (1997))

University	Multiplier (diffusion effect)
Bristol Polytechnic	1.15
Lancaster	1.15 – 1.25
Lancaster Polytechnic	1.50
Liverpool	1.45
Manchester	1.17 – 1.25
South Shields	1.30
Southampton University	1.20
Stirling	1.24 – 1.54
Strathclyde University	1.66 – 2.15
University of East Anglia	1.20
Wolverhampton Polytechnic	1.03 – 1.10
Yorkshire & Humberside	1.30
Rovira i Virgili	**1.59**

Table 7. Production Effects of the URV, 1999. (Thousand Euros)

Sector	URV Investment	Employees' Consumption	Students' Consumption	Total Effect
1. Agriculture	5673.71	10750.05	12862.90	29286.66
2. Energy	12218.82	13652.84	17415.93	43287.59
3. Metals	1084.60	514.58	453.28	2052.46
4. Minerals	1999.96	432.04	508.51	2940.51
5. Chemistry	2644.66	3447.92	3693.34	9785.92
6. Machinery	6110.85	2616.95	2265.68	10993.48
7. Automobiles	686.36	1505.73	984.50	3176.60
8. Food	3929.77	8374.44	10187.03	22491.24
9. Textile	1420.07	2816.44	5940.26	10176.77
10. Paper	2181.19	1453.60	5556.54	9191.33
11. Other industry	2246.07	1669.57	1449.03	5364.67
12. Construction	14109.42	1717.77	2512.77	18339.95
13. Commerce	12259.39	17213.78	17090.11	46563.28
14. Transportation	2122.50	2779.50	5349.53	10251.53
15. Finance	3882.88	4908.31	4209.71	13000.91
16. Private services	6266.15	9988.55	16629.37	32884.07
17. Public services	5322.96	984.62	695.74	7003.32
18. Rovira i Virgili University	50.83	54.38	9781.24	9886.45
Total	**84210.18**	**84881.08**	**117585.49**	**286676.75**

Table 8. Production Effects of the URV. Direct, Indirect and Induced Effects, 1999. (Thousand Euros)

Sector	Direct Effect	Indirect Effect	Induced Effect	Total Effect
1. Agriculture	1472.48	12128.07	15686.11	29286.66
2. Energy	1027.73	20536.55	21723.31	43287.59
3. Metals	24.04	1227.22	801.20	2052.46
4. Minerals	54.09	2204.42	682.00	2940.51
5. Chemistry	721.21	3702.89	5361.82	9785.92
6. Machinery	4074.87	2854.97	4063.64	10993.48
7. Automobiles	775.31	98.85	2302.44	3176.60
8. Food	7218.16	3220.10	12052.98	22491.24
9. Textile	3852.49	1974.67	4349.61	10176.77
10. Paper	5204.76	1700.28	2286.29	9191.33
11. Other industry	1460.46	1298.31	2605.90	5364.67
12. Construction	13342.47	2209.54	2787.94	18339.95
13. Commerce	8967.10	9309.30	28286.88	46563.28
14. Transportation	3461.83	2481.31	4308.39	10251.53
15. Finance	492.83	4816.01	7692.07	13000.91
16. Private services	11882.01	4408.64	16593.42	32884.07
17. Public services	5349.01	0.00	1654.31	7003.32
18. Rovira i Virgili University	9718.37	14.94	153.14	9886.45
Total	**79099.22**	**74186.05**	**133391.47**	**286676.75**

transformed approximately into 1.6 units of income. This result is very close to those in other similar studies. Table 6 shows a comparative exposition of multipliers in higher education studies cited in Huggins and Cooke (1997).

Universities generally play an important role within its local economy, which can be quantified in terms of output and income effects. The values in table 6 suggest that the URV multiplier is in line with other similar studies of universities' impact. From table 6, therefore, we can take our results as general enough to measure the economic impact and income generation of the Rovira i Virgili University in the Tarragona region.

Table 7 summarises the production effect of URV activity, the total of which is 286676.75 thousand euros. Investment by the University produces 29.4% of the total effect, the employees' consumption produces 29.6% while the students generate the remaining 41%.

At the sectorial level, commerce receives the largest impact (16%). This is followed by energy (15%), private services (11%) and agriculture (10%). These four sectors therefore jointly receive 52% of the overall impact. We should point out here once more that the results of the model underestimate the real effect on construction activity because the lack of data means that I have not taken into account purchases of residence made by the URV employees.

The overall economic impact can also be divided into direct, indirect and induced

Table 9. Employment Effects of the URV, 1999. (Number of jobs)

Sector	Investment	Employees	Students	Total
1. Agriculture	644	1221	1460	3325
2. Energy	75	84	108	267
3. Metals	91	43	38	172
4. Minerals	151	33	38	222
5. Chemistry	122	159	170	451
6. Machinery	454	195	169	818
7. Automobiles	138	302	197	637
8. Food	149	319	387	856
9. Textile	72	143	302	517
10. Paper	185	123	470	778
11. Other industry	235	175	152	562
12. Construction	1531	186	273	1991
13. Commerce	1061	1490	1479	4031
14. Transportation	189	248	477	915
15. Finance	28	35	30	93
16. Private services	564	899	1496	2959
17. Public services	1095	203	143	1440
18. Rovira i Virgili University	10	10	1838	1858
Total	**6795**	**5867**	**9229**	**21890**

effects (table 8). The last row in this table indicates that the global impact was 3.62 times larger than the initial demand generated by the University. The decomposition of the production effects shows that direct effect is 27.6%, indirect effect is 25.9% and induced effect is 46.5% of the overall impact. By activities, the indirect effects are especially large in energy, agriculture and commerce because these activities are very integrated into the productive system. The induced effects show the largest values in commerce, energy, private services, agriculture and food. As is logical, the endogeneization of households causes the major impact in those activities with higher connection with consumption demand.

Finally, table 9 shows the occupation effects generated by the presence of the University. We can see that in 1999 the Rovira i Virgili University created 21890 jobs. Commerce received the largest effect, with 18.4% of the overall occupation. The effect received by agriculture is also important. This is explained mainly by the students and employees demand for consumption.

We should point out that the values in table 9 have to be taken very carefully. The input-output model assumes that production technology is fixed and implies that the proportion of workers is fixed. This hypothesis does not take into account any technological changes in the productive processes or changes in the proportion of employment.

5. Concluding Remarks

Universities today are large economic institutions that can have an important impact on their local economy. The size of these institutions illustrates the importance of higher-education activity in generating income and economic growth in regional economies.

In this paper I have presented a way of calculating the economic effects of a public institution of higher education. Specifically, I have used the input-output method to analyse the economic contribution of the Rovira i Virgili University in the Tarragona area. For the empirical application, I constructed an input-output table for the province of Tarragona in 1999, using the RAS technique. By incorporating the URV into the table as an individual activity, I have shown how the University affects sectorial production and job creation.

The URV has a clear economic impact on the productive system. The largest impact of the University's investment is on construction; consumption by URV employees mainly benefits commerce, energy and agriculture. Finally, the biggest impact of student demand is on energy, commerce and private services. In conclusion, my study shows that there is a real and large economic contribution produced by the University's expenditure at the territorial level.

Finally, for several reasons, we have to take the values in this paper with the usual caution for empirical applications. Firstly, the input-output method assumes that production technology is invariable in all activities, which implies that the adjustments in the productive systems are rigid. Secondly, the model does not take into account changes in prices, so adjustments come only from changes in quantities. Finally, there are information deficiencies that have to be taken into account. The Tarragona region is not always covered by the official sources of information. In some cases, therefore, I have had to apply indirect calculations for the unknown variables.

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