EVALUATING THE STRUCTURAL EFFECTS OF A BIG CULTURAL EVENT: THE CASE OF THE INTERNATIONAL EXPO ZARAGOZA 2008

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Abstract

In the summer of 2008, the *International Expo Zaragoza 2008* "Water and Sustainable Development" was held in Zaragoza (Aragon, Spain). This project was expected to modernize the city and transform the Aragonese economy, with positive long-term effects on production and employment. The aim of this paper is to analyze these effects from an economic perspective, analyzing the impacts produced by the investments and tourism expenditures associated with this Expo and the structural changes, measured by forward and backward linkages and dependence graphs. Our results suggest that the small and non-permanent structural transformations are balanced by the negative effects of the international crisis.

Key words: Input-output, forward and backward linkages, impact analysis, Expo Zaragoza.

JEL classification: D57; D61; D57.

1. Introduction

International Expositions and other large cultural and sporting events have been traditionally viewed as special occasions to drive a modernization or revitalization process in the areas (cities or regions) chosen to host them, given the concentration of investment efforts, usually co-financed by the regional, national and international governments.

The city of Zaragoza, in Spain, has a certain tradition in the organization of this type of international events. International Expositions have been held in Zaragoza, in 1868, 1885 and 1908. The first was a response to earlier exhibitions in Paris and London; the second was an updated version of the first one, and the third, in 1908, was a Hispanic-French exposition to mark the Centenary of the Zaragoza Sieges. (The latter had more of a focus on industry than its predecessors.) Since then, two other international expositions have been held in Spain, in Barcelona (1929) and Seville (1992).

Zaragoza won the right to stage the International Expo Zaragoza 2008, with the theme "Water and Sustainable Development". The aim of this event was to reflect on, discuss, and consider solutions to the problems of water and sustainability. Zaragoza lies in the center of the Ebro valley, a large and important agricultural region of Spain, and the Expo site was constructed on the banks of the Ebro river, around a kilometer of the city center.[1] On April 23rd 2005, the State Company Expoagua 2008, S. A. was created, a

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[1]The Ebro river flows for 565 miles (910 km) in a southeasterly course to its delta on the Mediterranean coast, midway between Barcelona and Valencia. It has the greatest discharge of any Spanish river, and its drainage basin, at 33,000 square miles (85,500 square km), is the largest in Spain; the river drains about one-sixth of the country.

public company managed jointly by the General State Administration, which financed 70% of the capital, the City of Zaragoza, which financed 15%, and the government of Aragon, which financed the remaining 15%. This group was responsible for the organization, promotion, management, and operation of the Exposition.

There is some literature analyzing the effects of international events from an urban perspective. For example, in Romero (2010), the Expo Seville 1992, the Barcelona 1992 Olympics, the America's Cup in Valencia 2007, and the Expo Zaragoza 2008 are all examined, focusing on the impacts on urban structures.

Similarly, there exists a vast literature on the socio-economic effects of such events, as in the case of the studies of cultural events (see Herrero et al. (2006) for the impacts of Salamanca Cultural Capital 2002).

However, most analysis of great events are mainly focused on sport, like the case of the women's tennis championship in Seville (Ramirez et al., 2007), the case of the 2002 FIFA World Cup (Lee and Taylor, 2004) or San Sebastian promotion (2005) for the World Championship Athletics held in San Sebastian. In addition, there are recent studies of the 2014 World Cup (Collado and Garola, 2012).

Other papers have examined the impact of International Expositions, such as the analysis of the International Exposition Lisbon 1998 (Gil-Perez et al., 1999), examining the effect of that event from an environmental perspective, since the Lisbon Expo was the first to focus on global problems, not just international relationship, and its theme was *"Oceans: A Heritage for the future"*. Regarding the Zaragoza Expo, Serrano et al. (2009) examined the associated investments and tourism expenditures, looking at impacts on regional production and employment, and finding that the effects were positive. These authors find that the Expo delayed the effects of the crisis, compared to other Spanish regions, and that Aragon's productive capacity, in structural terms, improved.

Our paper builds on this literature by analyzing whether this kind of event has any structural effect on the economy, which we will evaluate for the medium term. We analyze the productive structure of the Aragon regional economy and the changes observed during the period pre-Expo and post-Expo. To do this, based on an existing regional input-output table for 2005, a series of input-output tables has been obtained for the period 2006 to 2010. We study the changes in the intersectorial forward and backward linkages and, based on the information provided by graph analysis, we look for significant structural changes.

Our main results show that the Expo investments and tourism expenditures had a modest, though positive, impact on Aragonese production and employment and, according to forward and backward linkages and graph analysis, we can say that the productive structure has not been modified by the Expo, but that it may well have changed the intensity of the relationship between sectors.

The rest of the paper is structured as follows: in Section 2 a brief description of the methodology used and the main databases is offered. In section 3 we estimate the impacts on production and employment from the Expo investments and tourism expenditure. In section 4, the main results regarding the structural characteristics of the Aragonese economy and the changes over time are presented. Section 5 closes the paper with a discussion and a review of our main conclusions.

2. Methodology and Data

Input-output analysis has been shown to be a powerful methodology for determining the full effects of large events, due to its capacity to capture direct and indirect effects on economic variables.

Broadly speaking, input-output models describe the production flows between all economic sectors in an economy, establishing the relationship between domestic and external industrial activities, as well as the economic flows between productive sectors, institutions, and final consumers. It shows a simplified, but real, description of the entire production process and of the inter-relationships between factors, productive activities, and agents. Clearly, one of the main reasons for its utility is the breakdown by branches of productive activity, allowing us to describe in detail the productive structure of an economy and the products and income transfers between different sectors.

More specifically, if we denote by $\mathbf{x}$ the production vector; $\mathbf{y}$ denotes the net final demand; $\mathbf{A}$ is the matrix of total technical coefficients, representing the technology, and $(\mathbf{I}\text{-}\mathbf{A})^{-1}$ represents the Leontief's inverse matrix, the equilibrium equation for this economy can be written as:

$$\mathbf{x} = \mathbf{A}\mathbf{x} + \mathbf{y}$$

or, in terms of the Leontief inverse:

$$\mathbf{x} = (\mathbf{I}\text{-}\mathbf{A})^{-1}\mathbf{y}$$

This is the equilibrium equation for the demand-driven model, showing the relationship between total output and final demand and the effects that changes in final demand may induce in the output of the economy. Matrix $\mathbf{A}$, and the associated Leontief inverse are representations of the production technology as far as their representative elements show, respectively, the sectorial inputs of sector j necessary per unit of production of sector j (a_{ij}) and the total inputs generated in sector i that are directly or indirectly incorporated per unit of final demand of sector j (α_{ij}).

On the basis of the previous equations, the effects of final demand changes over main economic variables can be analyzed. Thus, if we denote by $\Delta\mathbf{y}$ an exogenous change in the final demand (due, as example, to an increase in investment, an increase in household's expenditures or an improvement in the trade balance), the additional output generated in the economy as consequence of this shock can be computed as:

$$\Delta x = \mathbf{e'}(\mathbf{I}\text{-}\mathbf{A})^{-1}\Delta\mathbf{y}$$

being $\mathbf{e'}$ a unitary row vector of adequate dimension. Moreover, if we denote by $\mathbf{l}$ a vector of sectoral labor coefficients $\mathbf{l} = \{l_j\}$, j = 1, …, n; $l_j = (L_j/x_j)$, the additional labor associated with the demand shock can be obtained as:

$$\Delta L = \mathbf{l'}(\mathbf{I}\text{-}\mathbf{A})^{-1}\Delta\mathbf{y}$$

The equations above allow us a first quantification of the economic effects associated with the Expo. However, in order to analyze the potential structural changes for the economy, we have to go further into the study of the direct and indirect links between sectors and the potential changes in the production technology. To do this, two types of strategies are followed. First, on the basis of matrix $\mathbf{A}$, a graph analysis is developed. The main results show that although there have been some small changes in the Aragonese economy, the productive structure has not changed as a result of the Expo.

Second, on the basis of the Leontief inverse $(\mathbf{I}\text{-}\mathbf{A})^{-1}$, an analysis of intersectorial linkages and the changes during the period of study is carried out, studying the role of sectors and looking for a taxonomy on the basis of the Rasmussen (1956) classification. The backward coefficients are calculated as a sum of the $(\mathbf{I}\text{-}\mathbf{A})^{-1}$ columns and show the production generated in the whole economy per unit of final demand. In other words, the backward coefficients inform about the capacity of a sector to drive economic activity when sectoral final demand increases (household consumption, investment, trade balance). The forward coefficients are calculated as the sum of the $(\mathbf{I}\text{-}\mathbf{A})^{-1}$ rows. These coefficients compute the sectoral production incorporated per unit of final demand of all the economy sectors; that way, these coefficients inform about the role of the sectors facilitating the activity of other sectors, supplying inputs to fulfill their final demands. According to Rasmussen (1956), economic sectors can be classified into four groups: key sectors (KS) are those whose unitary forward and backward coefficients are higher than the average; a backward sector (BS) is one whose unitary backward effect is higher than the average but the unitary forward effect is not; a forward sector (FS) is one whose unitary forward effect is higher than the average but the unitary backward effect is not; and, finally, a non- significant (NS) sector is one in which both the unitary forward effect and the unitary backward effect fall below the average. The understanding of these sector groups gives us important structural information about the whole economy. A key sector depends on other industries, that is to say, it uses inputs from other sectors in order to incorporate them in its production process and, in turn, its output is sold to other industries to be modified in their production process. In summary, it is a sector highly integrated in the economic structure, which pull and push the activity of the sectors. In a BS or a FS just one of the two perspectives can be highlighted.

The empirical bases for implementing the analysis presented in the previous section are the regional input-output tables.

The last input-output table which exists for Aragon is that of 2005. This table was constructed by Perez and Parra (2009) and was an update of the table of 1999, produced by the Ibercaja Research Department, Ibercaja (2003). In our work, first, the Aragonese input-output table of 2005 is updated to 2006, 2007, 2008, 2009 and 2010, and these are then used to analyze changes in the productive structure of the Aragonese economy during the period. Then, we use Leontief´s demand model to analyze the impact that the Expo had on production and employment in the Aragonese economy.

In order to update the Aragonese input-output tables, we need the data for the aggregate magnitudes for the relevant years. These measures are: intermediate consumption, value added, gross production, and total resources. In addition, we need information on imports and on the components of final demand, such as exports, final consumption expenditures, and gross capital formation. This information comes from a range of sources: the INE (National Statistical Institute) (2013a and 2013b), IAEST (Aragon Statistical Institute) (2013a and 2013b), C-intereg (2013), and Datacomex (2013).

Once we have this data, either from the statistical sources directly, or using estimation methods, we need an updating method to construct the table. We choose the GRAS method, proposed by Junius and Oosterhaven (2003) and improved by Lenzen et al. (2007), because it is an improvement on the RAS method, and allows updating of matrices, even if they are not squared. Further, the GRAS method allows negative

components, which is very important in a regional input-output table where it is quite common to encounter negative figures - for example, in agricultural taxation, or in certain final demands.

The GRAS method is implemented in two parts. First, it is applied to the table of intermediate inputs; in this case we use the total values of intermediate consumption and of the final demand components, as well as the total of uses. Second, the GRAS method is applied to the value added table; in this case we need the total of gross value added for each sector and the totals at aggregate level of employee compensation, gross operating surplus, and taxation. This allows us to construct updated tables for 2006, 2007, 2008, 2009 and 2010 of total inputs (but not input-output tables of regional inputs, due to the lack of statistical information). A final common aggregation level of 24 sectors has been considered, also matching the coexisting CNAE-93 and CNAE-09 nomenclatures. More information on the specificities of this process is available upon request.

Additionally, in order to analyze the effect that the Expo had on the economy of Aragon, we first need data on the investment and tourism expenditures associated with the Expo; and we then estimate their impact on the economy (on the main economic magnitudes and on employment), as other authors such as Banguero et al. (2009) do, by using the Leontief´s demand model. As we have said, the Expoagua State Company was established for financial support of the Exposition in 2005 and from this source we obtain a range of investment data. However, other entities invested in the Expo 2008 (Serrano et al, 2009); the data used to calculate the impacts are mainly obtained from this source, but we need to adapt them to our objectives and we implement an annual distribution.

Table 1 presents the share of the Expo investment and tourism expenditure as a percentage over Aragonese GDP. We can see that the percentage it represents is very small, suggesting at this first step that the expected impact of Expo investment is not going to be very significant.

Table 1: Expo investment and tourism expenditure as a percentage over Aragonese GDP

Thousands of Euros	2005	2006	2007	2008
Total Expo investment	25,501	341,050	625,967	535,320
Expoagua and SEEI	4,710	107,713	258,136	262,601
Accompanying plan	17,237	151,477	211,529	165,265
Associated projects	3,553	81,859	156,302	107,453
Tourism expenditure	0	0	0	283,618
GDP in Aragon	28,184,16	30,625,26	33,285,27	34,672,23
Percentage of Expo investment over Aragonese	0.09%	1.11%	1.88%	1.54%
Percentage of tourism expenditure over Aragonese				0.82%

Source: own elaboration based on Serrano et al. (2009).

The tourism expenditure data connected with the Expo are also obtained from Serrano et al. (2009). In this case, it is not necessary to do a distribution in years, because this expenditure was largely in 2008. Thus, all accounted tourism expenditure will be applied to the input-output table for 2008. Similarly, in order to evaluate the impact of the Expo on employment, employment coefficients are also obtained (defined as hours worked in production, for each industry).

3. Economic impact assessment

As it has been presented previously, to estimate the impacts that the Expo investment and tourism expenditure had on the Aragonese production and employment we make use of the Leontief´s demand model. In our case, we have calculated the impact that investment and tourism expenditure have had on both magnitudes, production and employment. In the following Tables, we present the results obtained for the shocks described in Table 1.

Table 2: Impact on production and employment from the Expo investment

Impact	Investment of Expoagua on		Investment of "Accompanying		Investment of "Associated		Total investment impacts on	
Year	producti	employme	producti	employme	producti	employme	Producti	employme
2005	11,657	67	42,173	249	8,788	52	62,620	368
2006	274,366	1,130	41,734	1,627	8,788	875	324,890	3,633
2007	662,891	2,562	533,219	2,144	403,014	1,580	1,599,12	6,286
2008	598,570	2,427	369,788	1,549	245,565	1,008	1,213,92	4,984
Total	**1,547,48**	**6,186**	**986,916**	**5,570**	**666,157**	**3,515**	**3,200,56**	**15,270**

Production is measured in Thousands of Euros; employment is measured in number of employees assuming an eight-hour workday. Source: own elaboration.

Table 3: Tourism expenditure impact in 2008

2008	On	On
Agriculture and ranching	42,851	1,270,153
Extractive industry	8,051	82,986
Energy and water	6,986	31,256
Food industry	76,049	398,809
Textiles, leather and footwear	2,272	41,841
Industry of wood and cork	806	8,418
Paper industry	7,622	50,708
Chemical industry	18,169	108,779
Rubber and plastic industry	3,379	26,542
Non-metallic mineral products	1,775	16,639
Metal	12,661	133,274
Transport material	4,118	17,275
Other manufacturing industries	705	8,701
Construction products	2,722	28,985
Trade of vehicles and fuel: repairs	15,347	320,339
Wholesale business	7,735	162,226
Retail trade	13,337	309,858
Hotel industry	151,314	3,382,366
Transport	29,846	545,295
Post and telecommunications	7,600	91,889
Finance, insurance and pension	36,490	424,710
Real estate activities	2,581	2,916
Other business services	121,356	1,822,481
Public services	0	0
Total	**573,773**	**9,286,444**

Production is measured in thousands of Euros; employment is measured in hours. Source: Own elaboration.

First, if we observe the impact from investments and we review the scarce literature on this topic, we see clear differences in production impacts and small differences in relation to employment. According to Serrano et al. (2009), the total impact on production between 2005 and 2008 was €2,183 million. Our estimation of the total impact on production is €3,248 million, largely because of the different methodology used. Our estimations are based on total input-output tables and not on tables of regional coefficients, so these estimations are of internal impacts (in Aragon) plus the impact in the rest of Spain (note that, for us, one third of the Expo impact benefited other Spanish regions). The small differences in the impact on employment are probably caused by differences in the labor coefficient estimations.

As we can see in Table 2, the total impact on production in the Aragon economy caused by the total investments resulting from the Expo is around €3,200 million, which represents approximately 4% of the 2008 gross production of Aragon. The impact on employment was more than 15,000 employees, approximately 0.60% of the employment in Aragon in 2005, 2006, 2007 and 2008. These impacts took place mainly in 2007 and 2008.

In Table 3, we see the impact of tourism associated with the Expo. The tourism expenditure causes a total impact on the 2008 Aragon economy of €574 million and an increase in employment of 9 million hours, equivalent to 3,180 workers if we assume an eight-hour workday. These represent approximately 1.66% of gross production and 0.50% of Aragon employment in 2008.

In 2005, 43.55% of the total impact because of the Expo investment benefited the Construction products sector, the largest beneficiary in that year. The Metal sector benefited by 12.31%, while the impacts on Hotel industry and Transport were very small. The effect on employment in this year is similar to the effect on production: the total employment generated in the Aragonese economy because of the Expo is 373 workers, of which 179 are in the construction sector.

In 2006 something similar happens, but on a larger scale: 44.77% of the total impact on production by Expo investments (representing €387 million) was in the construction sector; the metal sector benefited by 12% of the total impact, and Other business services benefited by approximately 6% of the total impact. Again, the effect on the hotel, transport, and commerce services is not significant. Our results suggest that the effect on employment of Construction is 35.51% of the total employment effect, while the second beneficiary is the Metal sector.

In 2007, the total effect on production caused by the total investment was €1,604 million, with the Construction products sector being the largest beneficiary. As for the effects on employment, we see that 36.88% of the total generated employment is in the Construction products sector, followed by Metal and Wholesale business sectors.

In 2008, when the Expo was open, the impact sharing was somewhat different. Because of the Expo, 5,019 jobs were created, approximately 50% in the construction sector and 10% in wholesale business. The total impact generated by tourism expenditure on production was €573 million; in this case, the Hotel industry (accommodation and catering) benefited the most, with 26.37% of the total, followed by the Food industry and Agriculture and ranching. The total impact on employment generated by tourism expenditure was 3,180 workers, with the Hotel sector being the largest beneficiary.

4. Structural change

Looking for changes in the economic structure and the interesectorial relationships, we have calculated the unitary forward and backward linkages (we can see them in Table 4) in order to determine whether there were any significant structural changes that we can ascribe to the Expo effect.

Table 4: Forward and backward linkages

Industries	2005 Bac	For		2006 Bac	For		2007 Bac	For		2008 Bac	For		2009 Bac	For		2010 Bac	For	
Agriculture	2,54	3,9	K	2,20	3,4	F	2,23	3,6	F	2,21	3,2	F	2,14	3,1	F	2,13	3,1	F
Extractive	2,26	2,6	F	2,14	2,6	F	2,11	2,6	F	1,96	2,4	F	1,91	2,2	F	2,04	2,3	F
Energy and	2,32	2,2	N	2,09	1,8	N	2,02	1,8	N	2,11	2,1	N	1,91	2,0	N	1,79	2,4	F
Food industry	3,24	2,9	K	3,04	3,0	K	3,12	3,1	K	3,01	3,1	K	2,84	2,7	K	2,87	2,9	K
Textiles.	2,56	1,9	B	2,53	1,9	B	2,55	2,0	B	2,15	1,9	N	2,52	2,0	B	2,62	2,1	B
Industry of	3,01	1,8	B	2,82	1,6	B	2,69	1,5	B	2,74	1,5	B	2,51	1,4	B	2,35	1,4	B
Paper industry	2,55	2,1	B	2,65	2,2	B	2,72	2,3	B	2,60	2,2	B	2,51	2,0	B	2,53	2,1	B
Chemical	2,89	5,3	K	3,13	5,5	K	3,16	5,5	K	2,89	5,0	K	2,90	4,4	K	2,79	4,4	K
Rubber and	2,97	1,9	B	3,08	1,8	B	3,13	1,8	B	2,99	1,7	B	2,78	1,7	B	2,79	1,6	B
Non-metallic	2,61	1,7	B	2,12	1,4	N	2,58	1,5	B	2,36	1,4	B	2,27	1,4	B	2,36	1,4	B
Metal	2,84	6,0	K	2,82	5,0	K	2,91	5,4	K	2,60	4,2	K	2,62	3,8	K	2,45	3,6	K
Transport	3,57	2,3	B	3,37	2,1	B	3,45	2,1	B	3,34	1,9	B	3,27	1,8	B	3,15	1,8	B
Other	2,92	1,2	B	2,18	1,3	N	2,89	1,2	B	2,49	1,1	B	2,50	1,1	B	2,49	1,1	B
Construction	2,49	1,9	B	2,57	2,0	B	2,60	2,1	B	2,30	1,5	B	2,15	1,6	B	2,08	1,4	N
Trade of	2,28	1,5	N	2,43	1,5	B	2,71	1,6	B	2,26	1,4	N	2,12	1,4	N	2,05	1,4	N
Wholesale	2,26	2,4	N	2,19	1,9	N	2,20	2,0	N	2,06	2,0	N	1,97	2,1	N	1,94	2,0	N
Retail trade	1,84	1,1	N	1,80	1,1	N	1,82	1,2	N	1,75	1,2	N	1,67	1,2	N	1,90	1,3	N
Hotel industry	2,31	1,3	N	2,20	1,5	N	2,23	1,6	N	2,14	1,6	N	1,98	1,5	N	2,00	1,6	N
Transport	2,33	3,5	F	2,28	3,4	F	2,31	3,4	F	1,92	2,8	F	1,83	2,6	F	1,88	2,6	F
Post and	2,12	1,5	N	2,17	1,7	N	1,88	1,5	N	2,16	2,3	F	2,07	2,3	F	2,07	2,4	F
Finance.	1,87	2,9	F	1,73	2,7	F	1,66	2,9	F	1,59	2,9	F	1,52	3,5	F	1,66	2,8	F
Real estate	1,68	1,3	N	1,61	1,3	N	1,60	1,3	N	1,55	1,1	N	1,67	1,2	N	1,50	1,2	N
Other business	2,22	4,6	F	2,00	4,2	F	1,96	4,3	F	1,88	4,1	F	1,78	4,1	F	1,86	4,0	F
Public services	1,79	1,0	N	1,70	1,0	N	1,71	1,0	N	1,66	1,0	N	1,62	1,0	N	1,62	1,0	N
Average	**2,48**	**2,4**		**2,37**	**2,3**		**2,43**	**2,4**		**2,28**	**2,2**		**2,21**	**2,2**		**2,20**	**2,2**	

Source: own elaboration.

In Table 4 we can observe the forward and backward linkages for the period 2005-2010. These coefficients suggest that the Aragonese productive structure is very stable along time and, at this aggregation level, the majority of sectors maintain the classification like KS (key sector), BS (backward sector), FS (forward sector) or NR (no relevant sector), which is very logical given the relatively high aggregation level and the short period studied.

In general terms, the Aragonese structure is characterized by a block of key sectors around three main activities: Metal, Chemical industry and Food industry. The sectors with high capacity to drive the economy (high coefficients of backward, above the average) are the Industry of the wood and cork, Rubber and plastic industry and, especially, Transport material. The sectors that have been traditionally forward sectors are Agriculture and livestock (it has been even a key sector in some periods because of its relationship with Food industry) and Other business services.

In global terms, from 2005 to 2010, the integration level of the economy decreases (the average unitary backward or forward decreases from 2.48 to 12.73, that is to say, a 12.73%). More specifically, there are three sectors that have been key sectors along all analyzed period, these are Food industry, Chemical industry and Metal. In Chemical industry and Metal we can observe some stability in the backward sector and a very important reduction in the forward coefficient from 2005, reducing their role as production providers, reducing the inputs supply to other sectors, by unit of product.

The Construction sector, which appeared as a backward sector, that is to say, it was a sector with capacity of increase the production of other sectors when Construction products final demand grew, becomes a no relevant sector in 2009, with the beginning of the crisis in the real economy.

On the contrary, there are two sectors that were not relevant in 2005 from this classification, Energy and water and Post and telecommunications; however, they increase their capacity of promote the economy because they become forward sectors by the end of the period.

The use of graphs is one of the most effective ways to display the dependence relationship between different sectors of an economy, within the input-output framework. In this paper, the arrows indicate value transfers resulting from sales or purchases, from supplier to demander. Our graphs, representing sectorial inter-dependencies, have been built considering four levels of value of purchases from other sectors: greater than 30% of sector production, between 20% and 30%, between 10% and 20%, and between 5% and 10%. A different color is used for each purchase level. The transfer percentages have been calculated by the technical coefficient matrix.

After processing all graphs, one for each year of the period 2005-2010, we can see that the structure of the sectorial relationships in the Aragon economy has changed in certain aspects, although some groups of sectors maintain fixed relationships. In Graph 1 we present the representation of the economic network for the year 2005.

First, we must emphasize that there is a first block of sectors associated with the Agriculture and livestock and Food industry that is a structural constant throughout the period. Agriculture and ranching sells part of its production to Industry of wood and cork, and a significant part to the Food industry. The Food industry sells a large part of its production to the Agriculture and ranching sector, and another part to the Hotel industry. These are the strongest relationships of the block. However, the relationship network is extended mainly through the relationship of the Agriculture and ranching sector with the Chemical industry, the Paper industry, and the Retail trade sector (and this, in turn, with the Wholesale business). We note that the main input supplier of the Hotel industry is the Food industry, and that this relationship is not modified during the period under study. As

a consequence, we can say that the impact from the Expo on this sector block has been negligible.
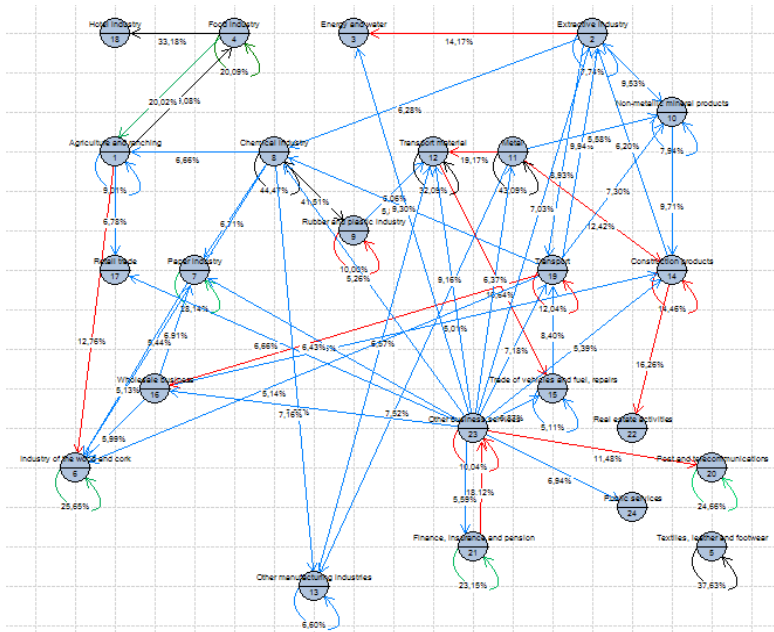
Graph 1: Economic network for 2005
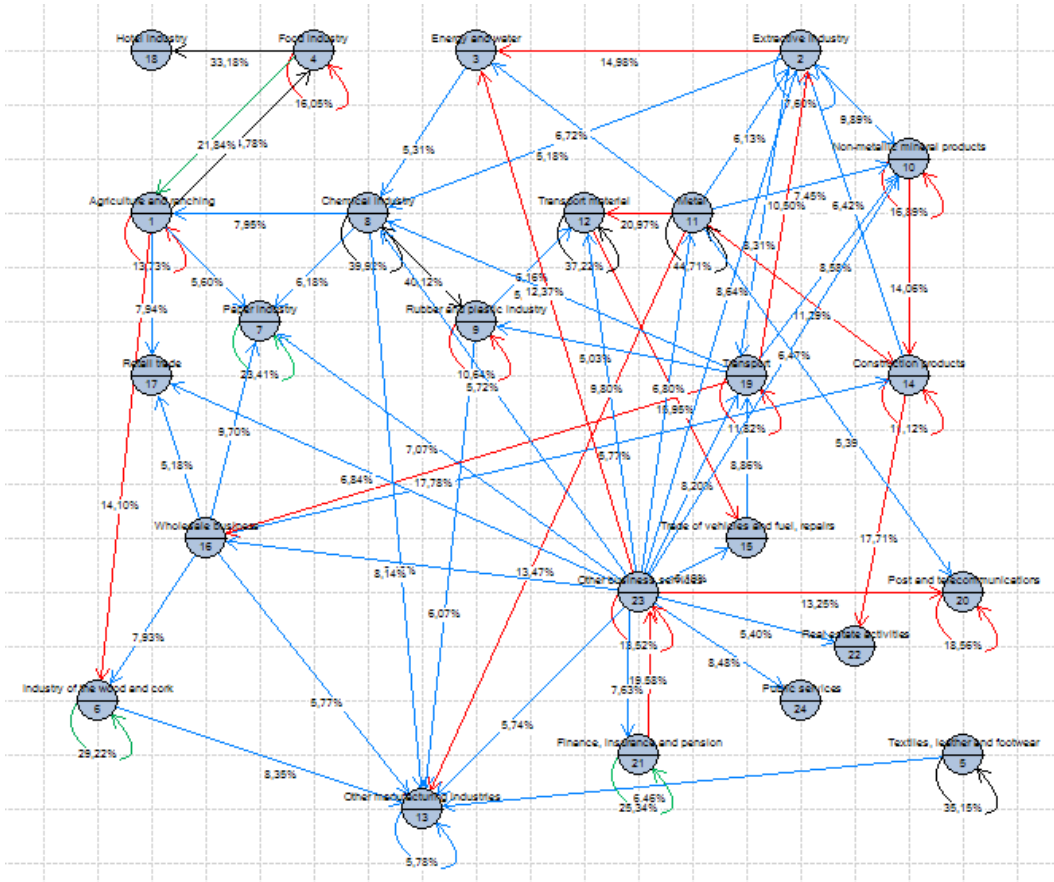
Source: Own elaboration.

In 2005, we observe a block of sectors in the center of which we find Construction products. This sector sells part of its production to the Real estate activities and Extractive industry, and acquires its inputs mainly from the Metal sector, Non-metallic mineral products, and Wholesale business. The network is extended through Metal and its links with Transport material and to Other manufacturing industries.

The third productive network of the Aragon economy is structured around Metal and Transport material, which buys inputs from Metal, Other business services, and Rubber and plastic industry (which also buys from the Chemical industry). The links of Metal with Energy and water, Extractive industry, and Non-metallic mineral products are important to this network.

In 2006 these relationships are almost fixed and there the same sector networks exist. However, small changes can be detected.
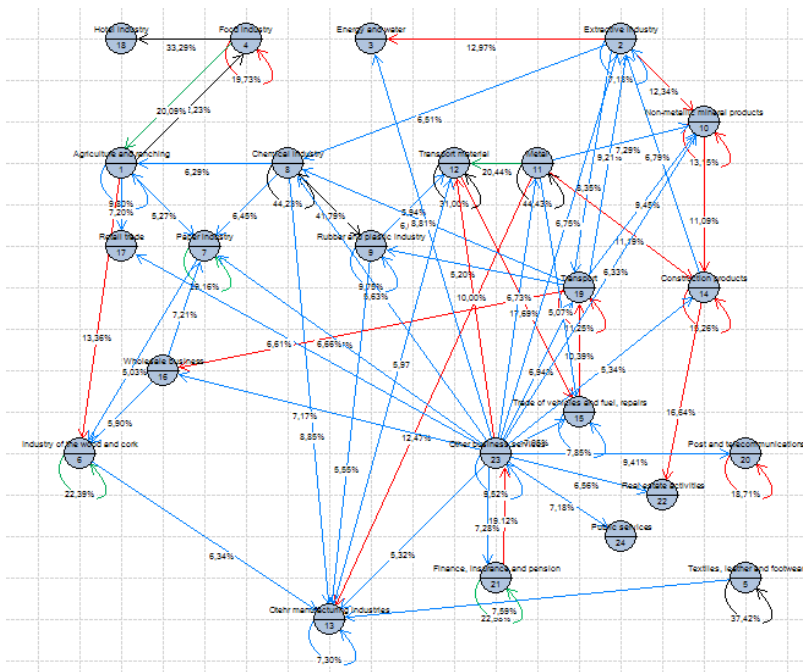
Graph 2: Economic network for 2006

Source: Own elaboration.

In Graph 3, for 2007, the changes in color clearly show the changes in intensity.

Graph 3: Economic network for 2007

Source: Own elaboration.

Note the strong links between Energy and water, Extractive industry, Construction products, and Real estate activities, revealing a stronger integration of the Construction products network. The same result can be observed for the Metal and Transport material where the mutual link and the links with Other manufacturing industries and Other business services are reinforced.

Graph 4 shows a significant structural change in 2008, the year of the Zaragoza Expo.

Graph 4: Economic network for 2008
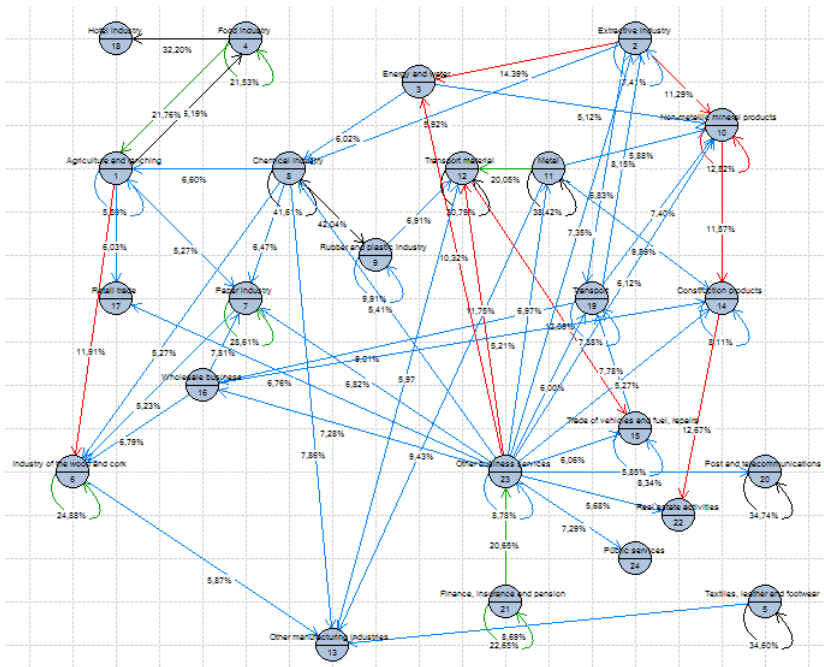
Source: Own elaboration.

The Aragon economy maintained the same three networks but the links are weakened. The weakness in the Construction products block was likely influenced by the end of Expo construction, but it is not so easy to tie the weakness in Metal and Transport material only to the end of Expo activities. We need other reasons for these results, and undoubtedly in 2008 the emergent crisis is a good candidate. The sector of other business services increases the intensity of its relationships with other sectors, especially with Finance, insurance and pension. This fact could be due to the Expo effect.

The largest change appears in 2009, the year in which the relationships of the Construction products sector with the other sectors is weakened (except with Real estate activities). In the years from 2005 to 2008 Construction products was related, for example, with Metal sector; however, in 2009 it only is related with Real estate activities, which maybe indicates that from 2005 to 2008 Construction sector was doing industrial activities and in 2009 it only did property business. The Extractive industry is still selling the bulk of its production to the Energy and water sector and to Non-metallic mineral products. This weakening of the relationships between the Construction product sector
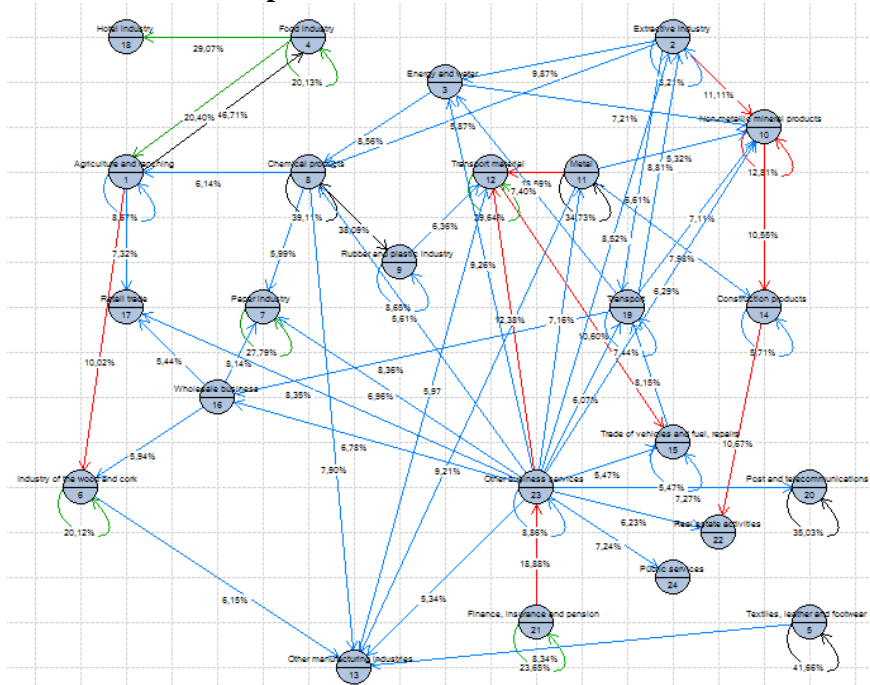
and other sectors may be due to the Expo, but it may equally be due to the economic crisis. We can perceive these changes more clearly in Graph 5.

Graph 5: Economic network for 2009
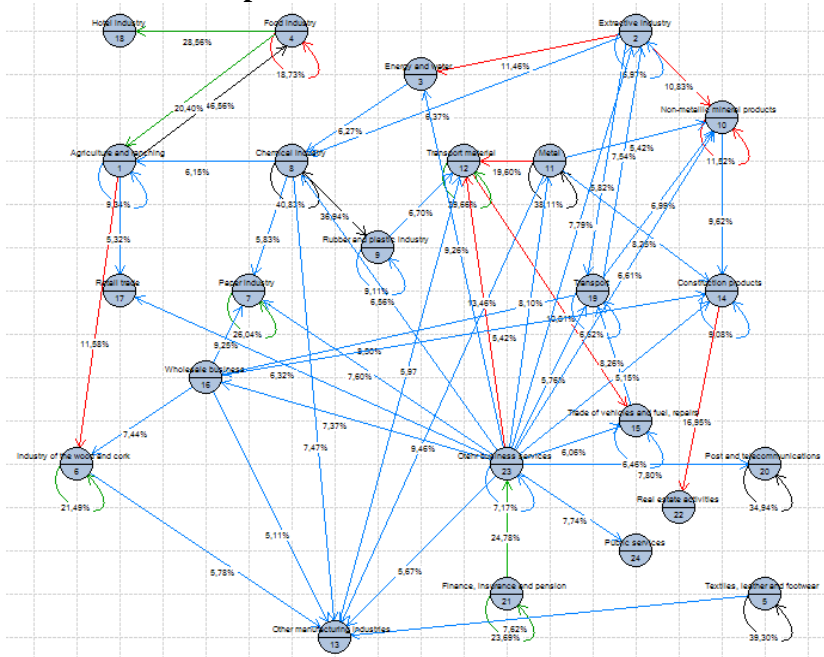
Source: Own elaboration.

Graph 6: Economic network for 2010

Source: Own elaboration.

In 2010 (see Graph 6), the relationships surrounding the Construction product sector are further weakened (it had lost strength in 2008), and the relationships between Energy and water and other sectors is weaker, probably as a result of two factors - rising energy prices and the economic crisis.

5. Final comments

From our main results, we can conclude that there have been no major structural changes and/or economic impacts in the Aragon economy, during the period under study that can be attributed to the effects of the 2008 International Exposition in Zaragoza (Spain). Moreover, some small positive effects were counter-balanced by the negative impact of the economic crisis.

From our Graphs, we observe that the structure of sectorial relationships in the Aragon economy has changed in certain respects, of which the most significant may be the weakening of the sectoral block of Construction products, in 2008, 2009 and 2010; however, this could equally well be due to the international crisis. A similar weakness has been observed in the Metal and Transport material block, but in this case the crisis is undoubtedly the main driver. Something that could be attributed to the Expo effect is the increase in 2008 of the intensity of the relationship of Other business services with Finance, insurance and pension. Another effect that could be attributed to the Expo is the reformation of the Construction products sector in years immediately prior to the Expo.

The mutual relationships (sales and purchases) among the block of sectors revolving around agriculture are permanent throughout the period; nor do these relationships change significantly over time. We can conclude that the impact of the Expo on this sector is negligible. Moreover, Agriculture and ranching is a sector that has been – relatively - significantly less affected by the financial crisis.

Finally, analyzing the total impact that the investments and tourism expenditures associated with the Expo had on the production of the Aragon economy, we estimate that these investments amounted to around €3,200 million, representing roughly 4% of the 2008 total gross production. Tourism expenditures amounted to €573 million in the 2008 Aragon economy, and an increase in employment of approximately 3,180 workers. However, as has been shown, these effects did not represented a noticeably changes in production patterns and structures.

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