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Article

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Strategic sectors and employment during the crisis: The case of Andalucía

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ABSTRACT

The economic crisis has resulted in the shedding of labour characterised by significant differences across the Spanish regions, among which the case of Andalucía stands out. This paper aims to explain the events that occurred between 2005 and 2010, focusing on analysing the region's productive structure and how it is reflected in its labour market. To do so, a linear SAM model is employed to identify strategic sectors, and their employment trends are then studied through shift-share analysis. The results show the progressive tertiarisation of the Andalusian economy, a regional countercyclical effect that is lower than the national average and sectoral effects on employment in the strategic sectors.

Keywords: regional accounts; social accounting matrices; multisectoral models; strategic sectors; shift-share analysis.

JEL classification: C67; D57; R15.

MSC2010: 93D25.

Sectores estratégicos y empleo durante la crisis: el caso de Andalucía

RESUMEN

La crisis económica ha generado una destrucción de empleo caracterizada por diferencias significativas en las regiones españolas, destacando el caso de Andalucía. Este trabajo trata de explicar lo ocurrido entre 2005 y 2010, centrándose en el análisis de la estructura productiva regional y cómo ésta se refleja en su mercado laboral. Para ello, se emplea un modelo lineal SAM que identifica los sectores estratégicos, mientras que la evolución del empleo se estudia a través del análisis shift-share. Los resultados muestran la progresiva terciarización de la economía andaluza, un efecto regional contracíclico menor que el detectado a nivel nacional y efectos sectoriales sobre el empleo en los sectores estratégicos andaluces.

Palabras clave: contabilidad regional; matrices de contabilidad social; modelos multisectoriales; sectores estratégicos; análisis shift-share.

Clasificación JEL: C67; D57; R15.

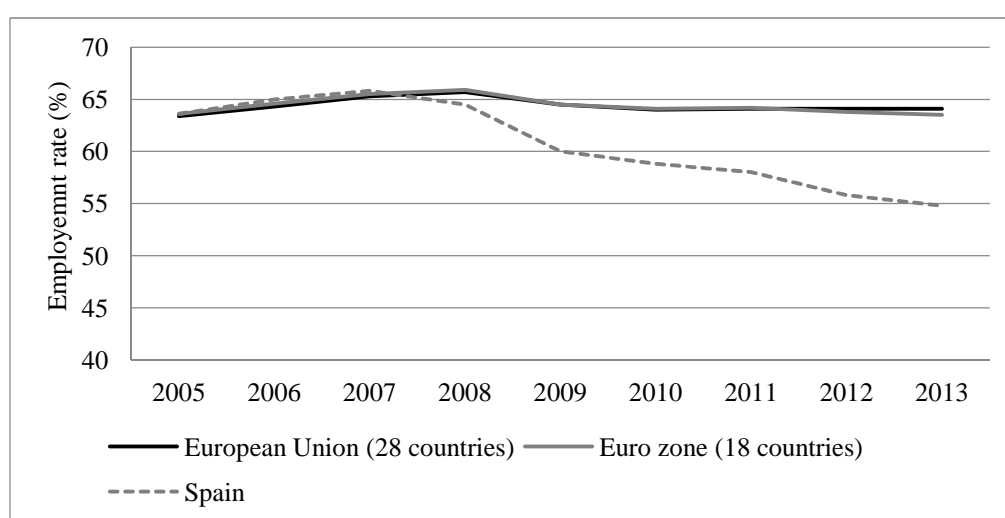
MSC2010: 93D25.



Introduction

The financial and economic crisis that began in the fall of 2007 has deeply affected the Spanish economy. The economic downturn has strongly impacted the Spanish labour market, which is particularly sensitive to the growth-decline stages of the business cycle (Bentolila, Dolado and Jimeno, 2012). As result, the Spanish employment rate began to decline steadily in 2008, reaching 54.8% by the end of 2013 (Eurostat, 2014); this is far lower than the averages of the European Union or Euro zone (Figure 1).

Figure 1. Employment rate



Source: Own elaboration based on Eurostat (2014).

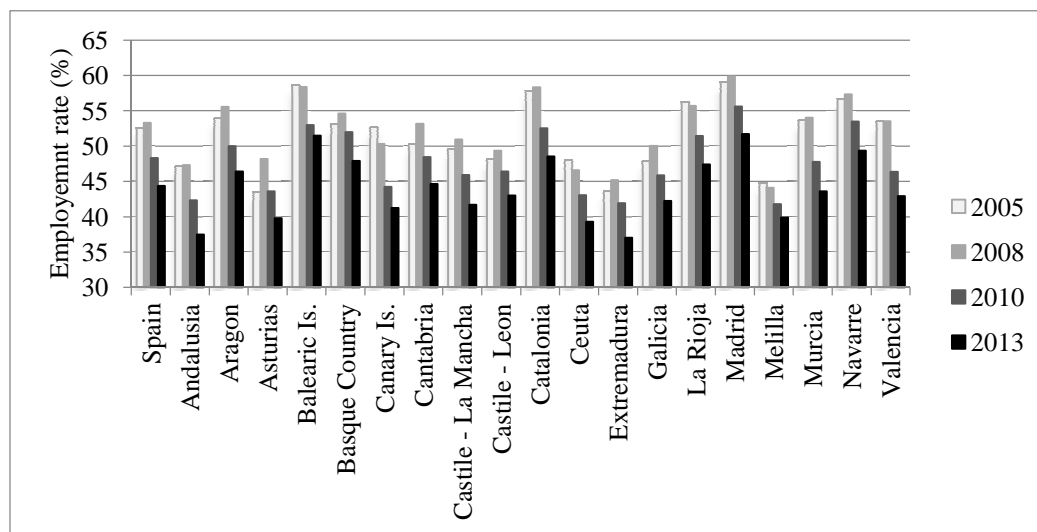
In this context of widespread labour shedding, Figure 2 shows that there are differences among economic sectors. Most sectors exhibit a decrease in the number of employees that is higher than the national average, with the exception of the Services sector. This decrease is particularly marked in the Spanish Construction sector, in which over 1.6 million out of 3.4 million jobs were destroyed between 2008 and 2013. The Construction sector became a relevant economic activity across most of the Spanish regions in the years before the crisis, greatly contributing to the national GDP (10.6% in 2007) and showing a relevant multiplier effect on the national economy due to its linkages with other sectors as well as its capacity to generate direct and labour-intensive employment (Jiménez, Ruiz and Peña, 2014). All of this indicates the dependence of the Spanish economy on the Construction sector and partly explains the boom in national unemployment, which reached 26.1% in 2013 (Eurostat, 2014), as a result of the crisis.

Figure 2. Changes in employment rate by economic sector



Source: Own elaboration based on INE (2015).

Figure 3. Employment rate by region

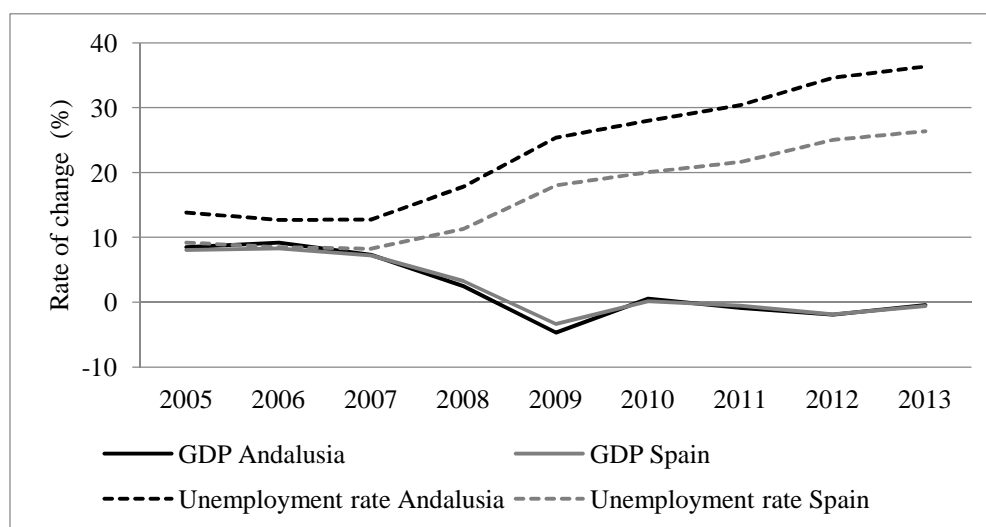


Source: Own elaboration based on (INE, 2015).

The effects of the crisis on the employment rate have also been uneven at the regional level, as shown in Figure 3. The decrease in employment in the richest regions, including those with higher GDP per capita such as the Basque Country, Navarra, La Rioja or Madrid, was more contained. Meanwhile, the less prosperous regions, located in the southern and eastern parts of the country, were worst affected by the Construction crisis and have exhibited the greatest job losses. Among them, one of the most striking cases is the region of Andalusia. This region had one of the lowest employment rates in Spain, reaching 37.5% by 2013; this is only 0.5 points above that of the Extremadura region. However, during the convergence period, which

occurred between 2000 and 2007, Andalusia's GDP showed higher levels of growth than the national average, with an average annual rate of 8.3% (IECA, 2014a) and an employment rate of 49.2% in 2007, which was only 5.2 points lower than the national average (IECA, 2014b). Later, between 2008 and 2013, this behaviour changed significantly, with more negative changes in GDP than average and an uninterrupted decrease in the employment rate greater than that experienced in the country as a whole (Figure 4).

Figure 4. Gross domestic product and unemployment



Source: Own elaboration based on IECA (2014a, 2014b) and INE (2014, 2015).

In this context, this paper aims to provide a deeper understanding of the behaviour of the Andalusian economy during the economic crisis, focusing on the analysis and evolution of its productive structure and how this is reflected in its labour market. In doing so, the paper first presents a comparative analysis of the Andalusian economic structure between 2005 and 2010, before and during the economic downturn, based on the information provided by Social Accounting Matrices (SAMs). Traditionally, structural analysis has been carried out based on Input-Output Tables (IOTs), especially when this analysis is focused on the short term (Cardenete, Mainar, Fuentes-Saguar and Rodríguez, 2014). There are several examples of this at both the national (Ramos and Robles, 2009; Sonis, Guilhoto, Hewings and Martins, 1995) and regional levels (Holland and Cooke, 1992; Thakur and Alvayay, 2012). However, SAMs provide more information than IOTs by integrating social statistics into the Input-Output Framework, which results in powerful databases that can be employed to build more sophisticated economic analysis tools, such as multiplier models or applied general equilibrium models. In the vein of the multiplier models, SAMs have also been employed to

analyse structural changes at both the national (Cardenete and Delgado, 2011; Reinert and Roland-Holst, 1994; Roberts, 1995) and regional levels (Llop, 2007). A number of studies analyse the economic structures of Spain in general and the region of Andalusia in particular and their evolution from the beginning of the previous decade to the onset of the financial crisis. The study of (Lima, Cardenete, Hewings and Valles, 2004) focuses on the nineties and outlines the ability of the Construction and Services sectors to stimulate economic activity in the region when faced with the inability of the Manufacturing industry to develop regional growth. The study of Cardenete and Fuentes (2009) extends this analysis to 2005, highlighting the consolidation of the Agriculture and Construction sectors as drivers of the regional economy while classifying the Food and Service industries as key sectors. Finally, the study of (Cardenete et al., 2014), which covers the period from 2005 to 2008, again notes the key role played by the Construction sector and the relevance of the Primary and Tertiary sectors in the regional economy, as well as the emerging importance of some industrial sectors such as the Manufacturing of coke and refined petroleum products or Metallurgy.

The impact of the evolution of productive structures on regional employment is evaluated in the second part of the paper through a traditional shift-share analysis (Dunn, 1960). This method and its subsequent developments have been used widely to describe economic growth, usually in terms of employment, both at the regional (Danson, Lever and Malcolm, 1980; Jiménez et al., 2014; Kowalewski, 2011) and sectoral levels (Fotopoulos, Kallioras and Petrakos, 2010; Gabe, 2006; Sirakaya, Choi and Var, 2002), by distinguishing between two types of factors. The first type of factor operates in a more or less uniform way throughout the territory under review, although the magnitude of its impacts on different regions varies with their productive structures. The second type of factor has a more specific character and operates at the regional level. The persistent unemployment in Andalusia has motivated some studies attempting to provide a deeper diagnosis of the region's labour market. In this strand, the work of Gonzalez and Rodriguez (2001) analyses the Industrial sector and highlights that the Andalusian productive structure did not promote employment during the period from 1988 to 1995. Conversely, the study of Jimenez et al. (2014) highlights the positive behaviour of regional and sectoral factors for the Industrial sector during the period between 2000 and 2007 and for the Service sector both before and during the economic crisis. In addition, this study also shows the national knock-on effect on the Andalusian economy, which was positive during the economic boom and negative thereafter.

The remainder of the paper is structured as follows. Section 2 is devoted to the structural analysis, showing the results for the Andalusian economy. In Section 3, shift-share analysis is carried out and the main results are presented. The work ends with the main conclusions.

Structural analysis of the Andalusian economy

Social accounting matrices framework

SAMs are matrix presentations of the entire set of economic flows among agents in a given time period, typically one year. Thus, these flows should satisfy standard macroeconomic identities. For example, the aggregate total spending should be equal to the total income, and the sum of each column therefore necessarily equals the sum of the corresponding row in the matrix structure. A simplified SAM structure is shown in Figure 5, highlighting its main components. The three matrices that summarise the economic transactions among agents, the intermediate consumption matrix, the added-value matrix and the final demand matrix, are shaded in light grey, and the total output is equal to the total demand.

Figure 5. Social accounting matrix: simplified structure

	Productive sectors	Primary factors	Institutions	Investment	Foreign sector
Productive sectors	Intermediate consumption		Consumption by public sector and households	GFCF	Exports
Primary factors	AV payments to factors				
Institutions	Taxes on activities, goods and services	Income distribution	Current transfers among institutions	Taxes on capital assets	Transfers from the foreign sector
Investment			Internal saving		Foreign savings
Foreign sector	Imports		Transfers to the foreign sector		

Source: Cardenete and Moniche (2001).

The intermediate consumption matrix shows the transactions in goods and services among productive sectors as well as within the public sector. The purchases of intermediate goods and services in each sector are displayed in the columns. As a result, the column totals indicate the intermediate consumption in each sector, whereas the row totals display the sales made by each sector in the economic system. In contrast, the added-value matrix shows the primary factors (labour and capital) employed in each productive sector, encompassing accounting items such as Gross Wages and Salaries, Fixed Capital Consumption, Net

Operating Surplus, Mixed Revenues and Employer Social Security Contributions. Finally, the final demand matrix shows final consumption spending, that is, private consumption spending, government spending, investment and exports to the foreign sector.

The SAM structure is completed by the “closure matrix” of the circular flow of income in the represented multi-sector economic structure. This matrix, which is on the lower right-hand side of the unshaded area in Figure 5, displays the relationships between added value and final spending. Thus, the rows show the total resources available to households and the public sector to cover consumption and investment spending, whereas the columns exhibit how these resources are allocated across consumption, savings or taxes.

As previously mentioned, SAMs are based on OITs but are supplemented by information drawn from National Income and Product Accounts, budget surveys and a host of tax, socioeconomic and demographic data. The empirical SAMs employed in this paper were built from the Andalusian Input-Output Framework for 2005 published by the regional statistics institute. The SAM for 2005¹ was elaborated through supply and use tables by means of input-output technology. By contrast, the SAM for 2010² was obtained through the application of an updating technique called the Cross Entropy Method (Cardenete and Sancho, 2006) to the SAM for 2008³. These SAMs include 36 and 35 accounts, of which 26 and 27, respectively, correspond to productive sectors, but these accounts have been aggregated into ten major sector groups, resulting in the same sectoral divisions available for the employment data used in the next section. Figure 6 presents the corresponding structure, called SAMAND. A two-digit number is added to the end of this name to identify the SAM for the corresponding year involved in the analysis, that is, SAMAND05 and SAMAND10. In its basic structure, SAMAND encompasses 18 accounts in both rows and columns, with 10 accounts for productive sectors and 8 accounts for institutions, including the foreign sector account. The data for each account are expressed in thousands of euros and valued at purchase prices.

¹ Cardenete, Fuentes and Polo (2010b).

² Campoy-Muñoz, Cardenete and Delgado (2014).

³ Cardenete et al.(2014).

Figure 6. Social accounting matrix for Andalusia

1	Agriculture, cattle and fishing	10	Non-commercial services
2	Extractive industries	11	Labour
3	Manufacturing industries	12	Capital
4	Electric power, gas and water production and distribution	13	Households
5	Construction	14	Savings / Investment
6	Commerce	15	Direct taxes
7	Transport, warehousing and communications	16	Indirect taxes
8	Other services	17	Government
9	Commercial services	18	Foreign sector

Source: Own elaboration based on (Cardenete et al., 2010a).

Structural analysis indicators

The information provided by the SAMs allows for a detailed analysis of the productive structure of an economic system through the application of several techniques. Among them, we employ Linear SAM Models, based on the inverse matrix of the models of Leontief (1941) and Ghosh (1958), and a combination of two types of intersectoral linkages, the *Backward Linkages* (diffusion effects) and the *Forward Linkages* (absorption effects) calculated from these inverse matrices. Before providing a detailed description of these linkages, the Linear SAM Models are briefly introduced.

Following (Cardenete, Fuentes and Polo, 2010a), a SAM is a square matrix of order n in which each row and column represents an account (productive sectors or institutions) that satisfies the corresponding budget constraint (total income is equal to total spending). Each component Y_{ij} of the matrix represents a bilateral income flow between account i and account j . By agreement, rows (i) show the monetary income in the corresponding accounts (receipts or monetary supplies), while columns (j) show spending (payments or monetary uses). The average spending coefficients, denoted by $a_{ij} = Y_{ij} / Y_j$, $i, j = 1, 2, \dots, n$, indicate the payments to account i per unit of income in account j . Based on the information presented above, the SAM can be expressed as follows:

$$Y_i = \sum_{j=1}^n \left(\frac{Y_{ij}}{Y_j} \right) \cdot Y_j = \sum_{j=1}^m (a_{ij} Y_j) + \sum_{j=m+1}^{m+k} (a_{ij} Y_j); n = m + k \quad (1)$$

The distinction between endogenous and exogenous accounts is respectively denoted by the subindices m and k ⁴. This allows for the distinction between the total incomes of the endogenous (Y_m) and exogenous (Y_k) accounts, as well as among four submatrices within the average spending coefficients: A_{mm} , A_{mk} , A_{km} , and A_{kk} . Thus, the total income of the endogenous accounts can be expressed by $Y_m = A_{mm} Y_m + A_{mk} Y_k$; then, following the same procedure applied to Leontief's equation, the accounting multipliers matrix M of the SAM is obtained:

$$Y_m = MZ \quad (2)$$

where $M = (I - A_{mm})^{-1}$ and Z is the vector of exogenous columns ($A_{mk} Y_k$). M represents the input requirement in response to unit income or spending increases in a given account and Z indicates the distribution of the income flows of exogenous accounts among the endogenous accounts. Referring to the changes in the exogenous account vector by dZ , the changes in the income of endogenous accounts is given by (Polo, Roland-Host and Sancho, 1990):

$$dY_m = MdZ = Md(A_{mk} Y_k) = MA_{mk} dY_k \quad (3)$$

The i -th column of M shows the total income generated in each endogenous account i when one unit of income flows from exogenous institutions to the corresponding endogenous ones. This interpretation, paired with normalisation⁵, allows for the calculation of the *Backward Linkages* ($BL_{.j}$):

$$BL_{.j} = \frac{M_{.j}}{\frac{1}{n} \sum_{j=1}^n M_{.j}} \quad (4)$$

$BL_{.j}$ allows for the determination of the diffusion effect or the effect on the economy of an increase in demand in the sector represented by account j , in other words, where the inputs required to increase the output of sector j come from. Those sectors whose $BL_{.j} > 1$ exhibit

⁴ It should be noted that the selection of the number of endogenous accounts (m) depends on the analysis to be developed; then, the number of exogenous accounts (k) is determined. The latter explain the changes in the incomes of the endogenous accounts.

⁵ Normalisation is accomplished through the division of the effect of each sector by the average effect of the sectors. In turn, the latter is calculated as the sum of the effects of all the sectors divided by the number of sectors considered.

dispersion power such that a change in the output of sector j has an above-average influence on the economic system.

The second type of intersectoral linkage, the *Forward Linkage* (FL_i), is calculated using Ghosh's model (Augustinovic, 1970; Dietzenbacher, 1997). FL_i quantifies the change in the output of sector i as a consequence of an increase of one exogenous unit in the primary inputs of sector j (or in their prices). Following Dietzenbacher (1997), each component of the Goshian inverse matrix, the distribution coefficients denoted by δ_{ij} , indicates how much to increase the output value of sector j to generate a one-unit increase in the added value of sector i . FL_i is calculated from these coefficients as follows:

$$FL_i = \frac{\sum_{j=1}^n \delta_{ij}}{\frac{1}{n} \sum_{i=1}^n \sum_{j=1}^n \delta_{ij}} \quad (5)$$

FL_i enables the analysis of the absorption effects or the consequences of a change in the valuation of the output of sector j on the system. Those sectors with $FL_i > 1$ demonstrate a dispersion capacity such that changes in their added values have above-average effects on the system.

Figure 7. Sectoral classification from BL_j and FL_i .

Linkages	FL < Average (FL)	FL > Average (FL)
BL > Average (BL)	Promoter sector	Strategic sector
BL < Average (BL)	Independent sector	Base sector

Source: Rasmussen (1957).

The combination of both linkages allows us to categorise the productive sectors according to the sectoral classification presented in Figure 7. Strategic sectors demand and supply large amounts of intermediate inputs to and from the remaining productive sectors such that any shocks to these sectors have above-average effects on the economic system. This is exactly the opposite of what occurs with independent sectors, whose influence on the economy falls below the average. Promoter sectors are in an intermediate position; these sectors are large demanders of intermediate inputs, which enables them to lead other activities and to foster economic growth. Finally, the outputs of base sectors are largely demanded by other sectors

and thus, variations in their prices or quantities have major effects on the remaining productive sectors.

By calculating the BL_j and FL_i , we can classify the productive sectors of the Andalusian economy. As shown in Table 1, the regional productive structure remains relatively stable because the classification of only one sector, Commerce (6), changes within the period under review. The change that occurred is of a certain importance due to the increase in the number of strategic sectors in the Andalusian economy, which totalled four sectors in 2010, including the previously mentioned Commerce (6) sector as well as Manufacturing industries (3), Construction (5) and Transport, warehousing and communications (7). As result of this change, the group of independent sectors decreased to three components: Extractive industries (2), Commercial services (9) and Non-commercial services (10). The remaining groups did not change between 2005 and 2010, so Agriculture, cattle and fishing (1) and Electric power, gas and water production and distribution (4) form the promoter group, whereas the base group contains only Other services (8).

Table 1. Classification of productive sectors of Andalusian economy in 2005 and 2010

#Account	Productive sector	2005			2010		
		FL	BL	Type	FL	BL	Type
1	Agriculture, cattle and fishing	0.78	1.07	Promoter	0.77	1.06	Promoter
2	Extractive industries	0.92	0.74	Independent	0.80	0.85	Independent
3	Manufacturing industries	2.10	1.10	Strategic	1.90	1.02	Strategic
4	Electric power, gas and water production and distribution	0.85	1.12	Promoter	0.82	1.07	Promoter
5	Building	1.09	1.43	Strategic	1.05	1.37	Strategic
6	Commerce	0.60	0.78	Independent	1.02	1.02	Strategic
7	Transport, warehousing and communications	1.00	1.00	Independent	1.08	1.01	Strategic
8	Other services	1.21	0.94	Base	1.07	0.90	Base
9	Commercial services	0.83	0.89	Independent	0.85	0.88	Independent
10	Non-commercial services	0.65	0.96	Independent	0.64	0.83	Independent

Source: Own elaboration.

Once the importance and role of each productive sector in the regional structure is identified, it is helpful to analyse the relationships among productive sectors by applying the *structural path analysis methodology* (Sonis, Hewings and Sulistyowati, 1997) to the regional economy. This methodology allows us to study sectoral relationships by calculating the Multiplier Product Matrix (*MPM*). That matrix is obtained from the components multiplier matrix *M* of the SAM:

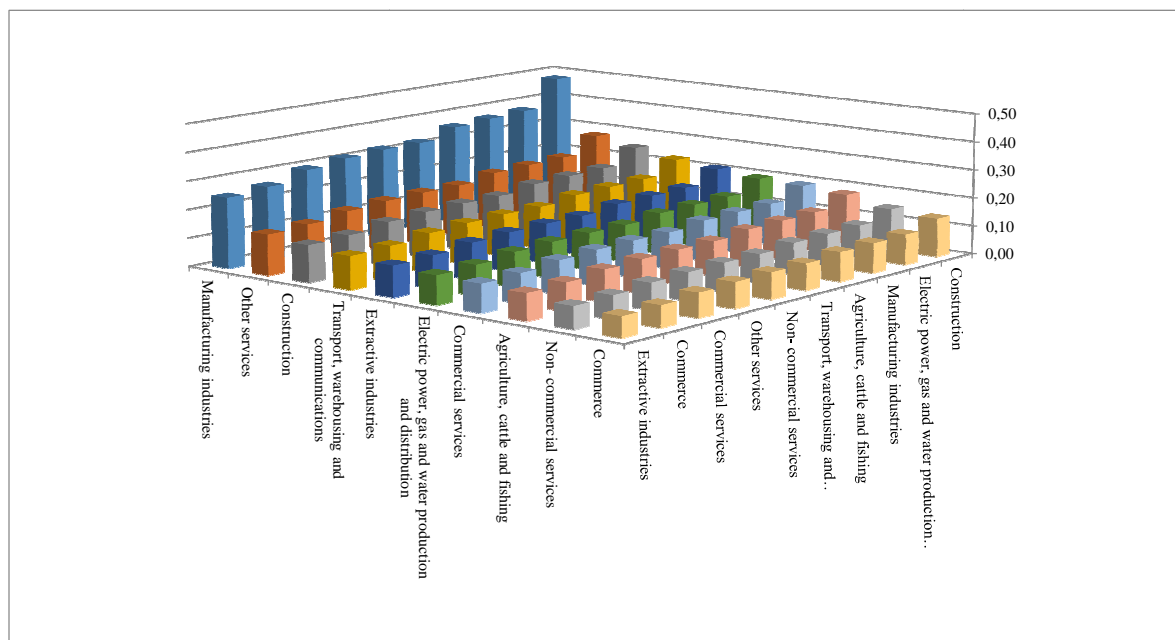
$$MPM_{ij} = \frac{M_{i.} M_{.j}}{\sum_{i=1}^n \sum_{j=1}^n m_{ij}} \quad (6)$$

Where $M_{i.}$, $M_{.j}$ are multiplier vectors whose elements are obtained from the sum of the corresponding row or column of matrix *M*. The product of these vectors is corrected by a factor called “global intensity” that corresponds with the sum of all the components of the associated matrix *M* (Lima et al., 2004)

Based on the *MPM*, a landscape can be built to allow for the visualisation of the interactions among sectors as well as of which sectors have power of dispersion and which other sectors are sensitive to dispersion. Changes in the former have a greater-than-average impact on the economy, whereas the latter are largely influenced by changes in the rest of the system. Figures 8 and 9 show the landscapes of the Andalusian economy in 2005 and 2010, respectively. In addition, Figure 10 displays the results obtained for 2010 reordered according to the 2005 sector ranking.

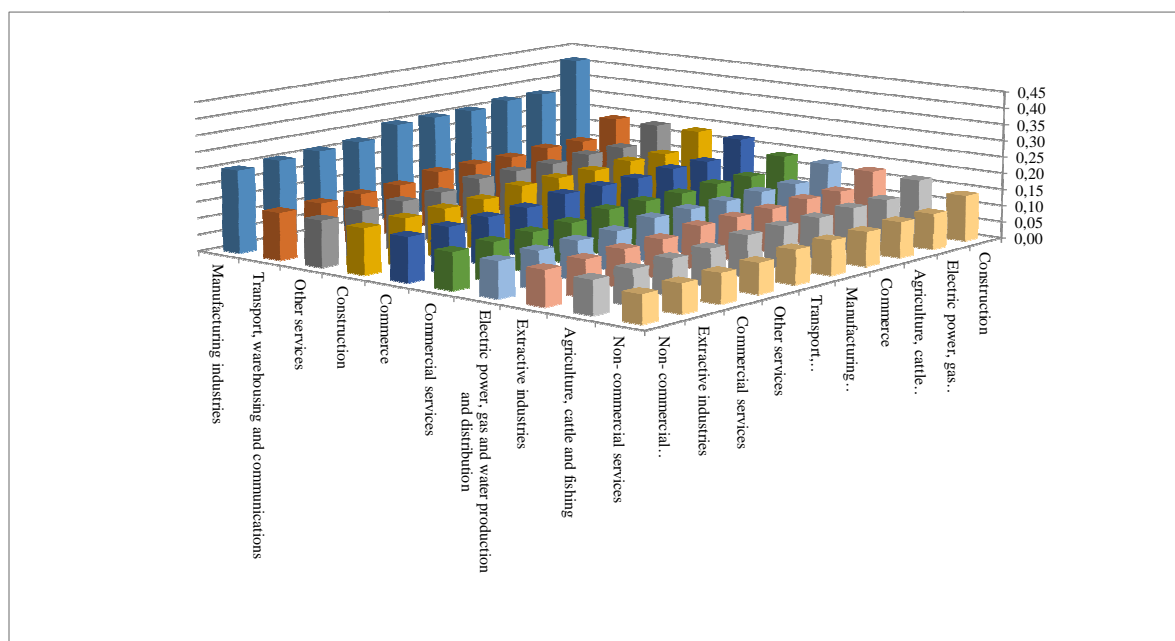
Figure 8 exhibits the ten accounts, in order of the largest intersectoral linkages in 2005. As seen, the Manufacturing industries sector (3) has the highest economic impact, regardless of the sectors with which it interacts, although its interaction with Construction (5) stands out. In contrast, Commerce (6) has the lowest impact, especially in its relation with the Extractive industries (2). It should be noted that the three strategic sectors in 2005 show major diffusion effects, along with the Other services sector (8). Meanwhile, the remaining activities of the tertiary sector and primary activities exhibit the lowest diffusion effects.

Figure 8. Landscape for the Andalusian economy in 2005



Source: Own elaboration.

Figure 9. Landscape for the Andalusian economy in 2010



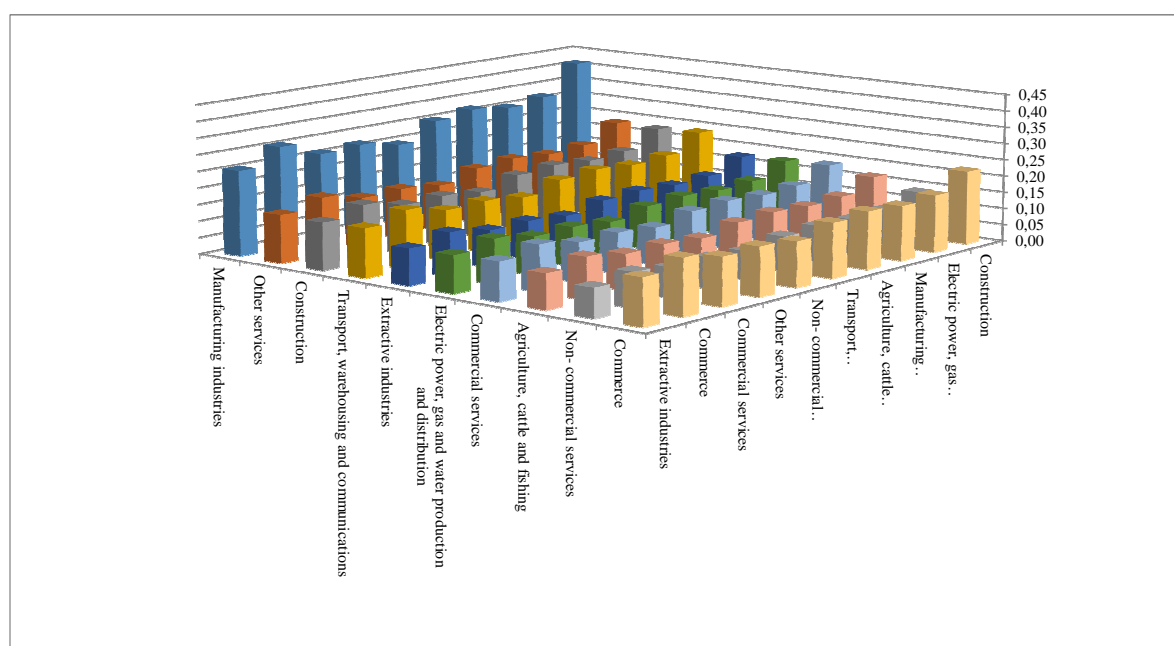
Source: Own elaboration.

The landscape for 2010 is displayed in Figure 9. The Manufacturing industries (3) sector continues to be the sector with the highest economic impact, particularly when it interacts with Construction (5). The Transport, warehousing and communications (7) sector has a

strong impact on the regional economy, pulling down Construction (5) and Other services (8). In contrast, the tertiary sector is increasing in importance, particularly in the case of the new strategic sector, Commerce (6), whose diffusion effect has also increased, surpassing Primary and Industrial activities. This finding reinforces the idea that the Andalusian economy is transitioning into a service economy.

Finally, Figure 10 shows the results obtained in 2010 reordered according to the ranking of the sectors in the base year, which allows for the visualisation of the slight changes in the Andalusian economic structure caused by the increasing relevance of the tertiary sectors of Commerce (6) and Transport, warehousing and communications (7), especially in their relationships with Construction (5). In addition, the other two strategic sectors, Manufacturing industries (3) and Construction (5), continue to have a greater impact on the regional economy during 2010.

Figure 10. Landscape for the Andalusian economy in 2010 based on 2005



Source: Own elaboration.

The sectoral analysis above is extended with the calculation of employment multipliers for each sector on the basis of both SAMs and employment data from the Annual Regional Accounts of Andalusia (IECA, 2014a). These multipliers indicate the degree of sensitivity of each productive sector to shocks to final demand in terms of employment. Thus, the employment multiplier for a sector j in the economy is as follows:

$$E_j = \sum_{i=1}^n w_{n+1,i} b_{ij} \quad (7)$$

With $w_{n+1,i} = Y^{e_i} / X_i$, where Y^{e_i} and X_i are employment and total output of sector i , respectively, and b_{ij} is component ij of matrix M for the associated SAM.

Table 2 displays the employment multipliers for each productive sector in the regional economy during the studied period. In 2005, industries belonging to the secondary sectors (2 and 4), in addition to Construction (5) and Transport, warehousing and communications (7), exhibit the greatest capacity to create employment, being able to generate between 19 and 29 jobs for every million euros injected into those sectors as a result of an exogenous shock to their own final demand. The activities of the primary sector are able to generate a significant number of jobs, specifically 18 jobs for every 1 million euros, which is slightly fewer than the amount generated by the Manufacturing industries (3). However, most of the activities of the tertiary sectors (6, 8, 9 and 10) have the lowest capacity to create jobs, especially Commerce (6) and Non- commercial services (10), representing barely 10 and 6 jobs, respectively.

Table 2. Employment multipliers for Andalusia in 2005 and 2010

# Account	Productive sector	Multipliers		Variation 2005-2010
		2005	2010	
1	Agriculture, cattle and fishing	18.06	15.78	-2.27
2	Extractive industries	25.54	24.23	-1.31
3	Manufacturing industries	18.88	14.78	-4.10
4	Electric power, gas and water production and distribution	29.12	21.44	-7.68
5	Building	22.10	18.46	-3.63
6	Commerce	9.82	15.40	5.58
7	Transport, warehousing and communications	20.51	18.89	-1.62
8	Other services	14.26	14.19	-0.07
9	Commercial services	10.54	8.66	-1.88
10	Non-commercial services	5.98	2.99	-2.99
1-10	All sectors	174.80	154.83	-19.98

Source: Own elaboration.

As can be observed, the Andalusian economy experienced a decrease in its capacity to generate employment during the crisis; thus, the same exogenous shock created a total of 155 jobs in the economy in 2010, whereas this figure was 175 jobs in 2005. This decrease is general across all the productive sectors, with the exception of one of the strategic sectors, Commerce (6), which can create 15.4 jobs, an increase of 5.6 jobs with respect to 2005. The general structure of the ranking of sectors according to their capacities to create jobs is maintained such that the industrial sectors continue to have higher capacities, although the Manufacturing industries (3) sector has lost its position to Agriculture, cattle and fishing (1) and the newly strategic sector of Commerce (6). Meanwhile, activities in the tertiary sector again exhibit a lower capacity to create jobs.

Shift-share analysis

The previous section made it clear that there have been slight changes in the productive structure of Andalusia during the period of study and this has been reflected in its capacity to generate jobs. However, performance within the group of strategic sectors is mixed during the period under review. The capacities of Manufacturing industries (3) and Construction (5) have been reduced further, whereas this capability has contracted less for the Transport, warehousing and communications (7) sector and has increased for Commerce (6). These findings raise a question about what caused this differential evolution during the crisis period.

The above question can be addressed through traditional shift-share analysis (Dunn, 1960). Despite its methodological simplicity and limitations, the shift-share method performs well in capturing the underlying changes in the target study variable and offers a fast and reasonably accurate analysis (Nazara and Hewings, 2004).

According to Mayor and Lopez (2008), E_{ij} denotes the initial value of employment in sector i in spatial unit j , with E'_{ij} being its final value. The change undergone by this variable can be expressed as follows:

$$E'_{ij} - E_{ij} = \Delta E_{ij} = E_{ij} \cdot r + E_{ij} \cdot (r_i - r) + E_{ij} \cdot (r_{ij} - r_i) \quad (8)$$

$$r = \frac{\sum_{i=1}^S \sum_{j=1}^R (E'_{ij} - E_{ij})}{\sum_{i=1}^S \sum_{j=1}^R E_{ij}} \quad r_i = \frac{\sum_{j=1}^R (E'_{ij} - E_{ij})}{\sum_{j=1}^R E_{ij}} \quad r_{ij} = \frac{E'_{ij} - E_{ij}}{E_{ij}}$$

The three change terms in employment equation (8) correspond to the shift-share effects. The first is the national effect ($NE_{ij} = E_{ij} r$), which indicates the positive or negative contribution to regional employment attributable to national development. The second term, the sectoral or structural effect ($SE_{ij} = E_{ij} (r_i - r)$), indicates the positive or negative influence if sectoral growth is respectively faster or slower. Finally, the third term is the regional or competitive effect ($RE_{ij} = E_{ij} (r_{ij} - r_i)$), which collects the contributions derived from regional specialisation in productive sectors, that is, the special dynamism of a sector in comparison to the dynamism of the same sector at the national level. In addition, the net total effect (NTE_{ij}) can be calculated as the sum of the sectoral and regional effects, showing the growth differential of regional employment in each sector relative to the national average.

Equation (8) can be modified by introducing the “homothetic change” proposed by Esteban-Marquillas (1972) to solve the limitation of the interdependence between the sectoral and regional components because both effects depend on the productive structure. The homothetic change E_{ij}^* of sector i in region j is interpreted as the value that employment in sector i in region j would take if the distribution of employment at the sectoral level were the same at the regional and national levels. Thus, the change in regional employment is given by the following expression:

$$\Delta E_{ij} = E_{ij} \cdot r + E_{ij} \cdot (r_i - r) + E_{ij}^* \cdot (r_{ij} - r_i) + (E_{ij} - E_{ij}^*) \cdot (r_{ij} - r_i)$$

where

$$E_{ij}^* = \frac{\sum_{j=1}^R E_{ij}}{\sum_{i=1}^S \sum_{j=1}^R E_{ij}} \quad (9)$$

The new third component denominates the net competitive effect ($NCE_{ij} = E_{ij}^* \cdot (r_{ij} - r_i)$) and measures the competitive advantage or disadvantage of the region in each sector with respect

to the total; meanwhile, the fourth term, known as the locational effect ($LE_{ij} = (E_{ij} - E_{ij}^*) \cdot (r_{ij} - r_i)$), shows the degree of specialisation in those sectors.

The previous model was applied to national and regional employment data from the Economically Active Population Survey (INE, 2015) during the period from 2005 to 2010. Then, the reference period was broken down in two sub periods using the beginning of the crisis as a criterion such that the first ranges from 2005 to 2007, encompassing the years before the crisis, and the second ranges from 2008 to 2010, covering much of the crisis period. In this way, it is possible to gain a better understanding of the impact of the crisis on the sectoral evolution of regional employment.

Table 3 displays both the national (NE) and net total effects (NTE) for each productive sector of the Andalusian economy. Predictably, the national economy had a positive effect on most productive sectors prior to the crisis and this effect became negative thereafter. However, there are some exceptions, such as in the cases of Agriculture, cattle and fishing (1) and the Extractive and Manufacturing industries (2, 3) during the period between 2005 and 2007, and Electric power, gas and water production and distribution (4) and Non-commercial services (10) during the period from 2008 to 2010.

Table 3. National effect and net total effect by regional productive sector, 2005-2010

# Account	Productive sector	2005-2007		2008-2010	
		NE	NTE	NE	NTE
1	Agriculture, cattle and fishing	-8.7%	-15.2%	-5.1%	1.1%
2	Extractive industries	-1.7%	22.2%	-13.6%	-4.7%
3	Manufacturing industries	-0.9%	-8.2%	-19.5%	-8.8%
4	Electric power, gas and water production and distribution	5.0%	-18.3%	0.9%	66.6%
5	Construction	14.1%	5.6%	-32.9%	-22.9%
6	Commerce	9.5%	2.6%	-7.7%	1.6%
7	Transport, warehousing and communications	4.7%	2.1%	-5.9%	26.3%
8	Other services	7.3%	10.4%	-4.6%	-0.3%
9	Commercial services	18.2%	20.8%	-3.6%	1.9%
10	Non-commercial services	4.7%	-0.8%	7.9%	15.1%

Source: Own elaboration.

In the case of the strategic sectors, it should be noted that the Manufacturing industries (3) sector presents negative effects in both periods, especially during the crisis period. Conversely, the remaining three strategic sectors follow the same general pattern but with different intensities. Construction exhibits greater effects, especially during the crisis period, when it represents the second sector with the greatest negative effects. Meanwhile, Commerce (6) and Transport, warehousing and communications (7) both exhibit effects that are positive in the first period but negative in the second.

The performance of the NTE differs significantly during the two periods under review. The less dynamic sectors during the period from 2005 to 2007 begin to create jobs during the crisis period, especially Electric power, gas and water production and distribution (4). Meanwhile, the leading sectors in terms of employment during the first period, such as the Extractive industries (2) or Other services (8), suffer slight reductions in their figures during the crisis.

Moreover, it is noteworthy that the evolution of NTE is largely derived from the sectoral effects (SE), as seen in Table 4, where the shift-share effects are shown by productive sector. Agriculture, cattle and fishing (1), the Extractive and Manufacturing industries (2, 3) and, to a lesser extent, Electric power, gas and water production and distribution (4) and Non-commercial services are sluggish during the period from 2005 to 2007, reinforcing the NE. The lack of dynamism in the main industries continues during the crisis period and is exacerbated in the Construction sector (5), although the remaining sectors move in the opposite direction.

The SE shows the mixed performance of the strategic sectors. The Manufacturing industries sector reduces its employment in both periods. As expected, the Construction sector (5), which was the second most dynamic sector during the period from 2005 to 2007, shows the greatest negative SE during the crisis period. In contrast, the remaining two sectors experience respective increases during the crisis period. These are particularly noticeable in the Transport, warehousing and communications sector (7), which breaks away from the negative behaviour recorded in the booming period.

Table 4. Shift-share effects by regional productive sector, 2005-2010

# Account	Productive sector	2005-2007						2008-2010					
		NE	SE	RE			NTE	NE	SE	RE			NTE
				TOTAL	NCE	LE				TOTAL	NCE	LE	
1	Agriculture, cattle and fishing	-8.7%	-15.8%	0.6%	0.4%	0.2%	-15.2%	-5.1%	3.4%	-2.4%	-1.4%	-1.0%	1.1%
2	Extractive industries	-1.7%	-8.8%	31.0%	45.5%	-14.4%	22.2%	-13.6%	-5.0%	0.3%	0.6%	-0.3%	-4.7%
3	Manufacturing industries	-0.9%	-8.0%	-0.2%	-0.3%	0.1%	-8.2%	-19.5%	-10.9%	2.1%	3.6%	-1.4%	-8.8%
4	Electric power, gas and water production and distribution	5.0%	-2.2%	-16.1%	-17.6%	1.4%	-18.3%	0.9%	9.5%	57.2%	101.5%	-44.4%	66.6%
5	Construction	14.1%	7.0%	-1.4%	-1.2%	-0.2%	5.6%	-32.9%	-24.3%	1.5%	1.4%	0.0%	-22.9%
6	Commerce	9.5%	2.4%	0.2%	0.2%	0.0%	2.6%	-7.7%	0.8%	0.7%	0.7%	0.0%	1.6%
7	Transport, warehousing and communications	4.7%	-2.5%	4.6%	5.7%	-1.1%	2.1%	-5.9%	2.7%	23.6%	40.0%	-16.4%	26.3%
8	Other services	7.3%	0.1%	10.3%	6.3%	4.0%	10.4%	-4.6%	3.9%	-4.2%	-2.2%	-2.0%	-0.3%
9	Commercial services	18.2%	11.1%	9.7%	11.6%	-1.9%	20.8%	-3.6%	4.9%	-3.1%	-3.4%	0.3%	1.9%
10	Non-commercial services	4.7%	-2.4%	1.6%	1.6%	0.0%	-0.8%	7.9%	16.4%	-1.4%	-1.4%	0.0%	15.1%

Source: Own elaboration

With regard to regional effects (RE), most of the sectors exhibit positive behaviour in terms of employment both before and during the crisis. One of the most striking exceptions corresponds to Electric power, gas and water production and distribution (4), which exhibits a negative evolution during the first period. There are also declines, although less severe, in Agriculture, cattle and fishing (1) and in most of the activities of the tertiary sector during the crisis period. As mentioned above, the RE performs differently with respect to the strategic sectors. In the Manufacturing industries (3), the Construction sector (5) and Commerce (6), the changes in employment are relatively smaller than those occurring in the other productive sectors. However, whereas employment declines during the first period and grows during the second in the first two sectors, Commerce (6) exhibits positive changes in both periods. Transport, warehousing and communications (7) also shows an increase, but a much more intense one, especially during the crisis period.

To obtain a better understanding of the RE, net competitive effects (NCE) and locational effects (LE) are analysed for the Andalusian case. With respect to NCE, during the period from 2005 to 2007, the dynamism of the Extractive industries (2) and Commercial services (9) stands out relative to the negative behaviour exhibited by Electric power, gas and water production and distribution (4), which is the exact opposite of what happened during the period from 2008 to 2010. It should also be noted that most of the service activities show some dynamism during this period, but this disappears during the crisis period. Moreover, during the crisis period, the strategic sectors exhibit an increase in employment that is higher than the corresponding sectoral average in both periods, especially Transport, warehousing

and communications (7). The above pattern is broken by the Manufacturing industries (2) and the Construction sector (5) only during the booming period.

The LE indicates that the Extractive industries (2), the Commercial sector (9) and Non-commercial services (10) grow faster than the sectoral averages, but their degrees of specialisation at the regional level are lower than those at national level during the period from 2005 to 2007. During the crisis period, this continues to be the case for the Extractive industries (2) but not for services activities. Both sectors are less dynamic but Commercial services (9) reduces its participation in regional employment further, whereas Non-commercial (10) and primary activities (1) increase their shares. A striking case is that of Electric power, gas and water production and distribution (4), which exhibits countercyclical behaviour at the regional level and a lower share of regional employment compared with national figures. The opposite occurs with the Other services sector (8), which is a procyclical sector with higher levels of specialisation. Finally, the LE shows that all the strategic sectors exhibit greater dynamism compared to the national level, but their degrees of specialisation vary. It is lower for the Manufacturing industries (3) and Transport, warehousing and communications (7) and higher for the other two sectors during both periods.

Concluding remarks

In this paper, a structural analysis of the Andalusian economy has been carried out for the period from 2005 to 2010, providing some interesting insights about its performance and the evolution of employment in its strategic sectors during the crisis period. Despite the severe consequence of the economic downturn in terms of regional production and employment, the Andalusian economic structure remains broadly unchanged, and there was even an increase in the number of sectors that invigorated the regional economy within the period from 2005 to 2010. Of the strategic sectors, the Manufacturing industries are shown to be among the most important in the region, including activities highlighted in previous studies, for example on the Food industry, Metallurgy and Petroleum refining. Despite the crisis, the Construction sector has been and continues to be a strategic sector in the Andalusian economy, thereby perpetuating the region's economic dependence on it, as already highlighted in previous works. Transport, warehousing and communications emerged as a strategic sector in 2005 and consolidated its position in 2010. In contrast, Commerce gained in importance over the period

of study, becoming a strategic sector of the regional network of intersectoral relationships and thereby continuing to strengthen the process of tertiarisation in the Andalusian economy.

The shift to the service sector reduces the impact of the primary sector on the regional economy, a traditionally relevant sector in Andalusia, although it continued to have a strong capacity to create jobs even beyond some of the service activities both before and during the crisis. It should be noted that the performance of service activities is mixed, both in their impact on the entire economy and in their capacity to create jobs. Most service activities exhibit lower impact and less capacity compared to other sectors but the two strategic sectors, Transport, warehousing and communications and Commerce, display better results.

With respect to the different performances of the strategic sectors in terms of creating jobs, the shift-share analysis shows that the general economic climate negatively impacted the Manufacturing industries both before and during the crisis, and this is reinforced by the sectoral influence over the complete study period and the continuing loss of specialisation. Although they are a bit more dynamic at the regional level during the crisis period, the above effects can explain the decreases in their capacities to create jobs in 2010 compared with 2005. The Construction sector was hardly hit during the crisis period, exhibiting positive behaviour at the regional level during this time, with slight but positive dynamism at the regional level, making the decrease in its capacity barely lower than that observed for the Manufacturing industries. Commerce is the most striking case, being the only sector, even among the strategic sectors, that exhibits good job creation performance during the crisis period. This behaviour can be explained by the modest but continuing sectoral and regional effect over the entire study period. In contrast, Transport, warehousing and communications, which was distinguished as a relevant sector with greater dynamism at the regional level during the crisis period, slightly reduced its job capacity, probably due to the simultaneous decrease in its degree of specialisation.

Finally, it should be noted that to obtain a whole picture of the impact of the economic crisis on the regional economy and its labour market, the above analysis should be extended until 2013. This task has not been accomplished in this study due to limitations in the available regional Input-Output Framework, pending for further works.

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