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# REGIONAL AND FARM SPECIALISATION IN SPANISH AGRICULTURE BEFORE AND AFTER INTEGRATION IN THE EUROPEAN UNION *

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***Abstract***

In this paper, we study the evolution of agricultural product specialisation at farm and county level from 1979 to 1997 in Spain, thus covering all the stages of the gradual implementation of the Common Agricultural Policy. We use a multiproduct version of Theil and Finizza's index of segregation that allows us to decompose farm product specialisation into county specialisation with respect to the national level, i.e., the usual measure of regional specialisation, and farm specialisation within counties. Our results confirm the importance of increasing regional specialisation but also highlight that trends of farm specialisation within counties have varied across large agricultural areas. In particular, regions more specialised in export-oriented products seem to have speeded regional specialisation.

**Keywords**: product specialisation and concentration, specialisation index, Common Agricultural Policy.

*JEL Classification: C43, Q12, Q18, R32*

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## 1. Introduction

Before entry in the European Community in 1986, agricultural policy in Spain provided a lower level of protection for farmers than the Common Agricultural Policy (CAP). Subsidies as a percentage of total production were just 2.3 percent in 1980. This value jumped to 15.1 percent in 1997. Foreseeing the changes in relative prices, the Government increased guaranteed prices before entry so that price convergence started two years before entry (i.e. in 1984) for most products. The official transition period started in 1986 and lasted until 1992. During those years, intervention prices and market regulations approached progressively the CAP s Common Market Organization (CMO) prices and regulations. From 1993 on, the Spanish farm has been fully integrated in the CAP s CMO.

In this paper, we study the evolution of agricultural product concentration and specialisation at farm and county level from 1979 to 1997 in Spain, thus covering all the stages of the gradual implementation of the Common Agricultural Policy and the integration of the Spanish agriculture to the European Market.

Integration to the European Market and implementation of the CAP generate in theory opposing forces in the process of specialization. On the one hand, the theory of economic integration [See, for example, Helpman and Krugman (1985), Krugman (1990) Krugman and Venables (1996) and Hitiris (1998)] predicts gains coming from product concentration and regional specialisation when integration occurs. These gains stem from comparative advantages, increased international competition and the efficient exploitation of economies of scale. Moreover, in the absence of policy intervention, agricultural product specialisation must be the result

of the influence of fundamentals such as weather and soil conditions. Thus, integration in competitive markets should lead to regional specialisation and product concentration within homogeneous regions. On the other hand, critics to the CAP point out that this policy introduces a market distortion that biases producers against product concentration within regions due to the price and income insurance that the CMO provides.

In fact, the acknowledged shortcomings of the CAP have triggered reforms in the past, the most important one being that of 1992. It mainly consisted of an attempt to decouple price and output levels and therefore it brought the system closer to the World Trade Organization rules. Although reforms have brought some efficiency to the overall system, they have not come without controversy (Weyerbrock, 1998). A number of reports have argued that some rationalization has been achieved, and the European Union is providing assistance to Members to move away from price support towards more transparent and less trade-distorting policies (see for example the recent Council, 2000).

The support price cuts and the implementation of direct aids to decouple the expansion of crop production is a process that is more advanced in some CMOs than in others, resulting in important distributive effects within the agricultural sector at regional level. Thus flexibility to make liberalisation compatible with *multifunctionality* and acknowledgement of the fact that the same regulations cannot be applied to agricultural producers the same way as to others sectors is claimed (Angelidis *et al.* 2000). On the other hand, it is still felt by many economists that

reforms have not gone far enough in terms of decreasing the level of protection, as, for example, stressed by Messerlin (2000).

This paper contributes to the empirical literature on agricultural specialisation in three different ways. First, we provide a descriptive study of the evolution of crop and farm concentration across regions in Spain for the four stages of the process of integration. The first phase took place before price convergence, ending in 1983. Even though integration officially started in 1986, most of price convergence had already taken place by 1987. The transition period officially ended in 1992, the year in which the Single Market Treaty was fully implemented. Finally, from 1993 until 1997 reforms speeded up. In our empirical analysis, we use the *Red Contable Agraria Nacional* (RECAN). This data set is a farm-level survey provided by the Spanish Ministry of Agriculture starting in 1979 and covering the entire period of integration. It is unique for several reasons. First, it is the only farm-level data in Spain. Second, it is available for several years prior to integration in the EU. Third, there is information on location within geographical units below the provincial level. Finally, the level of aggregation for crop information is very thin, thus minimizing the problem of aggregation bias.

In our second contribution, we study the evolution of regional and farm specialisation in the Spanish agricultural sector from 1979 until 1997. Previous studies have focused on regional specialisation, assuming implicitly that farm specialisation within regions is relatively low [Peterson (1995) and Hubbell and Welsh (1998)]. In the Spanish case, there is evidence of the existence of important differences in inland and Mediterranean agriculture [Garcia-Alvarez-Coque *et al.*

(1999)], but there are no previous studies dealing with crop specialisation at farm level within narrow geographical units. Here, we follow Theil and Finizza (1971) and use a general version of their informational measure of segregation to study the relative importance of farm crop specialisation with respect to regional specialisation. For a sufficiently small geographical unit, the similarity in fundamentals such as weather and soil conditions will drive the pattern of very similar crops across farms within the same region. Thus, we expect small farm specialisation within regions, and relatively large regional specialisation. As shown by Mora and Ruiz-Castillo (2000), both measures can be aggregated into an overall measurement. In this paper, farm specialisation with respect to the national standard can be decomposed into two terms, "between regions specialisation" and "within regions specialisation".

Finally, in our last contribution to the literature, we follow up on several empirical papers [Deutsch *et al.* (1994), Boisso *et al.* (1994), and Mora and Ruiz-Castillo (2000)] which have introduced bootstrap techniques to compute confidence bounds for different statistics. We present bootstrapped standard error estimates of our decompositions of overall specialisation. Thus, we are able to study the importance and evolution of regional as opposed to farm specialisation and test the significance of the changes.

Among our main results, we emphasise the following four: (1) Crop concentration has increased in the North, the East, and the South, whilst it has decreased in the North-East and the Centre. (2) This result cannot be replicated when studying farm concentration indexes. In all regions, perhaps with the exception of Centre, farm concentration has gone down. (3) Farm specialisation has gone up

mainly as a result of an increase in county-level specialisation. (4) However, the evolution of county-level specialisation has been different across large regions. In regions initially specialised in export-oriented products, i.e. fruits, vegetables and vineyards, regional specialisation has increased the most. In regions where generous CAP policies were implemented for the main crops, regional specialisation has either increased very slightly or, as it was the case in the North, decreased. Moreover, farm specialisation within small regions has decreased in the areas more oriented towards foreign markets.

The rest of the paper is organized as follows. Section 2 of the paper presents the data and describes the composition across large agrarian regions of agricultural production in Spain and its evolution from 1979 until 1997. In section 3, we deal with the multi-product version of Theil and Finizza's index of segregation while Section 4 presents the empirical results related to the specialisation index. Finally, Section 5 provides some concluding comments.

## 2. Data Description

### *2.1 The Data Set*

We use data from the *Red Contable Agraria Nacional* (RECAN), an annual national survey prepared by the Spanish Ministry of Agriculture. This survey has been part of the *European Farm Accounting Data Network* (FADN) since 1985. The questionnaire is filled in by county accountancy agencies that collect information directly from the commercial farms.[1] Every year, the survey has information on crop nominal production of around 7000 farms and 70 crops.[2] Because of sample size, we must aggregate the crop information into 10 major agricultural products: Livestock production, field crop, grain cereals, vineyard, potatoes, industrial crops, vegetables, fruits, dried pulses, and olive grove. Farm location is reported only at provincial level, a geographical unit that includes several agrarian areas for most provinces. However, it is possible to interact this information with altitude above sea level and create three areas within each province: ( a ) the high region includes all farms located 600 meters above sea level in the same province; ( b ) the intermediate region comprises firms located between 300 and 600 meters above sea level; and ( c ) the low region, which includes all firms below 300 meters above sea level. After interacting the province code with the altitude dummy variable, we split the country into 107 different geographical units, with an average size of 4.97 square kilometers. The average number of firms per geographical unit and year is 70, a relatively small

[1] Commercial farms are mostly farms where more than one Agricultural Work Unit is employed.
[2] For a complete explanation of the data set, see San Juan et al. (2000).

number. Therefore, our measurements of specialisation may be suffering from small sample problems: random allocations of firms in the sample may lead to high levels of regional specialisation measurements purely by chance. We address this problem in two ways. First, we aggregate all years into four periods that coincide with the relevant stages of the Spanish integration into the EU. Second, we follow up on several empirical papers [Deutsch et al. (1994) and Boisso et al. (1994)] that have introduced bootstrap techniques to compute standard errors so that we can asses the degree of accuracy in our specialisation indexes.

*2.2 Crop Concentration by Large Agrarian Regions*

Before turning to the study of specialisation, it seems interesting to give a brief description of the major trends in product concentration for the larger agrarian regions and the periods under study. Following previous studies on regional specialisation, we look at product concentration in five major agrarian regions: (1) The North includes Galicia, Asturias, Cantabria, and the Basque Country, all mountainous regions in the North with rainy and mild weather. (2) North East is formed by Navarra, Rioja, Aragon, Catalonia, and the Balearic Islands, all regions being crossed by the valley of the river Ebro, plus the Mediterranean areas of Nothern Catalonia and the Balearic Islands. (3) Centre, with Castilla-Leon, Castilla-La Mancha, Madrid, and Extremadura, is a plateau with a range of mountains crossing it North-East to South-west and with continental weather. (4) East includes the Mediterranean regions of Valencia and Murcia. Finally, the South (5) is composed

of Andalucia. The Canary Islands were dropped from the sample since one of its major crops, the banana, was not coded in all the years of the study.

Table 1 is divided into 5 panels, each one referring to each of the major regions. The four columns in each panel represent the proportion of each of the crops in every period as a percentage of total agricultural production. The crops are ordered within each region according to its weight in the 1979:1983 years.

The North clearly exhibits regional concentration in livestock production and field crops, which are typically related with high environmentally adapted dairy and beef farms. Concentration in these two crops steadily increased from 87.1 percent of total production in the 1979:1983 period to 95.3 percent in the 1993:1997 years. On the contrary, grain cereals and vineyard, which amounted to about 7.1 percent of the production at the beginning of the sample, declined its share in total production to 1.5 percent. Potatoes kept their share of total production at about 2.2 percent in all years. The rest of the crops only had a marginal presence before entry into the European Union and remained so for the entire period.

In the Northeast, livestock production decreased its share from 37.2 percent to 12.4 percent. In fact, it only remained important in the North-west Catalonian region of Lleida, where intensive hog production is concentrated. On the other hand, fruits, vegetables and vineyard, crops in which the region enjoys certificates of origin, increased their share from 20.1 percent to 45.4 percent of total production. Vegetables, a production linked not only to fresh consumption, but also to canned vegetables, increased its share by an astonishing 321 percent. This trend reflects that the Spanish canned vegetables industry is now concentrated in La Rioja and Navarra

in the North-East and, also, Murcia in the East. Grain cereals remained stable at almost one third of total production while potatoes and field crop stayed at less than one tenth of total production for the entire period. The observed increase in olive groves is common to most other large regions and took place in the last stage after reform of the CAP. This is probably due to the effect of the price support system. In 1985, the average minimum guaranteed price was 180 pesetas per kilo. By 1997, the minimum income guarantee to the olive oil producer reached 540 pesetas. This increase in the support benefited marginal areas with trees with lower productivity levels, as in the Ebro valley.

In the Centre, grain cereal has always been the most important crop. However, its weight seems to have slightly declined from around 50 percent at the beginning of the 1980s to 40 percent for the 1993:1997 period. The timing suggests that the implementation of set-aside new CAP policies after 1992 may have contributed to this decline. This is in sharp contrast with the observed increase in both vegetables and vineyard. The spectacular increase in vegetables was mostly concentrated in irrigated lands in Extremadura and the Tajo valley in Castilla-La Mancha, whilst vineyards of the Duero valley and the Valdepeñas area, both with certificates of origin, account for most of the increase in the vineyard s share on total production.

Vegetables and fruits are the largest crops in the Eastern region. In the first period, 1979:1983, they amounted to 71.2 percent of total production. Fifteen years later, their share on total production had increased to 81.9 percent. The output from this region is mostly export oriented to the rest of the EU, and, since prices of these

crops are less protected in the CAP, this trend clearly shows that the East is concentrating production in crops where it is more competitive.

Vegetable production in the South was, with 10.7 percent, only the fourth largest crop in the years before entry in the EU. By the end of the period, the percentage had jumped to 29.3 percent and this product had become the most important. The increase in industrial crops was also substantial, 5.9 percentage points. In contrast, grain cereals, olive grove, fruits, and livestock production all decreased their share.

In order to summarise all these trends, we present in Table 2 two indexes of product concentration. The first one is the percentage of the three largest crops over total production by each large region. Obviously, the higher this percentage, the more concentrated production in the region is in these three products. The second index of concentration that we show is Theil s entropy measure of concentration. For each region r and period t, we compute

$$E_{rt} = \Sigma_i (Y_{irt} / Y_{rt}) \log_{10} \left((Y_{it}/Y_t)^{-1}\right) \qquad (2.1)$$

where $Y_{irt}$ is the production of crop i in region r and period t; $Y_{rt}$ is total production in region r; $Y_{it}$ is national production of crop i, and $Y_t$ is total production. The logarithms are taken on base 10 in order to normalise the index between 0 and 1. Higher values indicate more entropy, or dispersion, and lower values indicate more concentration. A number of stylised facts can be drawn from Table 2: (1) The North and the East are the regions with more product concentration by the end of the process. In fact, three products account for almost all production in 1993:1997**.** The North-East is the least concentrated in terms of the three largest crops. Similar results

are obtained when using the Theil entropy measures. (2) Concentration has increased in the whole sample in the North, the East, and the South, while it has decreased in the North-East and the Centre, regardless of the index that we look at. For the South, concentration increased remarkably during the transition period (1984:1987) and the recent years (1993:1997). However, the top three products changed during the 1980s and by 1993:1997 they were vegetables, grain cereals, and industrial crops. Therefore, olive grove has dropped from the top three in the South. We will comment on this later on. (3) Finally, while the East has become a relatively concentrated region, the North-East, a similar region in terms of concentration by 1979:1983, has followed the opposite direction and diversified.

*2.3 Farm Concentration by Large Agrarian Regions*

Trends and changes in crop concentration may take place either through changes in the ownership and size of the farms or through changes in the way that farms operate. It is thus of interest to enquire whether the observed trends in concentration and diversification in the large agrarian regions are related to possible changes in farm size. The pressure and potential provided by a bigger market with decreasing tariffs may lead to farm concentration in order to take advantage of economies of scale. On the other hand, price support, on top of certain direct payments and structural funds, provide an effective way to sustain farmers income, rendering changes in ownership and size less likely.

We show in Table 3 the evolution of farm concentration by large agrarian regions. Again, we present two measures: the proportion of the top 100 farms over

total production by each large region in the first panel, and Theil s entropy measure in the second panel. The striking result is that, in spite of the differences in trend of crop concentration across regions, there seems to be uniformity regarding farm concentration. More precisely, the results show that there is a tendency to farm dispersion in all regions, perhaps with the exception of the Centre.[3]

Both the North and the North-East experienced most of the changes during the transition period. This fast reaction to the integration in the North was partly induced by the milk price war , which pushed up dairy prices, and the decision of the Spanish government not to supervise the implementation of the CMO milk quotas[4]. In the North-East, large farms specialised in cattle intensive feeding suffered a profound crisis during the first half of the 1980s due to the increase in feeds prices.

The South shows a gradual trend towards more farm dispersion. This trend is interesting in that it is the mirror image of product concentration. In this region, both gradual product concentration and farm diversification are present throughout the sample. The reason of this combination is related, as in the North-East, with the increasing output of Mediterranean products which are linked to the food export expansion but cannot take full advantage of economies of scale.

The East mainly experienced diversification in the 1990s. And again, this result is in sharp contrast to what we observe by looking at the evolution of crop concentration, where the most important changes took place during the 1990s.

[3] This feature is nevertheless compatible with Census reports showing that the number of all farms, i.e. those employing any number of Agricultural Work Units, is decreasing.

[4] Spain had a deficit of milk production that led to a price war in the dairy industry to attract dairy farmers and increase regional market quotas in fresh milk. By doing so, the Spanish local dairy industry tried to keep the domestic market away from international competition.

Finally, no clear pattern emerges from the data in the Centre. There was an increase in farm concentration right after integration, but by the end of the period this effect had vanished, possibly due to the 1992 cereal and grains CMO reform that increased direct support to compensate the reduction in the intervention price.

The overall conclusion by looking at the evolution of farm and crop concentration is clear: the two processes may not be and have not been closely related. In the remaining sections of the paper, we will focus on the study of crop specialisation at farm and county levels.

*2.4 Crop Specialisation by Large Agrarian Regions*

Olive grove production in the South shows very clearly why looking at crop concentration and related indexes is not useful to study the patterns of specialisation. The South is specialised in olive grove production in the sense that its share in regional production is exceptionally high for national standards. In 1995, for example, 64 percent of all olive trees in Spain were in the South. As a result, olive grove for the whole period averages 19.7 percent of total production in this region whilst it only represents 3.4 percent at the national level. However, olive grove is not the most important crop in the South.

In Table 4 we present a direct measure of regional specialisation by region and product. This measure is the ratio of the crop s share in the regional production to its share in the country as a whole:

$$I_{ir} = (Y_{ir}/Y_r) / (Y_i/Y) \qquad (2.2)$$

where $Y_{ir}$ is the production of crop i in region r; $Y_r$ is total production in region r; $Y_i$ is national production of crop i, and Y is total production. Values higher than one show that the crop is more important in the region than in the country, and this intuitively suggests that the region is specialised in this product. In this section, we will follow this interpretation of the index $I_{ir}$.

A number of interesting results can be drawn from Table 4: (1) The North is only specialised in livestock production and field crop, and its pattern remains constant throughout the years. (2) In the North-East, the major change has to do with the evolution of vineyard and livestock production. We already know from Table 1 that the production share of vineyard increased whilst the share of livestock production decreased. In Table 4 we observe that the region has made a dramatic change in crop specialisation, leaving livestock production and specialising in vineyard. The region also experienced a large increase in the share of fruits. However, this was a feature that also took place at the national level. Therefore, the region has simply maintained its status of specialisation in the fruits market. (3) In the Centre, changes in specialisation are small, and only vineyards seem to have increased effectively their relative importance. (4) For the East, the most noticeable change is related with vegetables. At the beginning of the period, the region s share of vegetables was more than five times larger than the nation s share. However, vegetable crops in the North-East and the South increased dramatically, bringing the index down to 2.85. The importance of fruits and vineyards remained constant. (5) Finally, Olive grove is still the crop in which the South most specialises, although there has also been a reduction of the index, in this case due to the increase in olive

grove production in the Centre and the East. The region has become specialised in grain cereals and, more intensively, in dried pulses. On the other hand, vineyard production, a crop in which the region was specialised at the late 1970s, has not followed the nation s trend, driven by the significant increase of production in the North-East and Centre regions, and the index has fallen sharply. Regarding vegetables and industrial crops, we witness a clear trend of increased specialisation in the first case, based on exports expansion, but a jump at the beginning of the integration and stability in the index afterwards in the second case, probably due to the CAP reforms of industrial crops support.

Note that our descriptive analysis has been implemented for very large agrarian regions. All of them present weather and soil heterogeneity, and therefore it is reasonable to expect several crops being important at this level of geographical aggregation. Our approach in the next two sections consists in studying specialisation at the smallest possible geographical unit, the farm, and also at county-level, where it is reasonable to assume that weather and soil conditions are homogeneous. By doing so, we can check how farms have reacted to policy and how fundamentals that are homogenous at county level are affecting the evolution of specialisation. In this sense, if county level specialisation decreased after integration whilst the opposite happened to farm-level specialisation, then it would be natural to think that the CAP profoundly affected production patterns in Spain. To do so, we need indexes of specialisation that aggregate both for products and geographical units. In the next section, we present indexes based on Theil and Finizza s index of segregation that satisfy this property.

**3. Regional versus farm specialisation.**

In the previous Section we have seen that a slow process of regional product concentration has taken place whilst firm concentration has, if anything, decreased. This fact may suggest that product concentration within the firm has also increased and that the evolution of regional concentration is merely a reflection of firms' responses to the changing environment due to trade diversion effects of integration and to the generalised introduction of guaranteed prices and subsidies with the implementation of the Common Agricultural Policy. In this section, we propose an application of a multi-product version of Theil and Finizza s index of segregation to test whether firm product specialisation has indeed taken place. In the next section, we present its application to the evolution of farm specialisation in Spain.

First, we can study product concentration in the Spanish agricultural sector by looking at the entropy measure for the entire national agricultural production at any period of time:

$$E = \Sigma_i (Y_i/Y) \log_{10} \left((Y_i/Y)^{-1}\right) \qquad (3.1)$$

This index is bound, so that $0 \leq E \leq 1$. It measures crop specialisation at the national level so that if national production is equally distributed across crops, then E takes its maximum value, E = 1. If all production is concentrated in one product, then E takes its minimum value, E = 0.

An obvious application of equation (3.1) to large regions was presented in the previous section. In the following, we will denote by r small county-level regions. Of course, the index can still be applied to them:

$$E_r = \Sigma_i (Y_{ir} / Y_r) \log_{10} \left((Y_i/Y_t)^{-1}\right) \qquad (3.2)$$

The set of indexes { $E_r$ } can be aggregated to compose an overall index of regional product concentration,

$$\hat{E}_{(r)} = \Sigma_r (Y_r/Y) E_r \qquad (3.5)$$

Note that equation (3.5) does not give us a comparison of specialisation at regional and national level. In order to analyse the extent to which the production pattern in a region differs from the national pattern, we can extend Theil and Finizza's measure of segregation to more than two products. In information theory,

$$I_r = \Sigma_i (Y_{ri}/Y_r) \log_{10} \left((Y_{ri}/Y_r)/ (Y_i/Y)\right) \qquad (3.6)$$

is known as the expected information of the message that transforms the proportions $\{(Y_i/Y)\}_i$ to a second set of proportions $\{(Y_{ri}/Y_r)\}_i$. The value of $I_r$ is zero when the two sets are identical; it takes larger values when the two sets are more different. It is straightforward to apply Theil and Finizza's result to the multiproduct case and show that the weighted average of the information expectations, $\hat{I}_{(r)} = \Sigma_r (Y_r/Y) I_r$, accounts for the difference between the national measure of concentration and the weighted average of regional concentration indexes. Thus,

$$\hat{I}_{(r)} = E - \hat{E}_{(r)} \qquad (3.7)$$

which is a measure of regional specialisation at county level: it shows by how much the regions' production patterns differ on average from the national one.

*3.1 Farm specialisation*

Regional specialisation at county level is mainly driven by weather and soil characteristics. Farm specialisation, however, is also affected by policy and management skills . Thus, it is natural to ask by how much farms specialise from the national pattern. We, then, define farm entropy as

$$E_f = \Sigma_i (Y_{fi}/Y_f) \log_{10} \left((Y_{fi}/Y_f)^{-1}\right) \qquad f = 1,..., F. \tag{3.8}$$

The weighted farm entropy average takes the form:

$$\hat{E}_{(f)} = \Sigma_f (Y_f/Y) E_f \tag{3.9}$$

A measure of total farm specialisation is:

$$I_f = \Sigma_i (Y_{fi}/Y_f) \log_N \left((Y_{fi}/Y_f)/ (Y_i/Y)\right) \tag{3.10}$$

and

$$\hat{I}_{(f)} = \Sigma_f (Y_f/Y) I_f \tag{3.11}$$

Finally, it is again straightforward to see that:

$$\hat{I}_{(f)} = E - \hat{E}_{(f)} \tag{3.12}$$

Intuitively, farm variation could be due to both a regional and a within-region effect. If we consider farm f specialisation within region r,

$$I_{rf} = \Sigma_i (Y_{rfi}/Y_{rf}) \log_N \left((Y_{rfi}/Y_{rf})/ (Y_{ri}/Y_r)\right) \tag{3.13}$$

and aggregate over farms and regions,

$$\hat{I}_{(rf)} = \Sigma_r \Sigma_f (Y_{rf}/Y) I_{rf} \tag{3.14}$$

then, the following result by Mora and Ruiz-Castillo (2000) applies:

$$\hat{I}_{(f)} = \hat{I}_{(r)} + \hat{I}_{(rf)} \tag{3.15}$$

Therefore, farm specialisation is divided into two components. Regional

specialisation measures differences across regions to the national standard. Within each region, it is possible to measure farm specialisation from the regional standard. If policy and management skills stand over fundamentals, we may expect the evolution of overall farm specialisation to be driven by the second component. In the next section, we present the decomposition (3.15) for the Spanish agricultural sector together with bootstrapped standard errors obtained from 1,000 simulations drawn from the empirical distribution with replacement.

## 4. The Decomposition of Farm Specialisation into Regional and Within Regional Specialisation

In this section, we apply the methodology presented in the previous section to Spanish data. We use county-level geographical units to account for regional specialisation. Thus, we study regional specialisation for the 107 geographical units that result from the interaction of the province codes with the altitude dummies. The results of the decomposition (3.15) are presented in Table 5. Each panel corresponds to one of the four periods. Bootstrapped standard errors were obtained with 1,000 replications of the empirical sample with replacement. Equation (3.15) at the national level is reported in the last row in each of the panels. We also show the values of this decomposition for each one of the larger regions. Obviously, the national decomposition equals the weighted sum of the regional ones, with weights equal to the share of each of the regions in the national agricultural output.

When we look at the national indexes, we observe that total farm specialisation has gone up from 57.8 to 67.6 , or 17 percent. The decomposition into a between and a within component shows that all of this increase is attributable to the increase in regional specialisation, from 27.9 in the 1979:1983 period to 40.0 index points in the 1993:1997 years. Farm specialisation within small agrarian regions has, if anything, decreased at national level, starting from 30.0 in 1979:1983 and coming down to 27.6 in 1993:1997, although we cannot reject the hypothesis that farm specialisation within small regions has remained constant.

In the descriptive analysis of the previous sections, it was shown how important agricultural specialisation in large agrarian regions is. Clearly, different

regions concentrate in different products. For example, whilst the North would produce mainly livestock production and field crops, the East concentrates production in vegetables and fruits. It is thus of interest to study decomposition (3.15) for each of the regions, as it can be expected that their specialisation will lead to different responses to the new environment of a bigger market and a new policy.

In the North, county-level specialisation has actually decreased for the whole period, whilst farm specialisation within small regions has remained stable at very low levels. This is consistent with the fact that the region as a whole is specialised in dairy and field crops. Furthermore, weather and soil conditions are fairly homogeneous across the region, and differ significantly from the rest of the country. An interesting question to address is why regional specialisation has decreased mainly in the 1988:1992 years. This was the period in which the milk quotas started being actively supervised by the central government, with an inevitable decrease in milk production and prices. In the next period, the Spanish quota increased and reforms were implemented, changing the evolution of regional specialisation.

The increase in regional specialisation in the North-East has been very moderate and took place at the beginning of the integration to the EU. On the other hand, farm specialisation within small regions has increased, reaching levels at the entry period similar to those in the East. It is interesting to note that production shares in the North-East increased for vineyard, fruits, and vegetables, whilst they decreased for livestock production. Our conjecture is that, in the North-East, a mixture of policy and market expansion effect is influencing the results on regional and farm level specialisation.

In the Centre, both regional specialisation and farm specialisation have increased during the whole period. However, the increase in farm specialisation within small regions has not been significant so that we cannot reject that farm specialisation has remained constant. On the other hand, the change in regional specialisation is significant and takes place gradually. This is consistent with the view that set-aside programmes, modulation in grain cereals, and lowering intervention prices put pressure on firms to specialise and take advantage of economies of scale.

Regional specialisation in the East increased significantly at the entry to the EU and remained stable afterwards. On the other hand, farm specialisation within small regions has decreased for the whole period. Thus, in the export oriented agriculture of the East the integration to the larger European market for fresh and processed food has driven the small regions to the highest levels of specialisation.

The South has experienced the largest increase in regional specialisation: an increase of 29.9 index points or 116 percent. At the same time, farm specialisation within small regions went down from 48.7 to 27.7. The national results are mainly driven by what happens in both the South and the East. Again, the reasons behind this increase in regional specialisation in the South are related to the intensification of production in crops with increasing exports, mainly vegetables to the EU.

To sum up our results, the evolution of county-level specialisation has been different across large regions. In regions initially specialised in export-oriented products, mainly the South and the East, regional specialisation has increased the most. In regions where CAP policies were implemented heavily affecting the main

productions, regional specialisation has either increased very slightly or, as was the case in the North, decreased. Moreover, farm specialisation within small regions has decreased in the areas more oriented towards foreign markets.

## 5. Concluding remarks

In this paper, we present indexes of crop and farm concentration for Spain based on a farm level survey carried out by the Spanish Ministry of Agriculture. The period of study spans from the beginning of the 1980s until 1997, thus comprising all stages that the Spanish agriculture experienced before and after entry in the European Union. We also develop an overall index of farm specialisation that decomposes into a between and a within regional term. Another property of the index is that it can be aggregated at different geographical levels, allowing a comparison between the decomposition in different large regions and the national decomposition.

In our empirical analysis, we first find that crop concentration has increased in the North, the East, and the South, whilst it has decreased in the North-East and the Centre. This variation cannot be replicated when studying farm concentration indexes. In all regions, perhaps with the exception of Centre, farm concentration has gone down. Moreover, the changes in the regional production patterns have taken place without dramatic changes in size and ownership of the farms.

We then study the evolution of regional and farm specialisation using county-level and farm information. Since the regions under consideration are homogeneous in weather and soil conditions, we assume that a decrease in county-level specialisation and an increase in farm specialisation within counties would highlight the effect of the CAP on the production patterns. Our results show that total farm specialisation has gone up 17 percent and that all of this increase is attributable to the increase in regional specialisation. However, the evolution of county-level

specialisation has been different across large regions. In regions initially specialised in more export-oriented products, mainly the South and the East, regional specialisation has increased the most. In regions where CAP policies were more generous for the main crops, regional specialisation has either increased very slightly or, as was the case in the North, decreased. Moreover, farm specialisation within small regions has decreased in the areas more oriented towards foreign markets.

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**Table 1. The Composition of Production by Agrarian Region**

| **NORTH** | **1979:1983** | **1984:1987** | **1988:1992** | **1993:1997** |
|---|---|---|---|---|
| *Livestock Production* | 64.95 | 76.79 | 82.48 | 84.45 |
| *Field Crop* | 22.19 | 11.57 | 11.78 | 10.82 |
| *Grain Cereals* | 4.11 | 4.23 | 1.77 | 1.46 |
| *Vineyard* | 3.02 | 2.62 | 0.41 | 0.11 |
| *Potatoes* | 2.65 | 2.13 | 1.87 | 2.34 |
| *Industrial Crops* | 1.72 | 1.51 | 1.12 | 0.58 |
| *Vegetables* | 1.17 | 1.02 | 0.35 | 0.17 |
| *Fruits* | 0.09 | 0.02 | 0.08 | 0.01 |
| *Dried Pulses* | 0.07 | 0.08 | 0.09 | 0.01 |
| *Olive Grove* | 0.00 | 0.00 | 0.00 | 0.00 |
| **TOTAL** | **100.0** | **100.0** | **100.0** | **100.0** |

| **NORTH-EAST** | **1979:1983** | **1984:1987** | **1988:1992** | **1993:1997** |
|---|---|---|---|---|
| *Livestock Production* | 37.15 | 15.74 | 13.25 | 12.44 |
| *Grain Cereals* | 29.01 | 35.05 | 31.36 | 26.04 |
| *Fruits* | 14.67 | 14.13 | 17.67 | 22.59 |
| *Field Crop* | 4.69 | 4.72 | 4.65 | 5.91 |
| *Vineyard* | 3.56 | 11.02 | 10.19 | 11.15 |
| *Potatoes* | 3.15 | 6.3 | 5.19 | 3.46 |
| *Industrial Crops* | 3.09 | 4.32 | 4.46 | 3.89 |
| *Vegetables* | 2.76 | 6.93 | 10.93 | 11.62 |
| *Olive Grove* | 1.48 | 1.56 | 1.94 | 2.46 |
| *Dried Pulses* | 0.38 | 0.19 | 0.32 | 0.39 |
| **TOTAL** | **100.0** | **100.0** | **100.0** | **100.0** |

| **CENTRE** | **1979:1983** | **1984:1987** | **1988:1992** | **1993:1997** |
|---|---|---|---|---|
| *Grain Cereals* | 47.24 | 53.26 | 45.97 | 39.08 |
| *Livestock Production* | 18.29 | 15.9 | 19.96 | 17.03 |
| *Industrial Crops* | 16.48 | 15.98 | 17.4 | 17.2 |
| *Field Crop* | 3.9 | 1.72 | 2.54 | 1.74 |
| *Vegetables* | 3.75 | 2.95 | 6.19 | 12.16 |
| *Vineyard* | 3.43 | 3.43 | 2.67 | 5.57 |
| *Potatoes* | 2.94 | 3.1 | 2.85 | 3.04 |
| *Dried Pulses* | 2.3 | 2.19 | 1.18 | 0.77 |
| *Olive Grove* | 1.46 | 1.14 | 0.84 | 2.62 |
| *Fruits* | 0.17 | 0.28 | 0.36 | 0.73 |
| **TOTAL** | **100.0** | **100.0** | **100.0** | **100.0** |

**Table 1. (continued)**

| **EAST** | **1979:1983** | **1984:1987** | **1988:1992** | **1993:1997** |
|---|---|---|---|---|
| *Vegetables* | 39.05 | 50.74 | 46.09 | 39.87 |
| *Fruits* | 32.11 | 30.32 | 36.29 | 42.05 |
| *Vineyard* | 11.09 | 7.82 | 10.05 | 12.14 |
| *Grain Cereals* | 6.77 | 6.70 | 3.71 | 2.31 |
| *Livestock Production* | 6.08 | 1.17 | 0.70 | 1.18 |
| *Potatoes* | 2.70 | 1.79 | 2.13 | 1.33 |
| *Dried Pulses* | 1.00 | 0.64 | 0.19 | 0.16 |
| *Field Crop* | 0.59 | 0.17 | 0.09 | 0.00 |
| *Olive Grove* | 0.39 | 0.29 | 0.58 | 0.80 |
| *Industrial Crops* | 0.16 | 0.31 | 0.11 | 0.10 |
| **TOTAL** | **100.0** | **100.0** | **100.0** | **100.0** |

| **SOUTH** | **1979:1983** | **1984:1987** | **1988:1992** | **1993:1997** |
|---|---|---|---|---|
| *Grain Cereals* | 26.87 | 21.93 | 13.52 | 24.23 |
| *Olive Grove* | 19.53 | 17.11 | 25.65 | 16.56 |
| *Industrial Crops* | 14.77 | 28.15 | 21.76 | 20.65 |
| *Vegetables* | 10.71 | 10.89 | 18.42 | 29.27 |
| *Fruits* | 8.9 | 9.69 | 7.26 | 4.22 |
| *Livestock Production* | 8.15 | 6.82 | 9.67 | 0.98 |
| *Vineyard* | 5.49 | 2.50 | 0.90 | 0.13 |
| *Potatoes* | 3.05 | 1.63 | 1.60 | 2.81 |
| *Field Crop* | 1.90 | 0.71 | 0.76 | 0.06 |
| *Dried Pulses* | 0.58 | 0.52 | 0.42 | 1.04 |
| **TOTAL** | **100.0** | **100.0** | **100.0** | **100.0** |

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**Table 2.** Evolution of Product Concentration by Agrarian Region

**Output Share of Top Three Products**

| | 1979:1983 | 1984:1987 | 1988:1992 | 1993:1997 |
|---|---|---|---|---|
| NORTH | 91.25 | 92.61 | 96.15 | 97.62 |
| NORTH-EAST | 80.85 | 64.93 | 62.30 | 61.09 |
| CENTRE | 82.02 | 85.15 | 83.35 | 73.33 |
| EAST | 82.27 | 88.89 | 92.44 | 94.08 |
| SOUTH | 61.18 | 67.20 | 65.84 | 74.17 |

**Theil s Entropy Measure**

| | 1979:1983 | 1984:1987 | 1988:1992 | 1993:1997 |
|---|---|---|---|---|
| NORTH | 49.24 | 40.14 | 30.17 | 26.63 |
| NORTH-EAST | 72.56 | 82.29 | 84.38 | 85.29 |
| CENTRE | 69.11 | 63.86 | 67.77 | 75.37 |
| EAST | 66.70 | 56.03 | 54.38 | 53.91 |
| SOUTH | 86.22 | 81.01 | 80.30 | 72.41 |

Note: Higher values indicate more entropy, or dispersion, and lower values indicate more concentration.

**Table 3.** Evolution of Firm Concentration by Agrarian Region

**Output Share of Top 100 Firms**

| | 1979:1983 | 1984:1987 | 1988:1992 | 1993:1997 |
|---|---|---|---|---|
| NORTH | 34.20 | 19.75 | 13.16 | 18.89 |
| NORTH-EAST | 28.66 | 19.46 | 18.10 | 18.25 |
| CENTRE | 16.45 | 21.92 | 17.97 | 18.03 |
| EAST | 29.60 | 26.10 | 18.80 | 24.59 |
| SOUTH | 31.30 | 26.51 | 22.13 | 20.31 |

**Theil s Entropy Measure**

| | 1979:1983 | 1984:1987 | 1988:1992 | 1993:1997 |
|---|---|---|---|---|
| NORTH | 94.47 | 95.78 | 95.64 | 95.71 |
| NORTH-EAST | 92.44 | 94.64 | 94.28 | 95.05 |
| CENTRE | 94.64 | 92.47 | 93.87 | 95.03 |
| EAST | 95.88 | 95.64 | 95.83 | 96.05 |
| SOUTH | 92.84 | 93.93 | 93.72 | 95.81 |

Note: Higher values indicate more entropy, or dispersion, and lower values indicate more concentration.

**Table 4. The Ratio of the Product s Share in Each Large Region to its Share in the Country**

| **NORTH** | **1979:1983** | **1984:1987** | **1988:1992** | **1993:1997** |
|---|---|---|---|---|
| *Field Crop* | 3.55 | 3.4 | 2.44 | 2.33 |
| *Livestock Production* | 2.39 | 3.59 | 2.66 | 2.88 |
| *Potatoes* | 0.89 | 0.61 | 0.63 | 0.83 |
| *Vineyard* | 0.69 | 0.47 | 0.09 | 0.01 |
| *Industrial Crops* | 0.17 | 0.12 | 0.10 | 0.05 |
| *Vegetables* | 0.15 | 0.10 | 0.02 | 0.00 |
| *Grain Cereals* | 0.12 | 0.10 | 0.07 | 0.05 |
| *Dried Pulses* | 0.05 | 0.07 | 0.15 | 0.02 |
| *Fruits* | 0.00 | 0.00 | 0.00 | 0.00 |
| *Olive Grove* | 0.00 | 0.00 | 0.00 | 0.00 |

| **NORTH-EAST** | **1979:1983** | **1984:1987** | **1988:1992** | **1993:1997** |
|---|---|---|---|---|
| *Fruits* | 2.07 | 1.97 | 2.21 | 2.31 |
| *Livestock Production* | 1.37 | 0.73 | 0.41 | 0.41 |
| *Potatoes* | 1.07 | 1.83 | 1.77 | 1.24 |
| *Grain Cereals* | 0.92 | 0.98 | 1.25 | 1.23 |
| *Vineyard* | 0.82 | 2.03 | 2.43 | 2.11 |
| *Field Crop* | 0.75 | 1.37 | 0.95 | 1.27 |
| *Olive Grove* | 0.46 | 0.62 | 0.56 | 0.63 |
| *Vegetables* | 0.38 | 0.76 | 1.00 | 0.82 |
| *Industrial Crops* | 0.31 | 0.37 | 0.46 | 0.43 |
| *Dried Pulses* | 0.30 | 0.15 | 0.56 | 0.81 |

| **CENTRE** | **1979:1983** | **1984:1987** | **1988:1992** | **1993:1997** |
|---|---|---|---|---|
| *Dried Pulses* | 1.82 | 1.87 | 2.07 | 1.61 |
| *Industrial Crops* | 1.66 | 1.42 | 1.80 | 1.91 |
| *Grain Cereals* | 1.50 | 1.49 | 1.85 | 1.84 |
| *Potatoes* | 1.00 | 0.89 | 0.98 | 1.09 |
| *Vineyard* | 0.80 | 0.62 | 0.62 | 1.05 |
| *Livestock Production* | 0.67 | 0.74 | 0.63 | 0.57 |
| *Field Crop* | 0.62 | 0.50 | 0.51 | 0.37 |
| *Vegetables* | 0.54 | 0.31 | 0.56 | 0.87 |
| *Olive Grove* | 0.46 | 0.44 | 0.23 | 0.68 |
| *Fruits* | 0.01 | 0.02 | 0.03 | 0.07 |

**Table 4.** **(continued)**

| **EAST** | **1979:1983** | **1984:1987** | **1988:1992** | **1993:1997** |
|---|---|---|---|---|
| *Vegetables* | 5.61 | 5.67 | 4.26 | 2.85 |
| *Fruits* | 4.55 | 4.23 | 4.55 | 4.32 |
| *Vineyard* | 2.57 | 1.45 | 2.40 | 2.30 |
| *Potatoes* | 0.91 | 0.51 | 0.73 | 0.47 |
| *Dried Pulses* | 0.79 | 0.54 | 0.34 | 0.34 |
| *Livestock Production* | 0.21 | 0.05 | 0.01 | 0.03 |
| *Grain Cereals* | 0.20 | 0.18 | 0.14 | 0.10 |
| *Olive Grove* | 0.11 | 0.10 | 0.15 | 0.20 |
| *Field Crop* | 0.09 | 0.05 | 0.00 | 0.00 |
| *Industrial Crops* | 0.00 | 0.01 | 0.00 | 0.00 |

| **SOUTH** | **1979:1983** | **1984:1987** | **1988:1992** | **1993:1997** |
|---|---|---|---|---|
| *Olive Grove* | 6.30 | 6.82 | 7.40 | 4.30 |
| *Vegetables* | 1.53 | 1.21 | 1.70 | 2.09 |
| *Industrial Crops* | 1.50 | 2.51 | 2.25 | 2.30 |
| *Vineyard* | 1.27 | 0.46 | 0.20 | 0.01 |
| *Fruits* | 1.25 | 1.35 | 0.91 | 0.43 |
| *Potatoes* | 1.02 | 0.46 | 0.55 | 1.00 |
| *Grain Cereals* | 0.85 | 0.61 | 0.54 | 1.13 |
| *Dried Pulses* | 0.46 | 0.43 | 0.75 | 2.15 |
| *Livestock Production* | 0.30 | 0.31 | 0.31 | 0.02 |
| *Field Crop* | 0.30 | 0.20 | 0.15 | 0.00 |

**Table 5. Regional versus Firm Concentration**

| **1979:1983** | $\hat{I}_{(r)}$ | + $\hat{I}_{(rf)}$ | = $\hat{I}_{(f)}$ |
|---|---|---|---|
| NORTH | 53.35 (0.34) | 8.59 (1.11) | 61.94 (1.18) |
| NORTH-EAST | 26.36 (0.66) | 29.84 (2.11) | 56.2 (2.63) |
| CENTRE | 17.93 (0.44) | 28.8 (1.57) | 46.74 (1.97) |
| EAST | 52.01 (2.33) | 38.82 (1.03) | 90.84 (2.98) |
| SOUTH | 25.65 (1.56) | 48.69 (2.44) | 74.34 (3.85) |
| **TOTAL** | **27.87 (0.86)** | **29.95 (1.47)** | **57.83 (2.31)** |

| **1984:1987** | $\hat{I}_{(r)}$ | + $\hat{I}_{(rf)}$ | = $\hat{I}_{(f)}$ |
|---|---|---|---|
| NORTH | 52.85 (1.76) | 7.83 (2.18) | 60.69 (3.86) |
| NORTH-EAST | 33.44 (1.11) | 25.53 (3.37) | 58.98 (4.29) |
| CENTRE | 18.98 (0.38) | 26.86 (2.76) | 45.84 (3.03) |
| EAST | 63.17 (3.22) | 34.12 (0.79) | 97.29 (3.04) |
| SOUTH | 49.64 (0.86) | 31.58 (3.69) | 81.23 (3.69) |
| **TOTAL** | **34.36 (0.57)** | **25.01 (2.73)** | **59.38 (3.24)** |

| **1988:1992** | $\hat{I}_{(r)}$ | + $\hat{I}_{(rf)}$ | = $\hat{I}_{(f)}$ |
|---|---|---|---|
| NORTH | 40.94 (0.47) | 8.05 (0.98) | 48.99 (1.24) |
| NORTH-EAST | 28.9 (1.25) | 35.76 (1.67) | 64.66 ( 2.8) |
| CENTRE | 21.79 (0.49) | 31.06 (2.57) | 52.86 (2.98) |
| EAST | 59.37 (2.35) | 36.06 (0.72) | 95.44 (1.94) |
| SOUTH | 56.4 (1.41) | 31.94 (1.79) | 88.34 ( 2.9) |
| **TOTAL** | **35.21 (0.67)** | **27.56 (1.52)** | **62.77 (2.16)** |

| **1993:1997** | $\hat{I}_{(r)}$ | + $\hat{I}_{(rf)}$ | = $\hat{I}_{(f)}$ |
|---|---|---|---|
| NORTH | 47.7 (0.46) | 8.01 (0.33) | 55.71 (0.37) |
| NORTH-EAST | 30.75 (0.94) | 38.83 (2.06) | 69.58 (2.92) |
| CENTRE | 24.91 (0.74) | 32.73 (2.22) | 57.64 (2.91) |
| EAST | 56.13 (0.79) | 31.07 (1.06) | 87.2 (1.44) |
| SOUTH | 55.5 (2.25) | 27.72 (1.82) | 83.22 (3.93) |
| **TOTAL** | **40.03 (0.60)** | **27.59 (1.39)** | **67.62 (1.95)** |

Note:

Bootstrapped standard errors with 1,000 simulations in parenthesis.

$\hat{I}_{(r)} = \Sigma_r (Y_r/Y) [\Sigma_i (Y_{ri}/Y_r) \log_{10} ((Y_{ri}/Y_r)/ (Y_i/Y))]$: Regional Specialisation

$\hat{I}_{(rf)} = \Sigma_r \Sigma_f (Y_{rf}/Y) [\Sigma_i (Y_{rfi}/Y_{rf}) \log_N ((Y_{rfi}/Y_{rf})/ (Y_{ri}/Y_r))]$: Farm Specialisation within Regions

$\hat{I}_{(f)} = \hat{I}_{(r)} + \hat{I}_{(rf)}$ : Farm Total Specialisation