

## A test of the market potential equation in Spain

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### A test of the market potential equation in Spain

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**A test of the market potential equation in Spain**

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**Running title:** A test of the market potential equation in Spain

**Abstract:** In this article we examine the relationship between regional wages in Spain and the market potential of these regions in the period 1955-1995. We demonstrate the existence of a spatial wage structure, in which wages fall with increasing distance from the highest income regions. This result strengthens the hypothesis that agglomerative forces were operating in Spain during the second half of the XX century.

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## 1. INTRODUCTION

The economic liberalisation and stabilisation measures introduced at the end of the 1950s favoured the transition of the Spanish economy towards a new phase in its long-term economic development. This period was characterised, among other elements, by high aggregate growth rates of production, by the lead taken by the industrial sector and by the wholesale reorganization of the country's economic activity. Linked to this, Spanish economic growth in the sixties was also typified by the advances made in the construction industry and the services sector, stimulated by the growing mobility of the work force that was becoming increasingly concentrated in the big cities.

The crisis of the seventies, which in the case of Spain stretched well into the eighties, put paid to these upward trends, and similar rates of aggregate growth were not recorded until the final years of that decade. This new phase in Spanish economic growth was no longer linked to the leadership of industrial production, but rather to that of the services sector. In parallel to this shift in references, major changes were also seen in the spatial dynamics associated with the advances in production. In this case, the tendency was no longer that of the growing spatial concentration of industrial activity, but rather towards its more equal distribution. Directly related to this, the migratory flows within the country also underwent a change during these years.

Various studies have sought to account for the trends described above. Specifically, a number have analysed the factors determining the spatial location of industrial activity and the changes this underwent in parallel with the growing integration of the Spanish economy in the wider international economy at specific times between 1955 and 1995. The most recent of these include Viladecans (2004), Alonso, Chamorro & González (2004) and

Paluzie, Pons & Tirado (2001, 2004). In all these studies, the importance of agglomeration economies is stressed. Furthermore, the relationship between the process of economic integration and the geographical concentration of industrial production seems to have followed an inverted U-shape path in the long term, i.e a first period of agglomeration was followed by a period of dispersion.<sup>1</sup> This result would be in line with the stylized facts observed in other economies such as the U.S, as shown by Kim (1995).

However, in Krugman's (1991) seminal paper on New Economic Geography, the core-periphery model, this relationship is monotonous, and economic integration leads to catastrophic agglomeration. In more complex models, the relationship between integration and agglomeration is no longer a simple, monotonous one and the bell-shaped relationship arises. Thus, in models in which barriers to labour mobility exist, such as that developed by Krugman & Venables (1995), economic integration can enter a final phase in which, thanks to the existence of wage differentials, the regions that were initially disadvantaged are able to reindustrialise. In fact, this bell-shaped relationship can be justified by many different theoretical principles. The most recent theoretical papers that predict it use an alternative modelling strategy: a linear monopolistic competition model that differs in the specification of preferences and transport costs from the Dixit-Stiglitz framework. Using this setting, Picard & Zeng (2005) obtain the bell-shaped prediction introducing transport costs in the agricultural good, Tabuchi & Thisse (2002) do so by introducing heterogeneity in migration behaviour and finally, Ottaviano, Tabuchi & Thisse (2002) obtain it by introducing urban costs associated with the formation of an agglomeration.

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<sup>1</sup>Pons, Tirado and Paluzie (2002) present evidence about the origins of this long-term process during the second half of the XIXth century.

We believe that the Spanish economy in the period 1955-1995 would be more consistent with the basic hypothesis of the model by Ottaviano, Tabuchi & Thisse (2002). In this model, there are two factors in the economy, a factor evenly distributed across regions and spatially immobile and a factor, manufacturing labour, mobile between the regions. The hypothesis of manufacturing labour mobility is more adequate in a regional context such as the Spanish economy in this period rather than the Krugman & Venables (1995) hypothesis of absence of labor mobility, more appropriate in an international context. Moreover, the introduction of urban costs is also reasonable because industrial agglomerations often take the form of an urban area, and Spain was not an exception.

The forces at work in the Ottaviano, Tabuchi & Thisse (2002) model are similar to those found in the core-periphery model. First, the immobility of the farmers is a centrifugal force. The centripetal forces are a backward and a forward linkage generated by the preference for variety. If a larger number of firms are located in a region, less varieties are imported and the equilibrium prices of all varieties sold in this region are lower. This, in turn, induces some consumers to migrate towards this region. The increase in the number of consumers creates a larger demand for the industrial good in the corresponding region, which increases operating profits and wages and leads more firms to move there. Hence, equilibrium wages exhibit a demand linkage, which forecasts that firms will be prepared to pay higher salaries in those regions that are closest to the main markets of consumption and production. Thus, the existence of a spatial wage structure, in which the nominal wage of a region increases with its market potential, would constitute evidence of the existence of agglomerative forces operating within the country.<sup>2</sup>

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<sup>2</sup> In fact, this relationship is amplified to real salaries through the forward linkage or price index effect. An increase in the number of consumers is associated with a decrease in the price index of the differentiated

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This direct relation between nominal wages and market potential has been estimated by Hanson (2005) for the US counties between 1970 and 1990, by Mion (2004) for the Italian provinces in the period 1991-1998, by Brakman, Garretsen & Schramm (2002, 2003) and by Roos (2001) for the German urban districts. In each of these studies the existence of a spatial wage structure is demonstrated.<sup>3</sup>

In this article, we analyse the existence of this relationship, as well as that of any possible variations over time, during the process of integration undergone by the Spanish economy in the second half of the XX century.<sup>4</sup> The case of Spain between the years 1955 and 1995 is of particular interest in that we are dealing with a period in which the Spanish economy passed from being virtually autarkic to become a European economy that was fully integrated within the international markets.

This article is organised as follows. First, we undertake a brief review of the evidence describing the location of industrial firms in Spain during the period 1955-1995. Based on this evidence and drawing on the predictions of the Ottaviano, Tabuchi & Thisse (2002) model, we establish the main hypotheses that are studied in section three. Specifically, we undertake an empirical analysis regarding the existence of a relationship that relates the nominal wages paid by the Spanish regions with their market potential, as well as of its evolution over time. Finally, in section four we present our main conclusions and discuss lines for future research.

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good. So if income is high in some region, we expect the real wage to be high both because the nominal wage is high and because the price index is low. (See Fujita et al., 1999). However, in this paper we focus only on the demand linkage and thus, exclusively in the relationship between nominal wages and market potential.  
<sup>3</sup> Fingleton (2005) or López-Rodríguez and Andrés-Faiña (2006) have analysed other related predictions of this kind of models such as the existence of spatial structures for regional incomes or prices.  
<sup>4</sup> In Paluzie, Pons and Tirado (2005), this relationship is estimated as a test of one of the predictions of the Krugman's (1991) model.

## 2. DESCRIPTIVE EVIDENCE: ECONOMIC INTEGRATION AND THE GEOGRAPHICAL CONCENTRATION OF SPANISH INDUSTRY

In this section we seek to present evidence regarding the integration of the Spanish market, as well as evidence regarding the evolution in the location and geographical concentration of industrial production in Spain over the last fifty years.

Table 1 describes the progress towards integration made by the internal market between 1955 and 1995 based on a monitoring of the evolution in the relative endowment of infrastructure. The association between these two variables derives from the fact that the commercial integration of the Spanish market is directly linked to a reduction in the transport and transactional costs generated by the expansion and improvement of the infrastructure stock.

**Table 1. Infrastructure stock as a percentage of GDP in Spain, 1955-1995**

	1955	1965	1975	1985	1995
<b>Infrastructure stock /GDP (%)</b>	<b>33.13</b>	<b>29.37</b>	<b>32.53</b>	<b>41.19</b>	<b>56.17</b>

Source - Mas *et al.* (1995/1998)

A number of interesting points can be drawn from the table. First, what is most noticeable is that the ratio under analysis presented a long-term tendency to increase during the process of Spanish economic development. In fact, only between the cut-off points of 1955 and 1965 was a small contraction seen in the values of this indicator, associated with the rapid rate of growth in Spanish GDP. Second, in the last twenty years of this period an acceleration was recorded in the growth trend of this variable. In general, in these years, the



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3 construction of highways and motorways and telecommunication networks were the most  
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5 dynamic sectors. In the last decade, however, the construction of high speed railway lines  
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7 was once more an important element in the growth of Spain's infrastructure stock.  
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10 Yet, the point that we wish to stress is that the dynamics of integration of the  
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12 Spanish market, measured by the evolution in the offer as regards infrastructure, clearly  
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14 increased in the last forty years of the period.  
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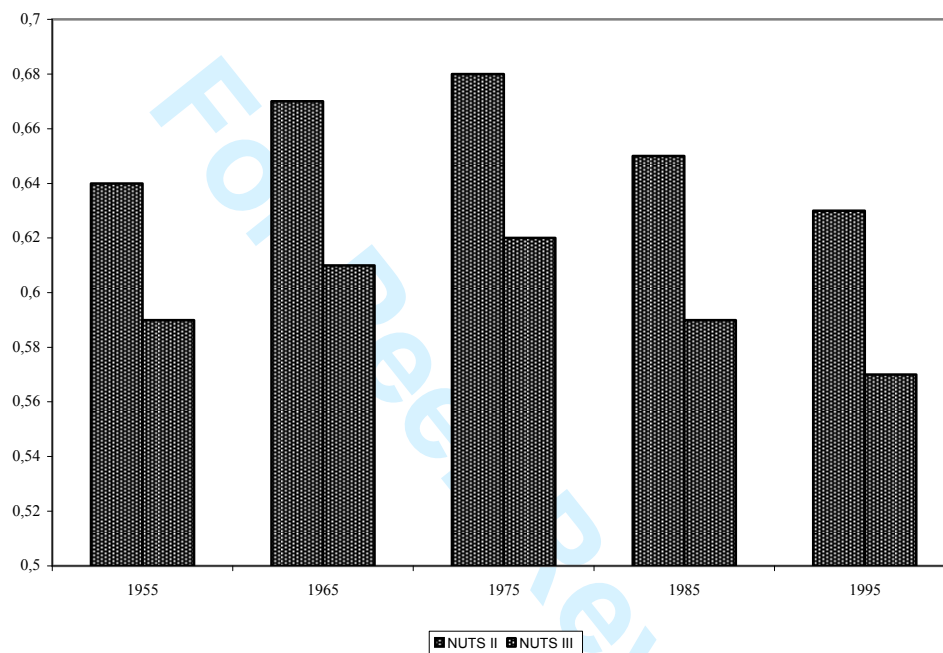
17 Given these conditions, we now need to analyse whether the evidence concerning  
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19 the evolution in the geographical concentration of industry in Spain has followed a long-  
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21 term profile that is in line with the changes experienced by the process of market  
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23 integration. Here, it should be recalled, that in broad terms, the increasing integration of the  
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25 Spanish internal market should favour both the initial appearance of a process of  
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27 geographical agglomeration of industrial production and the subsequent opening up of a  
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29 process of dispersion typical of a highly developed economy. In other words, the spatial  
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31 concentration of industry should describe an inverted U-shaped curve during the process of  
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33 integration of the Spanish market.  
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38 Figure 1 presents an indicator whose purpose is to describe the evolution in the  
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40 geographical concentration of industry in Spain during the period of study. The indicator  
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42 has been constructed from data prepared by the *Fundación BBVA* from the provinces and  
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44 autonomous communities concerning their gross added value at factor cost. More details  
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46 concerning the construction of these indicators can be found in Paluzie *et al.* (2004).  
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50 As can be seen, there was a growing trend in productive agglomeration during the  
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52 first three cut-off points to be analysed, that is the years between 1955 and 1975. Since that  
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54 date, a period of gradual reduction in the geographical concentration of industry in Spain  
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was initiated.<sup>5</sup> In other words, the evidence indicates, in line with the forecasts of the Ottaviano, Tabuchi & Thisse (2002) model that industrial agglomeration followed an inverted U-shaped path in parallel with the progress experienced by the process of integration of the Spanish market.

**Figure 1. Coefficient of industrial location (Gini)**



Source: Paluzie *et al.* (2004).

In short, the descriptive evidence is consistent with the existence of forces favouring agglomeration in the productive processes, which in the context of a reduction of transaction costs favoured an initial increase in the geographical concentration of the activity. Furthermore, in this context, the initiation of a process of dispersion, in the mid-seventies, could have been caused by the appearance of urban congestion costs that ended

<sup>5</sup> Other indicators such as the Hirschmann-Herfindahl index show the same tendency (See Paluzie *et al.* 2004).

up favouring the initiation of a process of dispersion in the advanced phase of the process of internal economic integration.

**3. EMPIRICAL ANALYSIS**

In this empirical analysis, we shall study the impact of market potential on nominal industrial wages during the period 1955-1995. In conducting the study we shall use wage cost figures per wage earner for the 47 mainland Spanish provinces (not including those of the islands, nor Ceuta and Melilla). This information is available for the mean of each manufacturing sector, as well as for the ten branches of manufacturing production into which the total industrial production is broken down. The original data are those provided by the *Fundación BBVA* for 1955, 1975 and 1995.

First, we shall analyse the descriptive evidence provided by these data. Thus, Figures 2, 3 and 4 show wages (unit labour costs) in the provinces at three key dates in the period: 1955, 1975 and 1995 respectively. Provincial wage is obtained as a weighted average of the wages of the different sectors considered. From an examination of the maps, the first common characteristic that we can deduce is that the regional distribution of wages is not by any means random. The highest wages are to be found in the provinces with the highest income and, furthermore, it can be seen that the provinces with the highest wages are, on the whole, surrounded by provinces with similar wage levels. The exception to this pattern is Madrid. We perform the Shapiro-Wilk test on normality of  $\log(W)$  and on lognormality of  $W$  (years 1955, 1975 and 1995). Both normality and lognormality are clearly rejected at the 1% level for every year. We conclude that the geographic distribution of nominal wages in Spain is unlikely to be the result of a random process.

As for the evolution in the distribution of regional wages during the period, four elements stand out: the persistence of a cluster of very high wages in the Cantabria cornice throughout this period, the gradual strengthening of a high wage cluster along the Ebro valley from Barcelona, passing through Tarragona and Zaragoza and extending up to Navarra and the País Vasco, the presence of a wage cluster in the Mediterranean axis characterised by higher wages but with certain discontinuities caused by the differential behaviour of the provinces of Girona and Castellón, and finally a cluster of relatively higher wages in the easternmost sector of Andalucía (Sevilla-Jaén-Cádiz axis) which gradually weakened over the years.

**Figure 2. Nominal wages in 1955 (in millions of pesetas)**

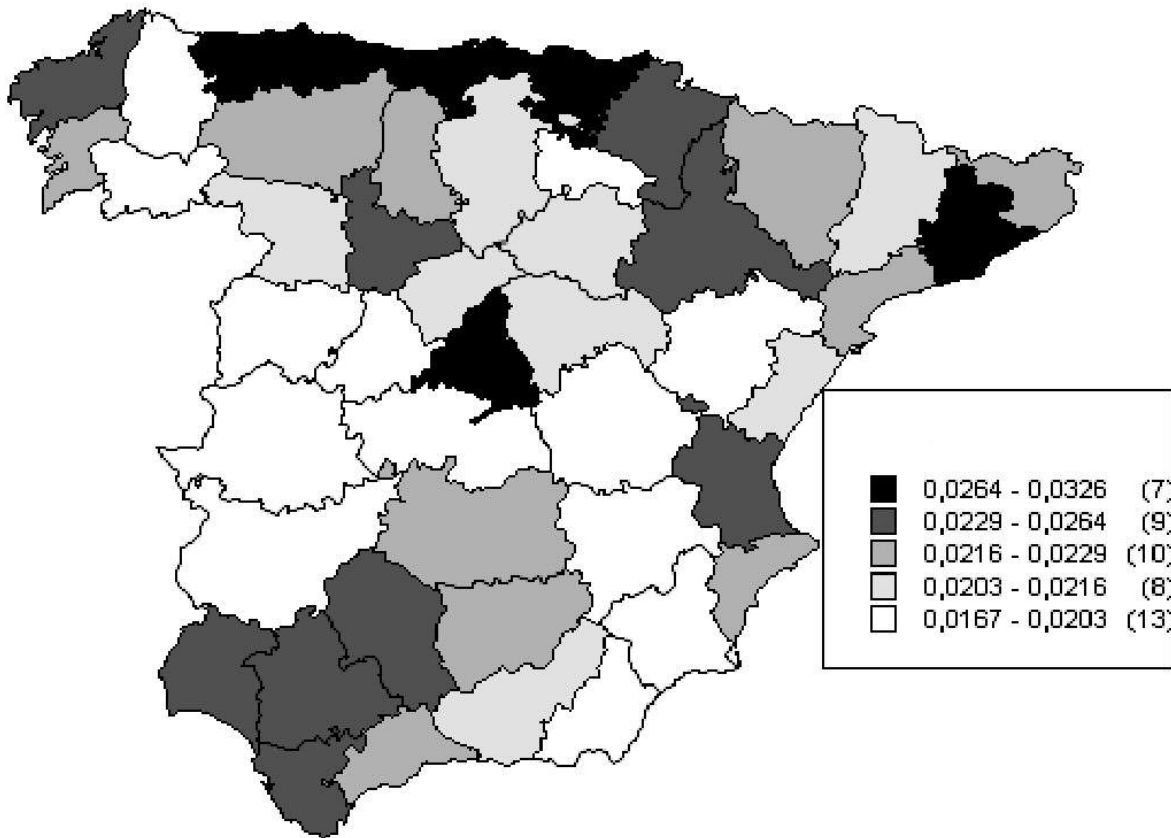
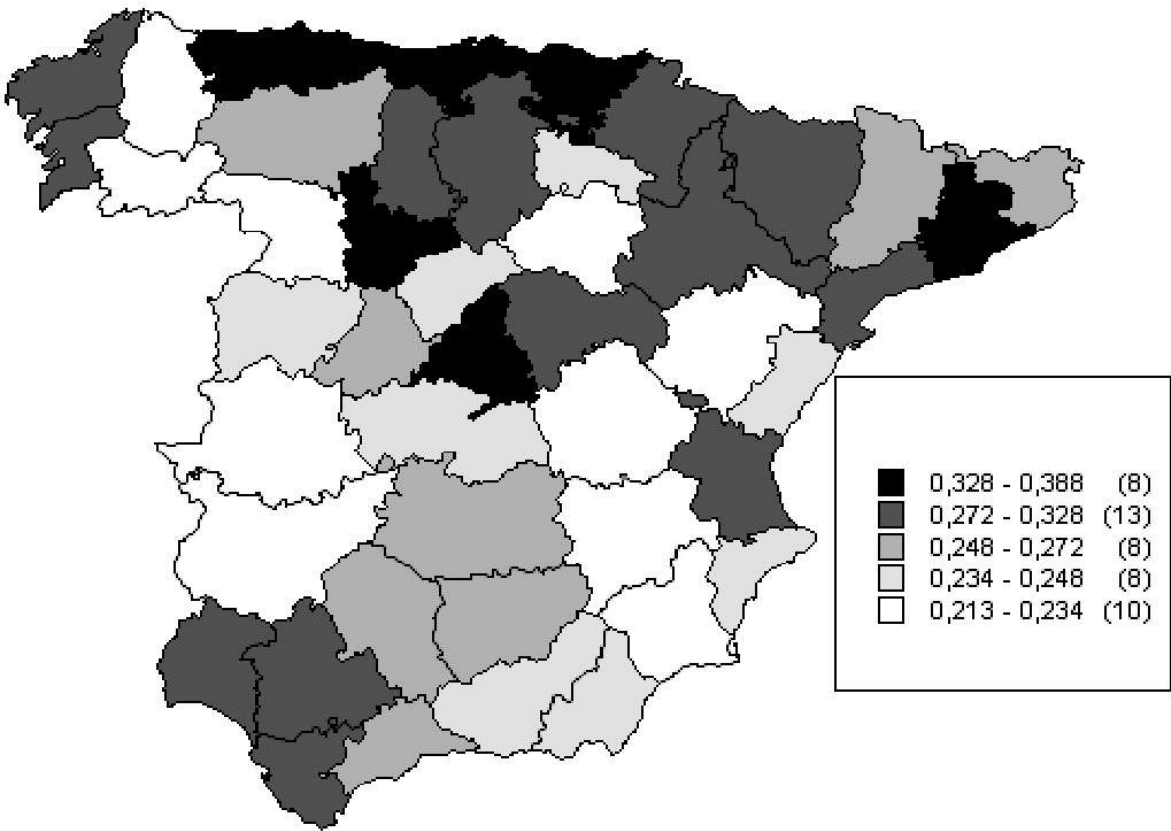
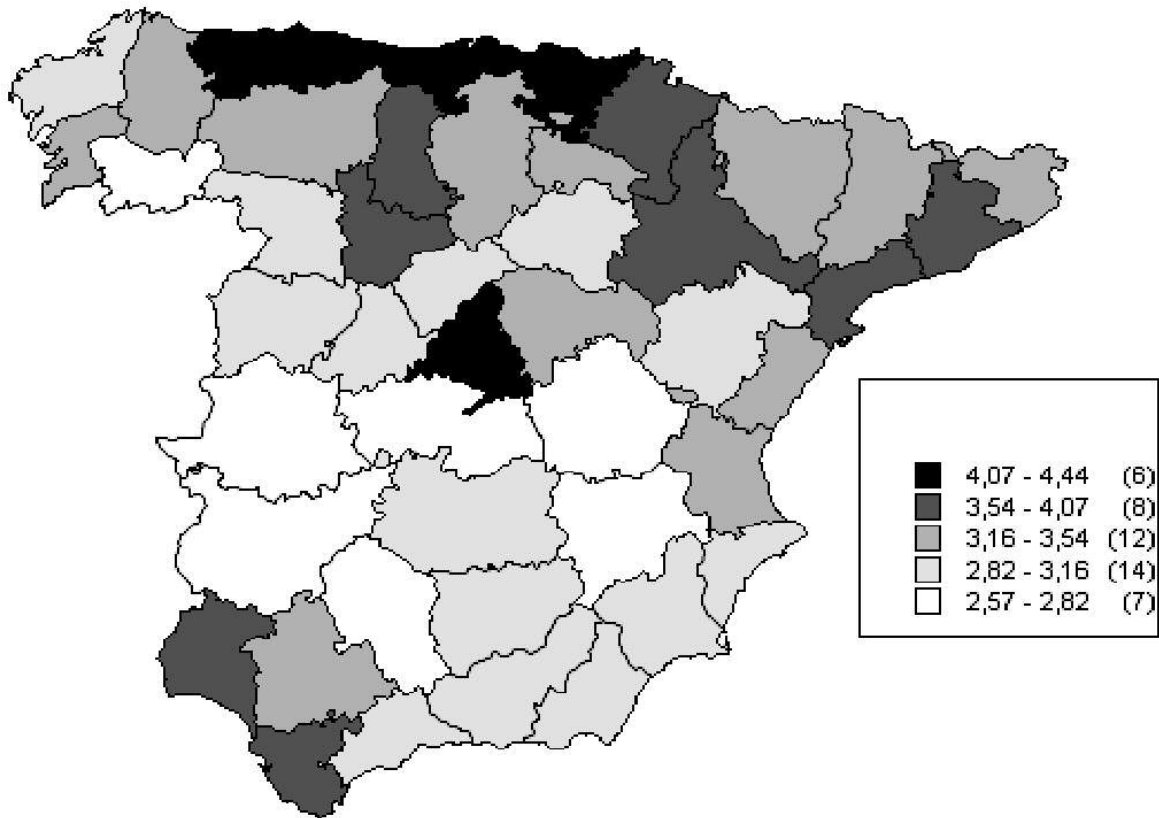


Figure 3. Nominal wages in 1975 (in millions of pesetas)



**Figure 4. Nominal wages, 1995 (in millions of pesetas)**



To determine the presence of demand linkages between regions that would explain the spatial distribution of wages in Spain illustrated by figures 2 to 4, we shall estimate Harris's market potential function:

$$(w_{rt}) = \beta_0 + \beta_1 \cdot MP_{rt} + u_{rt} \quad (1)$$

where  $w_{rt}$  is the nominal wage in region  $r$  at time  $t$ ,  $MP_{rt}$  is the market potential of region  $r$  at time  $t$ . The market potential is an indicator of the market access of region  $r$  and is defined in its modern version as:

$$MP_{rt} = \sum_s Y_{st} e^{-\beta_2 \cdot D_{rs}}$$

where  $Y_{st}$  is the GDP in province  $s$  in period  $t$  and  $D_{rs}$  is the distance between provinces  $r$  and  $s$ .

Taking logs, equation (1) becomes:

$$\log(W_{rt}) = \beta_0 + \beta_1 \cdot \log\left(\sum_s Y_{st} \cdot e^{-\beta_2 \cdot D_{rs}}\right) + u_{rt} \quad (2)$$

$\beta_0$ ,  $\beta_1$  and  $\beta_2$  are the coefficients that have to be estimated.

This equation can be considered a reduced form of the equilibrium wage equation that is central to main of the NEG models, such as Krugman (1991) core-periphery model, Helpman (1998) and Ottaviano et al. (2002).<sup>6</sup>

The market potential equation relates the nominal wage in region  $r$  with the income in other regions, weighted by distance, and therefore, analyses whether regional wages fall with increasing distance from the regions with high income levels. In other words, we are seeking to verify whether a spatial wage structure existed in Spain in the second half of the XX century. In addition, in the case of Spain, unlike that of the USA, the job market can be considered as having been fairly rigid during the period of analysis. Were we to detect a spatial wage structure, despite this institutional framework, this would provide important evidence in support of the existence of strong agglomerative forces.

The data corresponding to the provincial GDP figures are drawn from the estimates provided by the *Fundación BBVA*. The distances used are the number of kilometres by road between the provincial capitals.

Table 2 shows the results of the estimates of equation (2) for three cut-off dates: 1955, 1975 and 1995, using the non-linear least squares method of estimation. Estimations

are performed for the sum of the sectors (TOTAL) and for the individual data of the 10 sectors considered individually (SECTOR). The main conclusion is that, in the case of Spain, we find evidence of the existence of a spatial structure of nominal wages which is related to the market potential of the regions.

The coefficients  $\beta_1$  and  $\beta_2$  are both positive and significantly different from 0. It should be remembered that the coefficient  $\beta_1$  is the effect of the market potential on the wages of a given province and that  $\beta_2$  represents the effect of distance to the various markets on the wages in a given province. In these conditions, the results obtained show how a high market potential has a positive influence on nominal wages. Similarly, and in line with the theoretical hypothesis, greater distances to the markets have a negative influence on the nominal wage offered in a region.

As for the magnitude of the estimated coefficients, we find that the estimated  $\beta_1$  coefficient in 1995 is very similar to that found by Roos (2001) for German districts in 1996. The  $\beta_2$  coefficient is higher than that obtained by Roos (2001) ( $\beta_2=0,028$ ) but lower than the obtained by Hanson (2005) for U.S. counties ( $\beta_2$  estimates are comprised between 5.4 and 16.3).

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<sup>6</sup> The estimation of the structural wage equation is not possible as we do not have all the necessary data. However, Hanson (2005) and Brakman et al. (2002) show that the results of the reduced estimation do not differ greatly from those obtained using the structural estimation.



If we examine the evolution of the estimated models, it can be seen that the estimate for 1995 does not represent a significant change compared to the results obtained for the years 1955 and 1975. The model has considerable explanatory power throughout the whole period, which would support the maintenance of the relationship between the market potential of the Spanish provinces and the location of industrial activity in them throughout the period under review.

**Table 2. Estimation of the market potential equation (Non linear least squares)**

	1955	1955	1975	1975	1995	1995
	TOTAL	SECTOR (*)	TOTAL	SECTOR (*)	TOTAL	SECTOR (*)
$\beta_0$	-3.642 (0.000)		-2.458 (0.000)		0.222 (0.126)	
$\beta_1$	0.112 (0.000)	0.120 (0.004)	0.133 (0.000)	0.139 (0.000)	0.083 (0.000)	0.097 (0.000)
$\beta_2$	0.077 (0.014)	0.079 (0.007)	0.087 (0.005)	0.091 (0.011)	0.102 (0.007)	0.113 (0.002)
N	47	436	47	455	47	467
R <sup>2</sup> adj.	0.382	0.804	0.251	0.815	0.161	0.837

Figures in brackets show the level of significance at which the null hypothesis of individual significance of the estimated parameter is rejected.

(\*) Includes dummy variables for the ten sectors.

However, interesting changes were recorded in the evolution of the values of the estimated coefficients. Specifically, a marked reduction was seen in the estimated value of the coefficient that relates wage levels with the market potential of a region in the second part of the period (1975-1995). These results are the opposite of those reported by Hanson (1998) for the US economy, where the effect of market potential on wages grew during the period 1970-1990. This result points towards a weakening in the demand linkages present in the Spanish economy from 1975 on. This could constitute indirect evidence on the

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3 existence of congestion costs that could compensate the agglomeration forces at work.  
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5 Although, a plausible explanation for this result might also lie in the changes to the  
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7 institutional framework of the job market after 1975, which have tended to impede the  
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9 emergence of wage differentials between the regions through the application of  
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11 mechanisms such as national wage fixing agreements at the sector level.  
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15 By contrast, the coefficient value that links the wage level with the distance from  
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17 the region in question to the various markets was found to increase over the period of  
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19 analysis. Here our findings do coincide with those reported by Hanson (2005) for the US  
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21 economy, but the result is still surprising given that the great improvements in  
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23 infrastructure made during the period led us to expect a reduction in the economic costs of  
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25 distance. Hanson (2005) argues that the estimated increase in trade costs could reflect the  
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27 ongoing secular shift in economic activity from low-trade-cost manufacturing to high-trade-  
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29 cost services.  
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#### 36 4. CONCLUSIONS

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39 In this article we have conducted an empirical analysis to determine whether one of the  
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41 predictions derived from New Economic Geography holds true in the case of Spain:  
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43 namely, the existence of a direct relationship between the market potential of various  
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45 locations and the wage levels that the firms located there are prepared to pay their workers.  
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48 The study has enabled us to demonstrate the existence of a spatial wage structure in Spain  
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50 in line with the relationship predicted in the theoretical literature, and to show that this  
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52 relationship remained stable throughout the period 1955-1995.  
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Hence, there is strong evidence on the existence of demand linkages between regions. One of the agglomeration forces present in the NEG models has been verified: a backward linkage that implies that the nominal wage of a region increases with its market potential. In the case of Spain, the establishment of institutional mechanisms such as the wage setting was not sufficient to compensate for the agglomerative forces of the market.

Moreover, the evidence presented in the paper also accords to the theoretical prediction of a bell-shape relationship between economic integration and industrial agglomeration. On the one hand, the descriptive evidence shows that since the middle of the seventies, the dominant tendency was towards that of the dispersal of the location of industrial production. On the other, in the empirical analysis, we have also shown that the effect of market potential decreased over time. A weakening of the demand linkages would be characteristic of the second fragment of a bell-shape curve linking integration and agglomeration, as predicted by Ottaviano et al. (2002), which in the case of Spain would have been attained from 1975 on.

This process has been analysed here from the perspective of the location of firms and the wages that the latter are prepared to pay their workers. Thus, a complementary path of analysis would be to observe whether there have been any changes in the factors that account for the workers' location decisions. In other words, to study whether the change in the origins and destinations of the movements of the population responded to a variation in the factors determining the decision to migrate, or whether, in agreement with the situation described here regarding the location of firms, the shift can be accounted for by the existence of changes in the market potential of the locations following the crisis of the seventies. A study of this nature would constitute a possible future line of research.

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