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Migrants and market potential in Spain over the XXth century: a test of the New Economic Geography

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ABSTRACT

In this paper, we perform a structural contrast of a new economic geography model in Spain, over three different periods: the 1920's, the 1960's, and the early years of the XXfirst century. In line with Crozet (2004), we analyse the possible existence of a forward effect, that is, the existence of a relationship between the workers' localisation decisions and the market potential of the regions. Our results show that this model is suitable to account for the migrant behaviour in Spain all over the XXth century. Moreover, the changes in the parameters estimated are consistent with a change in the migratory model and reflect the tendency towards a redispersion of economic activity in the last decades.

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1. Introduction

New Economic Geography (NEG) provides a theoretical framework in which to analyse the determinants of localisation and the spatial concentration of economic activity, including their long-term evolution (Fujita, Krugman and Venables, 1999). Several studies show the existence of a non-monotonic relationship between the process of market integration - one of the characteristics of economic development - and the degree of concentration of activity in the territory (Puga, 1999). This type of inverted U-shaped relationship usually appears when immobile factors of production exist, such as labour in international models, and land in models at the regional scale. But while theoretical models are able to explain the processes of concentration and dispersion of economic activity, empirical analyses of the true explanatory potential of NEG models are relatively scarce (Neary, 2001). This is because they have to use quasi-structural empirical models, which enable the parameters defined by the theory to be estimated. Furthermore, given that the interest of models of this type lies, primarily, in their understanding of long-term changes, empirical studies need to be based on evidence of long-term processes, which hinders even further their realisation.

Against this background, this article reports a case study that enables us to estimate the values of the basic parameters of a standard NEG model at several points in time. Specifically, it estimates the explanatory power of a model of the internal migration that occurred during Spain's process of economic development. The contribution of this paper is two-fold. First, the long-term analysis allows us to undertake a comparison of periods characterised by the agglomeration and dispersion of economic activity. Second, this study focuses on an examination of migration patterns, a phenomenon that has been largely neglected by the literature of NEG. In fact, most NEG analyses examine the possible existence of a backward market effect, that is, the existence of a relationship between firms' localisation decisions and the market potential of the regions (Hanson, 2005). In this study, however, in line with Crozet (2004), we analyse the possible existence of a forward effect, that is, the existence of a relationship between the workers' localisation decisions and the market potential of the regions.

In this paper, we perform a structural contrast of a new economic geography model that focuses on the forward linkage over three different periods: the 1920's, the 1960's, and the early years of the XXfirst century. Our results show that a NEG model is suitable to account for the migrant behaviour in Spain all over the XXth century. Moreover, the changes in the parameters estimated are consistent with a change in the migratory model and reflect the tendency towards a redispersion of economic activity in the last decades.

The rest of this paper is organised as follows. Next we describe the evolution in the location of industrial activity in Spain from the middle of the nineteenth century - and the start of the Industrial Revolution - to the present day, and examine the magnitude and the main directions of the migratory flows during this period. The study of these phenomena should allow us to establish the chronological evolution in the concentration and dispersion of economic activity over the last century, and serve to identify the most suitable points in time for carrying out our empirical analysis. The third section describes the theoretical NEG model that underpins the empirical analysis of the determinants of emigration. The data available to us, as well as the way in which we use them, are discussed in the fourth section. The fifth section presents the results of the empirical model. In particular we analyse the changes in the parameters over time, and how these changes affect the migratory model. The study concludes with a section in which we summarise our main conclusions.

2. The process of concentration and dispersion of economic activity in Spain

2.1 Industrial location

The theoretical models developed within NEG show that, in the presence of scale economies, market integration favours the agglomeration of economic activity. However, the same models also show that in the presence of very low transport costs, the tendency towards agglomeration can be off set by a dispersion process.[1] Thus, the long-term evolution in the spatial concentration of economic activity in a country might adopt an inverted U-shape.

Spain's modern economic development coincided with the process of reform instigated by the liberal regimes of the nineteenth century. In addition to the changes in the legal system, which were to permit the initiation of capitalist growth, the advances made in transport infrastructure, in particular the railways, allowed an acceleration of

[1] Such a phenomenon would occur, above all, as the result of the appearance of congestion costs in urban areas.

the processes of regional integration and a territorial specialisation in production. The literature available about this and later periods has focused primarily on the concentration of industrial activity. Indeed, industry was the sector that led Spain's economic development during the nineteenth and most of the twentieth centuries. Thus, in the second half of the nineteenth century - a period in which Spain increasingly opened up to the outside world – the country experienced a growth in the spatial concentration of its industrial activity in a very limited number of regions (Tirado, Pons and Paluzie, 2002; Rosés, 2003).[2] This period has even been characterised as that in which just one region, Catalonia, came to represent the "factory of Spain" (Nadal, 1985).

During the early decades of the twentieth century the industrial sectors associated with the second technological revolution consolidated their position.[3] At the same time, the economic policy of this period underwent a "nationalist shift" which curbed to some extent Spain's relations with the outside world. The concentration of industrial activity, however, became more marked (Tirado, Pons and Paluzie, 2003). And this, despite the consolidation of new centres of industry in places that included the Basque Country, Zaragoza and Madrid (Betrán, 1999).

Very few data are available for the Civil War years (1936-1939) and those of the immediate post-war period (the 1940s). During the war the spatial distribution of industry was altered dramatically. Yet, in broad terms, the growing concentration of industrial activity was soon re-established. From the start of the 1950s, the concentration continued to increase, and finally, the pattern of concentration reached its maturity in the 1960s and early 1970s (Paluzie, Pons and Tirado, 2004).

The data describing the concentration of industrial activity suggest the beginning of a shift in this trend in 1975.[4] As Spain continued to open up its economy to the outside world, along with the crisis that hit many sectors at the end of the 1970s and through the 1980s, the country witnessed the start of the redistribution of its industrial activity (Paluzie, Pons and Tirado, 2001)[5]

[2] The main sectors during this period were the textile, food, and iron and steel industries together with mining.
[3] We refer primarily to electrical energy, the chemical industry and the transformation of metals.
[4] Paluzie, Pons and Tirado (2004) report a number of indicators of the evolution in the concentration of industrial activity between 1856 and 1995.

2.2 Changes in migration patterns

The process of territorial localisation described above is coherent with the localisation process of the factors of production. In short, the spatial concentration/ dispersion of economic activity is only possible if capital and labour are mobile. In terms of migration patterns, the evidence available suggests that the take off in the number of permanent internal migrations, basically of rural origin, could have taken place after the 1860s (Erdozáin and Mikelarena, 1996).[6] Whatever the case, the rates of internal migrations during the second half of the nineteenth century and the first decade of the twentieth, although they increased, were not very high (Silvestre, 2005).

The number of internal migrations within Spain accelerated during the second decade of the twentieth century and became even greater in the 1920s. This coincided, moreover, with a fall in the number of those emigrating abroad, which had been particularly significant in the early years of the twentieth century (Sánchez-Alonso, 1995). The increase in the number of internal migrations was due, primarily, to an increase in non-agrarian labour opportunities, as well as the wage differences between regions (Silvestre, 2005). The spatial distribution of the migration pattern during this period was characterised, as it was in other countries, by a high degree of concentration (Silvestre, 2001).[7] Each place of destination, moreover, exercised its power of attraction over what was, in general, a very geographically close group of places of origin. This fact, as well as the low rates of migration from the south of the country (somewhat isolated from the main nuclei of development), has been accounted for on the basis of the relatively high costs of migration (in the broadest sense, that is, including the costs of insertion in the place of destination) by Pons et al. (2007) who used a NEG model to test this hypothesis.

Following the Civil War and the immediate post-war period, internal migration continued to grow during the nineteen-fifties and, above all, during the sixties and the early seventies. The main difference between the movements before and after the war was, probably, the incorporation en masse of migrants from the southern provinces of

[5] The crisis that affected the mature and heavily concentrated sectors, including the iron and steel industry, the textile sector, shipbuilding and electrical machinery, facilitated this spatial redistribution of activity that began at the end of the 1970s.

[6] Mobility in pre-industrial societies was very high. However, most migrations were temporary and, largely, related to the farming calendar. See Silvestre (forthcoming) and many studies cited therein.

[7] In 1930, 45.8 per cent of all those Born in Another Province were living in one of the two main places of destination, Madrid (22.9%) or Barcelona (22.9%).

the country, those in Andalucía, Extremadura and (to some extent) Castilla-La Mancha (Ródenas, 1994a). Those studies that have examined the reasons for migration in this period agree in recognising wage differences and job opportunities in the industrial sector (in addition to the costs of migrating) as the main causes (García Ferrer, 1979; Santillana, 1981; Ródenas, 1994b). The concentration of these movements, although not as marked as in the period leading up to the war, continued to be high and indicative of the great capacity of attraction of a relatively small number of points of destination (Silvestre, 2001; Ródenas y Martí, 2005).[8]

Moreover, despite the transformations over time, it is safe to say that the migration patterns recorded between the middle or the end of the nineteenth century and the early years of the 1970s conform to the same *disequilibrium* model of migration. That is to say, migration was mainly determined by the existence of economic differences (in general, quite major differences) between locations (in general, just a few well-defined places of destination and origin).[9]

However, between the early 1970s and the early eighties (1974-1982) there were major changes in the migration model. On the one hand, migration rates fell (see, for example, Bover and Velilla, 1999). The reduction in migration in this period has been explained, not so much in terms of the reduction in wage differences, but rather in terms of the increase in national unemployment (Bentolila and Blanchard, 1990; Bentolila and Dolado, 1991).[10] Spatially, during the seventies there was a reduction in the concentration of both emigration and immigration (see, for example, García Coll and Stillwell, 1999).[11] Thus, several of what had traditionally been the main places of destination started to lose their capacity to attract migrants. At the same time, during the 1970s and the following decades, many of the traditional places of origin reduced their rates of emigration and even became net recipients, in particular various provinces along the Ebro Valley and the Mediterranean coast and around Madrid.

Internal rates of migration, however, rose once more after 1982, in particular those over a short distance (see, for example, Olano 1990; Bover and Velilla, 1999).

[8] According to the census, in 1970, 47.5 per cent of all those Resident in Another Province were living in Madrid or Barcelona (23.8 and 23.7% respectively).
[9] The characteristics of disequilibrium and equilibrium models of migration are explained, for example, in Greenwood (1997).
[10] Other factors that led to a reduction in migrations rates during the eighties and the following decades, including the increase in redistributive policies and social policies, are analysed in Bentolila (2001).
[11] A similar process has been described by Sanz, Perdiguero and Lanaspa (2004) as regards city size. They describe an increase in the localisation of population in a small group of cities up to the 1970s. After this date, a convergence process would appear to have been set in motion among the medium-sized cities.

Yet, unlike in previous decades, and due to the increase in the spatial dispersion of emigration and immigration (that is, the increase both in the number of important places of destination and origin), the increase in the gross number of migrations was not accompanied by an increase in net migrations (for example, Ródenas and Martí, 2005).

These and other changes have given rise to a number of interesting reflections regarding the existence of a change in the migration model. Thus, while there is no overriding empirical evidence for Spain, some authors, in line with studies conducted in other countries, have suggested that traditional *disequilibrium* models have lost their capacity to explain the migrations that occurred after the decade of the eighties. *Equilibrium* models emphasise, by contrast, reasons that are not strictly economic but which are related rather to the quality of life (amenities), for example the climate, the quality of the area or the costs generated by the agglomerations.[12]

However, recent evidence shows that, despite the existence of certain changes in the migration pattern due to the growth in importance of quality of life factors, economic factors continue to have considerable explanatory power in the most recent migrations (see, for example, Antolín and Bover; 1997, De la Fuente, 1999; Bover and Velilla, 1999; Bover and Arellano, 2002; Ródenas and Martí, 2005).[13] Thus, spatially, the growing importance of the services sector is evident, since, in general, this sector is much less concentrated than its industrial counterpart, which accounts for the increasing dispersion of migratory destinations. This phenomenon has probably been strengthened by the existence of high housing costs, which will have led migrants to seek locations at some distance from the big cities.

In short, the evidence available on the evolution in migratory flows and the territorial distribution of industrial activity suggests that the process of concentration /dispersion of the emigrant population over the long term might also be explained by an NEG model such as that used by Crozet (2004) and Pons et al. (2007). This model should take into account both the forces favouring the agglomeration of industrial activity up until the 1970s, as well as the appearance of congestion costs, and therefore the forces favouring dispersion during the last few decades of the twentieth century. To

[12] See the recent review of studies in Clark et al. (2003). For Spain, see the discussion in De la Fuente (1999).

[13] These studies identify basic explanatory elements concerning the decision to migrate among the characteristics of the individual involved (level of education, family characteristics, employment, etc.). Based on this evidence, they show that, in fact, economic motives as well as those related to the quality of life can coexist as factors determining emigration or immigration. Their relative importance depends on

examine this hypothesis, in this study we analyse three specific periods in the process of the economic development of Spain during the twentieth century, in which internal migrations have been particularly high. Two of these, the 1920s and the 1960s, correspond to periods of considerable growth in the concentration of industrial activity. The last period analysed, the early years of the twenty-first century (2000-2004), corresponds to a period of dispersion.[14]

3. Migration choice in a NEG model

We consider a NEG regional framework developed by Crozet (2004) that combines Helpman (1998) and Krugman (1991) frameworks. The model is not fully developed, our main purpose being that of estimating an structural equation that links worker's migrations decisions with market access we will present the main features of the model and the price index and migration equations from which this equation is derived, and will not describe the nature of the final equilibrium.

The economy has three sectors, a perfectly competitive agriculture, a monopolistically competitive industry and a monopolistically competitive non traded services. Each of these sectors employs a single factor, farmers in the agricultural sector and workers in the industry and services sector. Each of these sector-specific factors (farmers and workers) is in fixed supply.

Let there be one country composed of R regions. The country has a fixed supply of L^A farmers, and each region is endowed with an equal share of the country agricultural labour force, this population is assumed to be completely immobile between regions. On the contrary, the labour force used in manufacturing and services is mobile over time and at any point in time we denote region r supply of mobile workers by L_r^M.

All regions have identical preferences and technology. The agricultural sector is perfectly competitive and produces a homogeneous good under constant returns to

the period and the country being analysed. For more on this, see, for example, Mueser and Graves (1995) and Clark et al. (2003).

[14] The 1980s, a period of "transition", is not analysed empirically here. This decade is included within the period (1983-1993) analysed in Crozet (2004). The results of this study are, however, compared with those reported here.

scale, which is traded between the regions at no cost. Both industry and services are monopolistically competitive sectors that produce a variety of goods under increasing returns to scale. The manufactured goods are subject to iceberg transport costs; we assume a fraction of the good melts away in transportation so that $T_{rs} > 1$ units of the good have to be exported from region r to deliver one unit to region s. This transport cost is assumed to be an increasing function of the distance between the two regions d_{rs}:

$$T_{rs} = Bd_{rs}^{\delta} \qquad (1)$$

Services are produced locally and not traded.

Consumers

All individuals in this economy share a utility function of the form:

$$U = I^{\mu} \cdot S^{\phi} \cdot A^{1-\mu-\phi} \qquad (2)$$

in which μ, ϕ and $(1 - \mu - \phi)$ are respectively, expenditure shares for the industrial goods, services and the agricultural good. A is the consumption of the homogeneous agricultural good. I is an aggregate of the industrial varieties defined by a CES function of the form:

$$I = \left[\int_0^{n_I} x(i)^{\rho_I} di \right]^{1/\rho_I} \quad , \qquad 0<\rho_I<1 \qquad (3)$$

where $x(i)$ denotes the consumption of each available variety and n_I is the number of available varieties in the economy composed by R regions ($n_I = \sum_{r=1}^{R} n_{Ir}$). If we set $\sigma_I = 1/(1-\rho_I)$, then σ_I represents the elasticity of substitution between any two industrial varieties. S is also an aggregate of service varieties defined by a CES function of the form:

$$S = \left[\int_0^{n_S} x'(i)^{\rho_S} di \right]^{1/\rho_S} \quad , \; 0<\rho_S<1 \qquad (4)$$

Consumers cannot import service varieties from other regions; therefore, the number of available service varieties in region r is the number of varieties produced within the region (n_{sr}). Setting σ_S = 1/(1-ρ_S), then σ_S represents the elasticity of substitution between any two service varieties.

Consumers maximize utility under the budget constraint:

$$Y = p^A A + \int_0^{n_I} p_I(i)x(i)di + \int_0^{n_S} p_S(i)x'(i)di \qquad (5)$$

Solving the consumer's problem yields the following demand function in region r of an industrial variety produced in s (all varieties produced in the same region are symmetric):

$$x_r(j) = \mu Y_r (p_{Is} T_{sr})^{-\sigma_I} P_{Ir}^{\sigma_I - 1} \qquad (6)$$

where

$$P_{Ir} = \left[\sum_{s=1}^{R} n_{Is} (p_{Is} T_{sr})^{1-\sigma_I} \right]^{1/1-\sigma_I} = \left[\sum_{s=1}^{R} n_{Is} (B d_{rs}^{\delta} p_{Is})^{1-\sigma_I} \right]^{1/1-\sigma_I} \qquad (7)$$

is the industrial price index in region s and measures the minimum cost of purchasing a unit of the composite index I of manufacturing goods, so it can be thought of as an expenditure function. While the price index of the aggregate of service goods in region r is:

$$P_{Sr} = (n_{Sr})^{1/1-\sigma_S} \cdot p_{Sr} \qquad (8)$$

Producers

Both industrial goods and services are monopolistically competitive industries. The production of each variety requires F units of mobile workers as a fixed cost and l_q units as a variable input, with $l_q = c.q,$ so the labour input requirement to produce a quantity q of any industrial and services variety at any given location is respectively:

$$l^I = F^I + c^I q^I \quad (9)$$

$$l^s = F^S + c^S q^S \quad (10)$$

Because of increasing returns to scale, the preference for variety by consumers and the unlimited number of potential varieties of manufactured and service goods, each variety will be produced by a single, specialized firm in only one region, so that the number of firms is the same as the number of available varieties. If n_{Ir} and n_{Sr} denote the number of varieties of good I and S produced in region *r*, the total employment in each industry or region *r* is:

$$L_r^I = n_{Ir}(c^I q_r^I + F^I) \text{ and } L_r^S = n_{Sr}(c^S q_r^S + F^S) \quad (11)$$

All producers have the same profit-maximizing price, which is a constant markup over marginal costs. Denoting w_r the mobile workers'wage in region *r*, the *fob* price of a variety produced in region *r* is:

$$p_{Ir} = \frac{\sigma_I}{\sigma_I - 1} c^I w_r \text{ and } p_{Sr} = \frac{\sigma_S}{\sigma_S - 1} c^S w_r \quad (12)$$

Equilibrium in the production side requires that the firms profits equal zero in each region so that no firm has interest in moving to the other region. The zero profit condition implies that the equilibrium output of any active firm is:

$$q^{I*} = \frac{F^I(\sigma_I - 1)}{c^I} \text{ and } q^{S*} = \frac{F^S(\sigma_S - 1)}{c^S} \quad (13)$$

Using (11) and (13) we obtain the following expressions for the number of firms in each region:

$$n_{Ir} = \frac{L_r^I}{F^I \sigma_I} \quad \text{and} \quad n_{Sr} = \frac{L_r^S}{F^S \sigma_S} \quad (14)$$

The price index of manufactures as a market potential function

The real wage of mobile workers is equal to the nominal wage deflated by the cost of living index in region *r*:

$$\omega_r = \frac{w_r}{P_{Ir}^{\mu} P_{Sr}^{\phi} p_{A_r}^{1-\mu-\phi}} \tag{15}$$

Recalling that the agricultural good is freely tradable and its price can be normalized to one, the real wage equation of mobile workers becomes:

$$\omega_r = \frac{w_r}{P_{Ir}^{\mu} P_{Sr}^{\phi}} \tag{16}$$

where P_{Ir} and P_{Sr} are respectively the price indexes of the industrial and service goods in region *r* that we obtained from the consumer's optimization problem and that can now be written more conveniently using the expression for the number of firms (equation (14)):

$$P_{Ir} = \left[\sum_{s=1}^{R} n_{Is} (Bd_{rs}^{\delta} p_{Is})^{1-\sigma_I} \right]^{1/1-\sigma_I} = \left[\sum_{s=1}^{R} \frac{L_r^{I}}{F^{I} \sigma_I} (Bd_{rs}^{\delta} p_{Is})^{1-\sigma_I} \right]^{1/1-\sigma_I} \tag{17}$$

$$P_{Sr} = \left(n_{Sr} \right)^{1/1-\sigma_S} \cdot p_{Sr} = \left(\frac{L_r^{S}}{F^{S} \sigma_S} \right)^{1/1-\sigma_S} \cdot p_{Sr} \tag{18}$$

Equation (17), the manufacturing price index equation, contains an important relationship. It says that other things equal, the price index in a region will tend to be lower, the higher the share of manufacturing that is concentrated in this region or in regions that are close, simply because a smaller proportion of this region's manufacturing consumption bears transport costs. In the NEG, this effect is called the *price-index effect* or *forward linkage*. In Crozet's model, which adds a third sector, the services sector, the price index of services (equation (18)) would, similarly, be lower in regions offering a relatively high number of service varieties. Considering the real wage equation (16) and supposing that the nominal wages in all regions were similar, workers' real income would be lower in remote regions where the price index is higher or in regions with a low density of services. The price index of manufactures can therefore be considered as the inverse of a market potential function: it exhibits a sum of market sizes in all regions weighted by distances.

Migration choice

Crozet (2004) specification of the migration equation in the model follows that of Tabuchi and Thisse (2002). Consider a mobile worker *k* from region *s* and his location choice among R regions (including *s*). His migration choice results from a comparison of the perceived quality of life in the various locations. For empirical convenience, the migration decision is designed to maximize the following objective function:

$$\pi^{k}_{sr,t} = V^{k}_{sr,t} + \varepsilon^{k}_{r} = \ln\left[\omega_{r,t}\,\rho_{r,t-1}[d_{rs}(1+bFR_{rs})]^{-\lambda}\right] + \varepsilon^{k}_{r} \qquad (19)$$

where $\rho_{r,t}$ is the employment probability for an immigrant in region *r* at date *t* and $[d_{rs}(1+bFR_{rs})]^{-\lambda}$ is a migration cost which increases with the distance between home and host regions. λ and *b* are strictly positive coefficients, and FR_{rs} is a dummy variable indicating whether regions *r* and *s* share a common border. ε_r^k is a stochastic component capturing worker's *k* personal perception of the characteristics of region *r*. To avoid endogeneity problems in the empirical application, migration choices at date *t* are determined from a comparison of V_{sr}^k across regions at date *t*-1. So, worker *k* will choose to locate in region *r* if $V_{sr,t-1}^k > V_{sj,t-1}^k$, $\forall\ j \neq r$. The probability of choosing region *r* is given by the logit function:

$$P(M_{sr,t}) = e^{V^{k}sr,t-1} \Big/ \sum_{j=1}^{R} e^{V^{k}sj,t-1} \qquad (20)$$

The expected migration flow between regions *s* and *r* is $L_{s,t}P(M_{sr,t})$. Similarly, the total outflow from *s* is $L_{s,t}[1-P(M_{ss},t)]$, the share of emigrants from region *s* choosing to go to region *r* is:

$$\frac{migr_{srt}}{\sum_{r'\neq s} migr_{sr't}} = \frac{e^{V^{k}sr,t-1}}{\sum_{j=1}^{R} e^{V^{k}sj,t-1} - e^{V^{k}_{ss,t-1}}} \qquad (21)$$

Using equations (12), (15), (17) and (18) and the definition of $V_{sr,t}{}^{k}$, this share can be written as:

$$\ln\left(\frac{migr_{srt}}{\sum_{r'\neq s} migr_{sr't}}\right) = \ln\left[\left(L^{S}_{r(t-1)}\right)^{\frac{\phi}{\sigma_S-1}}\right] + \ln\left[\sum_{s=1}^{s=R} L^{I}_{s(t-1)} \cdot \left(w_{k(t-1)} \cdot \left(d_{rs}\right)^{\delta}\right)^{1-\sigma_I}\right]^{\frac{\mu}{\sigma_I-1}} + \ln\left[w^{1-\phi}_{r(t-1)} \rho_{r(t-1)}\right] + \ln\left[d_{rs}\left(1+bFR_{rs}\right)\right]^{-\lambda} + \widetilde{a}_{s(t-1)}$$

(22)

being

$$\widetilde{a}_{s(t-1)} = -\ln\left(\sum_{j=1}^{R} e^{V^{k}{}_{sj,t-1}} - e^{V^{k}_{ss,t-1}}\right)$$

Equation (22) captures the trade-off faced by potential migrants that have to choose among several possible locations. The variable in the left-hand side of the equation is the share of migrants from a given region who have decided to move to region *r*. The first two first terms in the right-hand of the equation denote regions *r*'s access to markets. The first is the price index for non-traded service varieties in region *r*. The second is the price index for manufactured goods in region *r* and is the most important. It corresponds to a market potential function and captures the forward linkage of the NEG models. Through this term, labour migrations are related to the location of industrial activities. The third term represents the expected wage in the region that is increasing with the host's nominal wage and the probability of being employed in this region. And finally, the fourth term captures the impact of bilateral distance on migration flows and can be interpreted as a measure of mobility costs. This is the relationship that centers the empirical analysis that is carried out in the next section.

4. Data and empirical strategy

As pointed out above, this article analyses the evolution in the explanatory power of a NEG model over different time periods, corresponding here to three stages in the economic development of Spain during the twentieth century: the 1920s, the 1960s and the early years of the twenty-first century. As we are dealing with periods that are so distant in time, it has not been possible to maintain complete homogeneity in the statistical sources used in preparing the evidence corresponding to each of these cut off times. Thus, the information available on internal migration patterns for the decade of the 1920s is based on the data from *born in another province* provided by the population census. Based on the figures of those born in another province, it is possible to estimate inter-censual migration flows by computing a coefficient of survival that takes into account the number of migrants that died between the two census dates.[15] The final variable is the migration rate, resulting from dividing the migratory flow by the actual population of the location of destination in 1920, between an origin *r* and a destination *s*.

For the 1960s, the information drawn upon is similar to that for the 1920s, the sole difference being that thanks to the fact that the 1970 census was the first to incorporate a question on the location of residence ten years before (in this case, the province of residence), it is not necessary to use the data for *born in another province* to estimate the inter-censual migration flow. Therefore, the variable used refers to the total number of persons that changed their province of residence in the period between 1960 and 1970.[16] The final variable is, once again, the rate of migration, resulting from dividing the migratory flow by the actual population of the location of destination in 1960, between an origin *r* and a destination *s*.

The dependent variable corresponding to the final period, 2000-2004, was obtained from the primary source describing recent migratory movements, the *Estadística de Variaciones Residenciales*.[17] In this case the mean gross rate of migration has been computed from annual data for the years between 2000 and 2004, corresponding to an origin *r* and a destination *s*. The actual population (censual) of reference for the locations of destination is that recorded for 2001.

As regards the number of observations considered, for each of the three periods we selected the (inter-provincial) migratory flows between all the points of origin and a sample of destinations. The main destinations in the 1920s were (in order of importance): Madrid, Barcelona, Sevilla, Vizcaya, Valencia, Guipúzcoa, Zaragoza, Valladolid, Santander, Córdoba, Cádiz and Alicante.[18] In the 1960s, the main destinations were (in order of importance): Madrid, Barcelona, Valencia, Vizcaya,

[15] This procedure is common in historical studies and also in the early studies of developed and developing countries (until the appearance of other macro and micro sources). See Silvestre (2005).

[16] This variable has been used in several studies. See, among others, Santillana (1981) and García Coll and Stillwell (1999).

[17] For more recent dates we have also used the *Encuesta de Migraciones*. However, this source is not without its problems. These include the fact that it understates migratory movements. For more on the sources available, see Ródenas and Martí (1997), Bover and Velilla (1999), and the studies cited therein, and Bover and Arellano (2002). Census data for the first few years of the twenty-first century are still not available, and will not be so until the census has been conducted in 2011.

[18] The migration accounted for by these destinations amounts to 70.3 per cent of the total. The number of observations is 492.

Alicante, Guipúzcoa, Zaragoza, Sevilla, Oviedo and Tarragona.[19] For the period 2000-2004, we widened the sample to include 19 destinations characterised by the fact that they appear as net receivers of population in all the years considered. In this case, therefore, we include destinations that are characterised by net population entries albeit quantitatively small. These, in order of importance, are: Barcelona, Madrid, Vizcaya, Asturias, Pontevedra, Guipúzcoa, León, Córdoba, Valladolid, Jaén, Ourense, Salamanca, Cáceres, Burgos, Lugo, Zamora, Palencia and Soria.[20]

The study undertakes a comparison of two types of empirical model. First, in order to test the basic explanatory power of the economic factors as determinants of the decision to migrate, we estimate a gravity-type equation. In this, as well as the nominal wages in the regions of destination (w_i), we consider that the migratory flows between two regions j and i (here, provinces) increase with the size of the region of destination (L_i) and fall with the distance between them (d_{ij}).[21] We also consider the possibility that the fact of sharing a border acts as an incentive to migration.[22] Thus the estimable equation is the following:

$$\log\left(\frac{migr_{jit}}{\sum_{i'\neq j} migr_{ji't}}\right) = \beta_1 \cdot \log\left(L_{i(t-1)}\right) + \beta_2 \cdot \log\left(w_{i(t-1)}\right) + \beta_3 \cdot \log\left(d_{ij}\right) + \beta_4 \cdot F_{ij} + \alpha_j + v_{ijt} \qquad (1)$$

Second, we estimate a specification, derived directly from an NEG model, which captures precisely the functional form that relates migratory movements with

[19] The migration accounted for by these destinations amounts to 73.1 per cent of the total. The number of observations is 460.

[20] The migration accounted for by these destinations, in 2001, amounts to 52.9 per cent of the total. The number of observations is 872.

[21] Wage data for the places of destination, all of which refer to the industrial sector, are taken from the *Encuesta de Salarios y Jornadas de Trabajo en los años 1914-1930,* prepared by the Ministry of Work, for 1920; from the *Renta Nacional de España y su distribución provincial. Serie homogénea. Años 1955 a 1993 y avances 1994 a 1997*, prepared by the BBV Foundation, for 1960; and the *Balance Económico Regional (autonomías y provincias). Años 1995 a 2004*, provided by FUNCAS, for 2000. In the case of the last period, the variable considered is, in fact, the probability of obtaining an industrial wage. In other words, we also considered the rate of unemployment of the points of destination, taken from the *Encuesta de Población Activa* for 2000. The data of the total active population and by sector are taken from the *Censos de Población* for 1920 and 1960 and from the *Encuesta de Población Activa* for 2000. In the case of distances, these refer to rail distances for 1919 and road distances for 1960 and 2000 between provincial capitals. We have also assumed that the internal provincial distance is 75 km.

[22] Although the inclusion of this variable is common in the empirical literature dedicated to international migration flows, its use in national analyses needs additional justification. In the case of Spain, we should bear in mind potential institutional differences that often exist between regions, for example those related to language. In this particular case, therefore, the fact that two regions share a border means, in many cases, that they share those elements which, all things being equal, will serve to increase bilateral migratory flows.

market potential. This relationship, proposed in equation 2, captures fully the market potential of the regions, on the understanding that their production is also sold in the neighbouring regions. In addition, it allows the direct estimation of the key parameters of the NEG models, such as the elasticity of substitution, transport costs and migration costs.

$$\log\left(\frac{migr_{jit}}{\sum_{k\neq j} migr_{jkt}}\right) = \frac{\mu}{\sigma_x - 1}\cdot\log\left(\sum_{k=1}^{k=R} L^x_{k(t-1)}\cdot\left(w_{k(t-1)}\cdot\left(d_{ik}\right)^{\delta}\right)^{1-\sigma_x}\right) + \alpha_1\cdot\log\left(L^y_{i(t-1)}\right) +$$

$$+\alpha_2\cdot\log\left(w_{i(t-1)}\right) - \lambda\cdot\log\left(d_{ij}\cdot\left(1 + b\cdot F_{ij}\right)\right) + \vartheta_j + v_{ijt} \qquad (2)$$

The first two explanatory variables describe aspects linked to the market potential of the regions of destination. The first, and the most important, corresponds to the market potential derived from the production of manufactured goods, and it is interpreted as being the inverse of the price index of manufactured goods in the region *i*. In this case, as we are dealing with traded goods, the market potential considers the size of the market of the neighbouring regions discounting distances (transport costs). The second variable describes the market potential derived from the production of services, in this case not traded outside the region. The third explanatory variable refers to the expected wage levels in the region of destination. Finally, the fourth variable refers to the existence of migration costs, which grow with distance and increase in those cases where the regions share a border.

Table 1. Coefficients and expected values

Coefficients		**Expected values**
σ_x	Elasticity of substitution-Sector x	$1< \sigma_x$
μ	Share of consumer expenditure on good x	μ=0.4 or 0.6
δ	Elasticity of trade costs to distance	$0< \delta$
$\alpha_1 = \Phi/(\sigma_y-1)$	Influence of local service supply	$0< \alpha_1 < 1$
α_2	Influence of expected wage	$0 < \alpha_2 < 1$
λ	Distance elasticity of migration cost	$0 < \lambda$
b	Influence of provincial borders on migration	$b < 0$
	No black hole condition	$(\sigma_x-1)/ \sigma_x > \mu$

Table 1 shows the expected values, consistent with the theoretical model, of the coefficients that are to be estimated. The comparison of the explanatory power of the migration equation and of the estimated values of the parameters over the three periods chosen allows us to detect whether the changes in the process of concentration/ dispersion of the economic activity account for changes in the model of migration.

5. Empirical analysis: results and discussion

The first group of results refers to the estimation of the gravity-type migration equation for each of the periods considered here. This estimation allows us to determine the explanatory power of the economic determinants of migration, before imposing a restricted behaviour on them by using the functional form derived from the NEG model. In Tables 2 and 3 we show the results of the estimation using ordinary least squares and including the fixed effects for each of the provinces of origin. The difference between both tables is that in Table 3 the market size of the provinces of destination has been broken down by sector: agrarian, industrial and services.

The results reported in Table 2 show that the explanatory power of the gravity equations is high. Furthermore, all the estimated coefficients are significant and present the expected sign. Thus, distance and the existence of a common border have, respectively, a negative and positive influence on the migratory flows. In addition, the wages at the point of destination contribute to an increase in migration. Finally, the size of the region of destination (the centripetal force in an NEG model) also has a positive influence on migration. Certain changes over time are, also, worth highlighting. First, the capacity of attraction of market size, proxied by the coefficient β_1, is greater for the 1920s, falls during the 1960s and increases again in the early years of the twenty-first century. Second, the attraction of industrial wages (β_2) falls over time, most notably at the end of the period. Similarly, the negative and positive impacts of distance (β_3) and the border effect (β_4) also fall and rise, respectively.

The results shown in Table 3, in which the effect of market size has been broken down by sector, allow us to approximate more closely the theory proposed by NEG. Here the existence of a positive relation between migratory flow and the size of the region of destination is explained by the regions' market potential, although only with respect to the sectors that operate in imperfect competition. Thus, in the large regions a greater variety of goods is available on the markets that operate in imperfect competition - industry and the services, so that their sale prices are lower.

Table 2. Gravity Estimation, Ordinary Least Squares/Fixed Effects

	1920-30	1960-70	2000-04
$\beta_{1,TOTAL}$	1.531 (0.000)	0.660 (0.000)	0.981 (0.000)
β_2	5.583 (0.000)	3.173 (0.000)	0.301 (0.040)
β_3	-2.190 (0.000)	-1.103 (0.000)	-0.884 (0.000)
β_4	0.230 (0.301)	0.786 (0.001)	0.997 (0.000)
N	492	460	874
R^2-adj.	0.676	0.489	0.674
Akaike	3.227	3.128	2.462
Schwartz	3.261	3.173	2.489

Notes: The probability of rejecting the null hypothesis that the estimated parameter is not significant is shown in brackets. Consistent standard erros estimation using White's method.

In addition, Table 3 shows that, in effect, there is no element of attraction to be derived from the size of the agrarian sector in the regions of destination. In fact, it would be more accurate to speak of a negative attraction (or expulsion), which acquires particularly high values in the estimation corresponding to the 1960s. In the case of the attraction derived from the size of the industrial sector, a positive effect is observed for the first two periods, albeit not so great in the second, while a negative effect is recorded in the last period. The service sector maintains its potential to favour agglomeration in the three periods. In the last two periods its capacity to attract is even greater than that of the industrial sector. The signs and estimated values of elasticity corresponding to the rest of the variables (wages in the regions of destination, distance and the existence of a common border) register inappreciable changes with respect to those shown in Table 2. Finally, Akaike's and Schwartz's criteria allow us to affirm that the explanatory power of the model used in Table 3, which is the one that most closely approximates to the reduced nature of the relationship extracted from the NEG theoretical model, is greater than that of the model used in Table 2, based on a more general gravity equation.

Table 3. Gravity Estimation, Ordinary Least Squares/Fixed Effects

	1920-30	1960-70	2000-04
$\beta_{1,AGR}$	-0.347 (0.000)	-1.785 (0.000)	-0.120 (0.005)
$\beta_{1,IND}$	1.006 (0.000)	0.535 (0.000)	-0.139 (0.032)
$\beta_{1,SER}$	0.628 (0.000)	1.446 (0.000)	1.110 (0.000)
β_2	1.616 (0.002)	2.811 (0.000)	0.264 (0.047)
β_3	-1.981 (0.000)	-1.135 (0.000)	-0.802 (0.000)
β_4	0.624 (0.001)	0.721 (0.001)	1.099 (0.000)
N	492	460	874
R^2-adj.	0.749	0.571	0.688
Akaike	2.977	2.958	2.420
Schwartz	3.028	3.020	2.458

The probability of rejecting the null hypothesis that the estimated parameter is not significant is shown in brackets.
Consistent standard erros estimation using White's method

The next step involves the estimation of the functional form described in equation 2. We should clarify the fact that it is not possible to offer a joint estimation of the parameters μ and σ_x. For this reason, as it is usual in exercises of this kind, we considered μ (proportion of total expenditure in consumption of manufactured goods) as an exogenous parameter to which we have assigned a reasonable value: 0.4. Furthermore, in order to compare the robustness of the results to the value proposed for μ, Table 4 also shows the results obtained when supposing that the participation in the expenditure of manufactured goods is 0.6. Under these conditions, it is possible to undertake a complete estimation of equation 2 by non-linear least squares. The results of the estimation are those shown in Table 4.

Table 4. NEG Framework Estimation. Non-Linear Least Squares/Fixed Effects

	1920-30	1920-30	1960-70	1960-70	2000-04	2000-04
	Model 1 **$\mu = 0{,}4$**	**Model 2** **$\mu = 0{,}6$**	**Model 1** **$\mu = 0{,}4$**	**Model 2** **$\mu = 0{,}6$**	**Model 1** **$\mu = 0{,}4$**	**Model 2** **$\mu = 0{,}6$**
σ_x	2.810 (0.021)	4.173 (0.009)	3.291 (0.004)	3.974 (0.007)	1.764 (0.002)	1.966 (0.003)
δ	1.794 (0.000)	2.119 (0.000)	1.981 (0.000)	2.049 (0.000)	0.892 (0.000)	0.949 (0.000)
α_1	0.819 (0.041)	0.815 (0.037)	0.974 (0.000)	0.968 (0.000)	0.902 (0.000)	0.915 (0.000)
α_2	2.061 (0.000)	2.152 (0.000)	2.227 (0.001)	2.319 (0.000)	0.215 (0.000)	0.184 (0.000)
λ	1.757 (0.034)	1.754 (0.029)	1.049 (0.021)	1.041 (0.028)	0.854 (0.034)	0.837 (0.031)
b	-0.815 (0.003)	-0.821 (0.007)	-0.931 (0.009)	-0.939 (0.023)	-1.214 (0.015)	-1.237 (0.018)
N	492	492	460	460	874	874
R^2-adj.	0.615	0.613	0.421	0.529	0.610	0.665
Akaike	3.259	3.262	3.294	3.071	2.654	2.629
Schwartz	3,293	3,296	3,317	3,128	2,637	2,612

The probability of rejecting the null hypothesis that the estimated parameter is not significant is shown in brackets.
Consistent standard errors estimation using White's method

In general, the parameters converge towards values that are consistent with the original theoretical model. The results are fairly robust to changes in the assumed value of parameter μ. The goodness of fit is, in general, high. In fact, although the model is subjected to stronger restrictions, its results are not much worse than those obtained in the case of the gravity models. The coefficients corresponding to the expected wages in the regions of destination (α_2), and the migration costs (λ and b), show the expected signs and are highly significant. Moreover, these coefficients reach values that are close to those estimated in the case of the gravity model. We observe, once more, a reduction over time in the attraction of industrial wages, as well as a reduction in the effect of transport costs and an increase in the border effect.[23] In short, the declining importance

[23] The results obtained for the period 2000-2004 are very similar to those obtained by Crozet (2004) for the period 1983-2000. The main difference is that, in our study, the elasticity corresponding to wages, although low, is positive and significant. By contrast, for the period estimated by Crozet, this elasticity is

of transport costs at the end of the period under analysis reflects the increase in the dispersion of migration detected in various studies, whereas the increase in the importance of the border effect reflects the increase, also reported in the literature, in short-distance migrations.

In the case of the values estimated for the parameters that define the market potential function in the NEG model, the exercise enabled us to obtain highly satisfactory results. All the parameters that capture the price index associated to the CES demand function presented the expected sign and were highly significant. Specifically, we should stress that the values reached by the elasticities of substitution between pairs of varieties of manufactured products (σ_x) were always strictly positive and above the unit value.[24] The elasticity of transport costs with respect to distance was also strictly positive.[25] Finally, the parameter that describes the influence of the size of the services sector (α_1) took the values and sign expected in the estimates corresponding to the three cut off times. These values are consistent with the restriction imposed by the theory and denote the presence of a high level of product differentiation in the services sector.

Therefore, the results obtained allow us to confirm that, in line with the predictions derived from the NEG model, migrants' decision making has been based on the market potential of the regions of destination (forward linkage). The migrants were attracted by productive agglomerations during the three time periods that capture the whole of the twentieth century (and the beginning of the twenty-first). The changes in the estimated values of the basic parameters of the NEG model in the last of the periods analysed allow us to understand, furthermore, how the changes in the localisation of economic activity have affected migrants' decision making. Similarly, the reduction in the elasticity of substitution for the industrial sector and the maintenance of the agglomeration affect derived from the size of the services sector suggest an increase in the importance of this sector in attracting migrants. In addition, the reduction in the overall elasticity of the transport costs of industrial goods seems to imply an increase in

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negative. It might be that the unexpected result obtained by Crozet is due to the fact that the period chosen includes the years of structural adjustment.

24 Particularly striking is the marked fall in the elasticity of substitution estimated for the period 2000-2004 (around 2) compared to the figures recorded for 1920 and 1960 (around 3). However, the values obtained are consistent with those obtained elsewhere (Hanson, 2005, Head and Ries, 2001).

25 The passing of time suggests the existence of a greater spatial reach of the agglomeration economies. In the first two periods, the results obtained show that the complete elasticity of transport costs (δ*(1-σ_x)) was very high, to the extent that a region's market potential is highly conditioned by the size of the local market (and not affected so greatly by the neighbouring regions). In the final period, however, the

the territory over which the economies of agglomeration generated by industrial production have been allowed to disseminate. Under these conditions we can account for the tendency towards a reduction in the spatial concentration of industrial activity, and we also explain the evidence pointing to internal migrations becoming less concentrated in a few regions.

6. Conclusions

This study reports an empirical analysis of a theoretical model developed within the framework of NEG that is based on the examination of the *forward effect* which relates migrants' decision making with the market potential of the regions. In so doing, we chose three cut off times representing three key periods in the long-term industrialisation of a country, Spain, and used various migration equations. Specifically, we used estimations derived directly from the theoretical model, as well as non structural estimations that allowed us to draw comparisons.

Our results show that Spanish migrants have been attracted by the productive agglomerations in each of the three periods analysed. In other words, we have shown that elements favouring agglomerations, such as those proposed in NEG, were present both in the phases of concentration and in the phases of the spatial redistribution of activity.

Furthermore, our results show that the estimated values of the parameters of the various migration equations have been modified over time. These changes allow us to account for the shift in tendency in the concentration of migratory flows in a context in which migrants continue to be attracted by major agglomerations. This is evident, first of all, in the loss of importance suffered by the industrial sector at the expense of the services sector as the sector that attracts migratory flows. Furthermore, our results also indicate an extension of the territory that defines the market potential of a region over the three time periods analysed, which explains why the new industrial agglomerations extend beyond the territorial area of the province. These two aspects, tending to favour the redistribution of economic activity and spatial migrations, will have more than compensated for the secular reduction in transport costs associated with emigration, an element that might have acted as an incentive for a greater concentration of migratory

reduction in the estimated value of δ implies an extension of the territory that defines the market potential of a region.

flows on the main destinations. In fact, in this context, migration costs have lost weight as an explanatory element of the decision to migrate over the twentieth century.

Overall, these changes would seem to reflect the existence of major changes in the migratory model, occurring primarily in the last decades of the twentieth century. However, our results also show that more recent migratory movements continue to be determined by economic factors such as the existence of agglomeration economies.

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