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Growth and Change in the Portuguese Urban System: 1890-2001

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Abstract

In this paper we analyse the long term evolution of the Portuguese urban system using an urban place data base. Urban places are defined as agglomerations with 10 000 inhabitants or more. Our data base is constructed from the 1890 to 1981 population censuses data and INE unpublished data for the 1991 and 2001 censuses.

We apply the rank-size model and use rank-size estimates to describe the evolution of urban hierarchy in the long run. Non paretian behaviour of the rank-size distribution will be analysed using the same methodology as in Delgado and Godinho (2004). The dynamics of the Portuguese urban system will be analysed through a Markov chain process, as in Delgado and Godinho (2005).

JEL classification: O18, R11, R12

Keywords: Urban hierarchy; Rank-size Distribution; Urban Growth; Markov Processes

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1. Introduction

The aim of this paper is to analyse the long term evolution of the Portuguese urban system, from 1890 to 2001. This is a study, following a previous research (Delgado and Godinho, 2004, 2005) on the structural evolution of Portugal's urban system, using an administrative city data base. In this paper we use an urban places data base. Our aim is to describe the evolution of the urban hierarchy and the long run trends of growth and change using the same methodology as in Delgado and Godinho (*op. cit.*).

In the first part of this paper we describe, briefly, our data base and indicate some of the main problems resulting from changing criteria and concepts, both regarding the definition of localities and their designation. Part 3 presents a characterisation of the Portuguese urban system, using basic descriptive statistics. In the following section we use the rank-size model to estimate the Pareto exponent and analyse the long term evolution of the size distribution of urban places. Deviations from rank-size linearity were analysed following the approach of Rosen and Resnick (1980). In order to understand the dynamics of urban places we examine mobility within size distribution through a Markov chain process; we also analyse the expected trend of the size distribution, projecting the observed transition pattern for the next decades. The last section presents some conclusions.

2. Data base

Our data base includes urban places in mainland Portugal with at least 10000 inhabitants at each census date, from 1890 to 2001. Places were defined accordingly to the existing definition in each census[1].

Since we used contemporaneous definitions and our data base covers a period of more than a century, there is variability in the concept and criteria used. The geographical definition of a locality and even its designation varies through time as a result of the evolution of population settlements, changes in the administrative division of the territory and correspondent boundary redrawing. Another source of heterogeneity results from

[1] Unless otherwise specified, all tables and figures result from own calculations using the data base.

differences of interpretation of the local reality in the diverse censuses (Marques, 1993:18); however data variability may be attenuated by the fact that we have imposed a 10000 inhabitant's threshold.

For 1890-1900 and 1920-1930 data are only available by *freguesia*[2]. For these years we used Nunes (1996) estimates which were calculated taking the demographic weight of each place in the total inhabitants of the *freguesia*[3] to which it belonged, assuming that it remains constant over time. Since the 1911 and 1940 censuses refer to *de facto* population, Nunes estimates must be interpreted as referring to *de facto* population.

For 1940, 1960 and 1970 censuses data are presented by *freguesias* and place. Generally each *freguesia* contains more than one locality but in some cases, the same locality belongs to several *freguesias*. In those cases the population of the locality was calculated aggregating the corresponding data at each *freguesia*.

As for the 1991 and 2001 censuses, the examination of the data allowed us to identify rough discrepancies in place definition. In these cases, we have rectified the data using the demographic weight of the place in the corresponding *freguesias* (for 1991 or 2001) to calculate its population in 2001 or 1991. In some cases the population of the locality corresponds to the population of the *freguesias* with the same denomination. For Barcelos the 1991 population was estimated considering the growth rate of the city's population in the nineties.

3. A brief characterisation of the Portuguese urban places

In Table 1 we present some basic data about the Portuguese urban system. Since we use a threshold of 10000 inhabitants to qualify a place as an urban place, the emergence of new urban places reflects both the growth of existing localities that passed the defined threshold and the creation of new places. The use of contemporaneous definitions may introduce variability into the territorial boundaries of a place as in its process of growth it may

[2] This is the smallest administrative unit of the country

[3] The 1911 census was used to estimate the population of each locality in 1920; for 1930, Nunes used the 1940 census. As explained in Nunes (1996: 9) this method may overestimate the results for 1930 and underestimate those of 1920.

experience an extension of its land area and integrate the territory of contiguous localities. So, over time, some places may lose their autonomy and disappear because they were incorporated in another place.

Table 1

Urban Places: some basic data, 1890-2001

Census date	Urban Population	Number of urban places			Average Size			Median Size (a)	Minimum Size (a)	Maximum Size (a)	Urbanization rate[4] (%)	Top Two Primacy Index[5] (%)	Primacy Index[6] (%)
		Total	Leaving the sample	New	All Centres	Existing centres in the previous census	New centres						
1890	540705	9			60078			14925	11783	301206	11,6	81,4	55,7
1900	641792	10	0	1	64179	70156	10384	15101	10384	356009	12,7	81,6	55,5
1911	760313	10	1	1	76031	83313	10499	17436	10499	435359	13,6	82,8	57,3
1920	840666	12	0	2	70056	82026	10204	14075	10158	486372	14,8	82,0	57,9
1930	1074525	16	0	4	67158	85280	12791	17200	10182	594390	16,9	76,9	55,3
1940	1310366	22	0	6	59562	77701	11192	13519	10072	709179	18,2	74,1	54,1
1950	1572690	30	1	9	52423	70006	11395	14041	10039	783226	19,9	67,7	49,8
1960	1906019	44	0	14	43319	56599	14860	15711	10263	802230	23,0	58,0	42,1
1970	2202342	57	1	14	38638	46818	13511	15919	10001	769044	27,1	48,8	34,9
1981	2875107	78	1	22	36860	45627	14544	19019	10081	807167	30,8	39,5	28,1
1991	3238937	101	2	25	32069	37852	14488	16879	10028	662782	34,6	29,8	20,5
2001	3821183	126	4	29	30327	35196	14040	16309	10095	563818	38,7	21,6	14,8

(a) Considering the total number of places in each date and measured in inhabitants

In 2001 the number of urban places is fourteen times bigger than in 1890 while urban population is about seven times bigger As a consequence, average city size in 2001 is roughly half the 1890 corresponding value. In the same period, median size grows from 14925 to 16309 inhabitants, with a maximum of 19019 inhabitants in 1981. The evolution of the dimension of the median urban place shows that there is no tendency to drastic increases in the dimension of the majority of places.

In the beginning of our time period, Portugal had an incipient level of urbanisation and an urban system characterised by a high level of primacy: more than 80% of urban population lived in Lisboa and Porto. From 1890 to 1920, we observe an intensive process of urbanisation, involving mainly the growth of existing urban places and, in particular,

[4] Defined as the ratio of total urban population to total population, in a given year, expressed in percentage.

[5] Defined as the ratio of resident population in two top cities to total urban population, in a given year, expressed in percentage.

[6] Defined as the ratio of the resident population in the largest city to total urban population, in a given year, expressed in percentage.

concentration of urban population in the city of Lisboa which, in 1920 accounted for almost 60% of total urban population.

After 1911, the emergence of new urban places had a decreasing effect on the average size of urban centres, but it is only after 1930 that this indicator exhibits a value inferior to that of the beginning of the period.

The average size of existing centres[7] is higher than the global average size and the new centre's average size, denoting a process of concentration of urban growth in those centres, which is accentuated in the early phases of the process of urbanisation. Generally, the average size of new centres tends to increase through time, but it is always lower than that of existing centres.

Table 2

Inter-census average growth rate (%)

Inter Census date	Total number of places (net movements)	Average size		Total Urban Population	Total Population
		All centres	Existing centres in both years		
1890-1900	11,1	6,8	16,8	18,7	8,2
1900-1911	0,0	18,5	18,8	18,5	10,8
1911-1920	20,0	-7,9	7,9	10,6	1,5
1920-1930	33,3	-4,1	21,7	27,8	11,9
1930-1940	37,5	-11,3	15,7	22,0	13,8
1940-1950	36,4	-12,0	13,1	20,0	13,8
1950-1960	46,7	-17,4	8,0	21,2	4,7
1960-1970	29,6	-10,8	6,2	15,6	-2,1
1970-1981	36,8	-4,6	16,6	30,6	14,9
1981-1991	29,5	-13,0	1,3	12,7	0,4
1991-2001	24,8	-5,4	7,3	18,0	5,3

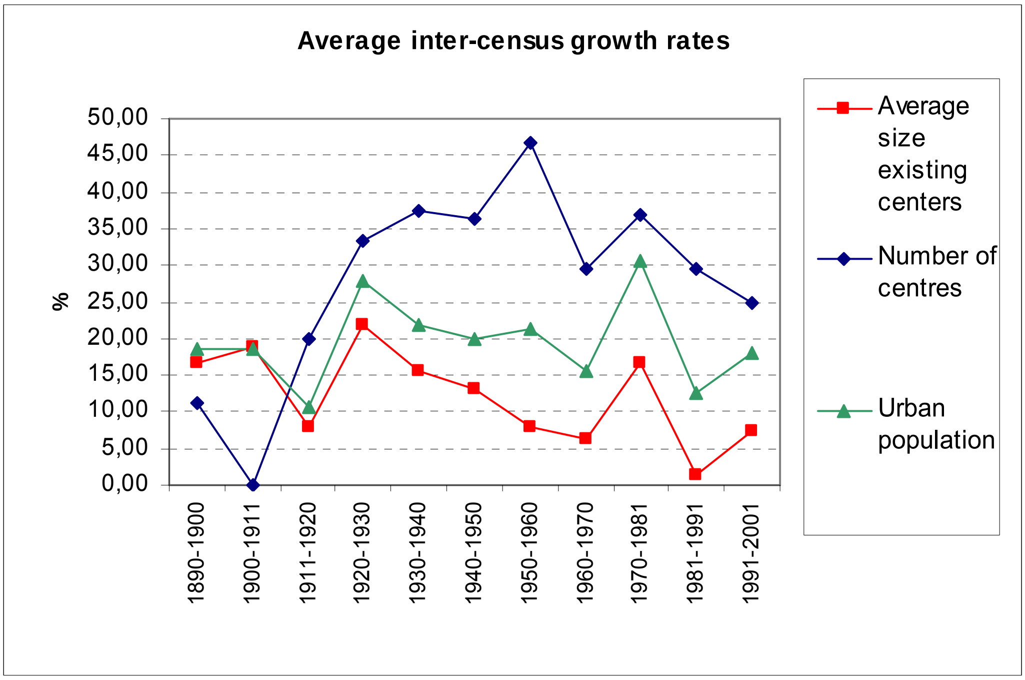
The growth rate of the number of centres reaches a maximum in the fifties, far exceeding the growth rate of average size of existing centres in both years (Table 2 and figure 1). Consequently, despite the fact that Lisboa and Porto continue to experience population growth, the top two primacy index decreases significantly. In this phase, the extension of the process of urbanisation, associated with economic development and industrialisation, implies the loss of relative importance of the two top cities in terms of demographic weight

[7] In each census date, from 1900 onwards, existing centres are all the urban places that in the previous census date had at least 10000 inhabitants.

but does not imply neither the loss of their population in absolute terms or a change of their rank in urban hierarchy. In fact, decentralisation of urban growth is only observed in the last two decades and it is associated to heavy population losses in Lisboa and Porto, in favour of nearby urban places (suburbanisation). In 2001, almost 70 % of the Portuguese urban population living in urban places with at least 10000 inhabitants, lived in places belonging to the metropolitan areas of Lisboa (45,4%) and Porto (23,2%)

Figure1

Average inter-census growth rates (%)



In conclusion, after a initial period of concentration in existing urban places, we witnessed the emergence of new urban places and heavy population losses in the two largest cities. Urban places are small with no significant tendency to increase in their absolute size. The average urban place had, by 2001, thirty thousand inhabitants and the median size was only slightly above the corresponding 1890 size. The urbanization rate , although increasing, is still under 40% in 2001. Finally, despite decreasing primacy index (22% in 2001, for the two top city index) 70% of Portuguese urban population lives in urban places belonging to the metropolitan areas of Lisboa and Porto and the largest urban place outside these areas, Braga, had less than 120000 inhabitants in 2001.

4. The rank-size evolution of Portuguese urban system

4.1. The rank-size model

The estimation of rank-size model requires the ordering of cities from the largest to the smallest and it relates the rank of a city with its size, measured by its population, as follows:

(1) $R_{it} = AP_{it}^{-\alpha}$ in logarithmic form, (1') $\log R_{it} = \log A - \alpha \log P_{it}$

where R_{it} is the rank of the i^{th} city in time period t, P_{it} is the size (population) of the i^{th} city in time period t, A is a constant and α is the Pareto/Zipf's exponent. This formulation is known as the Pareto equation[8].

City size distribution is then characterised by the number of cities and two parameters: the exponent (α) and the constant term (A). The exponent is a measure of city size inequality in a given urban system and time period. Using Pareto's formulation, when $\alpha > 1$ the rank-size curve is steeper and city sizes are more evenly distributed than that predicted by Zipf's law ($\alpha = 1$). In particular, considering the limiting value of $\alpha \to \infty$ all cities would have the same size. On the other hand, when $0 < \alpha < 1$, the rank-size curve becomes flatter. In this case, urban hierarchy is more contrasted than in Zipf's case and cities in the top of the hierarchy are larger. Here we obtain a more heterogeneous distribution of city sizes. In the limiting case of $\alpha \to 0$, there would be just one city in the urban system.

4.2. The rank-size evolution of the Portuguese urban system

In order to analyse the long term evolution of the size distribution of Portuguese urban places we constructed a rank-size graph and studied how the shape of the rank-size curve evolved through time. Next we estimated the rank size model by ordinary least squares (OLS) and analyse the long term evolution of slope estimates. Then we study the deviations from rank-size linearity, following the approach of Rosen and Resnick (1980).

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[8] Another formulation is that of Lotka (1924), which is given by the following equation: $P_{it} = BR_{it}^{-\beta}$ or, in logarithmic form, $\log P_{it} = \log B - \beta \log R_{it}$ where B is a constant and β is the inverse of Pareto exponent. The two formulations can further be related to as $B = A^{\beta}$.

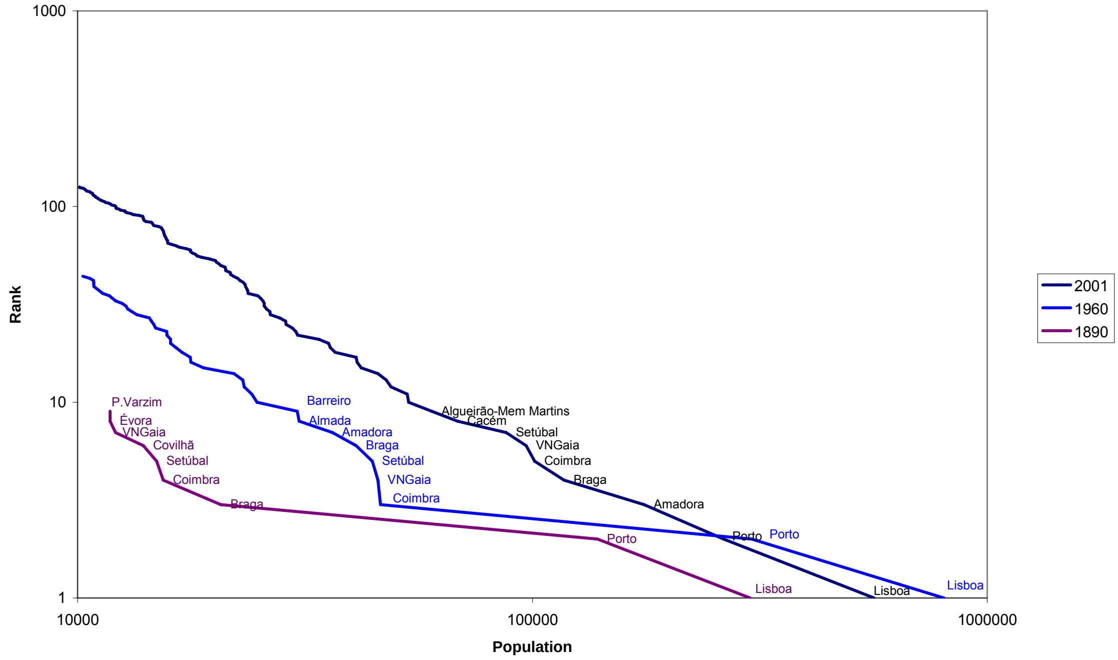
4.2.1. The rank-size graph

In a rank-size graph the vertical axis shows the rank of each urban place[9] and the horizontal axis its corresponding population. The plot of all urban places, for a specific year, using a log-log scale, describes a downward sloping line. The grouping of different rank-size lines in the same graph allows us to study the evolution of the shape of the line. Generally we expect an upward movement of the line, reflecting both the increases in the number of urban places and in their demographic weight. However, if the largest core urban places experience a period of population decline whereas suburban peripheral areas tend to grow, we may observe a clockwise rotation of the rank size line.

Figure 2 shows the rank size lines for 1890, 1960 and 2001[10]. From 1890 to 2001 the upward movement of the line reflects the increase in the demographic dimension of urban places as well as the growth of the number of places with at least 10000 inhabitants. However, from 1960 onwards, there is a left shift of the rank-size line on the *X* axis, due to the decline in the size of the two largest cities. In fact, the demographic dimension of Lisboa, in 2001 is lower than the observed value for 1940, as a consequence of a persistent process of population losses, starting in the sixties and only interrupted in the seventies, when the resident population of the capital approaches its 1960' value due the income population from former Portuguese African territories. The graph also illustrates a similar process for Porto, whose 2001 demographic weight is very similar to 1940, despite the fact that population losses start only in the eighties.

[9] The largest urban place rank is 1; the second largest 2, etc.
[10] A full version of the graph is available, on demand, from the authors.

Figure 2
Rank-size graph: 1890-2001



Another important characteristic of the long term evolution of the urban system is the change in individual city ranking. In fact, excluding Lisboa and Porto, the relative position of the top urban places changes: from 1890 to 1960 inland cities, like Covilhã and Évora, disappear from the top of the hierarchy, whereas from 1960 to 2001 urban places in the south band periphery of Lisboa[11] - Almada, Barreiro - give place to those in its northwest band – Agualva-Cacém and Algueirão-Mem Martins, for instance.

4.2.2. Results from the estimation of the model

The rank-size model, as described by equation 1’ has been estimated by means of ordinary least squares. Table 3 presents the estimates of the Pareto/Zipf’s coefficient, α. The individual parameter estimates are all statistically significant at 5% significance level and the quality of the adjustment is quite good, since all R^2 values are high.

[11] Traditionally linked to manufacture in heavy chemical industries, metal works and shipyards.

Table 3
Results of OLS estimation: 1890-2001

Date	Number of Places	α (absolute value) *	R^2
1890	9	0,556	0,870
1900	10	0,558	0,875
1911	10	0,545	0,901
1920	12	0,564	0,894
1930	16	0,653	0,894
1940	22	0,724	0,860
1950	30	0,828	0,883
1960	44	0,987	0,884
1970	57	1,088	0,923
1981	78	1,214	0,944
1991	101	1,316	0,970
2001	126	1,363	0,987

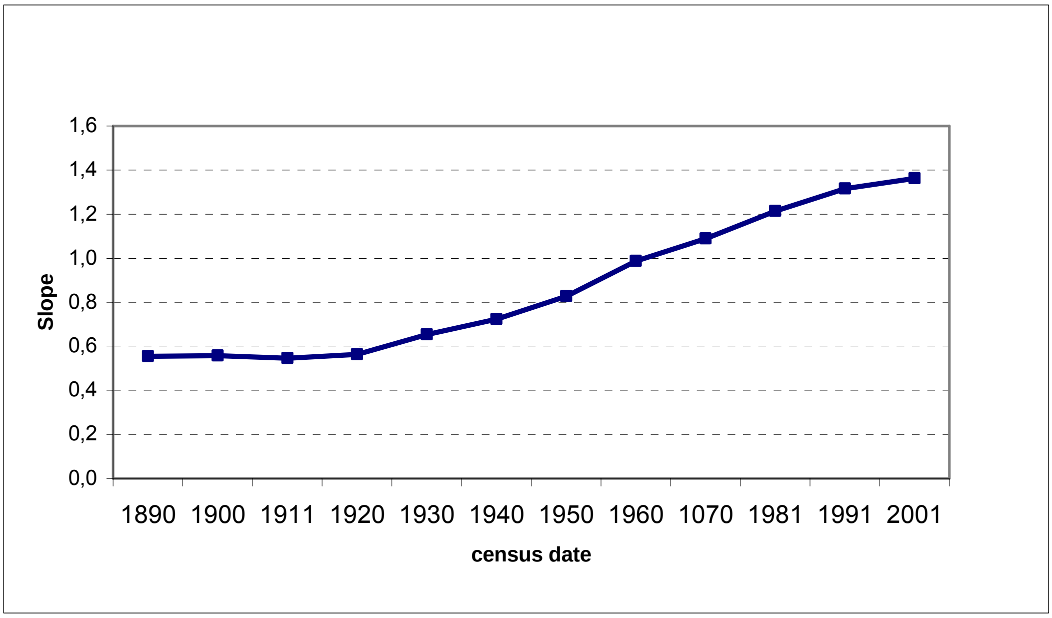
* All statistically significant

Slope estimates[12] start from values far lesser than one (0,56) and are almost stable till 1920 increasing afterwards. The long term evolution of α estimate (Figure 3) indicates a narrowing of city size inequality. In the beginning, the urban system is dominated by primary cities implying a more heterogeneous distribution of city sizes. Growth in the number of cities and in the size of intermediate urban places contributes to reduce city size inequality. After 1970 the emergence of new centres, the growth of suburban places in the Lisboa and Porto periphery, together with the absolute decline of those two top cities, is reflected in a slope greater than one and increasing, pointing to a more even distribution.

In conclusion, in the first part of the period intensive urbanisation and concentration of population in the two top cities generates a more heterogeneous distribution whereas, in the last decades, the rise in α values seems to indicate that intermediate urban places and the proliferation of new urban places are the source of a more equal distribution, despite the fact that, overall, the Portuguese urban system may still be characterised by a deficit of intermediate cities.

[12] In absolute value

Figure 3
Evolution of slope estimates: 1890-2001



4.2.3. Deviations from rank-size regularity

The shape of the rank-size line signals a non paretian behaviour of the distribution. Therefore, we examine the deviations of the rank-size distribution from linearity by adding a quadratic term to equation 1', following the standard approach in literature. Thus, we estimate the following equation:

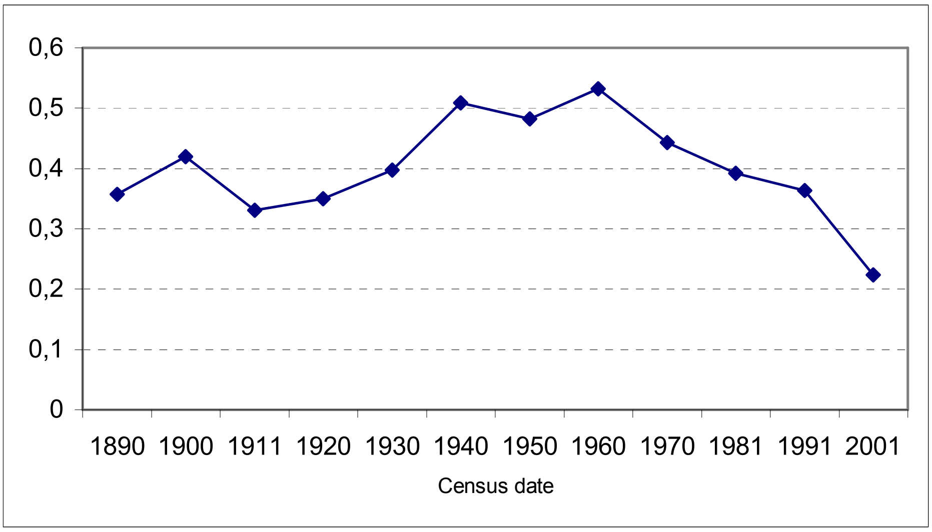
(2) $log\, R_{it} = a + b\, log\, P_{it} + c(log\, P_{it})^2$

The value of the parameter c characterises the curvature: when c>0, the rank-size curve is strictly convex (upward concavity) and when c<0 it is strictly concave (downward concavity). An upward concavity is obtained when the city size distribution has a smaller number of middle-sized cities than predicted by Zipf's Law. In this case, there is a deficit of intermediate cities in favour of largest cities dimension or the number of small cities. A downward concavity means that there are a larger number of middle-sized cities than expected. In this case, there is an excess of intermediate cities relatively to the dimension of the largest cities or to the number of small cities. In rank-size distributions with an upward concavity, the largest city will be larger and smaller cities will be more numerous than expected in a linear relationship between the logarithm of city size and the logarithm of its order. On the other hand, in rank-size distributions with a downward concavity, middle-sized cities are larger than expect in a linear relationship between the logarithms of size and order.

The long term evolution of parameter *c* is depicted in Figure 4. The estimates of *c* parameter are all statistically significant at 5% significance level, except in the beginning of our time period[13] and all R^2 values are high.

Figure 4

Long term evolution of c estimates



The estimates of parameter *c* are always positive indicating that middle-sized urban places are smaller than expected in a linear relationship. The long term evolution of *c* estimates shows an increasing trend till 1960, where c attains a maximum. Since *c* decreases afterwards, this characteristic is less accentuated in recent years, signifying that urban growth has favoured urban places of intermediate size. This evolution reflects first a process of urban growth characterised by concentration of urban population in the largest places followed by an extensive process of urbanisation through the emergence of new relatively small places and the growth of intermediate places.

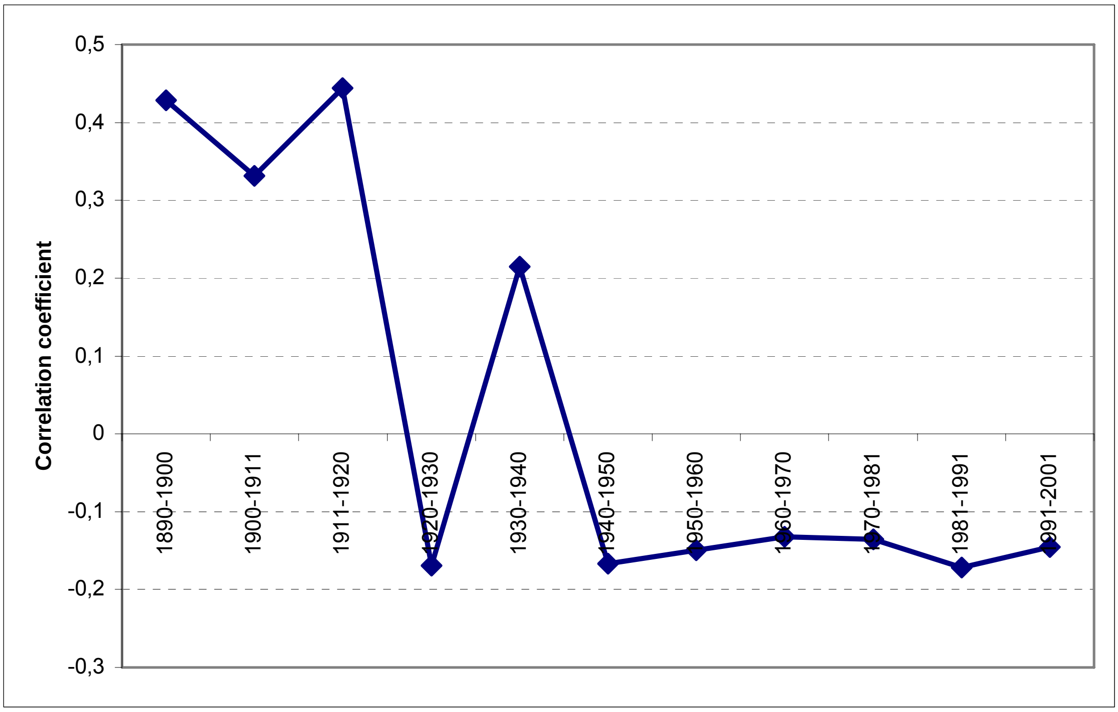
The presence of a curvature in the rank-size distribution is seen as a violation of Gibrat's Law. In order to generate a log-normal distribution, city growth rates must be independent of city size and also independent from period to period (Parr, 1976: 286-287; Moriconi-Ébrard, 1993: 245). To analyse this aspect we compute correlation coefficients between

[13] 1890 and 1900

annual average growth rates and city size, in the beginning of each inter-census periods (Figure 5), and between successive annual average growth rates (Figure 6).

Figure 5

Pearson's coefficient of correlation between annual average growth rate and initial size

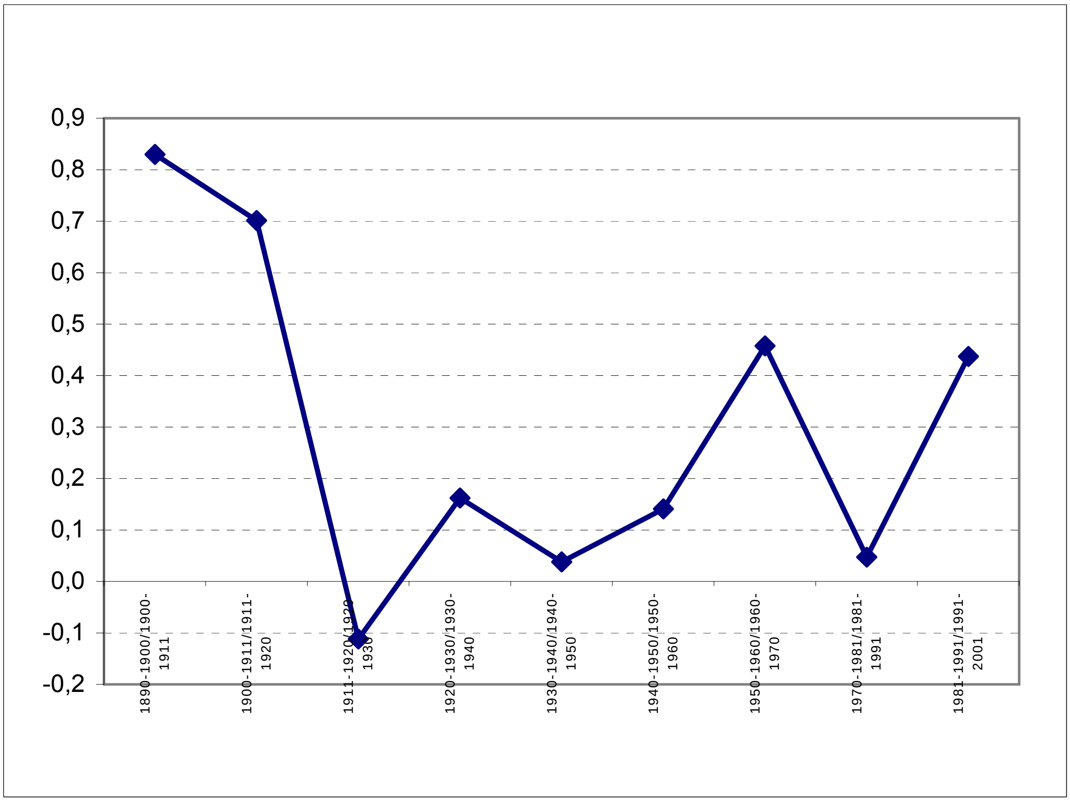


A positive correlation between growth and initial size means that there is an increased inequality over time (divergent size distribution), while a negative correlation signifies that the size distribution of urban places will be more equal over time (convergent size distribution).

At the beginning of the period there is positive correlation between annual average growth rate of urban places and their initial size, with correlation coefficients becoming always negative but near zero from 1940-1950 onwards. Although we obtain a weak correlation, the change in coefficient sign points to the existence of different patterns in the urbanisation process, with growth favouring the larger urban places, for positive values, and a tendency towards urban growth decentralisation, for negative values, which corroborates our previous results.

Non-linearity can also result from the existence of autocorrelation of growth rates over time (Figure 6). In general there is a positive correlation between successive growth rates of urban places. Particularly, there is a high positive correlation between successive growth rates of urban places from 1890 to 1920, evidence of the cumulative nature of urban growth. A significant positive correlation is also registered for the 1950-1970 and 1981-2001 periods.

Figure 6
Pearson's coefficient of correlation between successive values of annual average growth rate



In conclusion, the size distribution of Portuguese urban places seems to result from a process of growth characterised by concentration of population in the largest places, in the early phase of our time period, followed by a selective growth process. However, more than the relationship between size and growth rates, the characteristics of the size distribution may result from autocorrelation in successive growth rates, in particular periods.

5. Mobility within size distribution

The analysis of the long term evolution of the size distribution of urban places does not account for the movements that occur within the distribution. In order to examine upward and downward movements in the size distribution through time we use a Markov Chain to describe changes within size distribution, from 1890 up to 2001.

The first economic applications of Markov Chain Process go back to the 1950's, but urban economists refer usually the work of Quah (1993) as the keystone reference. In the context of empirical analysis of convergence or divergence between regions or countries, Quah uses a stationary first order Markov Chain to infer about patterns of "inter-temporal evolution of the entire cross section distribution" (Dobkins and Ioannides, 2000, 232). The same methodology was used by Eaton and Eckstein (1997) in order to examine the predicted evolution of the size distribution of cities in France and Japan, by Dobkins and Ioannides (2000) and Black and Henderson (2003), in the USA, by Lanaspa *et al.* (2003), in Spain and Delgado and Godinho (2005) in Portugal, to study the dynamics of the size distribution of the urban system. In the 2005 study we had an administrative city data base, which did not account for important changes in the urban hierarchy of the country, since urban places are not necessarily administrative cities. This is particularly evident in the case of suburban places around Lisboa and Porto.

5.1 Methodology[14]

Take F_t as the cross section distribution of city sizes at time *t*. In order to provide a discrete approximation of that distribution we must consider a set of *K* different size classes or states and calculate the frequency of cities in each state at time *t.* The evolution of city size distribution is represented by a (*K, K*) transition probability matrix, *M*. Each element of this matrix (p_{ij}) indicates the probability that a city belonging to state *i* in time period *t* reach state *j* in the next period. The transition probabilities are given by:

$$(3)\ p_{ij} = \frac{m_{ij}}{\sum_{j=1}^{n} m_{ij}}, \text{ and } \sum_{j=1}^{n} p_{ij} = 1$$

[14] Delgado and Godinho, 2005, *op. cit.,* pp. 16-17.

where m_{ij} is the observed number of cities that belonging initially to state i are in state j in the next period, and n represents the number of possible states. The elements of M are estimated from the relative frequencies of changing of state between two subsequent periods[15].

The frequency of cities in each size class in time $t+1$, given by a $(K,1)$ vector F_{t+1}, is then described by the following equation:

$$(4) \quad F_{t+1} = M F_t$$

where the $(K, 1)$ vector F_t denotes the frequency of cities in each class, at time t.

Considering $M_{t,\ t+1}$ as the transition matrix for the $(t,\ t+1)$ period we calculate this matrix for all periods in the sample (T) and obtained each element of the estimated average period to period transition matrix ($\overline{M}$), by computing the average of p_{ij} for all the T periods[16].

5.2. Empirical results

The use of a Markov transition matrix requires the definition of a discrete set of states. Following Eaton and Eckstein (1997) and Lanaspa *et al.* (2003) we defined cell upper points in the size distribution of urban places according to their size relative to the average size in each census date. We obtained seven states, corresponding to the following intervals: more than twice the average (state 1); between the average and twice the average (state 2); between 0,75 and the average (state 3); between 0,50 and 0,75 of the average (state 4); between 0,33 and 0,50 of the average (state 5); less than 0,33 of the average (state 6) and a residual state (state 7) accounting for places that, in each census date, enter or leave the sample. As our data was obtained from population censuses, each period is defined by consecutive census dates and has a variable length[17].

We estimate the matrix in Table 4 by computing the average of the relative frequency of places in each state, from eleven inter-censuses[18] transition matrixes. In the average transition matrix, large values in diagonal cells and low values or zeros in the off diagonal

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[15] Although they are only an approximation of the true probability, Anderson and Goodman (1957) show that (3) is the maximum likelihood estimate of the true p_{ij}.

[16] The long-term distribution of F_t (F_∞) represents the equilibrium distribution of urban places under the assumption that the movements observed from t to $t+1$ are repeated as $t \rightarrow \infty$.

[17] Inter-censuses periods correspond, generally, to a decennium.

[18] The nature of the data does not allow equal length time periods.

cells indicate the persistence of the relative position of urban places within the distribution; zero values in cells far from the diagonal indicate that there are no drastic movements in the relative position/size of an urban place from one period to another. In this last case mobility is a gradual process that occurs between contiguous states.

Table 4

Average transition matrix 1890-2001

Cell's upper end points	Cell's upper end points							Total
	∞ (state 1)	2 (state 2)	1 (state 3)	0,75 (state 4)	0,5 (state 5)	0,33 (state 6)	out of Sample (state 7)	
∞	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	1
2	0,22	**0,74**	0,00	0,04	0,00	0,00	0,00	1
1	0,00	0,83	**0,10**	0,06	0,00	0,00	0,00	1
0,75	0,00	0,14	0,36	**0,47**	0,02	0,00	0,01	1
0,5	0,00	0,00	0,03	0,34	**0,50**	0,11	0,01	1
0,33	0,00	0,00	0,01	0,05	0,38	**0,54**	0,03	1
out of sample	0,00	0,00	0,01	0,03	0,10	0,05	**0,81**	1

Diagonal terms are higher in the extremes of the distribution, indicating that the probability of moving from the initial state is lower for larger urban places and for those places that are out of the sample. In fact, in the case of urban places with at least twice the average size, there are no downward movements. On the other extreme, the 0,81 probability of remaining out of sample is the effect of the trends observed in the beginning of the period since in the last decades a significant number of places entered into the 10000 inhabitants group. Urban places in the 2^{nd} state have a 0,22 probability of ascending to the 1^{st} state. However, when they ascend to the next stage, they tend to remain there.

Mobility is very high in the 3^{rd} state. In fact, urban places in this size class have a 0,83 probability of moving to the adjacent higher state. In the 4^{th} state existing urban places tend to move to the next two higher adjacent states; in particular, there is a 0,14 probability of a leap frog from the 4^{th} to the 2^{nd} state.

Downward movements are scarce: the highest probability is obtained for places in the 5^{th} state, which have an 0,11 probability of descending to the next lower state.

Finally, the analysis of the seventh row shows that those places that are out of the sample – having less than 10000 inhabitants – when they enter the sample they tend to enter to the two next adjacent states. In fact, the probability of entering directly to the 5th state is higher than the probability of movement to the 6th state. However, there are some small places that enter the sample directly to states 4 and 3: that's generally the case of rapidly growing suburban places in the largest cities periphery.

The average transition matrix is absorbent and we can not use it to project the long run equilibrium distribution of urban places sizes. Instead we have projected the observed transition pattern, from 1991 to 2001 (Table 5) into the next decades. Multiplying the size distribution of urban places in 2001 by the projected transition matrix, under the assumption of stability of the nineties transition pattern, allowed us to estimate the relative distribution of urban places, by size class, in those dates (Table 6).

Table 5

Transition matrix 1991-2001

Cell's upper end points	Cell's upper end points							Total
	∞ (state 1)	2 (state 2)	1 (state 3)	0,75 (state 4)	0,5 (state 5)	0,33 (state 6)	out of Sample (state 7)	
∞	**1,00**	0,00	0,00	0,00	0,00	0,00	0,00	1
2	0,10	**0,90**	0,00	0,00	0,00	0,00	0,00	1
1	0,00	0,63	**0,13**	0,25	0,00	0,00	0,00	1
0,75	0,00	0,00	0,48	**0,45**	0,07	0,00	0,00	1
0,5	0,00	0,00	0,05	0,34	**0,51**	0,00	0,10	1
0,33	0,00	0,00	0,00	0,17	0,83	**0,00**	0,00	1
out of sample	0,00	0,00	0,06	0,21	0,61	0,00	**0,12**	1

The 1991-2001 transition matrix differ from the average transition matrix of table 4. The main differences concern the last two rows: places that are out of the sample and places in the next state have a very high probability of moving to the 5th state but the probability of ascending directly to the 4th state is not negligible.

Applying this transition matrix to the 2001 size distribution vector, allows us to draw some conclusions on the projected frequency distribution of urban places, in the next decades. Comparing the 2001 distribution in the first row of the table 6, with the projected distributions there is a tendency towards the concentration in the first state. In fact this result is not unexpected as the average size of urban places has been falling as a consequence of the declining dimension of the two largest urban places and of the enlargement of the urban system in the bottom. That is, the size associated with each state has been diminishing, allowing rapidly growing urban places in the periphery of Porto and Lisboa to catch the 1st state.

Table 6
Projected frequency distribution of urban places, by class dimension, under 1991-2001 transition

Year	Cell's upper end points							Total
	∞	2	1	0,75	0,5	0,33	out of sample	
2001 **a)**	0,06	0,10	0,14	0,28	0,36	0,00	0,06	1
2011	0,07	0,18	0,17	0,29	0,24	0,00	0,04	1
2021	0,09	0,27	0,18	0,27	0,17	0,00	0,03	1
2031	0,12	0,36	0,16	0,23	0,12	0,00	0,02	1
2041	0,15	0,42	0,14	0,19	0,09	0,00	0,01	1
2051	0,19	0,46	0,11	0,15	0,07	0,00	0,01	1

a) effective distribution

On the other hand, smaller urban places tend to enter rapidly the intermediate states. We must note that the 6th state has really a very narrow size band which may explain the nil values we have obtained.

6. Some concluding remarks

As we have stated in the beginning, this paper presents the first results of an on going research. We need to consolidate our data base in order to be able to include urban places with at least 5000 inhabitants and to understand better some changes that seem to occur in some places.

The effort to arrive to a coherent data base took much of our effort and we could not develop some of our initial aims. In particular, our work seems to indicate that there is spatial concentration in the process of growth, specially in the last decades, and we intend to analyse this question in the next future.

We need also to compare the present results with the results we have obtained for administrative cities. Is there a specific process of growth for urban places that belong to administrative cities?

Finally the evolution of the Portuguese urban system over more than a century (1890-2001) seems to portray structural changes that occur in the political regime, in the economy and in the geopolitical status.

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