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Nordics

02|2013

City Size, Population Growth and Industry Composition in the Nordics

The population growth of a region is a decisive factor for the development of its real estate market. Laws according to which these developments take place can therefore provide extremely important information for investors. One such law is, for example, Zipf's Law, according to which the largest city of a country is always twice the size of the second largest one, etc. In the so-called Nordic countries, Denmark, Finland, Norway and Sweden, the population has developed almost precisely according to this pattern, as the latest Nordics Investment Compass published by PATRIZIA Immobilien AG shows.

Population growth is a fundamental determinant for the balance between demand and supply across real estate markets. The residential property market is an obvious example on how population growth directly determines prices and regulates future investments as well as construction activities. But also in the retail and offices sectors population growth influences decisions to rent (additional) space via the production decision of firms, as it is a major demand driver. Therefore, the evolution of urban systems within a region or country is essential as it defines the long term demand of space and determines the supply needed to fulfill this growth. With some cities growing faster than others, it is important to track population growth developments for a given region, since they might reflect future (investment) opportunities. Furthermore, within a certain region the determination of an urban hierarchy of cities might also be a strong indicator of their robustness against future changes, therefore influencing the long term performance of any investment. Based upon this background, we concentrate our focus on the description, evolution and characteristics of cities and their population growth in the Nordics, one of the regions in the focus of most internationally active real estate investors. The questions to be answered handle the existence of a common pattern across cities when trying to explain their size and also the extent to which cities grow or shrink across time. Finally, we pay attention to the industry composition (primary, secondary and tertiary sector) and how this behaves with regard to population and economic growth.

THE SIZE OF THE NORDIC URBAN AREAS

The size of cities – as measured by the logarithm of population – follow a common pattern called "Zipf's law", which is "one of the most conspicuous empirical facts in economics"[1], dating back to the work of George

[1] Gabaix, X. 1999: Zipf's law for cities: an explanation, The Quarterly Journal of Economics (114) 3, 739-767.

Kingsley Zipf in 1948[2] . According to this law the size of the largest city is twice as large as the second-largest city, and so on. Zipf's law states that if we rank cities by their size and place the logarithms of the size-rank in the y-axis and population on the x-axis, we get a straight line with a slope coefficient of -1. This coefficient can interpreted as a "equilibrium", by which values larger than |1| indicate a high dispersed city size distribution and less than |1| a more uniform city size distribution. Based on the Oxford Economics databank about the European territorial units (NUTS 3) we show Figure 1 the rank-size rule for 70 Nordic areas in 1998 and 2012[3]. (see Figure 1)

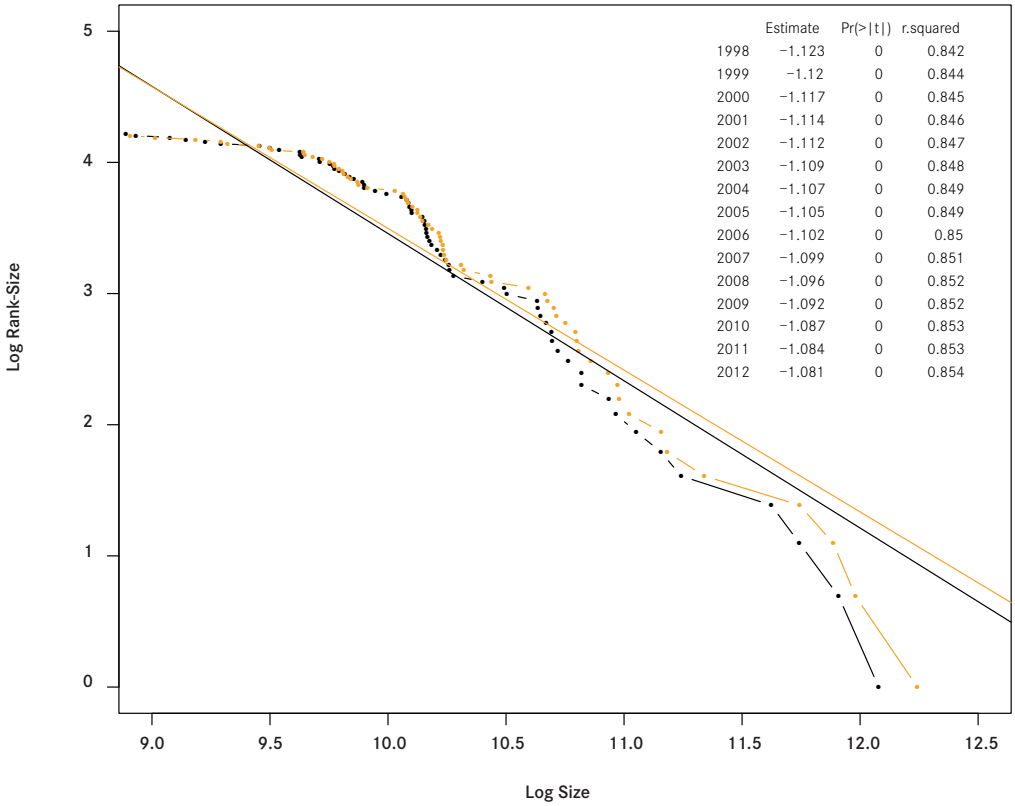
The equilibrium slope for all Nordic regions shows high dispersion in 1998 with a slope of -1.12. The high concentration of cities between the range of ca. 11.8 and 12.35 population indicates that there are more medium sized cities than predicted by the Zipf's coefficient. When seeing the eight largest cities on the right side it is remarkable to observe a disproportionally large size when comparing them with the predicted straight line. However, the growth of these cities between 1998 and 2012 is very large in comparison to medium or small cities on the left side. The table shows how the Zipf's equilibrium coefficient (column "estimate") changes over time from large city size dispersion in 1998 to a nearly perfect equilibrium of -1.08 in 2012. The first conclusion concerning the city-size-distribution in the Nordics is that the evolution of urban centers during the last 15 years can be explained by Zipf's law, which proposes that the largest city is twice as large as the second-largest city, and so on. Secondly, when estimating the slope coefficient in 2012 it is noticeable that the size distribution of Nordic centers – subject to some frictions – is approximately near to a steady state (slope = -1.08). This implies that on average the population movements until 2012 have led to a proportional distribution across the 70 urban areas, giving investors a first hint, that the regularity described by Zipf's law can add value in the process of identifying attractive investment locations.

THE GROWTH RATE OF THE NORDIC URBAN AREAS

Urban systems – e.g. several cities – can be characterized by different sizes, labor and transport costs, industry composition, etc. Additionally they also will be determined by some kind of natural conditions, such as access to sea, climatic conditions and of course geographic location. Within a certain region or country and during a certain period, e.g. 1 year, some cities (Number of Cities = N) tend to experience population growth, while others have a growth close to zero and some will suffer a resident outflow, showing a population decline. The differences across the N growth rates in this region can be a consequence of some citywide shocks, such as politic or natural shocks[4], that affect the growth of – at least a certain number– cities. If we observe the growth rates of these three groups of cities every year we can expect that the mean city growth rate lies near zero and the distribution of cities becomes interesting. When the size of cities follow a Zipf's coefficient of about -1 – as already seen before –, cities' growth rates have the same mean (of zero) and the same variation (of one) over time and space. This is called "Gibrat's Law", which proposes that the evolution of urban centers is identically and independently distributed (Gauss normal) as well as spatially and size invariant (Markov normal). For the investor it is therefore important to understand in which growth phase a city is to underpin the decision to enter or exit a given market. (see Figure 2)

RANK-SIZE RULE NORDIC COUNTRIES – BLACK 1998, YELLOW 2012

Figure 1



Source: PATRIZIA

[2] Zipf, G. 1949: Human Behavior and the Principle of Last Effort, Cambridge, MA.
[3] The NUTS nomenclature is a classification defined by the Eurostat office of the European Union. The third hierarchy level contains small regions rather than cities.
[4] Following the economic growth model of Gabaix 1999, S. 746.

Between 1998 and 2012 the Nordic countries had a total population increase of 8.4% (from 23.5 Mio. to 25.5 Mio.) distributed across the 70 territorial units. If Gibrat's law is true, we would expect that the distribution of the cities' growth rates[5] has the form of a (normal) bell curve. Figure 2 shows the yearly distribution of all Nordic growth rates and the probability for rejecting the normal distribution. With exception of 2006 and 2009, population growth in the Nordics is identically and independently distributed with a yearly mean of zero. With some cities growing (right side) and others shrinking (left side) it is observable that on average cities' evolution is concentrated between a range of ca. ± 1% pa. The main implication of Gibrat's law is the fact that cities will always grow and shrink over time and space with an average of zero. Furthermore, during this growth-process they will move from the left to the right side of the bell curve in order to go back to their original starting point. In the case of the capital cities, only three of them have been continuously growing, whereas Copenhagen (the NUTS 3 region and not the metropolitan area) shows a much more modest development.

SIZE, ECONOMY AND INDUSTRY COMPOSITION OF THE NORDIC URBAN AREAS

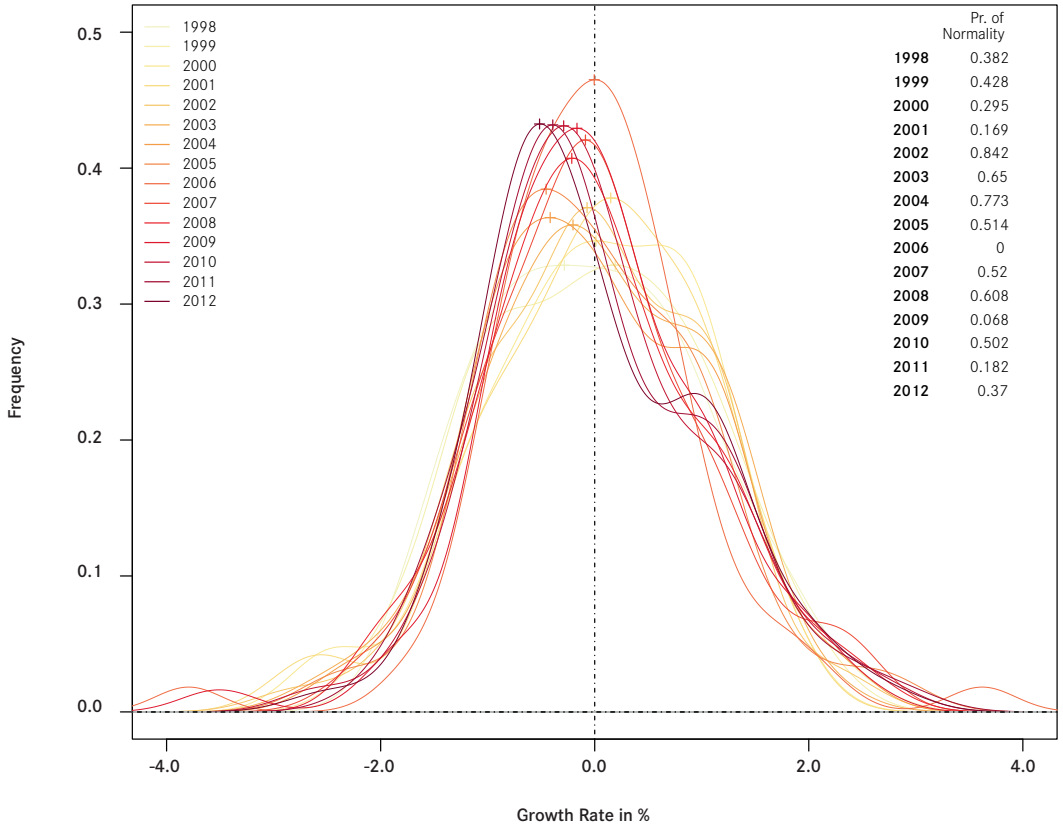
Economic activity and population are directly related. Industries can be categorized with respect to their distance to the city center, with the move from primary to tertiary bringing more and more industries to the city centers: The primary industry includes agriculture, mining, fishing, etc., the secondary manufacturing goods, light industry, etc. and lastly the tertiary industry all services for selling products. Given the characteristics and natural conditions of cities, a certain "industry mix" will lead to different output levels and therefore boost or hold migration. (see Figure 3)

Figure 3 shows four panels according to four different population sizes of cities: low, medium-low, medium-high and high[6]. Each panel shows furthermore the log GPD of the city on the y-axis and the contribution of the tertiary sector to the whole GDP of the city on the x-axis. The latter is an indication of the extent to which the services sector contributes to the development of a city, as it refers to the services specialization level of the city. Small Nordic cities (left panel) have a negative response to an increment in the ratio of specialization with respect to the service industry. This means that small urban centers have on average higher production levels whenever they concentrate on primary or secondary industry activities. Compared with that, large urban centers increase their GPD when the ratio of service specialization increases.

Population and its development over time have an enormous impact on the determinants of real estate markets. When concentrating on residential real estate markets it is clear that prices, construction activities and demand are directly predetermined by population movements, but also the commercial sectors, e.g. office and retail, are influenced indirectly via the "production" and location decisions of companies. Based on 70 Nordic urban centers, we confirm that the size of cities follow a "Zipf's-equilibrium", in which approximately the largest city is twice as large as the second-largest city, and so on. Furthermore, we show that a certain number of cities will grow and shrink with a common mean of zero. It is therefore important for investment decisions to identify the population growth cycle, in which a specific urban center is in, in order to accurately predict future developments and support possible entry and exit decisions. Lastly, we illustrate how industry composition in combination with size can determine the production output of a group of cities.

POPULATION GROWTH CONVERGENCE DISTRIBUTION NORDIC CITIES 1998-2012

Figure 2



Source: PATRIZIA

[5] Exhibit 2 shows the Kernel density function for the normalized population growth rates, see: Giesen, K. and Suedekum, J. 2009: Zipf's Law for Cities in the Regions and the Country, IZA DP No. 3928. Probability of normality under the null of normality.

[6] Classification of the four groups according to the quartile distribution of log Size.

Therefore, investment decisions should definitely look beyond the raw GDP figures and growth rates and identify well "industry-diversified" cities in order to infer their robustness against possible future shocks, resulting in a much more shock resistant portfolio. For the investor this will ultimately lead to a investment portfolio generating less volatile and more predictable returns.

Basic Literature
Fujita, M., Krugman, P. and Venables, A. 2001:
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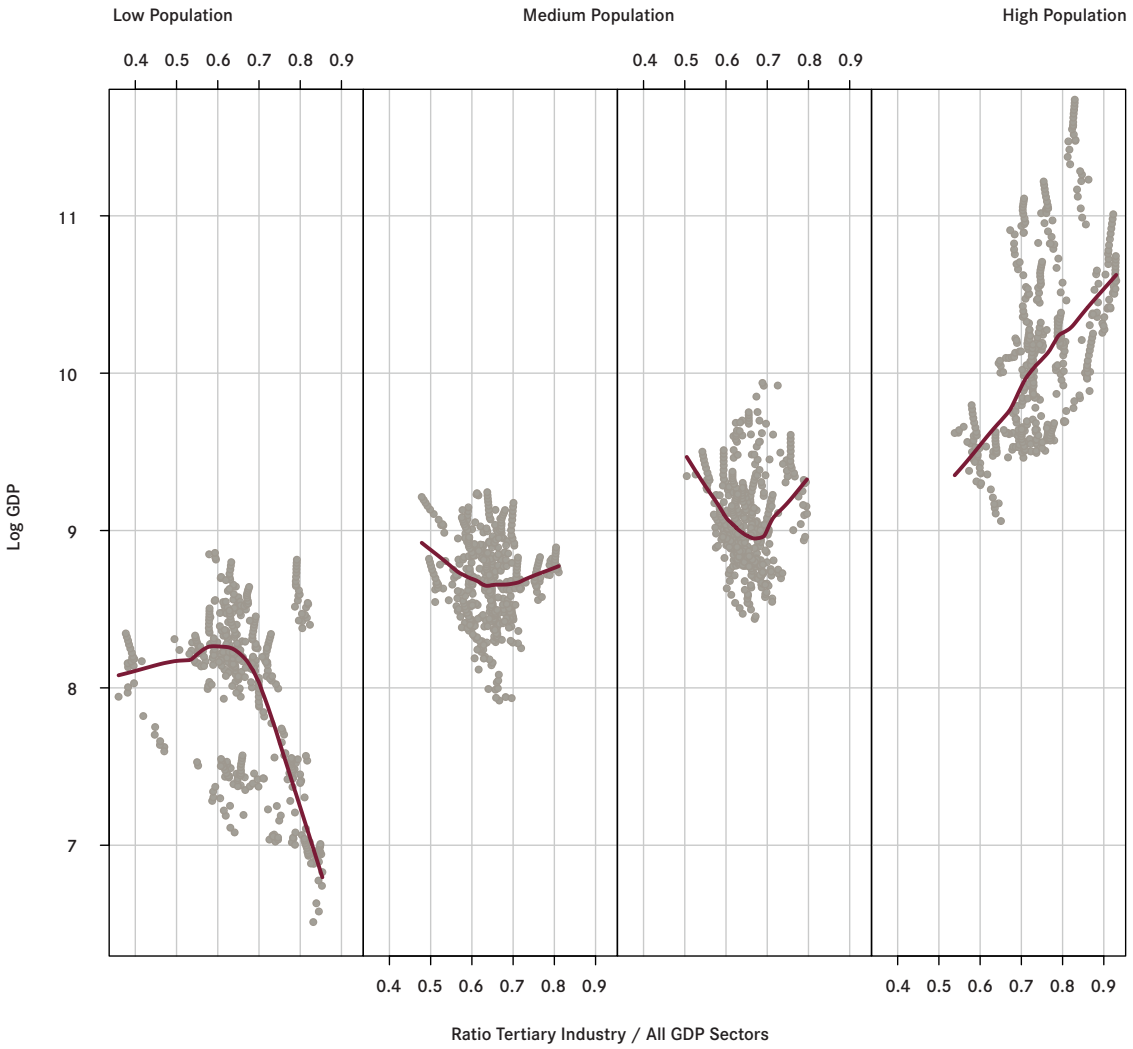
SIZE, ECONOMY AND INDUSTRY COMPOSITION NORDIC CITIES 1998-2012

Figure 3



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