EXTENDED ABSTRACT

Title: Urban growth in the long term: Belgium, 1880–1970

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Abstract:

The urban growth literature has a long tradition. Why some cities grow while others decline is still an open question, although several theoretical explanations have been proposed. These theories can be summarised into three main drivers of growth (Davis and Weinstein, 2002): the existence of increasing returns to scale, the importance of locational fundamentals and random growth.

Each of these drivers of urban growth involves different theoretical mechanisms. The existence of increasing returns suggests the presence of endogenous mechanisms in city growth that can lead to multiple equilibria (Davis and Weinstein, 2002; Bosker et al., 2007), depending on the initial conditions. Locational fundamental theory highlights the role played by geographical characteristics: the presence of a natural harbour, a specific climate or access to the sea, among many other physical characteristics, can determine cities' populations (for instance, Ellison and Glaeser (1999) stated that natural advantages can explain at least half of the observed geographic concentration in the US). Finally, random urban growth postulates that population growth in cities is a random variable.

Studies testing the influence of increasing returns to scale and locational fundamentals have usually relied on parametric (cross-sectional or panel data) growth regressions, applying an instrumental variable approach in most cases. The lastest advances in this

literature have come from the use of plant-level data (Holmes and Stevens, 2002; Barrios et al., 2006) and case studies using an identification strategy of instruments that reveals the influence of some historical events on cities' growth path (e.g., Bleakley and Lin, 2012; Garcia-López et al., 2015). However, most of these studies have adopted a short-term perspective, and even panel data analyses have considered a few decades at most.

The approach taken in the random growth literature is different. First, from the theoretical point of view, random growth can only hold as a long-run average, while the influence of other factors, such as locational fundamentals and increasing returns, may change (or even disappear) over time. With random urban growth, the growth process of cities tends to be multiplicative and independent of their initial size, a proposition that has become known in urban economics as Gibrat's law. Several theoretical models (Gabaix, 1999; Duranton, 2007; Córdoba, 2008) have been developed to explain the fulfilment of Gibrat's law in the context of external urban local effects and productive shocks, associating it directly with an equilibrium situation. Therefore, city-level variables can explain temporal variation in growth rates across cities, but random growth theory provides an explanation for the long-term growth.

Second, on the empirical side, although seminal contributions (e.g., Eaton and Eckstein, 1997) have also used parametric growth regressions to test Gibrat's law, since the 2000s, several studies have proposed alternative methodologies to parametric growth models. González-Val et al. (2014) reviewed this literature, concluding that most studies today use nonparametric estimates of urban growth or unit root tests. Nonparametric estimates of growth have become popular in this literature, providing estimates of growth that vary with the initial population over the entire distribution of city sizes. However, these kernel regressions estimate the unconditional relationship between growth and size; city and time fixed effects and any other control variables are omitted. Thus, authors have carried out nonparametric analyses for cross-sectional data (Eeckhout, 2004) as well as for a pool of growth rates from different time periods (Ioannides and Overman, 2003; González-Val, 2010).

The use of the panel data methodology and unit root tests in the analysis of urban growth, first suggested by Clark and Stabler (1991), can provide a more precise test of Gibrat's law. This idea was emphasized by Gabaix and Ioannides (2004, p. 2358), who expected "that the next generation of city evolution empirics could draw from the sophisticated econometric literature on unit roots". However, some empirical limitations have reduced the spread of these techniques. While several papers have applied panel data unit root tests to analyse urban growth (e.g., Black and Henderson, 2003; Resende, 2004; Henderson and Wang, 2007; González-Val and Lanaspa, 2016), the list of studies looking for unit roots in individual time series of cities' populations is quite short. Why? Unit root tests need large sample sizes (at least 40 observations) to have reasonable power (Clark and Stabler, 1991). However, long time series of year-by-year city populations are usually not available, and studies on the temporal evolution of city sizes have considered decennial census data in most cases. Therefore, the lack of annual data for a sample of cities over a long time period on a consistent basis has limited the use of unit root testing in empirical work.

To our knowledge, only three studies have considered annual populations of cities to test Gibrat's law using unit root tests: Clark and Stabler (1991), Sharma (2003) and Bosker et al. (2008). Clark and Stabler (1991) used data on the seven largest cities in Canada from 1975 to 1984 (10 temporal observations by city). Sharma (2003) considered a sample of 100 Indian cities for the period 1901–1991 (90 years), and Bosker et al. (2008) used a dataset of 62 West German cities from 1925 to 1999 (except for five missing years during the Second World War). Although the efforts of these authors to obtain annual city population data and exploit the properties of the unit root tests fully are worthy, these studies still show an important limitation: they focused on the largest cities. Nevertheless, some studies have confirmed the different patterns of growth of small cities (Partridge et al., 2008; Devadoss and Luckstead, 2015) and, thus, the behaviour of the largest cities cannot be extrapolated to the whole distribution of cities.

In this paper, we take advantage of Ronsse and Standaert's (2017) new data set of Belgian cities. They constructed a data set of 2,680 Belgian municipalities for the period 1880–1970. To compose this data set, they combined the population census data, which are collected every ten years, with the yearly data on births, deaths and migration from the city population registers (the *mouvement* data). To reconcile the two data series, Ronse and Standaert (2017) used a state-space approach, which models the *mouvement* data as a noisy signal of the true change in the population growth. As the *mouvement* is collected by each city individually, the noisiness of its signal is allowed to differ for each city. Furthermore, the model incorporates information on the changes to the administrative borders of the cities, allowing the population data to change more drastically in those years.

This unique data set allows us to carry out a robust long-term analysis of urban growth because the time dimension is long (90 temporal observations by city) and, at the same time, it contains information for all cities, covering the whole city size distribution. Therefore, as far as we know, this is the most comprehensive test of Gibrat's law using unit root tests ever conducted.

The Belgian case is interesting because of some specific historical characteristics of the country. As a relatively young country on the European continent, the Belgian state came into existence following a liberal revolution in 1830. Set up as a parliamentary democracy, headed by a monarch with limited powers, the Belgian state quickly became a haven for political liberalism in 19th-century Europe. At the same time, however, the young nation wanted to ensure that it had the most up-to-date information about the population living within its borders. Following the newest scientific methods, the state apparatus created a highly developed statistical department, which, whilst not unique, was well ahead of its time. The continuous efforts of this department have led to a richness of statistical data spanning the entire history of the country.

Our basic hypothesis for the long-term growth of Belgian cities is random growth. As mentioned above, random growth can hold as a long-run average, while the effect of other factors may change or dissipate over time. We follow the methodology proposed by Clark and Stabler (1991), who suggested that testing for random growth is equivalent to testing for the presence of a unit root. Using both time series and panel data unit root tests, we obtain strong validation of the random growth hypothesis, that is, Gibrat's law, which implies that urban growth is independent of the initial city size. This evidence supports a multiplicative growth process of cities in Belgium, and this kind of growth is consistent with many theoretical urban economics models (Gabaix, 1999; Eeckhout, 2004; Duranton, 2007; Córdoba, 2008). Nevertheless, even if city shares follow a unit root, this growth process is compatible with a degree of convergence in the evolution of city growth rates; that is, with some kind of mean-reverting component (Gabaix and Ioannides, 2004).

The long-term pattern of random growth does not imply that the city size distribution has remained static over the years. On the contrary, a unit root implies that all shocks have had permanent effects on the city share, and, in particular, when allowing for structural breaks, we find that exogenous historical shocks had a permanent effect on city shares: the timing of the structural breaks coincides with some major historical events, such as the World Wars and the economic crisis of 1929–1933.

The alternative explanations for random growth considered in the literature are, basically, locational fundamental theories and increasing returns to scale (Davis and Weinstein, 2002). Although our results are not specifically a test of random growth versus locational fundamentals or random growth versus increasing returns to scale, the strong support obtained for random growth clearly cast some doubts on the relevance of the two alternative theories in the Belgian case.

Keywords: city size, urban growth, long term, random growth, unit root tests, Belgium

JEL codes: C12, C22, N93, O18, R11, R12