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Industry churning and the evolution of cities: Evidence for Germany ☆

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Abstract

In this paper we show that the recent model by Gilles Duranton [Duranton, G., 2007. Urban evolutions: The fast, the slow, and the still. American Economic Review 97, 197–221] performs remarkably well in replicating the city size distribution of West Germany, much better than the simple rank-size rule known as Zipf's law. The main mechanism of this theoretical framework is the "churning" of industries across cities. Little is known in urban economics about the determinants of local industry turnover so far. We present an empirical analysis of the excess churning index for West German cities, which describes the strength of intra-city industry reallocations over time. We find that urban growth and industry turnover are not notably correlated: Some, but not all fast-growing cities have notably changed. Secondly, human capital is positively related to growth and turnover, but only among successful cities. Industrial change within unsuccessful cities is driven by the disappearance of old-fashioned and declining sectors such as agriculture or mining. On a more general level our results suggest that the recent model by Duranton is a powerful description of the urban growth process. Still there are some aspects that are not captured by that model, which are at the core of other theories of urban growth.

JEL classification: O18; R11; R12

Keywords: Industry turnover; Urban growth; Structural change; Churning; City size distribution; Zipf's law

1. Introduction

Due to various forms of localized increasing returns, most economic activity is concentrated in cities and cities are the main engines of economic growth. Yet, there is no evidence that all economic activity within a country will eventually end up in one or a few large metropolitan areas. The data rather suggests that the distribution of city sizes remains remarkably stable over time, and is at least close to the famous rank-size rule known as "Zipf's law." Successful theories of urban growth all come to grips with this basic fact.[1] A limitation of most existing approaches, however, is that they have little to say about how cities change their face—i.e., their industry composition—during the growth process, and how urban growth is related to (changes in) local economic structures. Cities are to a large extent characterized by their economic structure, and urban growth depends on the performance of the local industries of which the city is composed (Simon, 2004; Combes et al., 2004). Case studies like those by Glaeser (2005) in fact suggest that the success of cities can be well understood by their ability to adapt and to change ("re-invent") their industry structure.

These issues have recently been taken up in an article by Gilles Duranton (2007). Three facts about local growth and industrial change are the starting point of his contribution. First,

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[1] Zipf's law implies that the country's largest city has twice the size of the second largest city, three times the size of the third largest, etc. Theories of urban growth that generate such or a similar equilibrium city size distribution include, e.g. Eaton and Eckstein (1997), Black and Henderson (1999), Gabaix (1999), Eeckhout (2004), Rossi-Hansberg and Wright (2007) or Córdoba (2008). A survey of this literature is provided by Gabaix and Ioannides (2004).

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Duranton shows that there is considerable "churning" of industries across cities. Single industries grow or decline relatively quickly in cities and cause rapid changes of the local industry compositions over time. Second, entire cities move relatively slowly up or down the country's urban hierarchy. The speed at which some cities take over others in the distribution of total city sizes is low compared to the frequent changes in the location hierarchy for single industries. Finally, these processes occur within a distribution of city sizes that is stable over time. Duranton develops a theoretical framework—based on a spatial version of the quality-ladder growth model by Grossman and Helpman (1991)—that accommodates all three facts. Industries move across cities following endogenous cross-sector innovations. Cities experience gains and losses of industries, which partly offset each other, so that entire cities "churn" less than single industries, and urban growth goes along with industry turnover. Finally, the model generates a concave distribution of city sizes in the steady-state, where individual cities are mobile within the distribution due to the endogenous industrial relocations. Using US and French data, Duranton finds that this steady-state city size distribution of his model matches the actual distributions in these two countries quite closely, actually better than Zipf's law.

The purpose of our paper is twofold. In a first step we use data on West German local industries over the time period 1977–2002 to study the robustness of Duranton's recent results. We find support for considerable industry churning in Germany, even after controlling for structural change. When calibrating the model using our data, we obtain the result that the simulated city size distribution resembles the actual West German distribution very closely. The model is a much more accurate description than Zipf's law, and it even achieves a better fit for West Germany than for France or for the US.

The second and main aim of this paper is to provide new insights about the determinants of churning and industry turnover in cities, which are the central mechanisms of the Duranton-model. We make use of an "excess churning index," which summarizes the strength of intra-city industry reallocations corrected for overall changes in total local employment.[2] The larger the value of this index is, the more change in the local industry composition has occurred over time. We provide an empirical analysis on the determinants of industry turnover at the local level, as measured by the excess churning index, and we address the following questions: What are the characteristics of cities that have exhibited the most rapid change, and how are industry turnover and growth related on the local level?

This exercise is important for at least two reasons. First, little is known about the determinants of industry turnover in urban economics so far. Substantive empirical contributions have analyzed the performance of metropolitan areas or single industries, and addressed the question which local economic structure is most conducive to growth (see e.g., Glaeser et al., 1992, 1995; Henderson et al., 1995; Combes et al., 2004; Simon, 2004). But the equally important issues, which type of cities exhibit the most rapid overall change in their industrial structure over time, and how the intensity of industry turnover is related to long-run city growth, have not been analyzed so far.

Second and even more important, we hope to inspire further theoretical work with our empirical results. Even though the model by Duranton matches several stylized facts very closely, it neglects other aspects of urban growth that have been emphasized elsewhere. In particular, it leaves aside human capital as an engine of growth, which is the central driving force, e.g., in Black and Henderson (1999) and in Eaton and Eckstein (1997). Below we will analyze, among other things, if skilled cities with a large employment share of university-trained workers exhibit more change over time than unskilled cities, as skilled Schumpeterian entrepreneurs may speed up the process of creative destruction of old-fashioned local industry structures. Furthermore, industries in the Duranton-model are inherently symmetrical. Thus, there is no special role assigned to local specialization patterns, even though Simon (2004) and Combes et al. (2004) convincingly argue that the initial structure is likely to influence a city's subsequent development. We will analyze if cities are more likely to change if they are initially specialized in certain industries, and if yes, in what type of industries.

We find that growth and churning are not notably correlated at the local level. Among the fastest growing cities there are some that have witnessed considerable churning of their industries. Following Glaeser (2005), we see those as examples of "reinvention cities" which are successful because of a rapid change ("reinvention") of their industrial structure. Yet, some other fast-growing cities have seen very little churning of their industries. Performing several estimations using different subsamples of cities, we find that human capital is the key engine of growth and industrial change in successful cities, but not in declining ones. In the latter group industry turnover is strongly driven by the disappearance of old-fashioned and declining industries such as agriculture or mining. Taken together, our empirical findings suggest that the model by Duranton (2007) is a powerful description of the urban growth process. Still there are some aspects that are not captured by that model, which are at the core of other theories of urban growth. In the light of our results, a combination of these different approaches seems to be a very promising agenda for further research.

The rest of this paper is organized as follows. In Section 2 we briefly review the main features of the Duranton model and simulate it using German data. Section 3 presents the empirical analysis on the determinants of local churning and growth. Section 4 concludes.

2. Brief review and replication of Duranton's approach

2.1. The model

Duranton (2007) embeds the quality-ladder growth model by Grossman and Helpman (1991) into a spatial framework. The economy consists of a large (discrete) number of industries (n), each producing a specific commodity of a certain quality at any point in time. Consumer preferences are symmetrical over the

[2] Churning indices have been used before by labor economists (see Davis and Haltiwanger, 1998), but detached from any spatial or urban dimension of employment.