Mansfield's Missing Link: The Impact of Knowledge Spillovers on Firm Growth

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ABSTRACT. The purpose of this paper is to provide a link between two of the seminal contributions of Edwin Mansfield. The first focuses on the determinants of firm growth and the second is concerned with university-based knowledge spillovers. By linking both firm-specific characteristics as well as access to knowledge spillovers from universities, the empirical evidence found in this paper suggests that knowledge spillovers as well as firm-specific characteristics influence firm growth.

Key words: university spillovers, firm growth

JEL Classification: M13, L20, R30

1. Introduction

Among his many compelling contributions, Edwin Mansfield ranked among the pioneers in economics focusing the determinants of the evolutionary process by which firms are created and then grow through an evolutionary process. According to Mansfield (1962, p. 1023), "Because there have been so few econometric studies of the birth, growth and death of firms, we lack even crude answers to the following basic questions regarding the dynamic processes governing an industry's structure. What are the quantitative effects of various factors on the growth of firms represented by Gibrat's law of proportionate effect? What have been the effects of successful innovations on a firm's growth rate?" It required no fewer than two sweeping articles in the Journal of Economic Literature (Caves, 1998; Sutton, 1997) at the end of the last century to review the literature on empirical tests of firm growth and Gibrat's Law spawned by Mansfield's pioneering research.

Towards the end of his career, Mansfield (1995), also pioneered a very different research trajectory, which focused on external sources of R&D, and in particular universities, as inputs into firm innovation.[1] Mansfield's research was instrumental in triggering a more recent wave of studies identifying the role that knowledge spillovers play, and in particular, knowledge spillovers from universities in generating innovative activity (Audretsch and Stephan, 1996; Jaffe, 1989).

Despite the enormous literatures triggered by Mansfield's seminal contributions, these two research trajectories remain separate. As the Caves (1998) and Sutton (1997) review articles confirm, the plethora of econometric studies focusing on firm growth in general, and Gibrat's law in particular, never consider the impact of external research on the growth of firms. Instead, this entire literature consists almost exclusively of trying to link firm-specific characteristics, principally size and age, but also in some cases R&D and other types of innovative activity, to firm growth. Similarly, the literature on knowledge spillovers has concentrated mainly on performance measures such as innovation and R&D, but has yet to consider the impact on firm growth (Audretsch *et al.*, 2005).

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The purpose of this paper is to provide the missing link between the literatures on firm growth and on university-based knowledge spillovers. In particular, we examine whether access to university-based knowledge spillovers has an impact on firm growth. In the second section we present the model relating not just firm characteristics, but also knowledge external to the firm, to firm growth. In the third section issues involving measurement are discussed. The results from estimating the growth rates of high-technology German firms are presented in Section 4. Finally, in the last section a summary and conclusion are provided. In particular, the results of this paper suggest that two of the seminal contributions made by Mansfield need to be linked together. Just as Mansfield discovered, not only is firm growth positively influenced by investments in knowledge, but accessing external knowledge generated by universities also contributes to firm growth.

2. Linking firm growth to university spillovers

Since the purpose of this paper is to link the two seminal contributions by Mansfield together, we introduce a model relating firm growth to characteristics specific to the enterprise as well as external knowledge from universities. The starting point is the most prevalent model for identifying the determinants of growth at the level of the firm, which has been based to test Gibrat's Law (Sutton, 1997).

Formalizing the relationship between size and growth, Gibrat's law assumes that the present size of firm i in period t may be decomposed into the product of a "proportional effect" and the initial firm size as:

$$\text{Size}_{i,t} = (1 + \varepsilon_t)\,\text{Size}_{i,t-1}, \qquad (1)$$

where $(1+\varepsilon_t)$ denotes the proportional effect for firm i in period t. Here the random shock ε_t is assumed to be identically and independently distributed. Taking the natural log and assuming that for small ε, $\ln(1+\varepsilon) \approx \varepsilon_t$,

$$\ln(\text{Size}_{i,t}) = \ln(\text{Size}_{i,0}) + \sum_{k=1}^{t} \varepsilon_{ik} \qquad (2)$$

It can be observed that as $t \to \infty$ a distribution emerges which is approximately log normal with properties that $\ln(\text{Size}_{i,t}) \sim N(t\mu\varepsilon,\ t\sigma^2_\varepsilon)$. Firm growth can then be measured as the difference between the natural log of the number of employees as:

$$\text{Growth}_{it} = \ln(\text{S}_{i,t}) - \ln(\text{S}_{i,t-1}) \qquad (3)$$

where the difference in size for firm i between the current period t and the initial period $(t-1)$ equals Growth_{it}.

This equation can be empirically estimated by:

$$\text{Growth}_{i,t} = \text{B}_1 \ln(\text{Size}_{i,t-1}) + \text{B}_2 \ln(\text{Size}_{i,t-1})^2 + \text{B}_3\text{Age}_{i,t-1} + \varepsilon_i \qquad (4)$$

where growth for firm i in period t is a function of initial firm size, size^2, age, and ε_i a stochastic error term.

Sutton (1997) and Caves (1998) survey and report on the large number of empirical studies estimating Equation (4). The evidence is systematic and compelling that both size and age are negatively related to firm growth.

Note that Equation (4) only considers characteristics specific to the enterprise. We extend this approach by including knowledge spillovers from universities,

$$\text{Growth}_{i,t} = \text{B}_1 \ln(\text{Size}_{i,t-1}) + \text{B}_2 \ln(\text{Size}_{i,t-1})^2 + \text{B}_3\text{Age}_{i,t-1}\text{B}_4\text{Knowledge}_{r,t-1} \times \text{B}_5\text{D}_{ind} + \varepsilon_i \qquad (5)$$

where D_{ind} is a vector of industry dummies controlling, for example, for the knowledge intensity of production in a specific sector. Knowledge_r, $t-1$ represents knowledge spillovers from universities.

3. Data set and descriptive statistics

To test the hypothesis that firm growth depends not only on firm size and age but also university spillovers, we use a unique dataset of 281 IPO firms in Germany. The dataset is collected combining individual data from IPO prospectuses, along with publicly available information from