The urban density premium across establishments[☆]

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A B S T R A C T

We use longitudinal establishment data to estimate the urban density premium for U.S. establishments, controlling for observed establishment characteristics and dynamic establishment behavior. Consistent with previous studies, we find an elasticity of average establishment earnings with respect to metropolitan area population of 0.03, controlling for the endogeneity of location and establishment and metropolitan area characteristics. More importantly, we find that the estimated density premium is realized almost entirely at entry and is constant over an establishment's life. We find little evidence that the endogenous entry or exit of establishments can account for any of the estimated density premium. We interpret our results as implying that the returns to agglomeration diffuse within a city through a reallocation channel rather than through an increase in the productivity of existing firms.

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1. Introduction

For years, urban economists have studied why observationally similar workers earn more in more densely populated locations. Studies have consistently found an elasticity of earnings with respect to urban density of between 0.03 and 0.10. This elasticity is generally robust to controlling for a variety of factors, including the migration of skilled workers across cities, the returns to worker experience at a particular location, and labor search and matching frictions.[1] Urban economists have also examined the returns to urban density for firms.[2] Only recent studies, however, examine the relationship between urban density and establishment-level outcomes at the micro level.[3] Consequently, there is little evidence on the role establishment characteristics, behavior, or composition play in generating the empirical estimate of an urban density premium for employers, much less how that premium evolves as establishments age.

In this paper, we estimate the density premium over the life cycle of U.S. establishments, controlling for a variety of observable establishment characteristics as well as dynamic behavior that may be endogenously related to urban density. We take advantage microdata from the U.S. Census Bureau's Longitudinal Business Database (LBD) to relate the average earnings per worker of an establishment to the population of its metropolitan area. Our main contribution is our ability to estimate the evolution of the urban density premium over time within establishments, controlling for a variety of establishment-level characteristics and behavior, including entry and exit. These estimates bring new evidence to bear on the micro-level underpinnings of the relationship between establishment earnings and urban agglomeration.

Consistent with previous research, we find a positive density premium; the elasticity of average establishment earnings with respect to metropolitan area population is about 0.03 after controlling for observable characteristics and the endogeneity of establishment location. More importantly, we find that the density premium *does not vary over an establishment's life cycle*. Specifically, we find that the density premium is constant with respect to

[1] See Glaeser (1999), Glaeser and Mare (2001), Freedman (2008), Bacolod et al. (2009), Glaeser and Resseger (2010), Baum-Snow and Pavan (2012, 2013), and De la Roca and Puga (2015), among others.

[2] See Glaeser et al. (1992), Henderson et al. (1995), Ciccone and Hall (1996), and Henderson (1997).

[3] Examples include Henderson (2003), Moretti (2004b), and Combes et al. (2012).

establishment age, implying that establishments reap most of the returns to agglomeration at entry. The invariance of the density premium to establishment age is robust to a variety of controls, holds after controlling for potential endogeneity issues, and is consistent across several sub-samples of the data.

A return to agglomeration for establishments that is constant over their life cycle is important for two reasons. First, the localized accumulation and diffusion of knowledge (whether it occurs through knowledge spillovers, differential rates of "learning," or some other mechanism) are thought to be a key driver of the urban agglomeration economies that generate a density premium. The notion that the accumulation and diffusion of knowledge affects the innovation, growth, and productivity of firms is pervasive throughout the urban literature (see Audretsch and Feldman, 2004; Rosenthal and Strange, 2004; Henderson, 2007 for reviews). In theoretical treatments of such returns in an urban context (e.g., Black and Henderson, 1999; Glaeser et al. 2015), spillovers generate increasing returns for the firm and *accumulate over time*. Theory dictates that firms in denser areas should have faster productivity growth, all else equal, because of these accumulated returns. To the extent that average establishment earnings reflect establishment productivity, this suggests that we should instead find a density premium that rises with the age of an establishment, since accumulated spillovers should make the establishment more productive over time, relative to establishments from the same cohort in a smaller city.

Second, several studies have found evidence of accumulated returns to agglomeration for workers (Glaeser and Maré, 2001; Baum-Snow and Pavan, 2012; De la Roca and Puga, 2015). That is, workers exhibit a greater premium in their wages the longer they reside in a denser location. These studies attribute the resulting steeper wage-city tenure profile to faster human capital accumulation in denser areas (i.e., faster "learning"), an interpretation that is consistent with the implications of the endogenous growth models. This, too, suggests that we should find a density premium that increases with the age of an establishment, since establishments are collections of workers.

Our results do not reject the presence of spillovers, nor do they contradict the evidence on the wage-tenure profiles of workers. They do, however, suggest that the primary channel by which knowledge diffuses and accumulates within a city is a reallocation channel that relies heavily on entrepreneurs and the establishment entry margin, not a spillover that directly affects the productivity of existing firms. Indeed, our findings imply that the representative firm framework used in most models of agglomeration, including those that postulate the existence of a "knowledge production function" (e.g., Griliches, 1979; Jaffe, 1989; Qian, 2013), cannot fully capture the dynamics of localized knowledge transmission. Our evidence is instead consistent with a story where knowledge moves across firms within a city through the entry margin. In this sense, we find a strong role for entrepreneurs as the mechanism for innovation and knowledge transmission within a metropolitan area.

Further analysis shows that the selection and sorting of establishments into or out of a metropolitan area likely do not explain our results. Establishment entry, exit, and relocation patterns reaffirm that any returns to agglomeration are realized primarily at entry, and suggest that they appear when an establishment is born and not necessarily when it moves to a new city. We find a selection effect in establishment exit patterns: low-earnings establishments are more likely to exit, and the probability of exit decreases monotonically with average establishment earnings. We also find that the probability of exit is somewhat higher for low-earnings establishments in high-density metropolitan areas. However, this does not translate into a stronger selection process. Within entering establishment cohorts, we find faster earnings growth, condi-

tional on survival, and a more truncated earnings distribution in less dense metropolitan areas.

Similarly, an examination of the characteristics of establishments at entry and establishments that relocate across metropolitan areas suggests a limited role for sorting. We find that the highest-earnings establishments are most likely to relocate, but that all movers tend to move to *lower-density* metropolitan areas, on average, when compared to a baseline of completely random relocation. Further analysis of relocations suggests that the density premium is realized primarily at birth and not at entry into a new city. First-difference estimates of the density premium for movers alone compared to all continuing establishments reinforce this result, suggesting that sorting on the relocation margin has little effect on our estimated density premium.

Finally, we examine the relative earnings differences of new single-unit firms and new establishments of multi-unit firms on the premise that the latter should be more likely to endogenously choose the location of their new establishments, and therefore have a higher estimated density premium. Our evidence does not suggest a role for sorting—entrants of multi-unit firms have relatively *lower* earnings in high-density metropolitan areas.

The next section elaborates on the theoretical mechanisms linking urban density and average establishment wage levels and changes over time. Section 3 describes the data and discusses our approach to measuring key variables. In Section 4, we first present evidence on the urban density premium across establishments and then describe how that density premium evolves over the establishment life cycle. Section 5 examines to what extent establishment exit, entry, and relocation account for our results. Section 6 concludes.

2. Knowledge spillovers and the firm

Productivity benefits derived from the localized accumulation and diffusion of knowledge are thought to be a key driver of an urban density premium. One example of this line of thinking is the seminal models of endogenous growth through knowledge spillovers (Romer, 1986; Lucas, 1988), where spillovers are the outcome of localized human capital accumulation. Another example involves models of spillovers and innovation, where the free flow of localized information between agents within a city fosters greater innovation (e.g., Jaffe, 1989). There is also empirical work that finds that worker wage-tenure profiles are steeper in denser cities (Glaeser and Maré, 2001; Baum-Snow and Pavan, 2012; De la Roca and Puga, 2015). This finding is attributed to a faster rate of human capital accumulation, consistent with the endogenous growth models. These models, and the related empirical work, share a common feature that the returns to agglomeration are captured through a higher rate of knowledge accumulation (through knowledge spillovers, faster "learning," or some similar process). With the exception of the evidence on wage-tenure profiles, however, this literature characterizes the productivity impact of this knowledge accumulation as a direct effect at the firm level. Therefore, we examine whether establishments experience accumulated returns similar to workers, as the endogenous growth theories imply.

Another mechanism by which knowledge accumulation and transmission could occur is through the entry margin. For example, innovation may diffuse across firms through spinoffs, as in Chatterjee and Rossi-Hansberg (2012). In their model, workers are tasked with generating innovations for a firm. Innovations vary in their quality, and those of sufficiently high quality induce their innovator to quit her existing firm and use the innovation to form a startup. Recent work on the Detroit automobile industry and Silicon Valley's high-tech industry by Klepper (2010), and on the fashion industry by Wenting (2008), show that a similar evolution of