



Outsourcing and computers: Impact on urban skill level and rent

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ABSTRACT

Cities in the U.S. with a higher initial share of college graduates have had a greater subsequent increase in this share over the past two decades. Concurrently, housing prices have grown faster in these skilled cities. This paper argues that the diffusion of computers and outsourcing may partly explain these two phenomena. In the presented model, skilled workers are more productive in skilled cities and need unskilled support services. The cities' unskilled workers can perform the support services, but when it is cheaper, such services can be undertaken by computers or outsourced to less-skilled cities. New technologies facilitating computerization and outsourcing can increase the skill share and housing prices in skilled cities relative to less-skilled cities, under reasonable assumptions. The basic economics is that the new technologies diminish the demand for unskilled workers in skilled cities and permit skilled workers to earn higher wages, which in turn increases the supply of skilled workers in skilled cities and drives up housing prices. Empirically, this paper documents five stylized facts that the theory can rationalize. Particularly important is rising skill premium in skilled cities relative to less-skilled cities, which supports a production theory involving shifts in labor demand.

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1. Introduction

There are two pronounced trends for U.S. cities. First, cities like Boston and New York with a higher initial *skill share*, which is defined as the share of workers having a bachelor's degree, have had a greater subsequent increase in this share (Glaeser, 1994; Berry and Glaeser, 2005). Second, these *skilled cities*, which have a higher initial skill share, have also undergone faster growth in housing prices (Glaeser, 2000). While various explanations, such as a consumer theory featuring an increased supply of skilled workers in the skilled cities, can connect these two trends, this paper proposes a production theory involving technological changes and shifts in labor demand.

The proposed theory is motivated by two salient technological changes: a decrease in communication costs (Doms, 2005) facilitating outsourcing¹ and a decrease in computing prices (Gordon, 1990; Jorgenson, 2001) triggering computerization, i.e., office automation. The theory suggests that both technological changes can increase the skill share and housing prices in skilled cities relative to less-skilled cities under reasonable assumptions. The theory is also consistent

with three additional stylized facts. First, unskilled business support jobs are increasingly concentrated in less-skilled cities, and this is not yet mentioned in literature. Second, computers are more intensively used in skilled cities. These two facts make outsourcing and computerization potential explanations for why skilled and less-skilled cities are increasingly dissimilar. Third, skill premium increases faster in skilled cities, which is also important as this supports a theory involving labor demand shifts.

The model comprises two cities and has two essential ingredients. First, the cities differ in their productivity. Second, skilled and unskilled workers are complements, while technology and unskilled workers are substitutes: To produce output, skilled workers need various kinds of support services, which can be performed by unskilled workers or computers or acquired through outsourcing. The outcome of the above assumptions is the following. Without the options of outsourcing and computerization, to put skilled workers in the more productive city requires the presence of unskilled workers in the same city. But housing is expensive in this city, and these unskilled workers demand higher wages to compensate for expensive housing. Thus, firms in the more productive city have less incentive to use local unskilled workers to perform the support services when outsourcing or computerization is possible, compared to other firms in the less productive city. This is why the more productive city is also the skilled city.

New technologies that lower prices of computers and communications can increase the skill share of the skilled city relative to the less-skilled city, as the new technologies decrease both the demand and

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¹ In this paper, outsourcing is defined as the location separation of production tasks that used to be performed in the same city. Outsourcing occurs whenever a plant hands over some of its tasks to a plant in another city, even when the two plants are owned by the same firm. This is vertical disintegration at the plant level.

supply of unskilled workers relative to skilled workers in the skilled city. The relative demand decreases due to technology–skill complementarity. The relative supply decreases because a greater number of skilled workers choose living in the skilled city as the technological changes increase skilled workers' marginal productivity more in the skilled city through lowering prices of the support services. Also critical is skilled city's higher unskilled wages that are necessary for the new technologies to trigger more computerization in the skilled city relative to the less-skilled city and to lead to outsourcing to the less-skilled city.

The reason why the new technologies can also increase housing prices in the skilled city relative to the less-skilled city is more subtle. In fact, one might expect that the new technologies would do the opposite, as they expect skilled city's unskilled wages would decrease and unskilled workers would move out. However, the model shows that the relative housing prices can go up under certain conditions. Particularly, the degree of labor mobility plays an important role.

The impact of the new technologies will be bigger if it is assumed that the city's skill share can increase the city's total factor productivity. Empirical evidence underlying this assumption is strong. [Rauch \(1993\)](#) shows that each additional year of city's average level of education can raise productivity by 2.8%, and [Moretti \(2004\)](#) shows that a one-percentage-point increase in the skill share can increase productivity by about 6%.

Why is it interesting to document and explain the mentioned urban patterns? The literature has found that skilled cities perform far better economically than less-skilled cities, primarily because skilled cities experience faster increase in productivity, which can partly translate into faster housing price growth ([Glaeser and Saiz, 2004](#)).² Since the patterns were pronounced in the past few decades, it is nature to wonder the role that outsourcing and computerization could play in making these changes. Although the literature of outsourcing in international trade and computerization in labor economics are both matured, integrating the notions of outsourcing and computerization into the literature on skilled cities has received relatively less attention. Therefore, it is rewarding to formulate a theory that relates computerization and domestic outsourcing to skilled cities and document supporting facts.

This paper extends the literature on domestic-outsourcing by venturing into analysis of local labor and housing markets. Currently, the literature focuses on locations and structures of firms. [Duranton and Puga \(2005\)](#) show that decreased communication costs have enabled firms to separate different tasks at different locations. This changes the clustering of firms from the previous pattern of sectoral specialization to the current pattern of functional specialization–management function is concentrated in commercial cities, and production function is concentrated in manufacturing cities. [Rossi-Hansberg et al. \(2009\)](#) are also concerned with geographic separation of firms' production tasks. In their model, lower communication costs result in concentration of management in the city center and concentration of production in the suburbs. Their work adds to the literature by rationalizing functional specialization within a city and providing empirical evidences. As for my paper, the model also predicts functional specialization–skilled jobs are more concentrated in one city and support jobs in another. Nevertheless, this paper makes a contribution by pushing the literature on domestic outsourcing further through examining how domestic outsourcing may interact with local labor markets and housing markets.

This paper also adds to the literature on computerization. There is a large volume of research that examines relationships between computers and skills in the national economy, but it would be interesting to extend the literature into an urban or regional context and examine whether relationships between computers and skills differ across

localities. The research of [Beaudry et al. \(2006\)](#) is in this direction and is related to mine, as they examine how new PC technologies increase local demand for skilled workers and how local supply of skilled workers affects the adoption of new PC technologies. My research is different, because I assume mobile labor and am able to study how the new technologies induce migration and affect urban skill level and rent.

This paper does not attempt to argue that outsourcing and computerization are the only or a most important hypothesis that explains faster increase in the skill share and housing prices of skilled cities. Alternative explanations may also account for the changes. For instance, [Berry and Glaeser \(2005\)](#) suggest that skill-biased innovations increase skilled firms' demand for skilled workers. Since these firms are concentrated in skilled cities, these cities may become increasingly and disproportionately skilled. Nevertheless, given the dramatic decrease in prices of computers and communications, it is interesting to examine whether outsourcing and computerization can have an impact.

The remainder of this paper is organized as follows. [Section 2](#) illustrates the stylized facts. [Section 3](#) presents a simple model that uses essential elements to highlight effects of outsourcing on the skill share and housing prices. However, this simple model cannot incorporate computerization and cannot predict the faster increase in the skill premium in skilled cities. Therefore, [Section 4](#) introduces a richer model. [Section 5](#) discusses the equilibrium, and [Section 6](#) analyzes effects of outsourcing and computerization. [Section 7](#) presents a simulation exercise that illustrates how the effects depend upon parameter values. [Section 8](#) concludes.

2. Stylized facts

This section presents five stylized facts on cities for the period of 1980 to 2000, using the cities' skill share in 1980 as the initial condition. The data sources are Decennial Censuses. Workers are private employed wage and salary earners, and cities are metropolitan areas with at least a quarter million people in 1990. These metropolitan areas generally follow the 1990 MSA/CMSA/NECMA definition.

2.1. Fact 1: Housing prices increase faster in skilled cities

[Fig. 1](#) plots the 1980 skill share for each city against the logarithmic change of real housing prices over the next two decades.³ The correlation is 40%. Housing prices grew faster in skilled cities compared to less-skilled cities. On average, a one-percentage-point increase in the initial skill share increased the growth of real housing prices by 1.7%.

This fact is not new. [Glaeser and Saiz \(2004\)](#) show that a one percentage point increase in the initial skill share can increase housing prices by 0.9 to 2.3% within a decade, controlling for housing prices, climate, industrial composition, economic condition, and year- and location-specific fixed effects. In [Shapiro \(2006\)](#), a significant positive impact of initial skill share on the growth of housing rental prices is also found. The impact remains robust, when the presence of land-grant colleges is used as an instrument for the cities' initial skill share in the estimation that addresses possible reverse causality and omitted variable bias.⁴

³ The average annual rent is calculated for each metropolitan area. The calculation includes renter-occupied housing units with cash rent and owner-occupied housing units that are non-farm, non-commercial, single family houses on less than 10 acres of land. House values are converted to annual rent using the 7.85% discount rate common in the literature, e.g., [Gyourko and Tracy \(1991\)](#).

⁴ The presence of land-grant colleges is an appealing identifying variation for the skill share (concentration of college graduates) in IV estimation examining the causal effect of the skill share on urban growth. [Moretti \(2004\)](#) and [Shapiro \(2006\)](#) provide evidences and argue that the presence of land-grant colleges satisfies the exclusion restriction of IV and does not correlate with unobservables such as geographic location, urban demography and local market conditions, as the presence is predetermined by Federal Acts in the 19th century. They also show that the presence of land-grant schools increases the rate of college attainment, but not vice versa. Thus, the IV estimation is not subject to reverse causality and omitted variables and produces consistent estimates.

² The cities that my paper is concerned with are metropolitan areas, which resemble local labor markets. [Glaeser and Saiz \(2004\)](#) find that, at the metropolitan level, the initial skill share has a positive impact on wage and housing price growth, but, at the city and municipal levels, the relationship between the initial skill share and housing price change is driven by low-skilled cities.

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