

A Model Study on the Effect of Housing Supply Elasticity on Labor Market

Yihui Zhong

Department of Economic Management, China University of Labor Relations, Beijing, China

Email: zyh3651@qq.com

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Abstract

We develop a model of wage and rent determination that features spillovers from export-sector shocks to the market for locally produced (nontraded) goods and services, mediated by housing supply elasticities. Our model can explain stylized facts such as “gentrification” in major cities driven by shocks to industries in which those cities specialize.

Keywords

Housing Supply Elasticity, Labor Markets, Productivity, Model Study

1. Introduction

Much recent public policy debate has focused on “gentrification”, the possibility of wealthier individuals moving into urban areas, causing rents to increase to levels no longer affordable for lower-income residents. Previously poor neighborhoods in cities such as San Francisco, Sydney and London have seen rent growth far outstrip their national average (Zillow, Inc.) in the past decade. We use some simple ideas from trade theory to explain how this phenomenon could occur. The Balassa-Samuelson effect is the proposition that, when factors of production are immobile, prices of nontradable goods will be higher in more productive countries. Intuitively, a haircut costs more in the US than in China because US wages represent the opportunity cost of higher US manufacturing productivity, even if the haircut is actually the same. This stylized cross-country result can be seen across regions within a country as well. As anyone who has ever tried to buy groceries in Shanghai can report, wages and prices appear to be higher in major cities than rural areas, even in seemingly homogeneous non-tradable sectors such as food services or retail where agglomeration or regional specialization does not appear to be a plausible explanation.

A seemingly natural category of explanations for this pattern would be imper-

fect mobility within a country. Indeed, influential literature in labor and urban economics has argued that although labor mobility in the US is an important mechanism of adjustment to shocks [1], it has declined over the past decades (Molly, Smith and Wozniak, 2013). There is significant variation in local restrictions on housing construction (e.g. the strength of permitting and zoning requirements) and geographic constraints, and as a result, housing supply elasticity varies dramatically across regions [2]. We consider a model in which workers demand a subsistence level of housing inelastically, which is supported by the observation that, as Ganong and Shoag [3] document, housing-related expenses are a disproportionately large share of spending for low-income households.

Motivated by these stylized facts, we focus our analysis on the differential effects of traded-sector shocks on the non-traded sector in the presence of housing frictions. We set up a model of urban wage and employment determination with three sectors (housing, tradables, and non-tradables) where housing supply can be either restricted or unrestricted. We predict that in cities where the supply elasticity of housing is low, non-traded-sector wages will increase in response to a positive productivity shock, but employment will not increase by much (i.e. the low housing supply response deters in-migration), along the lines of the Balassa-Samuelson effect. By contrast, if the housing channel is an important conduit for spillovers between the sectors, then in high-supply-elasticity cities, productivity shocks should generate primarily immigration rather than increased wages in the non-traded sector.

Our model relates to three existing strands of the literature. Firstly, our setup can be thought of as a hybrid between a Heckscher-Ohlin model (driven by the proportions of immobile factors) and a Ricardian model (driven by exogenous sectoral comparative advantage), in the sense that wages are determined both by traded-sector productivity and by a housing friction that causes imperfect labor mobility. It should be noted that the structure of production bears further examination. For example, the pattern of sectoral specialization in particular regions, e.g. software engineering in San Francisco, could be driven by an increasing-returns model such as that of Helpman/Krugman [4]. We suspect that our model predictions would be even stronger in such a setting, but we have not yet worked out this case.

Secondly, our model is related to the recent literature on urban sorting. Our model is similar in spirit to the predictions of Ganong and Shoag [3] on migration patterns in response to productivity shocks in the presence of housing supply frictions. We believe that their model captures an important feature of regional sorting (the housing supply constraint), but we add the tradable/non-tradable distinction for realism—productivity shocks seem unlikely to affect all industries in a city identically—and to consider relative-price effects in local sectors. Inasmuch as wages differ between sectors, questions of sectoral allocation also have inequality implications.

Other recent work on regional sorting includes Diamond [5]. Diamond develops a general-equilibrium model of wage and rent determination that also al-

lows a role for varying amenities by city. Much of the empirical work in this area [6] has drawn on the idea that, based on spatial arbitrage, amenities can be identified as a residual from the relationship between wages and costs of living (*i.e.* if real wages are lower, amenities must compensate). It is important to note that our model provides an alternative explanation of the same phenomenon: while utility is equal across regions in our setting, the consumption pattern is not. Households substitute toward traded goods in regions where nontradables are expensive, potentially causing an observationally similar pattern (real wages as adjusted by higher prices would appear to fall). While a full decomposition of regional amenity vs. productivity effects is beyond the scope of our paper, we hope to pursue further extensions in this direction.

Finally, our paper is related to a recent literature on identifying the local spillover effects of productivity shocks. In fact, the source of productivity variation that we use is taken from a well-known recent example, Autor, Dorn and Hansen’s [7] analysis of the local effects of China trade exposure on US manufacturing.

2. Theoretical Model

2.1. Individual UMP

Suppose there are two sectors in any given city. The traded sector produces quantity $x_{T,p}$ hires n_T amount of T-type workers at ω_T , and faces a nationally competitive price of 1; while the non-traded sector produces quantity $x_{N,p}$ hires n_N amount of N-type workers at ω_N and sells at a locally competitive price p . At the same time, for $i = T, N$, the sector-representative worker i has reservation utility $\bar{u}_T > \bar{u}_N$, faces rent r and chooses to consume h_i amount of housing, which is larger than the subsistence level, \bar{h} .

$$\begin{aligned} \log U_i &= \alpha \log x_{T,i} + \beta \log x_{N,i} + (1 - \alpha - \beta) \log (h_i - \bar{h}) \\ \text{s.t. } \omega_i &= x_{T,i} + p x_{N,i} + r h_i \\ x_{T,i} &= \alpha (\omega_i - r \bar{h}) \\ x_{N,i} &= \frac{\beta (\omega_i - r \bar{h})}{p} \\ h_i &= \frac{(1 - \alpha - \beta) (\omega_i - r \bar{h})}{r} + \bar{h} \end{aligned}$$

Assume $N = n_T + n_N$, then the aggregate demand is

$$\begin{aligned} X_T &= \alpha [(n_T \omega_T + n_N \omega_N) - N r \bar{h}] \\ X_N &= \frac{\beta}{p} [(n_T \omega_T + n_N \omega_N) - N r \bar{h}] \\ h &= \frac{(1 - \alpha - \beta)}{r} [(n_T \omega_T + n_N \omega_N) - N r \bar{h}] + N \bar{h} \end{aligned}$$

Spatial equilibrium implies that i will supply labor in a city *if and only if* $\log \bar{u}_i \leq \log U_i$. Perfect competition in production further implies that wages are

set so that $\log \bar{u}_i = \log U_i$.

$$\begin{aligned} \log \bar{u}_i &= \log U_i \\ \Rightarrow \omega_i &= \frac{\bar{u}_i}{\alpha^\alpha \left(\frac{\beta}{p}\right)^\beta \left(\frac{1-\alpha-\beta}{r}\right)^\beta} + r\bar{h} \\ \frac{\partial \omega_i}{\partial r} &= \frac{\beta \bar{u}_i}{\alpha^\alpha (\beta)^\beta (1-\alpha-\beta)^\beta} p^\beta r^{\beta-1} + \bar{h} \\ \frac{\partial \omega_i}{\partial r} &> 0 \end{aligned}$$

2.2. Production and Aggregate Labor Demand

Assume each sector is endowed with 1 unit of capital, and the production processes follow

$$X_{T,i} = A_i n_T^{\theta_T}$$

$$X_{N,i} = A_i n_N^{\theta_N}$$

We assume $\theta_T < 1$ and $\theta_N < 1$ (decreasing returns to scale in both sectors). Perfect competition implies

$$N_T = \left(\frac{A}{\omega_T}\right)^{\frac{1}{1-\theta_T}}$$

$$N_N = \left(\frac{p}{\omega_N}\right)^{\frac{1}{1-\theta_N}}$$

$$N_N \omega_N + N_T \omega_T = A n_T^{\theta_T} + p n_N^{\theta_N}$$

Market clearing implies that aggregate labor demand is

$$\begin{aligned} \frac{\omega_T^{\frac{1}{1-\theta_T}}}{\omega_N^{\frac{1}{1-\theta_N}}} &= \frac{\beta A^{\frac{1}{1-\theta_T}}}{\alpha p^{\frac{2-\theta_N}{1-\theta_N}}} \\ \frac{n_T}{n_N} &= \frac{\alpha P}{\beta} \end{aligned}$$

2.3. Housing Market

Now consider two cities, one where housing construction is restricted and one where it is not. As Ganong and Shoag [3] do, we parametrize the supply restriction through increasing marginal cost of construction (for example, perhaps it becomes increasingly difficult to obtain permits over time; or, land runs out and denser construction is necessary). For simplicity, we abstract away from maintenance cost: we assume price-to-rent ratio is constant and normalize it to 1.

In the city without the housing supply restriction

$$MC_{UR}(h) = 1 = r_{UR}$$

In the city with the housing supply restriction

$$MC_R(h) = h = r_R$$

Then market clearing implies

$$0 = r_R^2 + (\alpha + \beta)N\bar{h}_{r_R} - (1 - \alpha - \beta)(An_T^{\theta_T} + pn_N^{\theta_N})$$

$$\frac{\partial r_R}{\partial r_T} = \frac{(1 - \alpha - \beta)\left(\theta_T An_T^{\theta_T - 1} + \theta_N \frac{\beta}{\alpha} n_N^{\theta_N - 1}\right) - \left[(\alpha + \beta)\bar{h} + \frac{\beta}{\alpha p}\right] r_R}{2 + (\alpha + \beta)N\bar{h}}$$

$$\frac{\partial r_R}{\partial r_N} = \frac{(1 - \alpha - \beta)\left(\theta_T \frac{\alpha p}{\beta} An_T^{\theta_T - 1} + \theta_N P n_N^{\theta_N - 1}\right) - \left[(\alpha + \beta)\bar{h} + \frac{\alpha p}{\beta}\right] r_R}{2 + (\alpha + \beta)N\bar{h}}$$

Taking the larger root of the r_R quadratic equation, then we know that when n_i goes up, the parabola moves down and right, making r_R larger. Therefore, we can see that

$$\frac{\partial r_R}{\partial n_i} > 0.$$

2.4. Aggregate Supply

Combining the previous results, we can see that aggregate labor supply in a city without housing restriction perfectly intersects with the wage axis at

$$\omega_i = \frac{\bar{u}_i}{\alpha^\alpha \left(\frac{\beta}{p}\right)^\beta (1 - \alpha - \beta)^\beta} + \bar{h}, \text{ for } i \in \{H, L\}$$

In a city with housing restriction, aggregate labor supply is complicated to express analytically, but it is straightforward to see that it is upward-sloping, because as the labor force increases, housing prices rise, which raises required wage. In other words:

$$\frac{\partial \omega_i}{\partial n_N} = \frac{\partial \omega_i}{\partial r_R} \frac{\partial r_R}{\partial n_i} > 0$$

Combining individual utility, labor supply and housing supply, we can see that aggregate labor supply is perfectly elastic in the unrestricted case. When housing supply is restricted, however, aggregate labor supply curve is upward sloping. Because workers must be indifferent between living in this region and others, for every additional migrant, the wage must increase to compensate for the cost of constructing a new unit of housing. Therefore, productivity, prices and wage in the non-traded sector will not equalize across regions with different levels of housing restrictions.

Now, consider the effects of a shock to A_i (productivity in the traded sector of a given region) in a city where housing supply is perfectly elastic: Because the price of housing does not change, the effects are relatively straightforward. Labor demand shifts out in the traded sector as a result of the shock and more traded sector workers enter the city. Workers will supply unit labor inelastically at a

fixed wage in each sector (the one that equalizes utility for their skill/sector type across regions, not necessarily the same wage in the two sectors). Finally, note that labor demand shifts out proportionately in the non-traded sector as well, due to additional demand from the new skilled workers.

The same shock in a city with housing restrictions and low elasticity of housing supply can be represented as follows: Since aggregate labor supply is upward-sloping, the wage in traded sector increases. Additional migrants to the city will also drive up the price of housing. In the non-traded sector, labor demand will shift out proportionally as in the no restriction case. However, labor supply here shifts upward. Note that this is not a movement along the labor supply curve, because the housing price increase is due to migration in the traded sector rather than migration within the non-traded sector. The non-traded sector wage will therefore unambiguously rise, while employment in the same sector may increase or decrease depending on the relative elasticities of labor supply and demand.

The model thus generates a prediction similar to the Balassa-Samuelson effect in trade: in areas where tradable productivity is higher, non-tradables will be more expensive. However, unlike the Balassa-Samuelson result, which is driven by intersectoral mobility (and thus the requirement of a single wage), here we allow the two factor inputs and their prices to differ, but a similar effect emerges because they compete for a single scarce and nonsubstitutable consumption good (housing). In this sense, we can consider housing as an indirect input to production.

We predict, in the style of Blanchard and Katz [1] or Saks [8], that productivity shocks in tradable sectors spill over into both wages and migration in the nontradable sector, but that the incidence in this spillover will vary based on housing market frictions. In cities where housing supply elasticity is high, demand shocks to nontradables (caused by productivity shocks) should cause non-tradables workers to move in. In cities where housing supply elasticity is low, productivity shocks should primarily result in wage increases for nontradables workers.

3. Discussion and Conclusion

3.1. Limitations & Future Directions of Research

Although our model predictions fit the general pattern observed among housing supply restrictions, rent growth, cross-sector spillover and trade, it remains untested. Empirical work identifying the direction and causation of cross-sector spillover is needed. Finding appropriate quasi-experimental evidence poses a big challenge; however, as truly, exogenous productivity shocks in places with housing supply restrictions are hard. At the same time, our model only predicts the direction of spillover as opposed to its magnitude. For example, the stylized mechanism described in our theoretical model seems to be a less appropriate description of negative industry shocks than positive ones. It seems likely that “downward elasticities” differ from “upward”: for example, it may be that rental

housing stock is only rarely removed from the market, even when demand falls, so that housing supply elasticity (especially if it reflects construction constraints) plays a very little role in mediating the effects of negative shocks.

Another limitation of our model is that it does not provide predictions about the timing of the effects we seek to measure. Ultimately, this is an empirical question that requires an understanding of the specific productivity shocks, and time series models to fit or even identify the dynamic patterns observed in the data.

Furthermore, our model is oversimplified in a variety of regards. We assume away inter-sectoral mobility by treating labor inputs to the two sectors as differentiated, which is reasonable only if the two sectors hire workers of different types. For example, it seems plausible to surmise that traded sectors are relatively skill-intensive in the US—when we break down the NAICS codes at the 2-digit level, we find the more traded sectors to include management, financial, and professional services (agriculture may be an exception). However, there are clearly skill-intensive nontraded sectors (local doctors, lawyers, and accountants) as well as non-skill-intensive ones (food service and retail). An alternative motivation for this modeling approach could be the presence of sector-specific human capital making it difficult to switch industries.

Lastly, we assume a representative consumer: no heterogeneity in preferences, and no moving costs, which means our model ignores any sorting based on preferences over housing quality—which might modify our results about rents and willingness to pay. This also means that our model is not well-suited to explaining changes in amenities, since models with amenities generally involve sorting of consumers with heterogeneous preferences over amenities. Because our empirical model is in first differences, so long as amenities do not change sharply in any single period, this should not dramatically affect our results. However, one direction we hope to pursue in future work is to consider research designs that could draw a sharper distinction between amenities and productivity shocks in explaining long-run trends in particular cities, such as the “re-gentrification” and rise in rents of certain inner-city areas that had previously been undesirable.

3.2. Conclusion

Our paper lays the ground work in understanding the link between housing market and trade, particularly the differential effects of traded-sector shocks on the non-traded sector in the presence of housing frictions. By explicitly modeling urban wage and employment determination, the housing market, and separately accounting for tradables and non-tradables, our model is able to produce widely observed rent and employment trends in gentrified neighborhoods.

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