Place Based Policies, Heterogeneity, and Agglomeration

By PATRICK KLINE*

Like politics, the process of economic development is intrinsically local. Communities vie ferociously for jobs, offering tax credits, infrastructure improvements, and in some cases cash to attract investment to particular regions, cities, or even neighborhoods. In the U.S., federal and state governments target resources towards particular areas in the hopes of stimulating investment, alleviating poverty, and in some cases even recovering from natural disasters. These place based policies, though hardly new, have just begun to attract serious attention from economists.[1] As evidence on the effects of these programs begins to trickle in, it is useful to develop a theoretical framework within which to evaluate them.

To many observers, spatially targeted policies are a sign of waste – an unfortunate cost of the political process. Why after all should governments pay firms to move to less productive areas and incentivize workers to live in neighborhoods they don't like? Moreover, serious questions exist about the winners and losers of such policies in a general equilibrium environment. I study here the welfare implications of place based policies using some stylized models of spatial equilibrium incorporating taste heterogeneity and agglomeration economies.

I. Baseline Model

Consider a continuum of workers of measure one, faced with the decision of locating in one of two communities $j \in \{1, 2\}$ where they will work and inelastically demand a single unit of housing.[2] Agents have quasi-linear preferences over local amenities and consumption. The value to worker i of locating in community j is:

$$\begin{aligned} u_{ij} &= w_j + A_j - r_j + \varepsilon_{ij} \\ &= v_j + \varepsilon_{ij} \end{aligned}$$

where w_j is the local wage level, A_j the dollar value of local amenities, r_j the local rental rate of housing, and ε_{ij} a mean zero error term representing heterogeneity in tastes for local amenities. The term v_j gives the mean indirect utility of residence in community j. Workers will locate in whichever community yields the highest utility. Hence workers locating in community one will have $\varepsilon_{i2} - \varepsilon_{i1} < v_1 - v_2$. Denote the distribution function of $\xi_i \equiv \varepsilon_{i2} - \varepsilon_{i1}$ by $F(.)$. Then we may write:

$$L_1 = F\left[w_1 - w_2 + A_1 - A_2 - (r_1 - r_2)\right]$$

where $L_1 = P\left(\xi_i < v_1 - v_2\right)$ is the measure of workers in community 1.

Firms have Cobb-Douglas production functions of the form $Y_j = B_j L_j^{\alpha} K_j^{1-\alpha}$ where B_j represents local productivity levels, L_j the measure of workers in each community, and K_j the stock of capital in location j. We assume that firms make zero profits, that output is sold on an international market at fixed price one, and that capital is supplied to each area at constant marginal cost c_j. Factor demands are chosen to equate marginal products to input prices. With some algebra, one arrives at the following local wage function:

$$\ln w_j = \frac{1}{\alpha} \ln B_j - \left(\frac{1-\alpha}{\alpha}\right) \ln c_j$$

Wages are increasing in the local productivity level and decreasing in the cost of capital. Note that the constant returns to scale assumption along with the infinite supply elasticity of capital prevents the derived demand for labor from sloping down. Thus wages are essentially an exogenous function of local productivity and the cost of capital.

Finally, we add a housing supply equation:

$$r_j = g_j\left(L_j\right)$$

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[1] See Bartik (1991) and Glaeser and Gottleib (2008) for reviews.

[2] I have assumed for simplicity that workers must live and work in the same area, hence our two communities are perhaps best thought of as metropolitan areas or regions. See Busso, Gregory, and Kline (2009) for a neighborhood level model involving commuting, labor force participation, and sectoral choice.

where the function $g_j(.)$, which we presume to be weakly increasing in its argument, represents the marginal cost to landlords of producing an additional unit of housing.

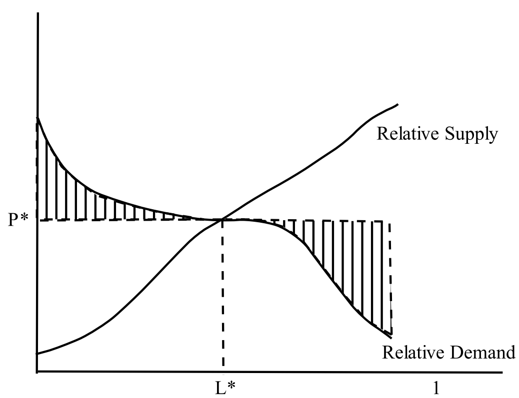
A. Equilibrium

With the necessary ingredients in order, we may now boil the model's equilibrium down to a single equation clearing the housing market:

$$g_1(L_1) - g_2(1-L_1) = B_1^{\frac{1}{\alpha}} c_1^{-\frac{1-\alpha}{\alpha}} - B_2^{\frac{1}{\alpha}} c_2^{-\frac{1-\alpha}{\alpha}} + A_1 - A_2 - F^{-1}(L_1) \quad (1)$$

where $F^{-1}(.)$ is the inverse CDF of ξ_i. The left hand side of (1) gives the relative supply cost of producing an additional unit of housing in community 1 which is weakly increasing in the fraction of residents in the community. On the right hand side we have the relative demand for residence in community 1 versus community 2 which, because of taste heterogeneity, is decreasing in L_1. This equilibrium admits a simple graphical representation depicted in Figure 1.

Figure 1



The relative demand curve represents an ordering of workers in terms of their relative tastes for community 1. Workers to the left of L* will locate in community 1, while those to the right will locate in community 2. The economic rents associated with each choice are depicted in the hatched regions of the Figure. Workers to the left of L* recieve a rent $v_1 - v_2 - \xi_i$, while those to the right recieve a rent $v_2 - v_1 + \xi_i$. It is only the worker at L* with relative valuation of the two communities equal to the cost of living difference P* between them who is indifferent as in the classic model of Jennifer Roback (1982).

It is straightfoward to consider comparative statics in this environment. The population in community 1 can be increased by decreasing the cost of building housing,[3] investing in local consumption amenities, or raising wages via capital subsidies or productivity enhancing investments in local infrastructure. The first approach effects a rightward shift in the relative supply curve, while the latter two yield a shift in the relative demand curve.

B. Welfare

To assess the aggregate welfare implications of place based policies we must construct a social welfare function. Define the aggregate welfare of workers as:

$$\begin{aligned} V &\equiv E\left[max\{v_1 + \varepsilon_{i1}, v_2 + \varepsilon_{i2}\}\right] \\ &= v_2 + E\left[max\{0, v_1 - v_2 - \xi_i\}\right] \\ &= v_2 + L_1 E\left[v_1 - v_2 - \xi_i | \xi_i < v_1 - v_2\right] \end{aligned}$$

The interpretation of this formula is quite simple. Total worker welfare equals the utility (v_2) that would result from forcing all workers to reside in community 2 plus the economic rents that accrue from allowing those workers who are so inclined to move to community 1. Consider then the effects of a productivity enhancing investment (increase in B) in community 1. Population will increase as will total economic rents. Meanwhile, community 2 will continue to pay the same wages and provide the same amenities as before, but as population falls the cost of living will decline leading v_2 to rise. Hence, total worker welfare must increase in both communities.

Social welfare depends not only upon the utility of workers but of landlords as well. A proper social wel-

[3] Technically what is required for an increase in population is for the housing supply function $g_1(.)$ to shift to a new function $\tilde{g}_1(.)$ such that $\tilde{g}_1(L^*) < g_1(L^*)$ and $\tilde{g}_1(l) \leq g_1(l)$ $\forall l < L^*$.

fare function W may be written as follows:

$$W = V + r_1 L_1 + r_2 (1 - L_1) - \int_0^{L_1} g_1(l)\, dl - \int_0^{1-L_1} g_2(l)\, dl$$

Now let us revisit the effects of an investment in community 1. Workers in both communities benefit, either from higher wages (in community 1) or lower rents (in community 2). Landlords in community 1 benefit from the increase in housing prices necessary to accomodate the population increase, but landlords in community 2 suffer a loss due to the decrease in housing values. Hence even seemingly benign changes usually induce losses on some parties.

How are we to determine whether such an intervention raises total welfare? First note that agent optimization implies $\frac{\partial V}{\partial v_j} = L_j$ because workers who switch communities in response to a change in the value of a location are to first order indifferent about the prospects of doing so.[4] With a bit of work it is possible to show that this implies:

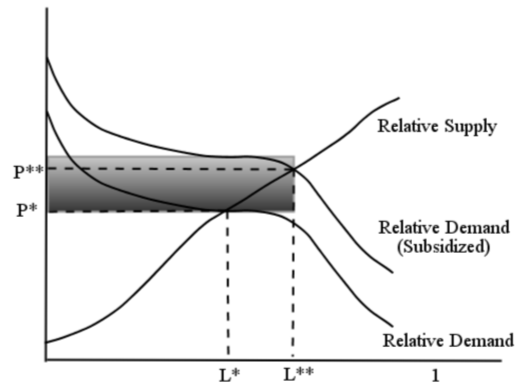
$$\frac{dW}{dB_1} = L_1 \frac{dw_1}{dB_1}$$

In words, the total welfare effect of the productivity increase amounts to the total increase in earnings it would generate. This should be intuitive as utility is assumed linear in income and total consumption equals total output. Hence the losses to landlords in community 2, large as they might be, cannot outweigh the gains to other parties.

Of course, governments often devise local interventions besides infrastructure investments. A common one is to subsidize labor or capital in a community. Consider the effects of introducing an ad valorum subsidy τ on wages in community 1.[5] The total dollar cost of the subsidy to the government is given by the shaded rectangle in Figure 2.

The subsidy shifts the relative demand curve up by $\frac{\tau}{1-\tau} B_1^{\frac{1}{\alpha}} c_1^{-\frac{1-\alpha}{\alpha}}$ and yields additional economic rents for workers in community 1 given by the portion of the shaded region below the subsidized relative demand curve and above P**. The portion of the rectangle below P** and above the relative supply curve goes to landlords in community 1 and residents of community 2 who experience reductions in the cost of living.

Figure 2



The deadweight loss of the subsidy is given by the sum of the small portion of the rectangle above the subsidized relative demand curve and the portion below the relative supply curve. These two deadweight loss triangles correspond to the behavioral responses of workers and landlords respectively. Intuitively, inframarginal residents (those to the left of L*) value the wage subsidies dollar for dollar. But marginal residents value them less as they would not have chosen community 1 were it not for the subsidy. Likewise, marginal landlords value changes in the rental rate of housing less than dollar for dollar because some of the housing would not be built were it not for the subsidies.

To first order, the size of the excess burden is proportional to the number of jobs created.[6] It is somewhat ironic then that job creation is often an explicit goal of such programs. The most successful programs are, according to this model, the most wasteful.

Place based subsidies are most efficient when relative supply or relative demand are inelastic so that few jobs are created but local prices change. For this reason, heterogeneity plays a critical role in determining the efficiency and incidence of these programs. If tastes are sufficiently idiosyncratic that the relative demand curve is vertical, local subsidies yield no deadweight loss and the benefits are captured entirely by

[4] See Busso, Gregory, and Kline (2009) for a derivation.

[5] A similar analysis would result if we considered a subsidy to capital.

[6] The marginal excess burden of the subsidy can be shown to be $w_1 L_1 \eta$ where $\eta = \frac{d \ln L_1}{d \ln \tau}$.

workers in the form of higher earnings. If tastes are homogeneous the relative supply curve becomes horizontal and the incidence of any place based subsidies falls on landlords.

The deadweights costs drawn in Figure 2 are small, but could in principle become quite substantial if a large enough subsidy were provided. Measuring such costs is a priority for empirical work. Equally important is the task of measuring program incidence since policy interest typically focuses on making transfers to workers rather then landlords.

II. Agglomeration

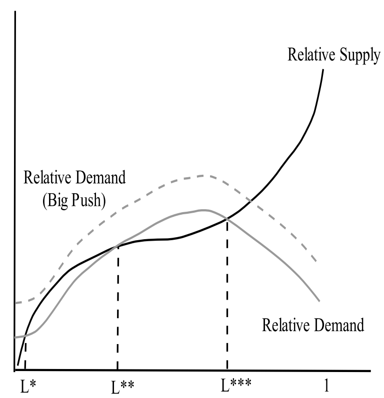
At least since Alfred Marshall (1890) economists have argued that the spatial concentration of economic activity is in part due to forces of agglomeration.[7] Consider then the case where productivity is itself a function of the number of workers in a location so that $B_j = h_j\left(L_j\right)$ where $h_j\,(.)$ is a non-decreasing function. In this case our equilibrium condition (1) becomes:

$$\begin{aligned} g_1\left(L_1\right) - g_2\left(1-L_1\right) &= h_1\left(L_1\right)^{\frac{1}{\alpha}} c_1^{-\frac{1-\alpha}{\alpha}} \\ &\quad -h_2\left(1-L_1\right)^{\frac{1}{\alpha}} c_2^{-\frac{1-\alpha}{\alpha}} \\ &\quad +A_1 - A_2 \\ &\quad -F^{-1}\left(L_1\right) \end{aligned}$$

Now a tension arises between the forces of agglomeration and the costs of housing a larger population. On the one hand increasing the size of community 1 raises the cost of living. On the other hand, it raises the wage. The relative strength of these two effects can have dramatic effects on the equilibrium behavior of the system. Suppose, for example, that agglomeration effects are strong enough for the relative demand curve to slope up over some range. Then multiple equilibria can emerge. Figure 3 illustrates such a case graphically.

Three equilibria exist here. The first being what a development economist might call a "poverty trap" for community one. At L* community one is small, has yet to develop a substantial agglomeration of economic activity and has low wages and a low cost of living. The second equilibrium at L** yields an intermediate amount of agglomeration and the third L*** is a fully developed equilibrium with high wages and a high cost of living. Nothing in this static model says which of these three outcomes will prevail. Indeed, without further restrictions an economy may switch between them haphazardly.

Figure 3



Consider then a simple tatonnement process where workers gradually migrate to whichever community yields higher net utility given the current allocation. Then the intermediate equilibrium at L** becomes an unstable tipping point. To the right of L** the marginal worker gains rents from locating in community 1 and so community 1 grows until it reaches the stable developed equilibrium L***. To the left of L** it is more attractive to locate in community 2 and so community 1 shrinks until it reaches the stable equilibrium L*.

Recall that everyone not in community 1 resides in community 2. Thus, for community 1 to be in the developed equilibrium community 2 must be in the so-called poverty trap. Depending upon model primitives social welfare may be maximized at any of these three equilibria with the optimum maximizing total economy wide output. If however agglomeration effects eventually exhibit diminishing returns and one community is much larger than the other, then it will generally be optimal for the smaller community to be pulled out of the poverty trap. Suppose for instance that we are interested in Detroit versus the rest of the United States. Moving Detroit from the poverty trap to the developed equilibrium will substantially increase output per worker in Detroit without sacrificing much in the rest of the country. Of course if agglomeration effects are globally convex, Detroit should be

[7] See Rosenthal and Strange (2004) for a review of the empirical evidence on this subject and Duranton and Puga (2004) for a review of the theoretical literature.

abandoned entirely and all population should concentrate in the same area.

Regardless, one can imagine a local government trying to develop itself out of the poverty trap at the expense of other communities without concern for aggregate welfare. It is clear from Figure 3 however that half-measures will be ineffective if the system exhibits Marshallian dynamics. A small shift upward in the relative utility locus will only effect a small movement in L* rather than a shift of equilibrium. In the terminology of Paul Rosenstein-Rodan (1943) a full escape from the poverty trap requires a "Big Push" as illustrated by the dashed locus of Figure 3. Only then will the developed equilibrium be unique. Note that once community 1 is in the basin of attraction of the developed equilibrium the intervention can be removed without reverting to the poverty trap.

This feature, it seems, underlies the promise of place based policies – that large temporary interventions may have lasting effects. If this is true then the traditional focus on excess burden seems misplaced given that the static efficiency costs of temporary subsidies are likely trivial compared to the potential long run benefits of equilibrium selection. Successful job creation strategies may be efficient after all.

Paul Krugman (1991) and others have pointed out that with forward looking agents an intervention of the traditional sort may not even be necessary. Expectations alone can, in some circumstances, serve to determine equilibria – if workers believe community 1 will be in the developed equilibrium next period then most of them will move to community 1 and the belief will be justified. It is difficult to know whether such self-fulling expectations are relevant for policy or what role governments might play in coordinating expectations. Here, as elsewhere, the empirical literature lags far behind theory.

Perhaps the first step for empiricists interested in assessing the relevance of models with multiple steady states is to examine the long run effects of large spatially targeted interventions that have lapsed. To date the only serious evidence on these questions comes from examining the long run effects of spatially targeted disasters such as the bombing of cities in Japan.

Donald Davis and David Weinstein (2002) find that despite extreme damage, the populations of Nagasaki and Hiroshima both reverted to their pre-existing trend lines within two decades of World War II. While the authors take this as evidence that steady states are unique, the evidence is also consistent with the view that expectations matter. Both cities were delivered small government aid packages in the aftermath of the bombings, but perhaps more importantly, the Japanese may have coordinated on the expectation that the devastated cities would be rebuilt.

The outstanding question, it seems, for those interested in the coordinating effects of local development programs, is whether the aspirations of previous generations associated with large scale regional projects have had long run effects. The jury is still out.

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