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# URBAN EXTERNAL ECONOMIES AND OPTIMAL MIGRATION

Vibhooti Shukla and Oded Stark

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## ABSTRACT

In this paper we utilize urban economics to identify socially optimal levels of urbanization and, by implication, optimal levels of rural-to-urban migration. Our analysis addresses, first, the case where there is only one urban center (region) in the economy and, second, where there are two. Since in this latter case inter-urban migration flows are possible as well, we examine the rationale underlying dispersal from the larger urban center to the smaller one.

After identifying the reason that private actions do not add up to the social optimum, we offer an analysis of instruments that could confer efficiency gains by closing the gap(s) between the privately efficient and socially optimal urban concentrations.

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## I. INTRODUCTION

Hitherto, urban economics does not seem to have significantly contributed to migration economics, although there are reasons to believe that such a contribution can be made. As our note demonstrates, it is possible to utilize urban economics to identify socially optimal levels of urbanization and, by implication, optimal levels of rural-to-urban migration. Our analysis addresses, first, the case where there is only one urban center (region) in the economy and, second, where there are two. Since in this latter case the possibility of additional, that is, inter-urban, migration flows opens up, we examine the rationale underlying dispersal from the larger urban center to the smaller one.

After identifying the reason that private actions do not add up to the social optimum, we offer analysis of instruments that could confer efficiency gains by closing the gap(s) between the privately efficient and socially optimal urban concentrations. On the basis of theoretical considerations and permissible parameter values, for the log-linear case, we are able to rank these instruments and thereby to suggest policy implications. The private decisions identified by us in this note are responsible for a smaller city size, or a smaller urban sector, than is socially optimal. We compare this outcome with another policy-related observation. A 1983 United Nations survey of 126 governments of less-developed countries (LDCs) found that all but three small island nations did not consider the distribution of their populations "appropriate" and that more than three-quarters stated they were pursuing policies to slow down or reverse internal migration, almost always rural-to-urban migration. These policies do not have a tantalizing success record. Might this lack of success be due to the fact that alongside the problems of congestion and pollution usually associated with rapid urban growth there are, over a significant range, powerful agglomeration *economies* conferred by urban concentration? This may help to explain why policies aimed at stemming rural-to-urban migration have a dismal success record (Stark 1980).

## II. EXTERNAL AGGLOMERATION ECONOMIES AND OPTIMAL MIGRATION: THE CASE OF ONE URBAN SECTOR

We start by focusing on the role of external agglomeration economies. Urban output  $Q$  which is homogeneous and internationally traded at a given unit price is produced by many small, identical firms employing

labor  $N$  and capital  $K$  with decreasing returns to internal scale and increasing returns to external scale

$$Q = G(N)F(N,K) \quad (1)$$

where  $G' > 0$  and

$$\begin{bmatrix} F_{NN} & F_{NK} \\ F_{KN} & F_{KK} \end{bmatrix}$$

is negative definite. Firms do not see themselves as influencing city size which is given by the aggregation of their profit-maximizing labor demands. With a perfectly elastic supply of private capital and labor at the going interest and wage rates  $r$  and  $w$  respectively, the firm's maximization problem is

$$\text{Max } G(N) F(N,K) - wN - rK$$

which renders the first-order conditions

$$G(N^e) F_N(N^e, K^e) - w = 0 \quad (2)$$

$$G(N^e) F_K(N^e, K^e) - r = 0 \quad (3)$$

and the second-order conditions

$$GF_{NN} < 0 \quad (4)$$

$$(GF_{KK})(GF_{NN}) - (GF_{NK})^2 > 0 \quad (5)$$

where  $N^e$  and  $K^e$  are the equilibrium levels of the employed labor and capital.<sup>2</sup>

Since firms do not incorporate the agglomeration effect in their employment decisions, the pair  $(N^e, K^e)$  differs from the social optima  $(N^*, K^*)$  that fulfill the following first-order conditions

$$G(N^*) F_N(N^*, K^*) + G'(N^*) F(N^*, K^*) - w = 0 \quad (6)$$

$$G(N^*) F_K(N^*, K^*) - r = 0 \quad (7)$$

and the second-order conditions

$$GF_{NN} + 2G'F_N + G''F < 0 \quad (8)$$

$$(GF_{KK})(GF_{NN} + 2G'F_N + G''F) - (GF_{NK})^2 > 0, \quad (9)$$

requiring that at the optimal level  $N^*$ , output increases with employment at a decreasing rate.

In order for (2) to entail a stable equilibrium,  $G(N) F_N(N, K)$  must cut  $w$  from above. Likewise for (6). Hence, over the relevant range,  $d[G(N) F_N(N, K)]/dN < 0$ . Therefore, a comparison of (6) with (2) implies that  $N^c < N^*$ . Thus, if the externality were to be internalized, urban employment and urban size would be larger and more rural-to-urban migration would be called for. The level of this socially optimal migration is  $N^* - N^c > 0$ .

### III. EXTERNAL AGGLOMERATION ECONOMIES AND OPTIMAL MIGRATION: THE CASE OF TWO URBAN SECTORS

Assume now an economy with two urban regions, each small relative to the rest of the economy. Due to historical, topographical, geographical, or other exogenous reasons one urban region,  $B$ , is backward, that is, with relatively little productive infrastructure which we denote by  $I_B$ , whereas the other,  $A$ , is advanced with  $I_A > I_B$ . The contribution of economic infrastructure,  $H(I)$  to production is captured by

$$Q = H(I) G(N) F(N, K) \quad (10)$$

where  $H' > 0$ . To simplify, we assume  $H(I) = I$ . The equilibrium employment levels in the two regions,  $N_A^c$  and  $N_B^c$ , are given by the solutions to the private maximization problems that entail the following first-order conditions for labor:

$$G(N_A^c) F_N(N_A^c, K_A^c) = w/I_A \quad (11)$$

$$G(N_B^c) F_N(N_B^c, K_B^c) = w/I_B. \quad (12)$$

Since  $w/I_A < w/I_B$ , we obtain

$$G(N_A^c) F_N(N_A^c, K_A^c) < G(N_B^c) F_N(N_B^c, K_B^c), \quad (13)$$

which implies (as  $d[G(N) F_N(N, K)]/dN < 0$ ) that  $N_A^c > N_B^c$ .

By solving the corresponding social optimization problem, we obtain the following first-order conditions:

$$G(N_A^*) F_N(N_A^*, K_A^*) + G'(N_A^*) F(N_A^*, K_A^*) = w/I_A \quad (14)$$

$$G(N_B^*) F_N(N_B^*, K_B^*) + G'(N_B^*) F(N_B^*, K_B^*) = w/I_B. \quad (15)$$

From comparisons of (14) with (11) and (15) with (12), we obtain that  $N_B^* - N_B^c > 0$ ,  $N_A^* - N_A^c > 0$  and that  $N_B^* - N_B^c > N_A^* - N_A^c$ , or that  $N_A^* - N_B^* < N_A^c - N_B^c$  provided (see (4) and (8)) that

$$GF_{NN} + 2G'F_N + G''F < GF_{NN},$$

which reduces to

$$2F_N/F < -G''/G', \quad (16)$$

that is, that agglomeration economies rise at a sufficiently rapidly diminishing rate; since the left-hand side of (16) is positive, only a sufficiently large absolute value of a negative  $G''$  can entail a *larger* social gain associated with removal of the backward region allocation inefficiency than with removal of the advanced region allocation inefficiency. Then, at a given social outlay, inducing rural-to-urban region B migration dominates inducing rural-to-urban region A migration since it is in the former where the agglomeration externality is *more* powerful. Or, urban dispersal from A to B entailing labor migration in this direction is socially superior to migration in the reverse direction, that is, migration making for a larger degree of urban concentration. Empirical evidence leads us to believe that at least for the case of India and for quite a large range of city sizes, condition (16) *does not hold*.<sup>3</sup> Productive efficiency may thus be hindered, not fostered, by labor population dispersal from larger to smaller cities.

#### IV. RANKING POLICY INSTRUMENTS

Having pointed out that the size of an urban area ought to be increased in order to enhance productive efficiency, we need to rank the instruments that a government may use for the purpose of externality correction. We shall address a Section I-type economy with only single urban region for which  $N^* - N^c > 0$ . In order to induce socially optimal urban growth and creation of additional employment, we assume the government considers recourse to output, capital, or labor subsidies.

Assume that (1) takes the form

$$Q = G(N) F(N, K) = BN^\gamma AN^\alpha K^\beta \quad 0 < \gamma < 1, \alpha + \beta = 1 \quad (17)$$

and that

$$w = w(N) = bN \quad b > 0. \quad (18)$$

That is, assume a positive agglomeration elasticity with the amount of output "shift" due to external economies increasing at a declining rate, a constant return to scale internal technology, and a unitary elastic labor supply. The private problem then is given by

$$\text{Max } ABN^\gamma N^\alpha K^\beta - (bN)N - rK.$$

However, if the government were to award a wage subsidy, the firm's decision problem would be

$$\text{Max } ABN^\gamma N^\alpha K^\beta - (1 - S_L)(bN)N - rK$$

where  $S_L$  is the proportion of the wage bill paid by the government. Solving the last problem renders

$$N^c = [\alpha/b(1 - S_L)]^{(1-\beta)/(2-2\beta-\alpha-\gamma)} [AB\beta^\beta r^{-\beta}]^{1/(2-2\beta-\alpha-\gamma)}. \quad (19)$$

This can be compared with  $N^*$ —the socially optimal city size given by incorporating the variability of city size in the agglomeration component of the production specification where

$$N^* = [(\alpha + \gamma)/b]^{(1-\beta)/(2-2\beta-\alpha-\gamma)} [AB\beta^\beta r^{-\beta}]^{1/(2-2\beta-\alpha-\gamma)}. \quad (20)$$

By equating (19) to (20), that is, capturing that amount of subsidy that will sustain the social optimum, we obtain

$$S_L = \gamma/(\alpha + \gamma). \quad (21)$$

We employ a similar procedure in order to derive the optimal capital subsidy, that is, solving

$$\text{Max } ABN^\gamma N^\alpha aK^\beta - (bN)N - (1 - S_K)rK$$

and obtain

$$S_K = 1 - \{\alpha/(\alpha + \gamma)\}^{(1-\beta)/\beta} \quad (22)$$

and derive the optimal output subsidy (for example, a sales tax concession) through solving

$$\text{Max } (1 + S_P)ABN^\gamma N^\alpha K^\beta - (bN)N - rK,$$

obtaining

$$S_P = [(\alpha + \gamma)/\alpha]^{(1-\beta)/\beta} - 1. \quad (23)$$

Since from the first-order conditions of the social maximization, that is, from the equivalents of (6) and (7) under (17) and (18), we obtain

$$(N^*)^2 = [(\alpha + \gamma)/b]Q^* \quad (24)$$

$$K^* = [\beta/r]Q^*, \quad (25)$$

we can rewrite (21), (22), and (23) as

$$S_L w N^* = \gamma Q^* \quad (26)$$

$$S_K r K^* = \beta [1 - (\alpha/(\alpha + \gamma))]^{(1-\beta)/\beta} Q^* \quad (27)$$

$$S_P Q^* = [((\alpha + \gamma)/\alpha)^{(1-\beta)/\beta} - 1]Q^*. \quad (28)$$

Whereas the capital subsidy is cheaper than the output subsidy,<sup>4</sup> the difference between the capital subsidy and the labor subsidy cannot be signed analytically. Fortunately, simulation experimentation<sup>5</sup> subject to  $\gamma < \alpha$  (the condition that the external labor efficiency or agglomeration parameter is lower than the internal one) reveals that the capital subsidy is consistently cheaper than the labor subsidy; for plausible ranges of the parameters  $\gamma$  and  $\alpha$ , say .10-.20 for  $\gamma$  and .60-.70 for  $\alpha$ , the capital subsidy is 20%-35% cheaper than the labor subsidy.

Our conclusion that subsidizing capital utilization might be the more efficient means to bring about socially optimal levels of industrial production, urban concentration, and rural-to-urban migration relates to earlier research<sup>6</sup> where we pointed out that although migration is a labor market phenomenon, modifying its patterns could optimally assume the form of intervention in capital markets. There it was argued that it is imperfections in the latter that are manifested through and corrected by migratory behavior. Interestingly, while it approaches migration from the production end, this note also suggests that intervention in the capital market could be the appropriate tool for bringing about the desirable level of migration.



## NOTES

1. These have been empirically confirmed in the United States by a number of studies, for example, Sveikauskas (1975) and Segal (1976) and for India by Shukla (1984).
2. In fact, the maximization problem renders an optimal employment level for the individual firm which we should have designated by a symbol different from  $N^c$ —say  $n^c$ . (Likewise, for  $K^c$ .) If there are  $m$  identical firms, then  $N^c = mn^c$ . Since  $N^c$  differs from  $n^c$  merely by a constant factor, we adopt a shortcut and refer to  $N^c$  from the start of the maximization process.
3. See Shukla (1984). One plausible suggestion offered by the empirical evidence is that dispersal should not be encouraged in the context of city sizes below 100,000.
4.  $S_p - \beta S_K = (d^c - 1) - \beta[1 - (1/d)^c] = (d^c - 1)(d^c - \beta)/d^c > 0$  since  $d^c > 1 > \beta$  where  $d = (\alpha + \gamma)/\alpha > 1$  and  $c = (1 - \beta)/\beta > 0$ .
5. See Shukla (1984).
6. See, for example, Stark and Levhari (1982).

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