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Restricting access in a job chains model of local employment creation

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Abstract The job chains model of local labor market change is a demand-driven analytic device for estimating the effects of new job creation. This paper explores the effects of restricting supply, i.e., limiting job access, on the model's primary outcomes: vacancy chain multipliers, welfare effects, and distributional impacts. Major sources of labor supply are the local unemployed, out of the labor force and in-migrants. Three simulations are reported relating to (1) restricting new jobs to current local residents (i.e., no in-migrants), (2) restricting new jobs to current residents in the first round of hiring only, and (3) restricting hiring to local unemployed/out of labor force on the first round alone. The results are compared to the basic model that assumes no supply-side restrictions. In terms of chain length, welfare effects, distributional impacts, and policy palatability, first-round restrictions on in-migrants would seem to be the most plausible option. However, as an economic development strategy, well-targeted demand-side initiatives would still seem to be preferable.

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1 Introduction

In a recent work, we have argued that a "job chains" approach provides a meaningful base for evaluating new local job creation.[1] Putting to one side grandiose schemes of programmatically generating high-tech clusters, information agglomerations, and the like, much of the motivation and political support for subsidizing local job creation originates in a concern that local labor markets are highly imperfect (Bartik 1991). Involuntary unemployment and widespread underemployment characterize most metropolitan areas. Under such circumstances, job creation impacts local workers by opening opportunities for them to exercise skills they already possess. As workers move up, vacancies are opened for others. Newly created jobs generate a vacuum effect down the chain. Welfare gains originate as previously under-employed or not employed workers fill vacancies along the chain.

The demand generated by new local job creation depends on the nature of the resulting job chain and, hence, the character of local supply. As the job chains approach makes explicit, demand is met by a number of sources of supply—existing jobholders, the local unemployed and out of the labor force, and in-migrants. Because public policy has played a role in generating local labor demand, a logical question emerges as to the wisdom of attempting to influence or restrict which workers benefit from the public program, i.e., to alter supply conditions for these new jobs.

Presumably, such restrictive efforts would be directed at promoting the chances of local residents vis-a-vis in-migrants (Bartik 2001). In a less obvious fashion, local development agencies might anticipate gains to the locally unemployed as larger than gains to the (under)employed who move up. Consistent evaluation of such propositions concerning supply restrictions requires the use of the same job chain framework used in the case of unrestricted supply.

This paper presents a first effort to extend the job chains approach to such supply restrictions. Because the mechanics of our job chains model build around a Leontief-type matrix, it is not surprising that much of the discussion to follow is reminiscent of input–output approaches to import substitution.[2] Like that literature, the present effort assumes that all supply sources (in our case labor supplies) are equivalent in terms of price and quality. Elsewhere we have defended this assumption at some length (Persky et al. 2004, Chap. 2). Key to that defense are the widely acknowledged wage rigidities in developed countries (see, for example, Bewley 1999) and the persistent underemployment of skilled and semiskilled workers in those same countries (see, for example, Feldman 1996). Taken together, these substantial labor market imperfections suggest that commonly advocated

[1] On job creation and the chain approach see Persky et al. (2004). There is a continuing interest among economists in job-creation as part of the broader process of job creation and destruction. This literature is well-summarized in Davis and Haltiwanger (1999). Job creation and destruction have been identified as central factors in the determination of endogenous growth following the Schumpeterian approach of Aghion and Howitt (1999). These perspectives are potentially consistent with a chain approach, but the job creation/job destruction literature has not intensively explored the connections. Something of an exception in this respect are Schettkat (1996) and Gorter and Schettkat (1999), who speculate on the importance of chains.

[2] Much of the new development economics is highly critical of import substitution policies in poor countries. Development economists now blame overeager and carelessly designed import substitution programs for exacerbating a range of third-world problems (Pack 1987). These are serious charges, although we suspect the pendulum has swung too far.

efforts to restrict labor supply at the local level will result in no significant changes in the price or quality of available labor.

In the next section, we review the job chains model. Building on this approach, we go on to perform a series of hypothetical policy experiments, in which we restrict labor market access in a number of ways. While hardly definitive, these experiments suggest that feasible supply restrictions generate only modest changes in the magnitude and distribution of program benefits.

2 The job chains model

The job chains model presented here attempts to predict the length of job chains, the welfare impact, and the distributional effects triggered off by local economic development programs.[3] As suggested above, two central assumptions inform our approach: wage rigidity and the persistence of involuntary unemployment/underemployment. We do not attempt to formally model the search and matching process that bring workers and jobs together.[4] However, given our assumptions, such processes will inevitably imply that recruitment patterns will vary across different skill and wage levels. Some job vacancies will be filled only with workers already holding very narrowly defined skills/jobs, while others may draw on a wider range of candidates. New job vacancies trigger a "multiplier" effect as successive workers move from one job to another.

In the absence of direct data on job chains we construct "synthetic" chains using data on actual job changers (i.e., people not positions). Akin to input–output production chains, we do not attempt to trace chains back to their original job. Just as input–output studies do not trace back through actual market transactions at every stage of production and instead average "input vectors" for each industry, we similarly construct "recruitment vectors" for a given job level simply using information on job changers. We do not need observations on entire chains, but only a representative sample of unrelated chain links. Such data are available from workers' longitudinal job histories. The key assumption here is that a given level of job is always filled according to the probabilities summarized in that level's "recruitment vector." If this assumption is roughly met, a good approximation of the chain set off by a newly created job can be pieced together from basic data on the "recruitment vectors."

[3] By local "economic development programs," we have in mind the traditional type of smokestack chasing in which a municipality or state subsidizes firms locating in their jurisdiction. Implicitly, we assume that the subsidies have no important effects on the composition of employment or the hiring patterns of the firm.

[4] The considerable literature on search and matching models in the labor market are reviewed by Mortennsen and Pissarides (1999). While such models can generate "involuntary" unemployment/underemployment, they often seem to lack the gross inefficiency of earlier Keynesian treatments. As such, our approach seems more consistent with the new Keynesian emphasis on efficiency wages (e.g., Bulow and Summers 1986) as a reasonable formalization of older models of dual labor markets, i.e., Doeringer and Piori (1971).

Table 1 "Average" metropolitan **Q** matrix and "average" metropolitan **T** matrix

	New wage group				
Origin	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)
a. "Average" metropolitan **Q** matrix					
Wage group 1	q_{11}=41.1	0.0	0.0	0.0	0.0
Wage group 2	q_{21}=25.0	q_{22}=52.9	0.0	0.0	0.0
Wage group 3	q_{31}=4.8	q_{32}=22.1	q_{33}=46.6	0.0	0.0
Wage group 4	q_{41}=2.2	q_{42}=1.5	q_{43}=18.5	q_{44}=47.3	0.0
Wage group 5	q_{51}=0.0	q_{52}=0.3	q_{53}=2.4	q_{54}=13.3	q_{55}=34.5
Column sum	73.1	76.8	67.5	60.6	34.5
b. "Average" metropolitan **T** matrix					
Unemployed	t_{11}=2.9	t_{12}=3.8	t_{13}=9.7	t_{14}=15.8	t_{15}=24.7
Not-in-labor force	t_{21}=4.0	t_{22}=3.8	t_{23}=7.5	t_{24}=13.5	t_{25}=30.5
In-migrant	t_{31}=20.1	t_{32}=15.6	t_{33}=15.4	t_{34}=10.0	t_{35}=10.2
Column sum	27.0	23.2	32.6	39.3	65.4

We start by constructing a square (origin–destination) matrix (**Q**) in which rows and columns represent jobs by wage level.[5] This matrix will play the role of the familiar transactions matrix (**A**) of input–output studies. The elements of this table, q_{ij}, show the probability that a job vacancy of a *j*-type position is taken by a worker currently in an *i*-type position. Table 1a presents our estimate of an "average" table for metropolitan areas in the US using five wage groups. This matrix of job changers is based on data from the Panel Study of Income Dynamics for 1987–1993.[6]

The entry q_{11} in the table shows the typical share of highest paid vacancies in the metropolitan market taken by workers already holding local jobs of the same category. As shown in Table 1a, our estimate for q_{11} is a bit over 40%. The value of q_{21}, the share of highest paid job vacancies going to workers currently holding jobs at the next highest level, is medium wage workers is 25%. q_{31} tells us that less than 5% of these highest paid vacancies go to workers holding jobs in the middle category and so on down the column.

The **Q** table as presented here is triangular, i.e., all the elements above the diagonal (q_{12}, q_{13}, q_{23}, etc.), are zero. Yet, obviously, in a typical metropolitan labor

[5] Ideally, job categories should be defined by a number of relevant characteristics, including, but not limited to wages, working conditions, stress, and security. Research such as that by Gittleman and Howell (1995) makes clear that jobs are multidimensional entities. The present, still exploratory estimation of the **Q** matrix does not attempt such an ambitious categorization, but this is an obvious direction for future research.

[6] Two data concerns should be noted. First, detailed job data from the PSID are only available for household heads (including unrelated individuals with their own household) and their spouses. Second the PSID data set does not provide a continuous job history even for spouses. On the other hand, the PSID is an attractive data set because it allows us to define both firm changers and position changers, where the first denotes a change of employers and the second a change of jobs within the same business. This means we are considering intrafirm and interfirm mobility as workers move along job chains. For the national PSID sample, about 600 individuals (heads and spouses) a year take new positions, with sufficient documentation to be included in this study. Of these, half are starting with a new employer. For more information on the sample data, its problems and advantages see Persky et al. (2004).

market, not all job moves increase an individual's wage level. For our wage groups 2–5, we expect a fraction of all vacancies to be filled by workers stepping down the wage hierarchy. In fact, before we triangularized the matrix, our data showed downward movers as accounting for 4% of group 2 hires, rising to 10.6% for group 5 hires. For columns 2–5 in **Q**, we have reallocated these downward job movers proportionally among the rows of that column at or below the diagonal. Our rationale is straightforward. In the absence of the newly created vacancy, these downwardly mobile workers would not have kept their higher job. Instead, they would have found a job at about the same low level, perhaps a lower level, or even been without work. The reallocation reflects, perhaps imperfectly, this simple observation. Downward moves are essentially exogenous to a job chain initiated by a new (net) job. The new chain does not create a vacancy at the higher level—that was already a given. Instead the new chain creates a vacancy further down the column, hence, the argument for triangularization.

Of course, job changers are not the only recruits for vacancies. In the **Q** matrix, the sum of the elements of the five i-rows for any column is less than one. Businesses do not just hire from local employed workers but also fill vacancies with unemployed workers, workers not currently in the labor force, and with workers in-migrating to the area. Any one of these hires is a chain-terminating event.[7] For the highest paid jobs, more than a quarter of all vacancies are filled from these three sources. Table 1b shows our average **T** matrix, where t_{pj} is the estimated probability that a vacancy in wage class j (columns j=1, 5) will be filled by a worker from a nonlocally employed source p (rows p=1,3). These estimates are made from the same sample of Panel Study of Income Dynamics (PSID) workers. Chain terminating events in our analysis play a role similar to primary inputs and imports in input–output studies. They act as leakages that dissipate demand chains in the local area.

The **Q** matrix allows us to approximate the net consequences of job creation at each job level.[8] The mathematics of this situation implies that we can solve for the total job hires by performing a Leontief-type inversion of the origin–destination matrix, $(\mathbf{I}-\mathbf{Q})^{-1}$. This short cut yields a multiplier-type matrix of m_{ij}'s, which shows the gross number of local i-type vacancies generated by a j-type new vacancy. Summing down the columns of this matrix gives us the total number of links or vacancies per chain, triggered-off by jobs of different types. Thus, $M_j = \sum_i m_{ij}$ gives the total number of expected vacancies associated with a newly created j-type

[7] Another potential candidate for terminating a job chain is "job destruction." Our treatment of job destruction here is similar to that of downward job mobility. A newly created job and resulting chain do not cause job destruction any more than they cause downward mobility. Job destruction is an exogenous event. Thus, the question is "What would the person, whose job is destroyed, be doing in the absence of the vacancy created by the chain?" Implicitly, we are assuming that all displaced workers whose jobs are destroyed and then find employment along a relevant chain would have been proportionately spread among the origin-cells (employed and not locally working) in the appropriate column. This assumption, like the similar assumption about downward mobility, is a key target for future research.

[8] Note that a newly created job at any level might be a direct job, an indirect job, or an induced job in standard input-output terminology. Each new job, whether direct or not and regardless of pay level, gives rise to a vacancy chain.

Table 2 Basic model multipliers

	New wage group				
	1	2	3	4	5
Vacancies in group 1	m_{11}=1.70				
Vacancies in group 2	m_{21}=0.90	m_{22}=2.12			
Vacancies in group 3	m_{31}=0.52	m_{32}=0.88	m_{33}=1.87		
Vacancies in group 4	m_{41}=0.28	m_{42}=0.37	m_{43}=0.66	m_{44}=1.90	
Vacancies in group 5	m_{51}=0.08	m_{52}=0.12	m_{53}=0.20	m_{54}=0.39	m_{55}=1.53
Total job multiplier	M_1=3.48	M_2=3.48	M_3=2.73	M_4=2.28	M_5=1.53

job including that initial vacancy.[9] M_j is the length of a type j chain and the multiplier matrix obtained corresponding to the **Q** matrix is given in Table 2.

For example, reading down column 1, we find that on average a new job in wage group 1 generates 1.7 vacancies in its own wage group, 0.9 vacancies in group 2, 0.5 in group 3, and so on. The column adds to the vacancy multiplier of 3.5.

Perhaps, the most interesting observation to be made from this disaggregation, concerns the extent to which high-level chains reach down to open vacancies in low-level wage groups. A new job in the highest wage group generates .36 vacancies in the two lowest wage groups. As noted above, only 2% of group 1 vacancies are actually filled by workers currently holding group 4 or group 5 jobs. For new high-wage jobs, the vacancies generated at these lower wage levels are opened only toward the end of the chain. If in the first round, a vacancy is opened up in group 2, then in the next round a vacancy might open in group 3. A group 3 vacancy, unlike a group 1 vacancy, has a real possibility of being filled by a worker in group 4 or group 5. While not all chains initiated in group 1 will reach these later rounds, those which do will contribute to building vacancies at the lower end of the job hierarchy.

Chain length is not in itself a measure or guarantee of real gains in economic welfare. Chains can include considerable "churning" (Schettkat 1996). Chains can be cut off before those most in need are affected. To quantify real gains, chains must be recast in terms of the welfare increments to all participants. The local welfare arising from the creation of different new jobs is conditioned by opportunity costs in evaluating welfare gains. For each job vacancy filled at level j, the welfare gain to job changers is just equal to $\sum_k q_{kj}\left(w_j - w_k\right)$, where (w_j-w_k) represents the difference in wages between the new job j and the old job k. Notice, we assume here that those changing jobs within the same occupational group, k, will experience no gain (or perhaps, only a negligible one), i.e., w_k-w_k=0.

The welfare gains to those previously unemployed, not in the labor force, or in-migrants depend on their opportunity costs: $\sum_p t_{pj} w_j \left(1 - c_{pj}\right)$, where t_{pj}, p=1 to 3, refers to the proportion of type j job vacancies filled from one of the three nonlocal employment categories—the unemployed, not in the labor force, and in-migrants, and c_{pj} refers to the opportunity cost foregone by typical workers moving from p to type j jobs expressed as a share of w_j, wages at level j.

[9] When **Q** is taken to be triangular, the chain lengths, M_j, are relatively easy to calculate in a recursive manner. In particular, if we follow our ranking of skill levels from 1 as the highest to n as the lowest, then: $\mathrm{M}_n = 1/(1 - q_{nn})$, $\mathrm{M}_{n-1} = \left[1/(1 - q_{(n-1)(n-1)})\right]\left[1 + q_{n(n-1)}M_n\right]$, $\mathrm{M}_{n-2} = \left[1/(1 - q_{(n-2)(n-2)}\right)\left(1 + q_{(n-2)(n-2)}M_{n+1} + q_{(n(n-2))}M_n\right)\ldots$

Table 3 Opportunity costs of the unemployed

	Wage group				
	1	2	3	4	5
	\$25.5–\$40	\$16.4–\$25.5	\$10.50–\$16.40	\$6.70–\$10.50	\$4.25–6.70
Expected unemployment rate	0.0225	0.0225	0.05	0.085	0.195
Estimated opportunity cost	c_{p1}=0.75	c_{p2}=0.75	c_{p3}=0.5	c_{p4}=0.40	c_{p5}=0.31

Note Throughout this paper, we assume that opportunity costs do not vary with p, but only with j For a sensitivity analysis of this assumption see Persky et al. (2004)

The basic assumption here is that the opportunity cost for any given group of p-to-j hires depends critically on the expected unemployment rate for that group. We make this proposition operational by setting opportunity costs to new hires from 25 to 75% of the new wage depending on group characteristics and the probability of involuntary unemployment. Our estimates are presented in Table 3. Not surprisingly on this scheme, new hires into the highest paying jobs tend to have a low probability of involuntary unemployment and a relatively high opportunity cost, while new hires into the lowest paying jobs tend to have a high probability of involuntary unemployment and a relatively low opportunity cost.

These various calculations generate an expected value of a new job chain starting at any given level, j. More specifically we define

$$V_j/w_j = \sum_i (w_i/w_j) m_{ij} \left\{ \sum_k \left[q_{ki}(w_i - w_k)/w_i \right] + \sum_p \left[t_{pi}(1 - c_{pi}) \right] \right\}. \quad (1)$$

The standardization of this welfare measure by the wage of a j-job can be interpreted in two ways. First V/w might be considered a discount to the simple use of wages as a measure of benefits. Alternatively, if the cost of generating jobs is proportional to their wages, then V/w can be seen as a rough benefit–cost index of subsidizing jobs at different wage levels.

The estimates of V/w based on the average **Q** matrix as augmented by the average **T** matrix are presented in the second row of Table 4. After allowing fully for job upgrading and the welfare gai1ns to new jobholders in the community, a newly created job at the highest paid level generates gains equal to 43% of the average wages of such a job. This share is well under 100% precisely because so many of the nonemployed hires at this level have strong job prospects and little chance of involuntary unemployment. At the other extreme low paying jobs in category 5 generate welfare gains equal to almost 70% of the average wage at this level.[10] If the public subsidy cost per dollar of wages at each level is about the same, the job chains approach suggests that generating wages on low-wage jobs is more efficient than on high-wage jobs. This result is robust across a range of sensitivity tests. It also holds across broad regions and phases of the business cycle (see Chaps. 5 and 6 in Persky et al. 2004).

[10] By assumption, this figure cannot be greater than 75% of the wage. For sensitivity analysis of the approach used here, see Persky et al. (2004).

Table 4 Basic model—chain lengths, welfare gains and distribution

	New wage group				
	1	2	3	4	5
Total job multiplier	3.48	3.48	2.73	2.28	1.53
V/*w*	0.43	0.42	0.56	0.62	0.69
*R**/*w*	0.07	0.10	0.22	0.49	0.58

Note Job multipliers measured in jobs. *V*/*w* and *R**/*w* are ratio measures relative to column *j* wage

The above approach is essentially concerned with efficiency considerations. However, it is easily disaggregated to focus on distributional questions. With the estimates already available, a slightly expanded "Rawlesian" welfare measure R^*/w can be calculated for each *j*. It shows dollar values of the welfare gains to non-immigrants getting or moving up from jobs at the lowest two levels when a chain starts at the *j*-level. The distributional measure, like the efficiency measure, is standardized to the wage level of the new *j*-job. More formally:

$$R^*_{\mathrm{j}}/w_{\mathrm{j}} = \sum\nolimits_{\mathrm{i}} (w_{\mathrm{i}}/w_{\mathrm{j}}) m_{\mathrm{ij}} \left\{ \sum\nolimits_{\mathrm{k}=4,5} \left[q_{\mathrm{ki}} (w_{\mathrm{i}} - w_{\mathrm{k}})/w_{\mathrm{i}} \right] \right\} + \sum\nolimits_{\mathrm{i}=4,5} (w_{\mathrm{i}}/w_{\mathrm{j}}) m_{\mathrm{ij}} \left\{ \sum\nolimits_{\mathrm{p}=1,2} \left[t_{\mathrm{pi}} (1 - c_{\mathrm{pi}}) \right] \right\}. \quad (2)$$

Row 3 in Table 4 presents estimates of R^*/w for our average metropolitan area. The results indicate that creating jobs at the top of the job hierarchy does relatively little for those near the bottom. A newly created job at the highest paid level generates gains to the two lowest groups equal to 7% of the average wages of such a job. The chains may be long at the top, but they are most often cut off before creating many vacancies at the bottom. Adding jobs in the two or three lowest groups has the strongest distributional impact. For example, gains to the two lowest groups from a new type-4 job amount to almost 50% of the average wage of that job. Again these results are robust to a number of sensitivity tests and across broad regions and phases of the business cycle. More important in the present context, they are consistent with recent work suggesting that low-wage workers are increasingly disconnected from promotion opportunities (Bernhardt et al. 2001). Under the circumstances, it is understandable that advocates for low-wage workers have suggested various policies to restrict access to subsidized jobs.

3 Restricting access

The last section gave a brief summary of what we estimate new local jobs are worth and how their distributional impacts vary. Results differ considerably depending on the wage levels of the new jobs, but seem robust to other potential influences. But all these estimates assume that the local authorities have no ability (or at least no desire) to control who actually gets the jobs in question. Here, we expand the analysis of job chains by considering three cases of supply restriction: restricting the entire subsidized chain to local residents, restricting only initial vacancies to local residents, and restricting initial vacancies to local unemployed and those not in the

Table 5 Excluding in-migrants—chain lengths, welfare gains, and distribution

	New wage group				
	1	2	3	4	5
Total job multiplier	6.08	5.34	3.59	2.62	1.63
V/w	0.56	0.52	0.58	0.63	0.69
R/w*	0.15	0.21	0.36	0.63	0.69

labor force. For each of these cases, we use the job chain approach to reestimate the matrix of chain lengths, the efficiency vector, and the distribution vector.[11]

Supply constraints of one sort or another have long been seen as attractive antidotes to the large share of newly created jobs taken by those already employed locally or immigrants from other jurisdictions (Bartik 2001). The purpose here is not to argue the normative motivations behind such programs, but to explore their likely consequences when evaluated by those norms. From this perspective, the distributive measures seem the most relevant to the policy debate.

Case 1. Restricting supply to current local residents, i.e., all vacancies filled from current residents This case is relatively easy to estimate, although hard to imagine executing in practice. The scenario requires excluding in-migrants from all subsidized new jobs and all vacancies created in chains generated by those jobs. Short of excluding all new in-migrants from local employment, it is unclear how vacancies connected to the subsidized job might be identified. However, it is useful to consider this case if only to see the logical extreme of the local import substitution approach applied to labor chains. In our estimations, we simply rule out in-migrants from taking any chain vacancy.

To effect this policy scenario, we alter the augmented **Q** matrix by setting all entries in the p=3 row for in-migrants to 0 and reallocating job recruitment proportionately across all other rows. Thus in column i, t_{pi} is set to 0 and its value is shared proportionately across all other i-column elements. Throughout, we maintain the hypothesis that the remaining supply of job candidates is sufficient to fill the specific chain and will do so in a manner proportional to the adjusted entries in the augmented **Q**.

Obviously the adjusted augmented **Q** matrix has larger entries everywhere but along row p=3, which now contains only zeroes. This restriction on supply produces a sharp increase in chain length (compare row 1 of Table 5 with the same row in Table 4). These longer chains reflect local hiring by employers who customarily recruit heavily from outside the metropolitan area. The change is particularly noticeable for chains starting at high wage levels. Thus, chains starting with a new job at the highest levels are now expected to average more than six vacancies, where previously the expectation was about 3.5. Of course, much of this increase in chain length simply involves churning at the highest level.[12] The size of the change, both absolutely and relatively, falls off steadily as we consider chains starting at lower and lower wage levels. For the lowest level, the average job chain increases only modestly from 1.5 to 1.6 vacancies. This

[11] In this section, we continue the assumption that demand side interventions take the form of direct subsidies to firms. Supply side interventions would then require firms to demonstrate that they have hired from specified labor pools, e.g., residents, local unemployed, etc.

[12] While churning within a wage group may be associated with some second order welfare improvements, we ignore these in our welfare measure *V/w*.

Table 6 Excluding in-migrants from first round vacancies—welfare gains and distribution

	New wage group				
	1	2	3	4	5
Total job multiplier	4.10	3.94	3.04	2.43	1.59
V/w	0.47	0.45	0.58	0.63	0.69
R/w*	0.08	0.11	0.25	0.55	0.64

result clearly reflects the increasingly marginal role in-migrants play in filling chains for low-tier jobs.

Welfare gains rise, but much slower than chain length. Compare row 2 in Table 5 to the corresponding row in Table 4. While the *V/w* measure rises throughout, lengthened chains result in more churning that dampens real improvements. Chains beginning at job level 4 and 5 show virtually no welfare gain. That is easily explained, because longer chains here always mean churning and no movement upward.

In terms of distributional impacts, the results show an increase in the extent of "trickle down" from high-end jobs to low-wage workers. In particular, the relative gain to a low-end worker from a new type-1 job is twice as large as in the base case (0.15 to 0.07). This result reflects the large share of high−end jobs going to in-migrants. These outsiders cut off the job chain in the metropolitan area. By increasing the shares of local job-to-job movers in a chain, the chances of a chain reaching down to benefit the two lowest levels is significantly increased.

Case 2. Restricting supply in first round only to current residents A much less drastic supply-side scenario involves restricting newly created subsidized jobs to current metropolitan residents. If any jobs can be steered toward residents, it would seem to be subsidized ones.[13] However, unlike the previous case, such a policy of supply constraint does not lead to substantial "trickle down."

To implement the simulation we use the Case 1 version of the augmented **Q** matrix for a first round, and then take all the resulting vacancies from that round as the starting point for subsequent rounds worked through the original augmented **Q** matrix from the base case. In a sense, the results are weighted averages of the two cases (Table 6).

In particular, the longer chains for high-end jobs in Case 1 are greatly curtailed once in-migrants can again compete with local workers in postinitial rounds. The expected chain length for type-1 job chains falls back from about six to about four, only half a vacancy more than the base case of 3.5. As a result, the "trickle down" effects stemming from high-end jobs are also curtailed, when these chains fail to reach lower job categories. The low-level distribution measure falls back from 0.15 to 0.08. With the base case value at about 0.07, the bulk of the increase in "trickle down" has been wiped out. The upshot of this scenario is that guaranteeing that high-end subsidized jobs go to local residents does not generate much immediate effect for low-end workers. If the resulting high−end vacancies are opened to outside competition, low-end workers are hardly better off.

[13] However, notice long standing critique of the Appalachian program where in-migrants took many newly created subsidized jobs (Hansen 1970).

Table 7 Restricted local unemployed and out of labor force for all first round vacancies-welfare gain and distribution

	New wage group				
	1	2	3	4	5
Total job multiplier	1.00	1.00	1.00	1.00	1.00
V/*w*	0.25	0.25	0.50	0.60	0.69
*R**/*w*	0.00	0.00	0.00	0.60	0.69

Case 3. Hiring only locally unemployed or locally not-in-labor-force on first round This supply constraint suggests restricting supply competition so that the unemployed can find jobs. The problem is that from the perspective of job chains, such an approach virtually guarantees the lack of a "trickle down" effect. Unemployed workers, who land high-wage jobs, are generally well-qualified with a wide range of opportunities in the long run. However, once they are placed, the chain is terminated, and there is no possibility of workers at lower levels moving up the chain.

This case is the easiest of the three to simulate because we simply concentrate all recruitment in the p=1,2 lines for the unemployed and not in the labor force (Table 7). The results are straightforward. Chain lengths are all 1.0. Welfare gains simply reflect the opportunity costs of the unemployed/out of the labor force in each group as originally laid out in Table 3. These result in *V*/*w* values ranging from 0.25 to 0.69. Distributional effects stop right where the chain stops, with the first worker.

It should be noted that this restriction has positive distributional consequences for low-end jobs. However, it completely disrupts the possibility of low-end workers obtaining vacancies opened by chains starting in higher end jobs. As a result, it raises serious doubts as to the wisdom of the policy in question.

4 Discussion

We have argued elsewhere that local public subsidies for economic development are unlikely to prove major engines of metropolitan growth and transformation. Rather they are most useful for their contribution to the welfare of mid- and low-wage workers in the metropolis (Persky et al. 2004). The job chains approach provides a means to estimate these contributions. In our previous work, we concluded that "trickle down" generates only very modest welfare gains for low-wage workers. Chains from high-wage jobs are long, but not long enough to strongly impact those at the low end of the wage distribution. Local chains starting with high-end jobs are just too likely to be cut short by in-migration from other metropolitan areas. Hence, we argued for targeting local economic development activities toward industries that draw directly on mid- and low-wage workers.

But what if local development authorities had the power to exclude in-migrants from vacancies generated directly and indirectly by their subsidies? As demonstrated in this paper, under such circumstances, high-end job chains get much longer and the real gains to mid- and low-wage workers increase substantially.

Here, “trickle down” works because a major disrupter of chains, in-migration, is ruled out through manipulation of the supply side of the labor market.

Just as trade barriers at the international level have been justified by the infant industry argument (Pack 1987), this type of in-migration restriction might also be justified by the claim that local workers given the chance will improve on current performance and match the productivity performance of in-migrants. Presumably, this is exactly what widespread underemployment means.

But of course not all, or even most, efforts at import substitution have been successful. Some jobs are just better matched to workers from outside. Local labor supply may sometimes be inadequate to meet local labor demand in a range of high wage, and presumably high-skilled jobs.

Resolving this question would have greater urgency, if the underlying policy being considered was even remotely feasible at the local level. The draconian measures required to limit all subsidized labor chains to local residents in effect require a prohibition on all in-migration because in practice it is extremely difficult to know which jobs belong to which chains. It is difficult to imagine a metropolitan area, state, or region undertaking such exclusions. Even if it were politically possible, draconian restrictions on in-migration would undoubtedly lead to retaliation by other jurisdictions.

Much more feasible, is the second policy exercise described above. Here the local-resident supply constraint is placed only on the first round of the subsidized job chain. Unfortunately, as noted above, a limitation of this type produces much more modest chain length and much less dramatic improvement for low-wage workers. It is hardly clear in this case that the results are worth the effort. This poor performance must be further compromised by any tendency for local political networks to use subsidized jobs as a form of patronage. Careful first-round targeting of industries will do a good deal more than this intervention on the supply side of labor market.

Finally in the last exercise, we see more clearly the trade-off between distributional effects through the creation of low-wage jobs and distributional effects through trickle-down from mid-level jobs. Restricting job access to the unemployed or not in the labor force does nothing for trickle down. The unemployed taking high-end jobs are very different from the unemployed who take low-end jobs. As suggested by our estimated opportunity costs, the former, unlike the latter, operates in labor markets with little if any involuntary unemployment. The unemployed are thus far from homogeneous. By limiting supply in this manner, economic development agencies would in effect cut off all chance of “trickle down.” Indeed, this approach to policy would make sense only if the basic assumptions of underemployment and learning on the job were fundamentally wrong. While distributional gains in newly created low-wage jobs are substantial, we suspect that for most local job creation projects, the unconstrained approach to supply does better by allowing at least some trickle-down from mid-level new jobs of group 3. This is not an unconditional endorsement of trickle-down but a recognition that at least for mid-level jobs trickle-down benefits should not be ignored.

Finally, this first effort at exploring the interaction between local economic development projects on the demand side of the labor market and various policies to restrict job access on the supply side would suggest caution in approaching supply restriction. To work well, restricting access requires heavy-handed supply interventions that are unlikely to be tolerated in a national system. Careful targeting of industries, rather than officious manipulation of labor markets still seems the best course for local development efforts.

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