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Are Economic Development Incentives Worth it? A Computable General Equilibrium Analysis of Pueblo, Colorado's Efforts to Attract Business

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Abstract. The regional impacts of economic development incentives are studied in the context of a computable general equilibrium (CGE) model. The object is to evaluate the effectiveness of several incentives used to attract new businesses in the city of Pueblo, Colorado. The results show that the regional benefits of these incentives are relatively small, and the net benefits to the local population when all impacts are accounted for are likely to be negative. Instead, the benefits are largely transferred to new businesses and employees who migrate to the region in response to the incentives. Contrary to perceptions about the multiplier impacts of economic development, the net impact on the local manufacturing sector is negative as well. The incentives cause a substitution effect, as investment is shifted toward export-oriented manufacturing sectors that are favored for economic development. These results address the seeming paradox that economic development can attract new businesses and jobs, yet be unpopular enough among local residents for them to vote against continuing it.

1. Introduction

This applied research focuses on the regional impact of economic development incentives in the context of a computable general equilibrium (CGE) model. The object of this study is to evaluate the effectiveness of several incentives in the city of Pueblo, Colorado to attract new businesses to the area. The incentives include capital development loans and grants, subsidized rent, and reduced business taxes and fees. The primary source of funding for these incentives is a one-half percent sales tax that was recently reapproved by voters for another five-year period. The economic impact of this and other incentives is projected over the next twenty years in a dynamic CGE model. The results show that the regional benefits of economic

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The results show that the regional benefits of economic development incentives are relatively small. In addition, net benefits to the local population that initially paid for the incentives are likely to be negative.

There are two important reasons for these conclusions. First, economic development incentives attract new businesses and create jobs but, under conditions approaching full employment, few of these new jobs are likely to be filled by local residents. Under these conditions, indirect benefits such as local spending by new businesses and their employees are the primary manner in which economic development benefits most residents of the local community. Second, the impacts of the funding of economic development incentives are often overlooked. While a one-half cent sales tax is relatively insignificant, in total it amounts to over $6 million per year in reduced income available for purchases in Pueblo. In addition, negative impacts of other incentives such as subsidized rent, lower fees and taxes, and even cash payments must be accounted for as well.

Does this imply that local residents who recently approved the half-cent sales tax are uninformed? Not necessarily. Voters initially rejected a ballot initiative in November of 2000 to extend the sales tax through 2006, with 63 percent voting against the measure. This could be interpreted to mean that when voters considered economic development, they could identify little in the way of direct benefits. The next year, an extensive campaign to tout the benefits of economic development to the community was mounted. Once the many jobs and businesses attracted to Pueblo had been cited, not to mention the potential dangers of not continuing these efforts, the sales tax extension was approved in November of 2001 by a substantial margin. It was as if people voted for economic development only after they were reminded of the many benefits it provides to the community, since they were not able to directly identify those benefits.

The next section provides relevant background data on the Pueblo regional economy, including information on population growth and migration into the region. This is followed by a description of the CGE model focusing on those issues specific to a regional economic model, especially the regional closures that are used. The results of the CGE model are then presented, followed by the conclusion.

2. Background and Study Area

Pueblo, a city of about 100,000 people in southeastern Colorado, is a traditional steel town, and as recently as 1980 more than 10,000 workers were employed with a local mill. When the mill went bankrupt in the early 1980s thousands were laid off as the city fell into a deep recession with unemployment exceeding 15 percent. In 1984, the citizens of Pueblo voted to pay a half-cent sales tax for a five-year period to fund the Pueblo Economic Development Corporation (PEDCO) in efforts to attract new business to the region.

The incentives to new businesses provided by PEDCO have varied on a case-by-case basis, but the most frequent incentives are provision of rent-free land and funds for capital improvements. The half-cent sales tax funds are earmarked for capital improvements only. Based on anticipated revenues of $6 million per year, the approximately $30 million collected over the five years would result in a subsidy of approximately $1.5 million per year over a twenty-year period. The rent-free land available is advertised as approximately 200 acres of improved land at the Pueblo Airport Industrial Park, valued according to PEDCO at $25,000 to $40,000 per acre. Based on this information, assuming a rental value of $2,500 per acre for the 200 acres amounts to an additional potential subsidy of approximately $500,000 per year.

In the past, these incentives proved to be relatively compelling to businesses seeking to relocate. In the initial five-year period for which the sales tax was approved, several large industrial companies were attracted to the area resulting in nearly 4,000 new jobs between 1985 and 1989. In subsequent years, however, the results have been less dramatic. One reason for this is that the number of communities with economic development incentives has skyrocketed, increasing competition for businesses. For the period from 1990 to 1999, as shown in Table 1, new businesses attracted by PEDCO using incentives from the sales tax have provided a total of just 1,273 new jobs.

Table 1. Jobs Resulting from Economic Development Incentives, 1990 - 1999

Industry	Number of Jobs
Dog, Cat and Other Pet Food	50
Food Preparations, NEC	80
Miscellaneous Plastic Products	78
Minerals, Ground or Treated	31
Miscellaneous Metal Work	42
Special Dies, Tools and Accessories	96
Service Industry Machines, NEC	55
Switchgear and Switchboard Apparatus	40
Wholesale Trade	66
Insurance Carriers	285
Other Business Services	450
Total	**1,273**

In addition to the lower number of jobs being attracted by the incentives, it appears that the new jobs are less likely to be filled by existing local residents. Pueblo County, whose population is made up mostly of the city of Pueblo and the nearby suburb of Pueblo West, had net migration out of the area through 1990. Thus it could be reasonably assumed that many of the jobs to that point went primarily to unemployed local residents.

As shown in Figure 1, in the late 1980s as the unemployment rate fell from 12 percent to 7 percent the number of new jobs was not accompanied by migration into the area. Since 1991, however, as the economy approached full employment the number of new jobs was closely paralleled by migration into the area. This leads to the conclusion that new jobs since 1991 have largely gone to new residents who migrated to the region.

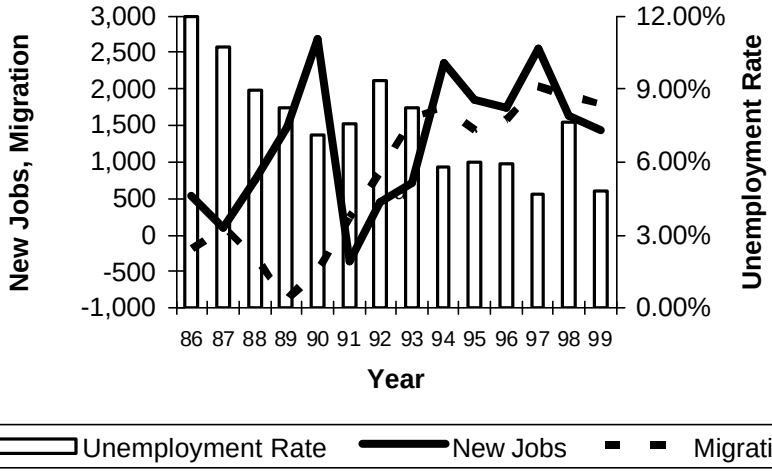

Figure 1. Pueblo County Unemployment, New Jobs and Migration (1986-99)

3. CGE Economic Model and Data

The regional economy is set up as a general equilibrium model to capture all impacts of economic development incentives. Production and consumption functions are set up to allow for substitution in response to changes in relative prices due to taxes and subsidies. Income effects of changes in taxation and returns to factors of production are also captured because all sources and uses of income must be allocated within the regional economy. Most importantly for the regional economy, migration is explicitly modeled to account for the impacts on regional output and income.

The dataset used is a complete set of input-output tables available from IMPLAN (2000). The dataset includes the value of regional output in each of 528 industrial sectors, including the breakdown of output that is consumed locally versus exported. The value of output is linked to the value of intermediate and primary inputs used to produce that output, including the percentage of those inputs that are purchased locally versus imported. The dataset also includes information on the value of regional consumption, includ-

ing the breakdown of local versus imported goods that are consumed in the region. The conversion of IMPLAN data into a CGE model is described by Rutherford (1999).

In the CGE model, the 528 sectors provided by IMPLAN are aggregated into four sectors: services (SVC), resource-intensive industries such as agriculture and mining (RES), local manufacturing (MFG), and export-oriented manufacturing (EXP). The local manufacturing sector produces output primarily for local consumption, while the export-oriented manufacturing sector is more heavily focused on producing output for export. The export sector is an aggregation of the sectors identified in Table 1, and is assumed to be the targeted sector for any economic development incentives.

3.1 Income Balance

There is a representative agent local resident (RA) endowed with regional labor and capital. There are also two other representative agents, a migrant (MIG) who supplies labor from outside the region and an investor (INV) who supplies capital from outside the region. The CGE model requires that consumption for each agent not exceed the income earned by that agent. As shown in equation (1), regional consumption for the representative agent, which is measured as a price index p_C times the quantity of consumption C_{RA} is limited to income I_{RA}. Income to the local representative agent derives from ownership of the factors of production labor L and capital K times the return to labor p_L and capital p_K, plus revenue from taxes on consumption (t_{SLS}) and output (t_{OUT}) minus the subsidy for economic development(s_{CAP}):

$$I_{RA} = p_L L + p_K K + t_{OUT} Y + t_{SLS} C - s_{CAP} K \geq p_C C_{RA} \tag{1}$$

Regional income is also earned by the migrant from labor supplied to the region (LS), and by the investor for capital supplied to the region (KS). Although it is possible that this income leaves the region, as shown in equation (1a) it is treated here as if these agents use their income for regional consumption in the same proportions as the local agent:

$$I_{MIG} = p_L LS \geq p_C C_{MIG} \qquad I_{INV} = p_K KS \geq p_C C_{INV} \tag{1a}$$

3.2 Consumption

Utility is modeled as a CES function of consumption in each period as shown in equation (2), where the parameter a_C is the share of consumption in time period t in overall utility and the parameter ρ_C is related to the elasticity of substitution between consumption in different time periods σ_C as follows: $\sigma_C = 1/(1-\rho_C)$. This elasticity can be adjusted to allow for varying levels of risk aversion:

$$U = \sum_t \left(\alpha_C C_t^{\rho_C} \right)^{1/\rho_C} \tag{2}$$

Consumption is modeled as a nested CES function as shown in equation (3), where consumers choose a utility-maximizing combination of goods from the import (M) and domestic (D) sectors. These privately produced goods are consumed in combination with goods produced by a public government sector (G):

$$C = G + \sum_g \left(\alpha_{DCg} D_g^{\rho_{DM}} + \alpha_{MCg} M_g^{\rho_{DM}} \right)^{1/\rho_{DM}} \tag{3}$$

As in the previous equation the parameter a_{DC} is the share of domestically produced good g in overall consumption and the parameter ρ_{DM} is related to the elasticity of substitution between domestic and imported goods σ_{DM} in the following manner, $\sigma_{DM} = 1/(1-\rho_{DM})$. The associated cost function includes the sales tax imposed on output sold in the region for private consumption, as shown in equation (3a). Each price is represented by a p followed by a subscript, so that p_{Dg} is the price of domestically produced good Dg and the parameter ?$_{DCg}$ represents the share of overall consumption spending p_C that is used for that particular good:

$$pC = pG + \sum_g \left(\theta_{DCg} (1 + t_{SLS}) pD_g^{1-\sigma_{DM}} + \theta_{MCg} (1 + t_{SLS}) pM_g^{1-\sigma_{DM}} \right)^{1/1-\sigma_{DM}} \tag{3a}$$

The government sector is set up in a similar manner to the private consumption sector, as shown in equation (4):

$$G = \sum_g \left(\alpha_{DGg} D_g^{\rho_{DM}} + \alpha_{MGg} M_g^{\rho_{DM}} \right)^{1/\rho_{DM}} \tag{4}$$

The cost function for the government sector shown in equation (4a) is also similar, except that the government does not pay sales taxes:

$$pG = \sum_g \left(\theta_{DGg} pD_g^{1-\sigma_{DM}} + \theta_{MGg} pM_g^{1-\sigma_{DM}} \right)^{1/1-\sigma_{DM}} \tag{4a}$$

3.3 Production

Producers of regional output (Y) are assumed to choose a profit-maximizing combination of inputs labor (L) and capital (K), as well as intermediate inputs of domestic (D) and imported (M) goods. Production is modeled using a nested constant elasticity of substitution (CES) formulation as shown in equation (5). Each parameter a followed by a subscript represents the share of that input in production. The nested CES function allows specification of different elasticities of substitution between primary inputs σ_{PF} =

$1/(1-\rho_{PF})$ than between intermediate domestic and imported inputs $\sigma_{DM} = 1/(1-\rho_{DM})$:

$$Y_S = \left(\alpha_L L^{\rho_{PF}} + \alpha_K K^{\rho_{PF}}\right)^{1/\rho_{PF}} + \left(\sum_g \alpha_{DYg} D_{gs}^{\rho_{DM}} + \alpha_{MYg} M_{gs}^{\rho_{DM}}\right)^{1/\rho_{DM}} \quad (5)$$

The associated cost function in equation (5a) shows that there is a subsidy for capital, s_{CAP}, which is initially set to zero:

$$p_Y = \left(\theta_L p_L^{1-\sigma_{PF}} + \theta_K (1-s_{CAP}) p_K^{1-\sigma_{PF}}\right)^{1/1-\sigma_{PF}} + \sum_g \left(\theta_{DYg} p_{Dg}^{1-\sigma_{DM}} + \theta_{MYg} p_{Mg}^{1-\sigma_{DM}}\right)^{1/1-\sigma_{DM}} \quad (5a)$$

Regional output is produced for either domestic (D) or export (X) consumption, using a constant elasticity of transformation (CET) function shown in equation (6). The CET function allows producers to move output between the local and export markets in response to changes in relative prices:

$$Y_S = \sum_g \left(\beta_{Dg} D_{sg}^{\tau_Y} + \beta_{Xg} X_{sg}^{\tau_Y}\right)^{1/\tau_Y} \quad (6)$$

The parameter $ß_{Dg}$ represents the share of output of domestically sold good g that is produced by sector s, and the parameter τ_Y is related to the elasticity of transformation η_Y in the following manner $\eta_Y = 1/(\tau_Y-1)$. The associated cost function includes the tax imposed on output produced in the region, t_{OUT}, as shown in equation (6a). The parameter f_{Dg} represents the share of revenue from sales of good g by sector s:

$$p_{Y_S}(1+t_{OUT}) = \sum_g \left(\varphi_{Dg} p_{Dsg}^{1+\eta_Y} + \varphi_{Xg} p_{Xsg}^{1+\eta_Y}\right)^{1/1+\eta_Y} \quad (6a)$$

3.4 Capital and Investment

The capital stock in sector s, K_s, depreciates over time at a rate δ, and is augmented over time in each sector by investment in that sector I_s as shown in equation (7). Investment in sector s comes from domestic output in that sector used to purchase capital. In addition, the capital stock can also be augmented by outside investment. The outside investment enters the capital stock production function in the same way that domestic investment does, although it does not directly take away from domestic output:

$$K_{st+1} = (1-\delta)K_{st} + I_{st} \quad (7)$$

3.5 Regional Closure

The results of regional CGE models are sensitive to the type of closure that is assumed, or how a region interacts with the outside world. Partridge and Rickman (1998) pointed out that CGE models have historically tended to use extreme assumptions of an immobile labor supply for short-run models or a perfectly mobile labor supply for long-run models. Rickman (1992) found that his results for a CGE model specifying flexible prices and imperfectly mobile factors produced predicted impacts that differed greatly from a model that specified fixed prices and perfectly mobile factors. Rickman and Treyz (1993) compared several different labor market closures in a regional model and found that one based on an assumption of an upward-sloping migration labor supply curve was the best in terms of forecast accuracy.

For the Pueblo region, from 1990 to 1999 the Bureau of Economic Analysis estimates that the real wage increased from $15,036 to $15,597, an annual increase of approximately 0.1 percent. As discussed earlier, the increase in the population due to net migration into the region during this period is estimated at approximately 1 percent per year. Based on the assumption that the average household is 2.7 persons, depending on whether one or two people work in the household the labor supply increases by between (1 / 2.7) = 37 percent and (2 / 2.7) = 74 percent of the increase in population for each migrating household. The increase in labor supply due to migration, is therefore, estimated at between 0.37 percent and 0.74 percent annually. This indicates a relatively elastic supply of labor (between 3.7 and 7.4) from outside the region with respect to changes in the real wage.

The regional CGE model, therefore, incorporates a relatively elastic supply of labor from outside the region in response to changes in the regional price of labor. Equations (8) below show the supply function for labor from outside the region LS used in the model. The supply function uses the relation between elasticity and the slope coefficient to explicitly incorporate the price elasticity of labor supply E_{LS}. This formulation results in increasing immigration as the sector-specific labor price increases, with the amount of the increase directly related to the elasticity of labor supply:

$$LS_s = E_{LS}\left({LS0_s}/{pl0_s} \right) pl_s \tag{8}$$

The supply of capital from outside the region is set up in a similar manner in equation (9), with the level of outside investment directly related to the elasticity of supply and the return to capital in sector s rk_s. The price elasticity of capital supply E_{KS} is also explicitly incorporated, and is assumed to have a value approximately double that of the elasticity of labor supply:

$$KS_s = E_{KS}\left({KS0_i}/{rk0_s} \right) rk_s \tag{9}$$

3.6 Benchmark

The general equilibrium model is set up using as a benchmark the 1998 IMPLAN data for Pueblo County. The benchmark data is used to assign initial prices and quantities, as well as shares for production and consumption functions. For example, the share of domestic output of good g consumed locally, $?_{DCg}$, is estimated based on the percentage of the consumption budget that goes to purchase domestic good g.

To solve the CGE model computationally, the production and utility functions described above are converted into a system of inequalities that fulfill the Walrasian general equilibrium conditions (supply-demand balance in each market, zero profits in production, income-consumption balance for each agent) in a mixed complementarity problem (MCP) as explained by Rutherford (1999). The MCP is then solved using GAMS Version 19.2 with MPSGE.

The benchmark data set is converted into a dynamic CGE model as described by Lau, Pahlke and Rutherford (2002). The regional economy is assumed to follow a steady-state growth path in the absence of economic development incentives equal to its population growth since 1985 of about 1.1 percent per year. The future is discounted at a real interest rate of 2 percent, and depreciation of the capital stock is set at 5 percent annually. The dynamic model is run from 2001 through 2020, a period of time assumed to be long enough for all impacts of the economic development incentives to take effect.

Because it allows for substitutability, the CGE model requires parameter values to be assigned for a variety of elasticities. To account for sensitivity to particular elasticities, a range of values was used for each of the parameters with each being assigned a benchmark as well as a lower and higher value. The range of parameter values is shown in Table 2.

Most elasticities were assigned a baseline value of 1.0, with a lower value of 0.5 and a higher value of 2.0, although the elasticity between domestic and imported goods was assigned a higher value of 4.0 since this elasticity is often estimated to be higher than others. This range of values is expected to be sufficient to identify sensitivity to changes in any elasticity. The elasticity of labor supply was initially set to 5.0, and the elasticity of capital supply was set to 10.0. These values reflect the relative responsiveness of migration to small changes in the real wage noted earlier, as well as the assumption that capital is even more mobile than labor.

Table 2. CGE Model Parameter Values

Elasticity between:	Lower	Baseline	Higher
Production:			
Primary Factors (PF)	0.5	1.0	2.0
Domestic and Imports (DM)	0.5	1.0	4.0
Domestic and Exports (DX)	0.5	1.0	2.0
Consumption:			
Time Periods (C)	0.5	1.0	2.0
Domestic and Imports (DM)		0.5	1.0
Migration:			
Labor Supply (LS)	2.0	5.0	8.0
Capital Supply (KS)	5.0	10.0	15.0

4. Results

The benchmark results were compared to an alternate scenario that approximates the economic development incentives in Pueblo, Colorado. This scenario includes a one-half percent increase in the sales tax, in which these funds are used to create a $1.5 million annual subsidy for capital in the export sector. In addition, the value of the land subsidy is incorporated as an additional $0.5 million subsidy on capital.

To account for sensitivity to elasticity parameter values, results are shown for the three elasticity combinations given in Table 2: a baseline set of values, a lower set of values, and a higher set of values. The results are presented in Table 3. The results show that the CGE model's projection of total jobs created ranges from 166 for the lower values to 569 for the higher values, with a midrange of 338 for the baseline. Output increases a total of $30 million per year when the model is run using the baseline values, with net total income after accounting for all impacts of the costs of funding the incentive increasing $8.36 million per year. Net total income is higher by $3.89 million when the model is run with the lower values and $10.68 million with the higher values.

Employee compensation and other property income increase by over $20 million in the baseline scenario, but this revenue goes largely to the new migrants and outside investors in this model. Revenues from sales and business taxes increase a total of $5.43 million in the baseline. Since the revenues from the increased sales tax are transferred directly to a subsidy to new business, the net increase indicates that there is a positive impact on overall tax revenues as a result of the economic development incentives.

Table 3. Projected Impacts of Economic Development Incentives, by Sector (Average Annual Changes, Dollar Values in Millions of 2000 $)

	EXP	SVC	RES	MFG	Total
Baseline Values					
Total Jobs	227	100	16	-5	338
Change in Real Wage	2.18 %	-0.07 %	0.16 %	-0.17 %	
Output	$22.57	$6.22	$1.97	-$0.73	$30.03
Employee Compensation	$6.16	$2.91	$0.65	-$0.19	$9.53
Other Property Income	$9.38	$1.69	$0.47	-$0.07	$11.47
Tax Revenue	$1.49	$2.59	$0.50	$0.85	$5.43
Lower Values					
Total Jobs	105	5310	-2	166	
Change in Real Wage	2.19 %	-0.08 %	0.16 %	-0.16 %	
Output	$10.44	$3.29	$1.21	-$0.30	$14.64
Employee Compensation	$5.03	$1.62	$0.54	-$0.11	$7.08
Other Property Income	$4.99	$0.89	$0.27	-$0.03	$6.12
Tax Revenue	$0.81	$2.37	$0.48	$0.83	$4.49
Higher Values					
Total Jobs	442	123	16	-12	569
Change in Real Wage	2.30 %	-0.08 %	0.06 %	-0.19 %	
Output	$44.01	$7.62	$2.02	-$1.65	$52.00
Employee Compensation	$7.66	$3.49	$0.47	-$0.39	$11.23
Other Property Income	$17.95	$2.07	$0.52	-$0.19	$20.35
Tax Revenue	$2.68	$2.70	$0.50	$0.86	$6.74

EXP: Export-Oriented Manufacturing MFG: Local Manufacturing
SVC: Service Businesses RES: Resource-Intensive Businesses

The capital subsidy encourages increased investment and output in the export sector relative to what would have happened in the benchmark, which increases the real wage in the export sector by over 2 percent. This encourages an inflow of labor into the export sector, but the real wage in the other sectors is virtually unchanged. While the model projects an increase of 227 jobs in the export-oriented manufacturing sector and 100 jobs in the service sector, the CGE model projects an increase of just 16 jobs in the resource-intensive sector and a small net decrease of 5 jobs in the local manufacturing sector.

This contradicts the conclusions of traditional input-output analysis, which would project a net increase in the local manufacturing sector as a result of indirect spending by the new businesses. Based on the net loss of jobs in this sector, it appears that the projected multiplier impact is offset by a substitution effect as capital is moved into the subsidized sector rather than other sectors. Rather than benefiting, once all impacts are accounted for, ex-

isting local businesses are actually harmed by the economic development incentives.

Combining the relatively insignificant wage increase with the cost of the subsidy relative to the increase in tax revenue, local residents are actually made worse off by the economic development incentives. When the model is run using baseline elasticity values, local income is lower by $6.22 million per year. This result is confirmed in the lower and higher elasticity value scenarios, where the drop in local income is $2.91 million per year for the lower values and $12.59 million per year for the higher values.

5. Conclusions

The CGE model analysis shows that economic development incentives produce some benefits for a region, but that the benefits are largely transferred to new businesses and migrants into the area who fill the jobs in those businesses. Once the negative impacts of the costs of the incentives are accounted for, it is likely that the original residents who pay for these incentives will be worse off than they would have been without them.

By attracting export-oriented businesses, an increase in output and jobs occurs in that sector. These new businesses and jobs tend to be widely publicized. But by subsidizing capital formation in a specific sector, a region's economic development is moved away from the path it would otherwise have taken. This means that jobs that would have been created in the local sectors do not materialize. Although these jobs that are not created do not appear in the newspaper, they represent an important negative impact of the economic development incentives.

These results address the seeming paradox that economic development can attract new businesses that result in new jobs, and yet be unpopular enough among local residents for them to vote against continuing it. Economic development needs to be sensitive to the needs of the local residents who finance it, and find ways to see that the local residents share in the benefits produced by this development. One way may be to use economic development funds for education and job training to improve the quality of the local labor force, in tandem with marketing efforts to attract businesses. A higher-skilled local labor force will increase real wages to those individuals over time, and will also make it easier to attract new businesses to the community. Retaining this higher-skilled labor force may be difficult for rural regions, however, as long as plentiful job opportunities exist in urban areas.

One reason that CGE models have not been used in the past for regional economic analysis is that they were expensive and difficult to develop, requiring programming skills beyond most local economic development economists. The regional model described here shows that a CGE model can be readily constructed from an IMPLAN data file, using GAMS and MPSGE software. These are all affordable software packages, and as described ear-

lier, a great deal of the documentation for developing and implementing CGE models is readily available.

Further research in this area will likely focus on identifying incentives for economic development that benefit local residents. One particularly interesting extension would be to incorporate the impact of incentives to improve the skill level of local residents. Another possibility is to include endogenous labor force participation to identify whether more business activity may increase employment of local residents. There may also be other benefits to local residents, such as increased home values, which could be identified in a more detailed regional model.

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