Sorting winners and losers: using CGE models to assess income distribution effects of economic development choices

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Abstract. Cities regularly face a wide range of economic development choices that inevitably create both winners and losers within their communities. Proper assessment of the impacts of such choices requires not only an appropriate modelling framework but also explicit understanding and incorporation of a city’s income distribution priorities. This paper proposes that a computable general equilibrium (CGE) model, which includes a structured social welfare function, can provide precisely such a tool to fully evaluate economic development choices, tradeoffs and implications. We leverage such a model for a small Colorado city and simulate sector-specific expansionary economic development policies. We apply the framework to understand the gains and losses of two distinct groups, namely original residents versus new arrivals, likely to be affected by such choices, alongside the welfare impacts to the city as whole.

JEL classification: R5, H7, O21

Key words: Local public economies, local economic development

1 Introduction

The devolution of economic development responsibilities from traditional federal and state entities to local levels, often referred to as ‘new federalism’, places a significant burden on cities (Rogers and Weiler 1995). Rather than merely relying upon state and federal government agencies to direct their way, cities are now forced to pursue these resources themselves. This pursuit can place them in competition with each other for these scarce resources, often effectively creating a zero-sum game between localities. This competition means that a city’s economic development efforts must be efficient, thereby maximizing their chances of success.

There are many different methods for evaluating how efficient an economic development strategy might be (Reese and Rosenfeld 2001). However, these methods can lead to possibly idiosyncratic representations of local development politics and present difficulty for local
officials who face the temptation to over generalize. Therefore, there is a need for an evaluation method that allows a city to modify an evaluative tool to meet its own specific characteristics, but flexible enough to allow for comparison across cities. As Reese and Rosenfeld (2001, p. 301) note, there is a need “to describe the unique character of each community that produces such a decision, stepping back from the macro analysis and seeking patterns among the idiosyncrasies”.

A city’s development decision is complex across both space and time. There are spillover effects into neighbouring localities. Development’s positive and negative aspects can affect another city’s residents through such variables as traffic congestion, crime, housing demand and labour market demand. Additionally, economic development’s effects reveal themselves over time. While a city’s original residents may make the initial economic development decision, labour migration implies that those original residents are not the only individuals who will be experiencing the benefits and costs of that decision. Economic development officials serve more than one constituency through these intertemporal and interspatial linkages.

Finally, while an economic development programme may be efficient, its implementation may alter income inequalities. In this sense, local officials must also decide how much inequality they are willing to tolerate in their pursuit of economic development. This question fundamentally reduces to how individuals are viewed – does the city take an egalitarian approach and value every individual equally or does it place a greater weight on the welfare of the less advantaged? In evaluating development’s expected benefits, a city must also either implicitly or explicitly reconcile the community’s stance on income inequality.

This work will address these pervasive economic development issues by developing an evaluation technique that includes distributional equity concerns using the results of a small city computable general equilibrium (CGE) model of Fort Collins, Colorado as an example. As Leatherman and Marcouiller (2004) note, the CGE approach is ideally suited for policy and economic impact analysis, as it is sufficiently flexible and unconstrained to provide useful representations of a diverse regional economy and the complex interactions within it. The empirical results generated by the CGE model clearly illustrate how Fort Collins’s chosen stance on income inequality will influence its choice of economic development projects. Additionally, we also demonstrate how a development proposal’s benefits are distributed across Fort Collins’s original and new residents, highlighting the often neglected difficulties and tradeoffs of development decisions.

2 Choosing the appropriate analytical framework

As Voytek and Ledebr (1991, p. 176) note, “communities and economic development professionals are faced with an almost bewildering array of industries and businesses on which to focus their economic development efforts”. Guiding this decision is an equally wide array of data collection and economic modelling techniques. A further complication for this decision is the reality that economic development has not blessed communities equally. Thus, there are some regions that lag behind others. Yet even among advantaged regions, there are winners and losers from economic development choices that nevertheless yield overall region-wide economic gains. Such internal inequalities from policy decisions are far less studied than differences in economic status between regions, in part because the tools to assess such internal inequalities are more complex than simple inter-regional comparisons. This paper’s approach bridges that methodological gap.

There has been significant research presenting the types of local economic incentive packages that are available to communities in a systematic way by analysing how those packages might be received by interested firms, as well as the ramifications of these different packages’
financing upon an individual firm’s tax liabilities (Rasmussen et al. 1982). In general, such approaches rely on partial equilibrium, often single-sector applications of cost-benefit analysis. While useful for understanding a single vantage point of a particular economic development policy, these analyses miss both the interaction between sectors, as well as the resulting sector-specific outcomes from policy changes.

Cost-benefit analysis argues that development should be pursued only when the costs are outweighed by the benefits (Bartik 1991). The calculation of these costs and benefits can be a difficult matter. While the explicit cost of a development program may be obvious in the form of tax incentives and rebates, what is not as obvious is the hidden opportunity cost such a program represents (Testa and Allardice 1988). Likewise, the determination of the benefit recipients and those who shoulder the burden of the costs is not necessarily straightforward. While the original residents may make the initial development decision, a project’s benefits may be disproportionately enjoyed by new city residents (Bartik 1993; Partridge et al. 2009). A further difficulty of cost-benefit analysis is the intertemporal effect upon prices and incomes. For example, local government expenditures and taxation are often capitalized into a city’s property values. In this way, a development project can affect not just the targeted industry sector, but also seemingly unrelated sectors by virtue of intersectoral linkages that would not be captured by a partial equilibrium analysis.

The ability to model these intersectoral linkages is the strength of the CGE model (see Partridge and Rickman 1998, for a comprehensive review of regional CGE models). By incorporating an input-output (I-O) model’s intersectoral linkages and a social accounting matrix’s (SAM) regional disaggregation of income to households, government, and exports, the CGE model allows for a nonlinear, endogenous solution that reveals a city’s relative price changes. By using a CGE model, we better encompass an holistic view of the local economy, incorporating the intended (and unintended) consequences of an economic development policy across all household groups, industries, and governments. Because the CGE includes local price changes, we can calculate a city price index (CPI) and better analyse real income and price changes resulting from changes in local labour demand. Similarly, the CGE model can reflect the locational heterogeneity of a city by modelling how workers fit into households. In this way, we can track how changing labour demand in an industry affects household incomes.

This ability to reveal how economic development can affect household incomes is an important tool in our evaluation technique. Rather than relying upon total income changes, the CGE model allows us to demonstrate how particular household groups may gain (or lose) from economic development. These gains and losses show how residents’ welfare can change. For example, while landowners may reasonably expect to benefit from higher land values, those community residents who do not own land or capital may see declines in their relative welfare as capital and land prices rise.

3 Building the community’s social welfare

In order to objectively assess gains versus losses between individuals due to changes in economic circumstances, we must incorporate a social welfare function (Boadway 1974; Sen 1977). A social welfare function allows us to make rational evaluations of welfare evolutions among a community’s citizens that explicitly include a normative weighting of the importance of equity in income distribution. We can use the same social welfare function to express a variety of perspectives on inequality, simply by choosing different aversions to social inequality (as expressed through income distribution). This choice represents a city’s willingness to tolerate unequal incomes (or a greater disparity between winners and losers), in its pursuit of economic development.
We utilize a social welfare function of the Bergson-Samuelson type (Bergson 1938; Samuelson 1947), whereby the social welfare function \( W \) is stated as a function of the vector of utilities \( U \) for all community residents

\[
W = W(U_1, U_2, \ldots, U_n)
\]

(1)

where \( n \) is the number of community residents, \( U_i \) is each resident’s utility level, and \( W \) is the overall welfare of the community. Taking the total size of residents’ utilities \( W \) as given, it is important to compare alternative distributions of this fixed total. The social welfare function allows one to capture these alternate distributions by capturing a community’s value judgements.

A community’s value judgements are indicated through the use of distributional weights for each individual. The actual value attached to an individual’s distributional weight depends upon society’s aversion to inequality in its income distribution. The best illustration is to examine the two extremes: If a society has an infinitely large aversion to income inequality, then it ascribes to a Rawlsian maxi-min philosophy, (meaning that it will not do anything to exacerbate its current income inequality and will only approve projects which reduce that inequality). In contrast, if a society has no aversion to income inequality (in other words, if its aversion were equal to zero), then it ascribes to a ‘Benthamite Utilitarian’ philosophy of social welfare, namely, “the principle of the greatest happiness of the greatest number”.

Because an economic development project necessarily implies a change in welfare, we proxy this change in welfare through changes in individual incomes. While income is not a perfect measure of welfare, it is readily available and easily measured. This welfare change (in terms of income, \( Y \)), can be stated formally as:

\[
\Delta W = \sum d_i Y_i^{-\eta}
\]

(2)

where \( d_i \) is an individual’s marginal contribution to social welfare multiplied times his or her’s marginal utility of income \( [(\Delta W/\Delta U_i)(\Delta U_i/\Delta Y_i)] \) and \( \eta \) is the elasticity of social welfare in response to a change in an individual’s marginal utility of income. If \( d_i = 1 \), this situation represents egalitarianism, implying that every individual in the community has exactly the same social weight as any other. In other words, the weight given to a person’s utility change is exactly equal to the weight given to any others. In contrast, as the value of \( \eta \) approaches infinity, the value of \( d_i \) approaches infinity as well, meaning that a person’s utility change is given an infinitely large weight in the calculation of society’s welfare. Any level of social aversion to inequality which is between these extremes of zero and infinity shows that society has some concern for the well-being of the less fortunate, but not to the extent of the Rawlsian maxi-min position where \( d_i \) would approach infinity.

To incorporate such distributional concerns, we include individual distributional weights. One method of deriving an individual’s distributional weight is by following Brent (1996) comparing individual income to the mean social income

\[
d_i = \frac{Y_i^{-h}}{\bar{Y}^h}
\]

(3)

where a person’s distributional weight, \( d_i \), is equal to \( Y_i \), his or her individual income, divided by a community’s mean social income, \( \bar{Y} \), both of which are adjusted by \( h \) which represents the

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1 Assuming identical preferences, the Utilitarian approach does allow income redistribution from the rich to the poor if one assumes diminishing marginal utility of income.
community’s stated social aversion to inequality. If \( h \) is set equal to 1 following common convention (Squire and van der Tak 1975), then the individual’s income is seen as a proportion of the community’s mean income. In other words, if he or she only earns one quarter of the mean income, then his or her distributional weight is four times that of someone earning the mean income.

Another alternative method of deriving distributional weights is outlined by Feldstein (1972). By using the ‘distributional characteristic’ of a product to attach distributional weights to a project’s output, the weighting scheme forms a component of the shadow prices, combining efficiency with distribution. This method is predicated upon the realistic assumption that the poor and rich in society have different consumption patterns. The consumption of particular goods, like food, housing and clothing, are then used to weight the utility of particular individuals by identifying the percentage of income an individual spends upon each of the goods in question.

We expand upon this social welfare analysis by developing a distributional weighting scale, which represents a combination of both Brent’s (1996) and Feldstein’s (1972) ideas. Here, the consumption patterns of an income group, as well as its income relative to that of the community’s mean income, are used to determine the distributional weighting used in the model. Instead of using an \textit{a priori} set of distributional weights like Feldstein, here the consumption patterns contribute directly to the calculation of the distributional weighting scheme. Likewise, these distributional weights surpass Brent’s by including a consideration of individuals’ consumption patterns rather than relying solely upon income. The distributional weights we use here can be defined as:

\[
d_i = f \left[ \frac{Y_i - h}{\bar{Y} - h} \right]
\]

where \( f \) is the percentage of a household group’s income which is spent on food, \( Y_i \) is the income level of a household group, \( \bar{Y} \) is the community’s mean income, and \( h \) is the chosen social aversion index. As a community increases its value of \( h \), its tolerance for income inequality diminishes which will lead to the poorer households receiving greater distributional weights, \( d \).

Because of the presence of a large research university, there are a large number of students in Fort Collins, and it is necessary to incorporate this characteristic into our analysis. The lowest two income groups have the highest incidence of students; however, this is not likely to be a long-term situation for them since the majority will move into higher income groups upon graduation. Because students are assumed to be transient members of the poor, their proportion is subtracted from each income group’s population. The variable \( s \) in Equation 5 below removes the student population from the lowest two household groups while retaining the working poor population of Fort Collins.

\[
d_{1,2} = f \left[ (1 - s) + (0.6s) \right] \left[ \frac{Y_i - h}{\bar{Y} - h} \right]
\]

Therefore, we attempt to capture the permanent, non-student members of the household groups, \( 1 - s \), as well as the working students, \( 0.6s \), which is based upon an student survey performed by the university in 2001 (Colorado State University Office of Institutional Research 2001).

It should be noted that this method of distributional weighting could be augmented by more products. Food is included here because it closely follows Engel’s Law, that the demand for food is income inelastic. The implication of this theory for the distributional weights means that the larger the percentage of income spent on food, the larger distributional weight that income group will receive. Obviously, this is an implied value judgement due to the nature of demand for food.
– those who spend more on food will always receive a greater weight than those who spend less. However, we argue that the rich see a smaller increase in marginal utility for equal increases in income than the poor, so in calculating the marginal social utility of income (the true goal of any distribution weight), the rich will receive a smaller weight than the poor. This concern is not counter to the city’s decision to choose how much income inequality it will tolerate. By including consumption within the distributional weighting scheme, the city can choose an egalitarian approach and still include a consideration for the poor.

By relying on easily observable income changes, this simple welfare function will illustrate that the level of social aversion to inequality chosen by a community matters. While admittedly there are more complex social welfare functions in the literature, a parsimonious approach does not alter nor detract from the ultimate findings and their implications.

Our approach then explicitly incorporates this modified distributional weight into our social welfare function, along with an explicit a priori selection of social aversion to inequality. By explicitly utilizing distributional weights, we allow for greater sophistication in analysing exactly how various groups of residents are affected by economic development.

4 Constructing the empirical

4.1 The local economy framework

The results of our approach will be illustrated using the empirical results of a static, computable general equilibrium model of Fort Collins, Colorado derived from Schwarm and Cutler (2003) and further described in Schwarm and Cutler (2005) and Cutler and Davies (2007).\(^2\) One of the first CGE models to fully model the interrelatedness of economic sectors at the city level, the Fort Collins CGE model has quickly shown its versatility in modelling the possible effects of a variety of economic policies and situations. This model has been successfully used to illustrate how employment effects in different sectors can affect economic growth, labour markets, and migration (Cutler and Davies 2007) in addition to the effect of a change in the US sales tax rate on a small city (Cutler and Strelnikova 2004), and the efficacy of using the tourism sector as a method of economic development (Burnett et al. 2007). To date, while the model has been used to focus on one sector’s role in economic development or the effect of fiscal policy changes, it has not been used to demonstrate that incorporating distributional considerations into a community’s decision-making framework may affect its choice of economic development policies.

There are 18 productive sectors, three factors, four housing sectors, six household sectors, a combined state/federal government sector, and five local government sectors. The model simulates a small open economy and includes local commuting and regional trade. The size of the local economy dictates a shadow exchange rate based upon the relative attractiveness of local capital, compared to the unlimited supply assumed to be operating in the rest of the world. Local residents who are dissatisfied with a minimum federal social safety net established by taxation and transfers may leave the local economy while other residents move in through a labour migration function. Simulation results are illustrated through changes in the gross city product, household income, exports, price level, and tax revenue variables.

All of the production sectors use three primary factors: land, labour and capital. Labour is further disaggregated into three skill groups, based on income. Each sector produces a

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\(^2\) The model’s closure equations, labour and land markets, and elasticities are presented in detail in these papers.
composite commodity that can be transformed into supply for domestic consumers and exports to the rest of the world (Armington 1969). Producers are assumed to maximize profits subject to their production technology.

Domestic consumers are divided into six household groups depending on their income levels. In this economy, the representative consumer maximizes a utility function subject to a budget constraint, which equals the revenue of the three primary factors less income taxes on labour in addition to any private and governmental transfers. This income is expended on demand for private goods, housing, savings and net transfers abroad. Within the optimization process, households determine the optimal quantities of composite private goods, which are imperfect substitutes of local and imported commodities.

The government is modelled at both the state/federal level and local level. The state/federal level collects income taxes, including payroll taxes such as Social Security, pays lump-sum transfers to the cities and households, and purchases inputs from the private productive sectors. For the state/federal level of this model, community-derived revenue does not have to equal expenditure. The local government level generates revenue through a property tax, sales tax and use tax. The local government also receives block grants as lump sum transfers from the federal/state level. The expenditure of this money is explicitly modelled with five local government sectors (police, transportation, fire, parks & recreation, and administration). These sectors hire labour and purchase from the productive sectors but are not profit maximizers.

Investment is modelled as an open flow. While local conditions may affect the availability of investment, domestic savings is fundamentally unrelated to the available investment capital of the town or region. Thus, saving is modelled as a residual function.

The foreign sector is taken to be the rest of the world which may be outside the region but still in the same country. In this way, the community is a small and open economy within the rest of the world, so world prices are treated as exogenous. Armington’s (1969) approach assumes that imports are imperfect substitutes for similar domestic commodities, thereby limiting the possibility of complete domestic consumption of foreign imports. For model closure, a trade balance is imposed with respect to the rest of the world, accounting for any surplus.

In line with the small open economy assumption, the intermediate and final demand goods consumed within the economy are a composite of both imported and domestically produced goods. Any excess necessary to balance the market is exported outside the economy to the rest of the world. The domestic labour market is cleared by a combination of existing resident workers, commuters, and finally new residents, preferentially selected by local labour demand in that respective order. The domestic supply of land in the economy is assumed to be fixed and includes some finite amount of undeveloped land. Capital is assumed to have free entry and exit in whatever quantities is necessary to clear the market. Finally, the local government is required to maintain a balanced budget.

4.2 Data

Data was collected on population, employment, wages earned, output, capital stock, land use and services supplied by the city in the study. For firms Impact Analysis for Planning was used to determine the initial parameters for intermediate good demand. These were modified to adjust for local conditions using expenditure surveys where available. Additionally Unemployment Insurance records were combined with ES-202 [now known as the Quarterly Census of Employment and Wages (QCEW)] data to determine wages earned by each worker for the four quarters of 1999. Estimates of commuting into and out of each city were obtained by feeding census time-to-work data through a gravity model to determine quantity and location.
4.3 Simulations

To illustrate the differences between choices of social aversion, five sectors in the economy are expanded one at a time in the Fort Collins economy. The specific sectors chosen, manufacturing, computer manufacturing, high services, retail, and the university/junior college sectors, are a representative mix of those industries typically targeted for economic development. As will be ultimately shown, one must conclude that Fort Collins’s choice of development path does indeed depend upon its chosen social aversion to inequality.

To execute the simulations for these sectors (excluding retail), the industry’s world price was increased to simulate the effect of an increase in the rest of the world’s demand. In other words, while these sectors experienced no real change in the actual production of the goods and services they produce, these four sectors encountered either increased demand by consumers outside the community or saw external conditions that affected their availability. The net effect is that products produced by these sectors possess greater value compared to goods produced by other sectors within the community. This greater value creates an increased demand for labour within each affected sector.

In contrast, the retail simulation was performed differently. Though Fort Collins’s retail exports have anecdotally been increasing, a significant portion of retail is still sold locally; therefore, to create an expansion of 1,000 new jobs in the retail sector (such as a new shopping centre), capital stock must also be increased. The presence of this new retail will also attract consumers from outside the area; therefore, the world price of retail is also increased to show the increased attraction of the community’s retail sector for the surrounding area.

5 Deriving the distributional weights

Because our approach explicitly seeks to consider the Fort Collins’s social welfare, the community’s composition is important. This approach isolates the original residents from the new residents who migrate into the city as a result of the simulated economic expansion. The original residents are those individuals who made the initial decision whether or not to pursue economic development and which type of economic development would best maximize social welfare. Since these individuals are self-interested, they evaluate their own welfare and not the welfare of any eventual new residents.

Following Squire and Van der Tak (1975), a community’s initial aversion to inequality will be equal to 1.0. It is important to note that this value does not imply that there is no aversion (where \( h = 0 \)), merely that there is some base-level consideration for the poor. From this initial starting position, the community’s aversion is modelled as a geometric expansion and contraction so as to simulate varying levels of social aversion to inequality. These values are designed to emulate different types of social welfare functions and are shown in Table 1.

If the community’s aversion to social equality equals zero, then each household group has the same distributional weight, excepting the influence of food consumption as well as the student population for lowest two household groups. Without these variables, the distributional weight for each household group will equal 1.

Values assigned for \( h \) are inserted into Equation 4 above thus determining the distributional weighting scale associated with each level of social aversion to inequality. This formula utilizes the city’s mean income as well as the mean income of each household group, both of which are presented in Table 2.

When the values for \( h \) derived from Table 1, the mean incomes per household group from Table 2, and the food consumption patterns and the percentage of students in each household
When the group are inserted into the distributional weighting formula, Equation 4, a distributional weighting scheme results which is shown in Table 3. The distributional weight, \( d \), given to the poorest household group (HH1) grows significantly larger as the community’s aversion to inequality grows which is shown here by geometrically larger values for \( h \). This implies that as the community increasingly abhors inequality in income, a dollar given to a household in HH1 will mean increasingly more to the community’s overall social welfare level than a dollar given to a household in HH5 or HH6.

Following the discussion of Feldstein’s weighting method mentioned previously and as demonstrated in Equation 4, one can see that the larger the proportion of income that a household group spends upon food consumption, \( f \); the larger the resulting distributional weight. This relationship follows Engel’s Law and serves to re-enforce the larger distributional weights \( (d) \), being given to the lower household groups. However, this effect is mitigated somewhat by the large percentage of students present in the poorest household group since their low-income status is assumed to be temporary.
6 Applying the model to assess local economic impacts

6.1 Original residents

To test the validity of considering income distribution in evaluating economic development, we will separate the CGE model’s results, considering both the original and new residents to Fort Collins.

As mentioned previously, raising a sector’s world price increases sectoral labour demand in Fort Collins by 1,000 workers, thereby creating additional income for households. Residents earn income from three factors of production: land, labour, and capital. The proportion of each simulation’s new income that accrues solely to the original residents is determined by the original residents’ ownership of the factors of production. Once the expansion of a sector occurs, the original residents are no longer the only ones affected by the decision. Therefore, to gain a greater understanding of how the expansion will ultimately affect the economy, we also examine the expansion’s effect for new residential households.

Because each expansion will cause a general increase in the domestic demand for capital, original residents will see their income grow by the growth rate in the rental rate of capital multiplied by the original amount of capital in the city for every sector and housing services group. However, this expansion also increases domestic capital stock beyond its initial value, and the original residents will own some of this new capital. Therefore, the original residents’ new capital is multiplied by the new rental rate for capital and summed across all the productive sectors and housing services groups and then added to the original residents’ initial capital stock. This sum is then multiplied by the final return rate of capital. Finally, we decomposed original residents’ total income from capital into each of the six household groups. Since land factor income is treated in a similar fashion within the CGE model, the steps taken to calculate the original residents’ income from land is identical to that from capital.

Calculating labour income follows a different pattern from that described above. The growth rate in wages for all three labour groups is multiplied by the original income level to determine the new level of wages across the city. This income is then decomposed into the six household groups. For example, the lowest household group (HH1) only has workers from the lowest labour group (L1), but HH2 has workers from both L1 and L2. This decomposition is carried out for all six household groups.

The sum of the nominal and real income changes for original residents generated by capital, land and labour is summarized in Table 4. Each column illustrates the incremental increase in income for each household group that would be generated by each of the simulations; therefore, the sum of each column yields the total increase in income for the original residents of the city.

<table>
<thead>
<tr>
<th>Household (HH)</th>
<th>Manufacturing Nominal</th>
<th>Manufacturing Real</th>
<th>Computer manufacturing Nominal</th>
<th>Computer manufacturing Real</th>
<th>Retail Nominal</th>
<th>Retail Real</th>
<th>High services Nominal</th>
<th>High services Real</th>
<th>University/junior college Nominal</th>
<th>University/junior college Real</th>
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</thead>
<tbody>
<tr>
<td>HH1</td>
<td>0.133</td>
<td>0.132</td>
<td>-0.011</td>
<td>-0.011</td>
<td>0.213</td>
<td>0.213</td>
<td>0.108</td>
<td>0.108</td>
<td>-0.074</td>
<td>-0.074</td>
</tr>
<tr>
<td>HH2</td>
<td>0.794</td>
<td>0.791</td>
<td>-0.152</td>
<td>-0.151</td>
<td>0.863</td>
<td>0.862</td>
<td>0.447</td>
<td>0.446</td>
<td>-0.281</td>
<td>-0.280</td>
</tr>
<tr>
<td>HH3</td>
<td>1.228</td>
<td>1.224</td>
<td>0.722</td>
<td>0.719</td>
<td>1.194</td>
<td>1.193</td>
<td>0.880</td>
<td>0.878</td>
<td>1.091</td>
<td>1.089</td>
</tr>
<tr>
<td>HH4</td>
<td>0.443</td>
<td>0.442</td>
<td>0.310</td>
<td>0.308</td>
<td>0.440</td>
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<td>0.331</td>
<td>0.330</td>
<td>0.446</td>
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<tr>
<td>HH5</td>
<td>1.420</td>
<td>1.415</td>
<td>1.254</td>
<td>1.249</td>
<td>1.625</td>
<td>1.624</td>
<td>1.105</td>
<td>1.103</td>
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<tr>
<td>HH6</td>
<td>2.679</td>
<td>2.671</td>
<td>6.611</td>
<td>6.583</td>
<td>2.509</td>
<td>2.508</td>
<td>2.294</td>
<td>2.290</td>
<td>2.858</td>
<td>2.854</td>
</tr>
</tbody>
</table>

Table 4. Nominal and real income changes for original residents (in millions of dollars)
community. A comparison of the totals across the bottom row shows that an expansion of the computer manufacturing sector would give the original residents the largest overall increase in income, largely due to the income received by the wealthiest household group, HH6.

To adjust this nominal income for price changes, the original residents’ initial total incomes is adjusted using the model’s original CPI while the residents’ new total income is adjusted using the new CPI. A negative number in Table 4 represents a decline in real income while a positive number represents an increase. No matter which simulation is run, the wealthiest household group, HH6, sees the largest increase in income. However, the community’s original residents in HH1 and HH2 experience a decline in real income when the computer manufacturing sector expands as well as when the university/junior college sector expands.

Because real income falls as prices rise faster than income, we presuppose that the income earned by these lower household groups is not growing as quickly as the CPI changes they face. This situation could be the result of a smaller increase in demand for lower-skilled labour or smaller growth rates for the returns to capital and land owned by these household groups.

When income is translated into real terms, one sees that the poorest original residents of the community are worse off due to an expansion of computer manufacturing or university/junior college sectors. If decision-makers only consider the total income change for Fort Collins, then computer manufacturing presents an attractive target for economic development, as shown by the highest column total in Table 4. This mindset would correspond to a social aversion to inequality equal to zero – every resident has an equal weight to any other. There is some logic to this approach in that it could be argued that those who benefit from this type of development could, in theory, more than compensate the losers (HH1 and HH2), for their loss. Indeed, that this is a theoretical possibility may be viewed by some as sufficient justification for the expansion of computer manufacturing.

That the column totals in Tables 4 are positive suggests that the increased real incomes of the upper household groups would offset any decrease for the lower household groups; however, this conclusion relies upon each household receiving an equal distribution weight. Would this conclusion change if Fort Collins has a stronger aversion to income inequality?

This question can be answered by adjusting the real income totals for Fort Collins’s original residents (Table 4) with the distributional weights derived in Table 3. These new distributionally adjusted totals are presented in Table 5 with the preferred sector expansion for each level of aversion to social inequality denoted with an asterisk (*). As one moves down each sector’s column, Fort Collins’s aversion to social inequality grows stronger (as the value of h increases). This stronger aversion gives the lower household groups larger distributional weights than the upper household groups within the income totals. Once this adjustment takes place, computer

<table>
<thead>
<tr>
<th>Aversion choice</th>
<th>Manufacturing</th>
<th>Computer manufacturing</th>
<th>Retail</th>
<th>High services</th>
<th>University/junior college</th>
</tr>
</thead>
<tbody>
<tr>
<td>h = 0</td>
<td>5.982</td>
<td>7.458*</td>
<td>6.150</td>
<td>4.587</td>
<td>4.259</td>
</tr>
<tr>
<td>h = 0.125</td>
<td>5.995</td>
<td>7.090*</td>
<td>6.187</td>
<td>4.562</td>
<td>4.109</td>
</tr>
<tr>
<td>h = 0.5</td>
<td>6.213</td>
<td>6.135</td>
<td>6.488*</td>
<td>4.612</td>
<td>3.712</td>
</tr>
<tr>
<td>h = 1</td>
<td>6.982</td>
<td>5.146</td>
<td>7.417*</td>
<td>5.010</td>
<td>3.260</td>
</tr>
<tr>
<td>h = 2</td>
<td>10.984</td>
<td>3.768</td>
<td>12.118*</td>
<td>7.447</td>
<td>2.211</td>
</tr>
<tr>
<td>h = 4</td>
<td>48.430</td>
<td>–0.192</td>
<td>57.848*</td>
<td>31.699</td>
<td>-8.326</td>
</tr>
<tr>
<td>h = 8</td>
<td>2274.121</td>
<td>–261.435</td>
<td>3124.937*</td>
<td>1606.559</td>
<td>–1000.884</td>
</tr>
<tr>
<td>h = 16</td>
<td>16140831.157</td>
<td>–1472687.350</td>
<td>25415831.527*</td>
<td>12900899.372</td>
<td>–8797854.224</td>
</tr>
</tbody>
</table>

Note: Preferred sector expansion for each level of aversion to social inequality denoted with an asterisk (*).
manufacturing, which seemed so appealing without any consideration for distributional equity, quickly loses its lustre, in large part because real income falls for poorer households under this expansion. In contrast, expanding the retail sector looks increasingly attractive because of its relatively more modest gains for the lower household groups. Interestingly, if decision-makers follow convention (Squire and Van der Tak 1975), and begin with an initial social aversion to inequality of 1.0, an expansion of the computer-manufacturing sector is never perceived as a welfare improvement (as measured by an increase in the city’s total income).

This result illustrates that Fort Collins’s choice of social aversion does matter significantly in deciding which economic development policy it chooses to pursue. Whether explicitly recognized or not, this choice is faced by every city (or state), that seeks to pursue targeted economic development policies and can profoundly influence both the economy’s development path and its income distribution for many years.

6.2 New versus original residents

While this decision is made by the original residents of Fort Collins, it does not solely affect them. The increase in local labour demand will serve as an attractant for new in-migrants into the city. In addition, the local student population will be affected by the economic development decisions undertaken by city leaders. Thus, the results of any sectoral expansion will be shared among several groups, but only one will make the initial decision to pursue expansion.

We can see from the positive income changes to every household group in Table 6 that new residents will benefit from any chosen expansion. This result is unsurprising because a household would not choose to move to Fort Collins unless the move represents a positive income change. Interestingly, new residents predominantly enjoy the increased income while original residents receive a much smaller percentage of the benefits.

A large influx of new residents that are not receiving correspondingly large incomes can actually lead to a decrease in the city’s mean income. In addition, depending upon the speed of the city’s expansion, the new residents may or may not be welcomed as a boon to the local economy. Specifically, wages may not adjust quickly enough to keep up with the new increased level of prices caused by the influx of new residents. Therefore, it is also important to note which simulation will yield the largest number of low-income residents vs. high-income residents. These results are shown in Table 7.

An expansion of the computer-manufacturing sector would provide the largest total increase in the number of new households while expanding the university/junior college sector would provide the least. Interestingly, the computer manufacturing sector also provides the highest increase in percentage of low income households, 23.2 per cent of the total new households created by its expansion while expanding the retail sector would provide the smallest increase in percentage of low income households with only 19.73 per cent of the total new households created by its expansion.

Table 6. Distributionally unadjusted real income changes to new residents (in millions of dollars)

<table>
<thead>
<tr>
<th></th>
<th>Manufacturing</th>
<th>Computer manufacturing</th>
<th>Retail</th>
<th>High services</th>
<th>University/junior college</th>
</tr>
</thead>
<tbody>
<tr>
<td>HH1</td>
<td>0.904</td>
<td>1.478</td>
<td>0.428</td>
<td>0.445</td>
<td>0.352</td>
</tr>
<tr>
<td>HH2</td>
<td>1.894</td>
<td>3.272</td>
<td>1.242</td>
<td>1.302</td>
<td>0.785</td>
</tr>
<tr>
<td>HH4</td>
<td>2.429</td>
<td>3.524</td>
<td>0.920</td>
<td>0.671</td>
<td>0.314</td>
</tr>
<tr>
<td>HH5</td>
<td>8.569</td>
<td>9.928</td>
<td>2.913</td>
<td>2.369</td>
<td>1.834</td>
</tr>
<tr>
<td>HH6</td>
<td>20.092</td>
<td>42.895</td>
<td>6.226</td>
<td>8.642</td>
<td>7.084</td>
</tr>
<tr>
<td>Total</td>
<td>43.446</td>
<td>75.510</td>
<td>15.795</td>
<td>17.304</td>
<td>14.523</td>
</tr>
</tbody>
</table>
### Table 7. Number of new resident households, in numbers and as percentage of total HH

<table>
<thead>
<tr>
<th></th>
<th>Manufacturing</th>
<th>Percentage</th>
<th>Computer manufacturing</th>
<th>Percentage</th>
<th>Retail</th>
<th>Percentage</th>
<th>High services</th>
<th>Percentage</th>
<th>University/junior college</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>HH1</td>
<td>103</td>
<td>20.83</td>
<td>219</td>
<td>23.20</td>
<td>75</td>
<td>19.73</td>
<td>68</td>
<td>20.68</td>
<td>64</td>
<td>20.22</td>
</tr>
<tr>
<td>HH2</td>
<td>76</td>
<td>15.38</td>
<td>142</td>
<td>15.08</td>
<td>60</td>
<td>15.92</td>
<td>53</td>
<td>16.15</td>
<td>49</td>
<td>15.63</td>
</tr>
<tr>
<td>HH3</td>
<td>172</td>
<td>34.74</td>
<td>332</td>
<td>35.22</td>
<td>133</td>
<td>34.93</td>
<td>113</td>
<td>34.72</td>
<td>114</td>
<td>36.11</td>
</tr>
<tr>
<td>HH4</td>
<td>23</td>
<td>4.63</td>
<td>40</td>
<td>4.29</td>
<td>18</td>
<td>4.72</td>
<td>15</td>
<td>4.57</td>
<td>14</td>
<td>4.50</td>
</tr>
<tr>
<td>HH5</td>
<td>72</td>
<td>14.61</td>
<td>121</td>
<td>12.82</td>
<td>59</td>
<td>15.47</td>
<td>47</td>
<td>14.51</td>
<td>45</td>
<td>14.35</td>
</tr>
<tr>
<td>Total</td>
<td>494</td>
<td>943</td>
<td>380</td>
<td>327</td>
<td>317</td>
<td>9.19</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The composition of the new households created is important since it can be argued that low income households are consumers of larger amounts of certain types of public goods and services than higher income households; however, under progressive income tax or proportional property tax systems, these households would pay less taxes to the local and county governments. Higher income households also demand public goods and services, but the higher tax revenues collected from these households counterbalance the public goods consumed.

When one does not isolate the welfare of original residents from the welfare of all eventual residents (new plus original residents), the optimal expansion choice now changes to favour computer manufacturing, as shown by the incomes enjoyed by all residents under all five simulations in Table 8. Interestingly, computer manufacturing results in the largest increase in income for all residents, while the optimal choice (given $h = 1$), of the city’s original residents, retail, results in the second smallest increase in income for all residents. This situation makes it apparent that the benefits that stem from expanding computer manufacturing are enjoyed largely by the new residents moving into the community while the benefits of expanding the retail sector are enjoyed largely by the original residents. Even when these results are adjusted with distributional weights, the conclusion still holds that while the original residents would choose retail expansion over computer manufacturing, the new combined set of residents would rather have chosen computer manufacturing.

### Table 8. Real income changes for all residents as result of simulation (in millions of dollars)

<table>
<thead>
<tr>
<th></th>
<th>Manufacturing</th>
<th>Computer manufacturing</th>
<th>Retail</th>
<th>High services</th>
<th>University/junior college</th>
</tr>
</thead>
<tbody>
<tr>
<td>HH1</td>
<td>1.036</td>
<td>1.468</td>
<td>0.641</td>
<td>0.553</td>
<td>0.278</td>
</tr>
<tr>
<td>HH2</td>
<td>2.685</td>
<td>3.121</td>
<td>2.104</td>
<td>1.748</td>
<td>0.504</td>
</tr>
<tr>
<td>HH3</td>
<td>10.781</td>
<td>15.131</td>
<td>5.259</td>
<td>4.753</td>
<td>5.243</td>
</tr>
<tr>
<td>HH4</td>
<td>2.871</td>
<td>3.832</td>
<td>1.359</td>
<td>1.001</td>
<td>0.760</td>
</tr>
<tr>
<td>HH5</td>
<td>9.985</td>
<td>11.177</td>
<td>4.536</td>
<td>3.472</td>
<td>2.708</td>
</tr>
<tr>
<td>HH6</td>
<td>22.764</td>
<td>49.478</td>
<td>8.733</td>
<td>10.933</td>
<td>9.938</td>
</tr>
<tr>
<td>Total</td>
<td>50.121</td>
<td>84.207</td>
<td>22.634</td>
<td>22.460</td>
<td>19.431</td>
</tr>
</tbody>
</table>

The composition of the new households created is important since it can be argued that low income households are consumers of larger amounts of certain types of public goods and services than higher income households; however, under progressive income tax or proportional property tax systems, these households would pay less taxes to the local and county governments. Higher income households also demand public goods and services, but the higher tax revenues collected from these households counterbalance the public goods consumed.

When one does not isolate the welfare of original residents from the welfare of all eventual residents (new plus original residents), the optimal expansion choice now changes to favour computer manufacturing, as shown by the incomes enjoyed by all residents under all five simulations in Table 8. Interestingly, computer manufacturing results in the largest increase in income for all residents, while the optimal choice (given $h = 1$), of the city’s original residents, retail, results in the second smallest increase in income for all residents. This situation makes it apparent that the benefits that stem from expanding computer manufacturing are enjoyed largely by the new residents moving into the community while the benefits of expanding the retail sector are enjoyed largely by the original residents. Even when these results are adjusted with distributional weights, the conclusion still holds that while the original residents would choose retail expansion over computer manufacturing, the new combined set of residents would rather have chosen computer manufacturing.

### 7 Conclusions

The intense competition generated by new federalism has upped the ante for city development planners, creating the need for new methods beyond traditional cost-benefit analysis. This research demonstrates how a city official can use a computable general equilibrium (CGE) model to show the myriad ways in which a development project can affect his or her city. The ability of a CGE model to show how a potential proposal can affect household incomes, local labour demand, and local prices gives planners a better tool for choosing between potential development projects.

We have also disaggregated the consequences of this decision into the opposing constituencies that a development official serves: a city’s original residents and the resulting new households after development takes place. We have also shown how Fort Collins can consider distributional equity in its evaluation of how a development proposal can alter its income distribution.

These steps allow a city to carefully consider how it wants to grow and what (or whom) it values. Is the prospect of an increase in overall income more than enough to counter increasing the inequality of that income’s distribution? Is a development project worth pursuing if the majority of its benefits accrue to new residents of a city? These and similar questions are ones that the framework and model methods presented in this paper help a city to answer.
References

Armington PS (1969) Theory of demand for products distinguished by place of production. IMF Staff Papers 16: 159–178


