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A REGIONAL ECONOMIC IMPACT MODELLING FRAMEWORK

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ABSTRACT

This paper presents a framework - transferable to other countries and jurisdictions - for constructing a regional economy-wide impact model that bridges the gap between expensive full survey techniques and less accurate synthetic models. The approach suggests inserting superior data into hybrid regional models. This involves the collection of region-specific information and promises greater accuracy and validity of impact analysis. The Foothills Model Forest region is used as a case study for this type of regional economic impact modelling. The results validate the approach.

Background

Potential changes in one sector of an economy can significantly impact other sectors in an economy. Estimating these changes at a regional level in the Canadian and other settings can be problematic because regional data are difficult to obtain and compile. To overcome these difficulties, provincial, national or other data from larger geographic areas are often applied in a regional context. This approach can only provide valuable estimates when the structure (sector sizes, trade flows etc.) is consistent between the larger area and the smaller region to which it is being applied. This restriction often does not hold, leading to inaccurate estimations of regional impacts.

There are three primary approaches used to estimate economy-wide or general equilibrium socio-economic impacts of changes in an economy: Input-output (I-O) models, Social Accounting Matrix (SAM) models, and the computable general equilibrium (CGE) models. While they area at times viewed as competitors, each is valid certain situations. They can

even be compliments. For example, I-O and SAM are building blocks in the development of a CGE model. I-O is the most commonly used of these models and is the least expensive but suffers from the constraints of fixed prices, a short-run time frame and unidirectional sectoral impacts among others. The SAM (which will be emphasized in this paper) shares much of the same framework as an I-O model but allows for the measurement of distributional impacts. The CGE model allows for many of the constraints of an I-O model to be relaxed and allows for multi-directional sectoral impacts but has greater data requirements and is costly to implement. The CGE model has only recently been extended to regional impact analysis.

Three common approaches are used to develop regional I-O tables used to develop impact models. The first is the pure survey approach that is costly and therefore rarely used at the regional level. Secondly, pure synthetic or non-survey approaches rely on regional adjustments to the coefficients from a model from a larger political boundary (Miller and Blair 1985). The third method combines these techniques and has been called a hybrid approach. The approach has grown out of the limitations of non-survey approaches and the prohibitive costs of pure survey approaches (Richardson 1985). This third method is the approach used in this paper.

Objectives

This paper discusses the methodology used in the construction of a regional model for a forested area in west-central Alberta, Canada known as Foothills Model Forest (FMF)[2]. The principles included developing this framework can be applied in other regions. FMF is an ideal candidate for a regional model as its economy varies significantly from the province of Alberta's economy. It is far more dependent on the forest sector, mining, and tourism than the provincial economy. For example the mining sector accounts for approximately 27% of the total output from the region while only 2.4% of the provincial economy comes from mining. As well the four main sectors of the FMF economy (forest, oil & gas, mining, and tourism) account for 85% of the FMF economy while the same sectors account for only 45% of the total value of output from the Alberta economy. The approach taken is selective precision. This requires the modeler to insert superior regional data into a synthetic model to create a hybrid model. While the discussion focuses on the FMF region, the methods used can be transferred to other countries or jurisdictions.

The general equilibrium economic impact model to be used is a social accounting matrix (SAM). A SAM is form of double-entry bookkeeping that provides a detailed account of the incomes and expenditures in a specified economy (Pyatt 1988). The advantage of a SAM over an I-O model is that it allows for the examination of distributional impacts (Alavalapati *et al* 1999). For example, who gains and who loses from the expansion or contraction of the regional economy. Does the project help those in poorer income groups more than in wealthy groups or does it exacerbate these differences? Johnson (1996) has noted that SAMs are particularly useful where data from disparate and inconsistent sources must be reconciled. This makes it particularly useful in developing hybrid models. It can also form the basis of a CGE model.

This paper will review the steps to take in developing a hybrid economic impact model using the Foothills Model Forest as an example region. Results from a hybrid model are compared to a synthetic approach. The paper ends with some concluding remarks.

Discussion

FMF is an example of a region where regional boundaries do not conform to census regions making the gathering of regional data problematic. Utilizing a pure survey approach is not suitable because of high costs. The top-down synthetic approach using provincial averages would likely lead to inaccurate results because of the different sizes of the sectors in the economy and the fact that more of the inputs would come from outside the region than from outside the province. Therefore, the collection of specific regional

data, especially with concern to trade flows provides a more accurate view of the regional economy than a purely synthetic approach. The application of provincial technical coefficients to the sub-provincial region in the construction of the model will be flawed if the source of inputs (imported versus domestic[3]) is not adequately addressed.

The construction of the hybrid SAM involves three steps. First, the provincial SAM must be synthetically regionalized to provide a base from which to start. Secondly, specific regional data must be gathered from a variety of sources and integrated into the model. Data was not available for all sectors so only data for selected sectors were gathered. Finally minor adjustments were made to ensure data consistency in the SAM framework.

Key sectors were identified as candidates for the collection or estimation of primary data. The forest sector, the visitor sector and household discretionary expenditures were identified as areas where primary data could be collected or estimated via survey techniques. Three different types of information were collected in the development of this hybrid economic impact model. First, instead of conducting a lengthy I-O survey, the forest sector, with just a small number of firms, were contacted directly for financial information. These records reveal detailed information required to construct an accurate and precise summary of the interindustry transactions in the regional economy. The oil and gas sector contains a large number of firms and its regional output and value of input were obtained form government records (Patriquin *et al* 1998). Second, a visitor sector was developed using the results of two separate studies. A visitor expenditure study was conducted to estimate the total value of output for the sector (Wellstead *et al* 2001). This sector is difficult to value and as such is often ignored or poorly estimated in regional models. The difficulty stems from businesses such as restaurants and gas stations that cater not only to the local population but to visitors as well. Local versus visitor expenditures at these business are not normally reported. A collection of secondary data sources was used to develop this unique estimate. A second study estimated the number of people employed in the visitor sector and the total wage bill for the sector (Wellstead *et al* 2000). A survey was distributed to all visitor-related and visitor-driven business in the FMF. Respondents were asked to provide the number of employees and the number that could be directly related to the visitor sector. Wage estimates by employee type were based on government sources. Applying service sector coefficients to the estimated value of total visitor sector output then completed the creation of the visitor sector. The third category of data was household discretionary expenditure data from a FMF household survey (Jagger *et al* 1998). This information was essential in understanding the level of economic impacts. Regardless of the wages that are paid in a region, only dollars that remain in the community will have an impact on the community. If money leaks out to other areas, the economic impact (positive or negative) will be lessened. Information from this survey also allowed for the creation of three income groupings on which the distributional analysis was based: less than $30,000, $30,000 to $59,999, and $60,000 or greater. Where detailed data for the model could not be obtained or estimated the synthetic provincial proxy is used.

Following the collection of data the model is ready for specification. The SAM model measures three basic elements present in all economies: consumption, production and income. Three models are specified each containing six sectors: forestry (logging and pulp), mining and related services, crude petroleum and natural gas (CPNG), wood (sawmills), visitor, and the rest of the economy - a composite sector representing all other sectors in the economy such as agriculture, non-forest manufacturing and non-tourism related services. The three models are a hybrid regional SAM, a synthetic regional SAM and SAM for the province of Alberta. The two regional SAMs would be expected to differ significantly from the provincial SAM based on our knowledge of differences in the regional and provincial economies. If large differences exist in the models, it will be assumed that the hybrid SAM is the most accurate model because of the more accurate data that went into the model.

A standardized shock was simulated for each sector in the three models. Details of the results are not presented here but can be found in Patriquin *et al* (2002). In summary the results follow along expected lines.

- The provincial SAM shows higher economic impacts in every sector. This supports evidence from past studies that identify smaller multipliers in resource-dependent export-oriented communities compared to larger geographic areas with more diversified economies (Stabler and Olfert 1994; Richardson 1985)

- The synthetic SAM overstated the economic impact in all sectors except the composite rest of the economy sector. The smallest difference was in the crude petroleum and natural gas sector where little new data was available while larger difference were in the wood and mining sectors. Again the hybrid SAM is assumed to be the more accurate of the two models.

Conclusions

Resource sectors can be a significant source of wealth in a regional economy. Potential changes in these sectors can significantly affect communities in the region. Economy wide models such as I-O, SAM, and CGE can help estimate these impacts. Data requirements are the largest constraint in the development of these models. Hybrid models using selective regional data collection present an affordable alternative to comprehensive survey techniques.

The results indicate significant differences between synthetic and hybrid models. Therefore consideration of this approach is warranted in the construction of regional impact models. In this paper, we have introduced a framework used to construct a detailed regional level economic database and impact model.

All economic impact models rely on the quality of available data. The approach adopted in this paper demonstrates improved regional economic estimation and overcomes the rigid assumptions in synthetic top-down models. The SAM model was used in this case study but the approach could be extended to more flexible models such as CGE.

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[2] Foothills Model Forest consists of Jasper National Park, Wilmore Wilderness Area and Weldwood of Canada Ltd.'s Forest Management Area. For more information on Foothills Model Forest and Canada's model forest program see www.fmf.ab.ca and www.modelforest.net/e/home_/indexe.html

[3] This refers to the area of study. Imported in a provincial model refers from outside the province while in a regional model it refers to outside the region.