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Input-output+econometric and econometric+input-output: model differences or different models?

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Abstract. Integrated input-output and econometric models are becoming increasingly widespread. The integrated model attempts to model the dynamic (lagged) time path of the economy which may be in a continual state of disequilibrium as it tracks toward continually shifting equilibria, therefore providing a more realistic picture of the dynamic characteristics of economic structure and change. Within this basic landscape there are many ways of implementing such a model. This paper compares and contrasts the methodology used in the Ohio and Queensland integrated models from both a theoretical and empirical perspective. The resulting models, although inherently similar, nevertheless have different characteristics that arise through both data availability and deliberate theoretical considerations.

1. Introduction

The conventional input-output model is static. If there is an exogenous stimulus to the economy, the reaction path is from final demand to intermediate and primary inputs. But there is no feedback loop from primary inputs to final demand if, for example, changes in gross operating surplus and tax levels impact capital and government expenditures. These income and expenditure coefficients (together with the assumption of constant average employment) may not be acceptable in an applied situation. If these coefficients and linkages vary in response to non-equilibrium conditions, then a more sophisticated model is required that would, among other things, introduce a dynamic structure to capture the response through time as the economy is subjected to external shocks. One way to do this is through the construction of integrated models.

The term *integrated* is used in this paper to refer to the merging of two methodologies, input-output (IO) and econometric (EC), in a regional context. Integrated models recognize that different modeling strategies exhibit different characteristics and attempt to splice the different approaches in a way to enhance the strengths and reduce the weaknesses.

Integrated models are not new to regional economics. Glickman (1977) suggests "combining the good qualities of both devices." Conway (1979) has constructed and maintained a refined version of the original Washington projection and simulation model. Integrated models also periodically attract fresh attention from various quarters. Klein (1989), for example, suggests that the integration of IO with EC approaches would be a useful exercise. More recently, Rey (1998) has reviewed a number of integrated models and suggests a taxonomy of integration strategies: coupling, embedding, and linking. The coupling strategy is the most comprehensive requiring the development of a full set of final demand accounts that permits a high degree of model closure and interaction between the EC and IO modules. Embedding uses prior information from an IO model to achieve parsimony in the specification of EC models without the specification of a full set of final demand accounts. In the linking strategy, the output of one module serve as inputs into the other in a recursive fashion.

How the IO and EC models are integrated depends on the modeler's objectives. Integrated models can range from models that are dominated by the IO table and use econometrically estimated equations to endogenize the linkages between factor inputs and final demand (IO+EC models) to models that use a regional EC model as a starting point and replace the output component with an IO block (EC+IO models). In practice the distinction between the two is often blurred, although each exhibits its own peculiarities and difficulties associated with the integration process (Dewhurst and West 1991). Both, however, are attempts to incorporate the advantages of the two techniques; namely, to retain the detailed sectoral disaggregation and structural information of the IO model and to superimpose it onto a dynamic, nonlinear framework.

This paper makes an exploratory attempt to compare two such models, the Queensland impact and projection model (QUIP) and the Ohio projection and simulation model (OPSM). The former is constructed for the State of Queensland in Australia and the latter for the U.S. State of Ohio, both of which are classified as coupled models. The model formulations developed in each case reflect the environment in which the models were constructed. Although the modelers' general objectives were similar, data requirements and availability conditioned initial modeling decisions and led ultimately to differing emphases on various theoretical issues.

2. The modeling environment

When constructing a model, analysts implicitly and explicitly assess the operating environment in which the model will ultimately cradle. Three factors loom large in the decision-making process: economic theory, data availability, and regional (economic) structure. In the vernacular of model validation theory, the first fits the category of perceived validity, while the last two largely determine its modeling validity.

Perceived validity is based on the notion of perceived reality. For example, if it were believed that the market characteristics conform to perfect competition, near-perfect knowledge, and market clearing, i.e., neoclassical behavior, then a model based on these assumptions (for example, a computable general equilibrium (CGE) model) would satisfy the criteria of perceived validity.

The respective authors of the Ohio and Queensland models discount the neoclassical paradigm in favor of non- or partial equilibrium market behavior.

> The integrated model acknowledges the possibility that the economy will not reach full market equilibrium, but rather is moving toward a state of equilibrium. Because of continual shocks to the economic environment, the point of general equilibrium is never reached but changes before the economy has time to fully adjust. The integration with the EC model permits the tracking of the economy over time as this adjustment process occurs and therefore provides a more realistic picture of the dynamic characteristics of economic structure and change (West and Jackson 1995).

The second facet of model validation, modeling validity, is concerned with how the model mirrors or replicates the perceived reality that it is intended to represent. This is the nexus of the different approaches addressed in this paper. Major considerations here include regional structure and availability and quality of data.

Regional structure plays a major role in model formulation and is reflected in the two models. Queensland is a diverse and decentralized region, 2.5 times the area of the State of Texas and 16.3 times the State of Ohio, but with only 28 percent of the population. Queensland long has been regarded as a resource-based frontier state with major emphasis on agricultural, mineral, and energy resources. Most of the population and economic activity is located along the coastal corridor with less than 3 percent of the population in the inland (West Queensland) region. The economic structure varies greatly between the inland, coastal, and southeast regions. Primary production (mainly beef and some sheep) and mining are the chief economic activities of the inland. Mineral and agricultural processing with more intensive cropping such as grain, sugar cane, fruits, and vegetables are the main activities in the coastal region. Brisbane, in the southeast corner, is the financial and administrative center and contains over 62 percent of the population and workforce.

The Queensland economy is still determined by primary activity. Because of its large area and decentralized nature, geographic differentiation is deemed an important factor. The well-defined trading patterns facilitate compilation of a regional database and interregional IO tables. National links were initially not seen to be as important as, for example, in more highly developed states such as Victoria. The Queensland model therefore has a strong regional focus.

Ohio, on the other hand, being much smaller in size and with a more highly developed economy requires a model with less geographic specificity but stronger national links, because national economic factors have a strong influence on the state. In one way, this is fortuitous because it provides one avenue to compensate for lack of region-specific data. Such a situation would not be tolerated in Queensland where the state economy is far removed from the national economy in terms of structure.

These regional and data characteristics will determine the modeling approach adopted and thus will impact the modeling validity of the model. There is one additional point that is fundamental to the discussion, namely model objectives. "The aim [of the Queensland model] is to retain the sectoral disaggregation of the input-output system but to model the closure mechanism within a dynamic framework, thus reducing the static and linearity restrictions" (West 1994). Further, "it retains the impact modeling structure of the input-output model." The Queensland model is an IO+EC model. The IO system is retained and closed using a system of endogenous EC relationships that form the basis of the feedback mechanism between primary factors and final demand lacking in the conventional IO model.

The Ohio model, based on the framework established by Conway (1979), is "similar to other regional econometric models" (Conway 1990) both in overall structure and in terms of individual equation specification. The regional IO table does not exist in its own right within the model, but only indirectly in the form of parameters of a set of EC equations. In common with other regional EC models, it is primarily a forecasting model. The Ohio model therefore fits into the EC+IO category. It is the differences resulting from these two fundamentally dissimilar methodologies that are of interest in this paper. These differences are summarized in Table 1.

3. Model overview

QUIP is a five region, 15 sector interregional model of the Queensland economy. It represents the latest in a series of developmental models for Queensland that started with exploratory work in 1988 for the Queensland Treasury (see, e.g., West and Jensen 1989; Dewhurst and West 1989; and West 1991, 1994). It is unique in Australia in terms of this class of regional model.

An overview of the QUIP model is given in Figure 1. Details of the full equation structure are given in West (1994). A major component is the contribution to local economic activity from unemployed and economically inactive household consumption of local goods and services, a feature lacking in the IO model. Other nonwage income, such as distributed profits, social security

Table 1. Model Characteristics

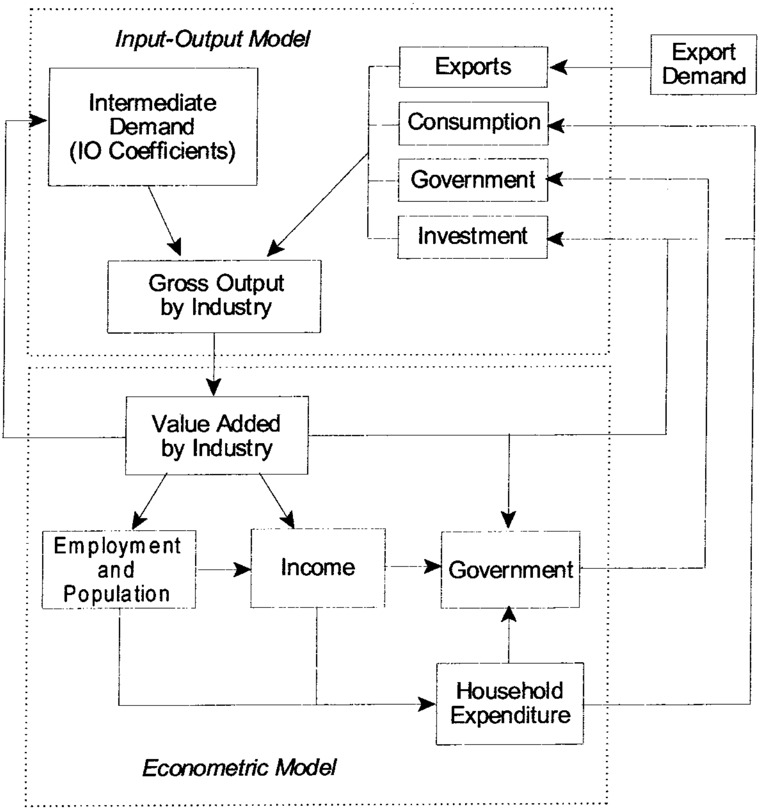
Characteristics	QUIP	OPSM
Geography	Five regions, interregional	Single region
Sectoral Detail	15 sectors per region	53 industries, 3 public sectors
Input-Output Data	Government publications	Special census data compilation
Solution Method	Gauss-Seidel plus classical Leontief matrix inversion	Gauss-Seidel, single set of simultaneous equations
Character	IO+EC, bottom up	EC+IO, top down
Primary Use Orientation	Impacts assessment	Projection and simulation
Modeling Issues	Emphasis on demo-economic interactions necessitated by dominance of IO in the model	Household consumption and other final demand activities forecast to enhance the output, income and employment projections. Household behavior of no special interest

payments, etc., thus become important, as well as population growth over time, both natural and induced.

The closure mechanism is a set of endogenous EC relationships using both cross-sectional and annual data. Industry output levels provide estimates of industry value-added, which in turn determines industry levels of wages and employment. Gross regional product also provides an input to the demographic block that calculates various population related variables. Wages, employment, and population statistics feed into the labor block that calculates labor force, unemployment levels, and the number receiving some form of government benefits including social security and unemployment benefits. These are required for the income block that calculates total household income, income taxes, and other taxes and deductions (and, hence, household disposable income). This in turn is used to estimate private consumption expenditure. A more detailed discussion of these components is given later in this paper.

The Ohio model is a single region, 53 industry, three public sector model of the State of Ohio (Jackson 1996). The model follows the framework established by Conway (1979) and adopted by the Regional Economic Applications Laboratory (REAL) in the early 1990s as a means of providing an impacts and forecasting capability with a strongly regional character. Similar models are in various stages of implementation for several midwestern U.S. States and the Chicago metropolitan area (see, e.g., Israilevich, *et al.* 1994). The equation structure of these models is provided in a number of sources, e.g., Conway (1990). Collectively, these models will be referred to here by the generic term *projection and simulation models* (PSMs).

Figure 1. Schematic representation of QUIP



The main objective of the PSM is to predict regional output, employment, and income by industry. Within the PSM there is much less emphasis on household consumption than in the QUIP model. Consumption and the other final demand equations are seen as means to improve output, employment, and income forecasts.

The REAL-type PSM has a distinctively regional character, derived largely from its foundation on local technology specifications from the Census of Manufacturing-yet it is driven more strongly by forecasts of national variables than is the QUIP model. In addition to productivity and wage rate links to national variables, output in the PSM is primarily export oriented and, therefore, is tied initially to national, industry-specific production indices. Such strong ties to the national economy are more appropriate to subnational models in highly industrialized, highly integrated national economic systems such as Ohio but not for a region such as Queensland.

The production of goods and services for export generates a set of internal demands as industries purchase intermediate goods from one another. Intermediate demand equations are adjusted over the forecast period to reflect changing economic structure. Mechanisms for accommodating technological change are described further below.

Initial solutions for output values are combined with forecasts of labor productivity to predict employment by sector, which, in conjunction with forecasts of labor force participation and unemployment rates, are used to obtain population forecasts. Employment forecasts by sector are combined with forecasts of wage rates to generate employment income, which is added to property income, transfer payments, residential adjustments, and personal contributions to social insurance to obtain total personal income. Total personal income and population forecasts are used to generate internal demands, including consumption, investment, and government expenditures. These internal demands for regional production feed once again into the output equations-resulting in a chain of increases in output, employment, earnings, population, income, and, again, final demand. Successive links in this chain of demands become negligible, and the simulation moves to the next forecast year. Figure 2 shows the general schematic representation of the OPSM.

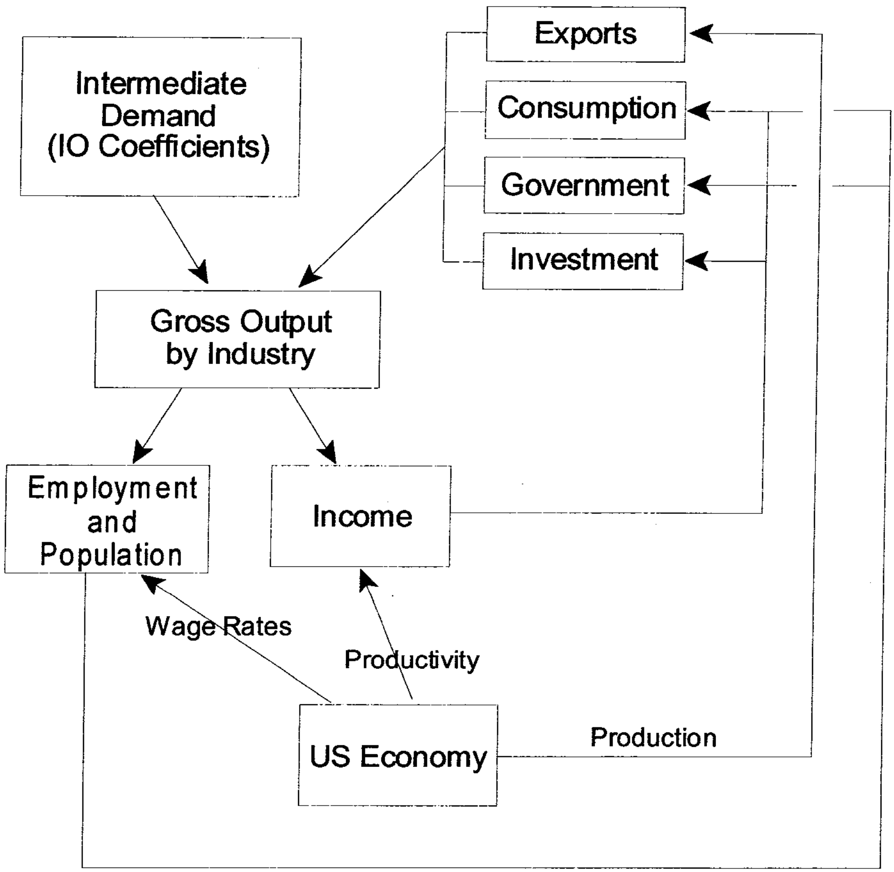
4. Main data sources

The core of the Queensland model is a 1985-1986, five region, 15 sectors per region interregional input-output table of Queensland, based on state and regional tables constructed by the Queensland Government Statistician's Office and the University of Queensland.

The primary sources of supplementary data are state and regional accounts produced by the Australian Bureau of Statistics (ABS) and the Queensland Government Statistician's Office (GSO). These include population census data, state and national accounts, gross regional product by region, manufacturing census, trade statistics, labor force statistics, household expenditure survey data, consumer price index and GDP deflators, taxation revenue, and government finance. A consistent set of industry data including value-added, employment, and wages are compiled in constant 1985-1986 values. This data set determines the choice of sector classification. QUIP uses relatively few national data (mainly for deriving projections of exogenous variables such as industry exports).

Data for U.S. states comparable to data for Australia's states and regions do not exist. The Ohio model uses state level industry employment and earnings data published by the Bureau of Economic Analysis (BEA). The BEA also pub-

Figure 2. Schematic representation of OPSM



lishes annual gross state product estimates, but gross output estimates by state are not generated. Manufacturing output is calculated, for example, using industry-specific cost of materials, value-added, and payroll data from the Census of Manufacturing, along with BEA wages by industry. Nonmanufacturing output data series are constructed using the Kendrick-Jaycox (1965) method with U.S. output and income data. Household expenditure survey data are not regularly collected by all states. Historical state government sector data come from various issues of *Governmental Finances*, published by the U.S. Department of Commerce, Bureau of the Census.

No government statistical agency publishes regional input-output tables (although some input-output multipliers and impacts estimates can be obtained from the BEA). There are several ways to obtain regional input-output tables. One avenue is to purchase the necessary data from a source such as IMPLAN that covers the entire U.S. Other private sources of input-output tables also exist. All of these sources, however, generate tables adapted from the national input-output accounts. The OPSM, however, uses input-output data extracted directly from Census of Manufacturing establishment records.

The national data used in the Ohio model come from a variety of sources, both public and private. In addition to U.S. sectoral export and production variables, it also uses U.S. business cycle variables and population and labor force variables in its forecasting equations.

5. Model components
5.1 Household sector

The household sector is one of the most important sectors in the QUIP model. In regional input-output analysis, induced consumption often dominates the multiplier effects. Because the Queensland model retains the explicit structure of the input-output model, accurate specification of the household sector is imperative. The household sector also is that sector where linearity is least tenable, so capturing other nonwage income, such as production-related income, interest and dividend payments, unemployment benefits, and aged and invalid pensions (including private superannuation funds) is also important to the model structure.

The Queensland model is fortunate to have access to region-specific household income by sector and expenditure data by major commodity group. Wages and salaries and employment for each sector are expressed as a function of that industry's value-added. Other nonwage income is estimated in aggregate form as a function of gross regional product, labor force, and the number in the population receiving some form of pension. Summing the separate income components gives total household income.

To estimate disposable household income, income taxes and other direct taxes and deductions need to be subtracted from total income. Other direct taxes includes estate and gift duties paid by persons to general government and employee contributions to unfunded retirement benefit schemes. Other deductions consists of consumer debt interest (excluding interest payments on housing loans) and payments overseas. These two items are estimated separately in aggregate form.

QUIP estimates a region-specific Friedman-type total household consumption function with error correction mechanism over the sample period along the lines of Davidson *et al.* (1978). It assumes a long-run equilibrium relationship between consumption expenditure and income, but at the same time allows for short-run disequilibrium fluctuations to occur via a partial adjustment mechanism. Total expenditure is broken into individual commodity expenditures through a series of demand functions for eight commodity groups: food, clothing, housing; household equipment and operation; transportation; tobacco and alcohol; health and personal care; and other expenditure.

The household demands for each commodity group are allocated to industry sectors by a conversion matrix, which is constructed as follows. First, a concordance table based on tables constructed by the ABS is used to disaggregate the eight commodity expenditures into 109 industry demands compatible with the Australian input-output table. Second, the various trade, transport and insurance margins, as well as commodity taxes, are reallocated using the margins matrices for household final consumption expenditure from the 1985-1986 Australian National Input-Output Accounts. Third, the 109-classification household expenditures are aggregated to the 15 sector level of the regional model. It is assumed that the conversion matrix remains constant over the modeling period.

Finally, the local expenditure component needs to be determined. The percentage change in household expenditure on each of the local and imported commodities from each sector is assumed to be equal to the percentage change in total household expenditure on all goods and services from that sector. Because the model is calibrated to the 1985-1986 input-output table, the initial local expenditure levels are determined from this table.

The household sector, *per se,* plays a much less direct and important role in the OPSM. Because no suitable data exist for measuring consumption data over time, national data are used to estimate household consumption functions for four consumption categories: Motor vehicles and parts (auto); other durable goods; nondurable goods; and services. Substituting state income estimates into these national expenditure functions provides estimates of regional consumption expenditure by major category, which are allocated to industry sectors. Important explanatory variables for these stochastic equations include relative auto; other durables; nondurables; and services prices; relative energy prices (auto); share of driving age population (auto); personal income per capita; and business cycle indicators. The OPSM treatment of households is more similar to that of traditional EC models than to that of the QUIP model. Relative sectoral output prices are assumed, implicitly, to be determined in the national market.

5.2 Government expenditure and capital formation

Final consumption expenditure by state government in the Queensland model is determined in a similar manner to final consumption expenditure by households. State government does not levy income taxes directly but collects taxes from employers in the form of payroll tax and through other indirect taxes such as commodity taxes, hotel licenses, stamp duties, land tax, etc. It also receives a substantial amount from the federal government.[1] QUIP therefore estimates three categories of government income: payroll tax, other indirect taxes and charges, and other government revenue. Payroll tax is mainly a function of wages paid while other taxes and charges, being levied on both industry and the public, is a function of general economic activity. Federal government grants are based mainly on population. Private fixed capital expenditure is expressed as a function of saving, gross regional product, and population, which is allocated to industry sectors using base year proportions.

In the Ohio model, state and local government expenditures series are constructed from data reported in the Census publication, *Governmental Finances*. The OPSM forecasts both state and local government construction expenditure and total state and local government expenditure. These equations are similar in form to the other final demand equations. Other state and local government expenditure is computed as a residual.

The Ohio model uses the relationships among U.S. federal government civilian output (FGCO), employment, and income, along with regional data on employment and earnings to generate historical regional output for this public sector. Regional FGCO is forecast using traditional EC formulations. The Ohio model forecasts three types of investment; residential structures, nonresidential structures, and equipment. Once investment in structures, maintenance, and repair construction, and state and local government construction have been computed, the historical series of federal government construction is determined as a residual. Investment final demand equations follows traditional EC formulations, forecast as a function of availability of funds, business cycle, and production variables.

5.3 Demographic relationships

The demographic block estimates labor demand and labor supply. In QUIP, full-time equivalent employment is related to value-added in each industry. Labor supply in the region is determined in part by labor demand and in part by population levels by category, namely working age population, children, aged persons, and invalids. The labor force is determined from total labor demand using an error correction model that gives a long-run elasticity of one but at the same time allows short-run disequilibrium adjustments. Unemployment is the difference between the labor supply and labor demand.

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[1] The federal government is responsible for collecting income taxes as well as a multitude of other indirect tax charges, such as wholesale and retail taxes, medicare, fuel taxes, etc., which are distributed to the states using a complicated formula based on population, size, etc.

The high correlation between labor force and employment is used to estimate the labor force participation rate which is the ratio of labor force to working age population, i.e. adult population less those on invalid and aged pensions. The working age population can be estimated from the inverse of this function. This in turn provides estimates of the adult population (age greater than or equal to 15) and total population. Net migration in each year is calculated as a residual. The net rate of increase in natural population growth (births minus deaths) is exogenously determined.

The Ohio model demographic block is similar to its QUIP counterpart. Labor demand in each sector is related to its output. Labor supply in the region is determined in part by labor demand and in part by population growth, including inmigration. Because household income plays a much less explicit role in the OPSM, those sections of the population not directly employed are not explicitly considered, although regional transfer payments, for example, are forecast and are a component of regional total personal income.

Full-time equivalent employment is estimated for each industry and each public sector. Total employment is the sum of all sectoral employment, including the three public sectors. The labor force participation rate is forecast separately, and regional employment is derived from output and productivity estimates. Unemployment is the difference between the labor supply and labor demand.

Total population is derived from the relationship between employment, the unemployment rate, and the labor force participation rate. Five of six shares of total population by age cohort are forecast and used to determine population by cohort. As in the QUIP model, net migration in each year is calculated as a residual.[2] The net increase in natural population growth (births minus deaths) is a function of forecast birth and death rates and total population.

5.4 Price and technology effects

A major criticism of the input-output model is constant coefficients over time. Both the Queensland and Ohio models are dynamic. Therefore, attention must be given to the effect of relative price changes and technological change as the models track the economy over time. These effects are reflected in changes in the input-output structure of the models.

The Ohio model adjusts for these effects indirectly. The regional input-output table for the benchmark year (1987) is used to provide a set of conditional output estimates for each industry over the historical period. These

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[2] While both models calculate net migration as a residual, this is simply for convenience. Their respective reduced-form equations will be substantially different because of the different structural equations in the rest of the demographic block.

estimates indicate the output required to deliver final demands assuming the industry structure of the benchmark year input-output table. Actual output is regressed on estimated output and other variables to capture business cycle effects. The resulting relationships can be used to adjust the estimated output figures in forecast years, thus reflecting the inherent changes in the input-output structure of the model.

The Queensland model takes a more direct approach, partly as a result of the ability to directly manipulate the input-output coefficients. Relative industry price changes are estimated each year using the conventional price model $\Delta p = A'\Delta p + \Delta v$, where v is industry value-added which is endogenously determined via EC relationships in the model. The intermediate coefficients are adjusted for relative price changes using $a_{ij,(t+1)} = a_{if,t}(1 + \Delta p_i/1 + \Delta p_j)$. Minor differences still will exist, however, between total sector inputs and outputs (because both primary inputs and final demands are estimated econometrically). To reconcile these differences, which could be regarded as being due to technological change rather than price effects, an RAS adjustment is used.

The methods employed by the two models are potentially one of the major differences between them. The Ohio model makes no attempt to separate the different effects that contribute to coefficient change and thus implicitly captures changes from all sources. These are not just restricted to price and technology effects as in the Queensland model, but also changes through import substitution as the region becomes more self-reliant over time. As QUIP implicitly ignores changes apart from price and technology effects, supplementing these adjustment mechanisms with procedures for identifying other sources of change would be a useful addition.

5.5 Solution methods

A major difference between the two models is the method of solution. While both use the Gauss Siedel iterative method, the implementations are different. These differences arise from the fact that the Ohio model is closer to an EC+IO type structure which incorporates the input-output identity as a set of output equations embedded in the overall equation system. This gives the OPSM the character of an enhanced regional EC model. QUIP, in contrast, retains the explicit structure of the input-output model and its classical output solution, $X = (I - A)^{-1}Y$, with the EC relationships integrated into the primary factor and final demand components. The Queensland model thus has the character of an enhanced input-output model.

Model structure has significant repercussions on the solution method for the respective models. Procedurally, the Ohio model is simpler to solve, as it comprises a single set of simultaneous equations. The price is that the input-output coefficient and flow matrices no longer exist in their own right. The Queensland model retains the explicit matrix structure of the input-output model, which in turn is embedded in a wider equation system. This latter approach is computationally intensive per iteration, because each iteration requires matrix inversion. QUIP takes an average of six to 10 iterations, while the OPSM will iterate an average 10 to 15 times before the system converges for any given year.

One advantage of the QUIP approach is that a natural component of its solution is a consistent series of variable coefficient annual input-output tables. This provides a powerful debugging and analysis tool and an efficient and effective method for updating the input-output tables for other purposes.[3]

In both models, the system has to be run twice in any impact situation: once to obtain the base or control solution and a second time with the exogenous shock. The difference between the two solutions gives a measure of the impact on the economy.

6. Summary and conclusion

This paper demonstrates that the integration of input-output and econometric methods can be achieved in a number of different ways. While both models are similar in that they see export production and population growth as the principal driving force behind regional economic growth and attempt to achieve the same overall objective (namely, to counter some of the limitations of input-output and obtain a much more useful and versatile tool for analyzing the regional economy), the final models are substantially different.

Many of these differences can be explained in part by data availability (there is no doubt that the Queensland model has access to a far richer region-specific database), but even so there has been a conscious effort on the part of the respective modelers to follow a particular modeling strategy. QUIP explicitly retains the traditional IO structure and the EC add-ons are modular in design—they could easily be removed and the model would still operate, albeit in a simplified form. The OPSM, on the other hand, has no identifiable IO structure.

The Queensland model has more geographical specificity, but less industrial detail. There are no direct endogenous links to the national economy, only indirect exogenous projections of some final demand components. The Ohio model is more closely tied to the national economy but assumes regional functional forms are identical to national functional forms, in part because of more

[3] Although it is a much more tedious process, annual input-output tables can also be derived from the OPSM. By shocking final demand for a single sector by one unit, the Ohio model will generate total output impacts for the 53 sectors, which corresponds to the column of the Leontief inverse for that sector. Shocking final demand for each sector generates the entire Leontief inverse from which the direct coefficients and transactions table can be derived.

limited data availability at the regional level. Neither model has a feedback loop to the national economy.

Because of the dominant role of the classical IO structure in the Queensland model, it is an impact model. It is less suited for forecasting, although it can be used for projections based on national forecasts. The Ohio model, while providing an impact assessment capability, is closer aligned with a forecasting model because of its more traditional regional EC modeling structure.

Data availability has, to a dominant extent, conditioned the structure of the two models. A lack of household-specific data precludes the formulation of the IO+EC focus of the QUIP type model for U.S. states, and a lack of interregional input-output data places the QUIP type model even further out of reach. It is possible, conversely, to extend the QUIP model to incorporate stronger ties to the Australian national economy. A rich region-specific data set opens the door to a wider range of modeling possibilities.

In summary, from the two models described in this paper, it is clear that theoretical considerations are only one aspect of model construction. A much richer understanding of economic models can be obtained by studying the whole environment and landscape in which they reside. For example, Queensland regions are more heterogeneous with respect to each other and the nation than those in Ohio. This in turn leads to significant differences in structural and solution techniques. Thus, even though both models have similar objectives, different methods have evolved. Differences between models can arise as much from differences in institutional environments as from differences in theoretical perspectives.

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