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How large do multi-region models need to be?

Florenz Plassmann [a,*], Andrew Feltenstein [b]

[a] Department of Economics, Binghamton University, Binghamton, NY 13902-6000, United States
[b] Department of Economics, Georgia State University, Atlanta, GA 30303, United States

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Abstract

Given the connectedness of most states with their neighbors, any economic analysis of changes in a state's policy needs to account for the interdependence between states. We examine in how much detail one needs to model the factor and commodity flows between states, and how much, if anything, is lost in the aggregation of neighboring states into larger regions. We develop nine dynamic multi-region general equilibrium models of the United States, with different aggregations of states (a two-region model, a 7-region model, and a full 51-region model) and different assumptions regarding intermediate inputs. We examine the same policy change with these nine models and find that all nine models suggest very similar economic effects of the policy change in the first year. Our overall conclusion is that small and highly aggregate models are not necessarily any less accurate than larger models.

Classification codes: D58; H71; H73

Keywords: Multi-region tax model; Non-Armington; Computational general equilibrium

1. Introduction

Consider the task of analyzing the expected effects of a change in the economic policy of a single region that is part of a larger political entity. A useful starting point for such an analysis is to view the region as a small open economy with a fixed exchange rate; this assumption would be justified for countries like Australia or the United States whose states do not have individual monetary policies, where capital as well as labor is fairly mobile across state borders, and where every state

* Corresponding author.
E-mail addresses: fplass@binghamton.edu (F. Plassmann), afeltenstein@gsu.edu (A. Feltenstein).

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trades intermediate as well as final goods with the other states and with foreign countries. While any study of a specific region's economic policy needs to account for such interdependencies, it is not obvious in how much detail one needs to model factor and commodity flows if the primary interest is in how changes in a region's economic policy affect this region's economy. Is it sufficient to combine the other regions into a single "rest of the country?" Does one need to include at least the region's immediate neighbors? Or does one need to model all regions within the larger political entity explicitly? For example, Feltenstein, Lebow, and Sibert (1988) develop a single-region model of Australia, Feltenstein (1997) constructs a two-region model of the state of Western Australia and the rest of Australia, Adams, Horridge, and Parmenter (2000) develop a six-region model of Australia's states, while Horridge, Madden, and Wittwer (2005) analyze a 57-region model of Australia's 57 statistical divisions. If one is interested primarily in the effects of economic policies in a single state, does a one-region model suffice or is a 57-region model likely to yield more accurate results? Similarly, Giesecke (2011) analyzes a one-region model of Los Angeles County, Park and Hewings (2009) develop a two-region model of Chicago and the rest of the United States, Morgan et al. (1989, 1996) analyze models in which the US states are aggregated into six regions, while Plassmann (2005) and Dixon, Rimmer, and Wittmer (2012) develop models of all 50 US states plus the District of Columbia[1]. One purpose of this paper is to examine how much, if anything, is lost in the aggregation of individual states into larger regions.

The issue of aggregation is important for two reasons. First, multi-region models require modelers to represent each state's fiscal policy. Collecting information on marginal tax rates, and determining effective (average) tax rates as well as levels of spending and other fiscal parameters can be quite difficult for a single state, let alone for several states. Conversely, if several states are to be combined into the "rest of the country," then one needs to calibrate a fiscal policy of this artificial region that corresponds to the aggregate fiscal policies of the individual states that this region represents. It is useful to know whether (1) the effort of gathering data for multiple states is worthwhile if one is primarily interested in the economic policy of a single state, and (2) whether calibrating economic policies for an artificial aggregate region introduces distortions.

A second reason why aggregation requires some thought stems from the need to model the technological structure of the industries in each region. Researchers often use applied general equilibrium models to simulate the economic effects of policy changes. Such models permit the description of production processes in considerable detail, for example, as a combination of intermediate inputs and value added. Intermediate inputs are generally modeled with input–output (IO) matrices. The Bureau of Economic Analysis (BEA) offers, free of charge, the IO matrix for the entire Unites States on which the official national income and product accounts are based. IO matrices on the state-level, however, are not freely available – for example, the *Minnesota IMPLAN Group* (MIG) sells state-level MIG IO matrices for about $1000 per state. Because the acquisition of such matrices puts a considerable burden on researchers' budgets, it is useful to know how much additional precision these state-specific IO matrices provide. How do simulation results differ if one assumes that the aggregate IO matrix for the United States is an acceptable approximation for state-specific IO matrices, and how much is gained by acquiring state-specific IO matrices? Answering this question is the paper's second purpose.

[1] Similarly, Lolos, Suwa-Eisenmann, Zonzilos, and Bourguignon (1995) develop a single-region model of Greece while Psaltopoulos, Balamoua, Skuras, Ratinger, and Sieber (2011) develop a two-region model of the Greek economy; Cruz and Willumsen (1991) and Maldonado, Tourinho, and Valli (2007) analyze one-region models of Brazil while Haddad and Perobelli (2005) examine a 27-region model of the Brazilian economy.