

The emergence of attractors under multi-level institutional designs: agent-based modeling of intergovernmental decision making for funding transportation projects

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Abstract Multi-level institutional designs with distributed power and authority arrangements among federal, state, regional, and local government agencies could lead to the emergence of differential patterns of socioeconomic and infrastructure development pathways in complex social–ecological systems. Both exogenous drivers and endogenous processes in social–ecological systems can lead to changes in the number of “basins of attraction,” changes in the positions of the basins within the state space, and changes in the positions of the thresholds between basins. In an effort to advance the theory and practice of the governance of policy systems, this study addresses a narrower empirical question: how do intergovernmental institutional rules set by federal, state, and regional government agencies generate and sustain basins of attraction in funding infrastructure projects? A pattern-oriented, agent-based model (ABM) of an intergovernmental network has been developed to simulate real-world transportation policy implementation processes across the federal, the state of Vermont, regional, and local governments for prioritizing transportation projects. The ABM simulates baseline and alternative intergovernmental institutional rule structures and assesses their impacts on financial investment flows. The ABM was calibrated with

data from multiple focus groups, individual interviews, and analysis of federal, state, and regional scale transportation projects and programs. The results from experimental simulations are presented to test system-wide effects of alternative multi-level institutional designs, in particular different power and authority arrangements between state and regional governments, on the emergence of roadway project prioritization patterns and funding allocations across regions and towns.

Keywords Institutional design · Intergovernmental relations · Infrastructure development · Agent-based modeling · Complex systems · Basins of attraction · Network governance

1 Introduction

Multi-level institutional designs that investigate the distribution of power and authority arrangements among federal, state, regional, and local government agencies are at the core of many public policy theories and frameworks, such as the Institutional Analysis and Development (IAD) framework (Ostrom 2005), Multiple Streams Framework (MSF) (Kingdon 1984), Policy Subsystem and Punctuated Equilibrium framework (Baumgartner and Jones 2002), Advocacy Coalition Framework (ACF) (Sabatier and Jenkins-Smith 1993), Policy Network framework (Marsh and Rhodes 1992; Rhodes 1997), and Governance Network framework (Koliba et al. 2010). The IAD framework, for example, draws on institutionalism and neo-institutionalism theories, game theory, transaction cost theory, and common resource pool theory to create a description of multi-institutional systems that explains the crafting of public policy as an institutional design problem within and

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