Designing and Developing A PECAS Spatial Economic Model of Mumbai

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Abstract

India is experiencing a dramatic economic boom. Mumbai is one of the major focal points of this boom, and is undergoing rapid growth giving rise to severe strains on its infrastructure. Efforts to plan and manage this growth and related infrastructure requirements in the Mumbai Metropolitan Region (MMR) include the development of a computer-based simulation model of the Mumbai spatial economic system. This simulation model can be used to support policy and infrastructure planning by running simulations to test alternative policy options and by helping establish a more complete understanding of the system and the forces at work within it.

The simulation model is being developed using PECAS, which stands for Production, Exchange, Consumption Allocation System. PECAS is a generalized theoretical framework and associated software package. It considers 'activities' located in a set of geographic zones covering the area under consideration. These 'activities' include economic industrial sectors, households and components of government. They produce 'commodities' – including categories of goods, services, labour, capital and developed space – and consume

'commodities' in this production according to their 'technology'. Flows of exchanges of 'commodities' from production to exchange locations (in the geographic zones) and from exchange locations to consumption are allocated using logit models taking into account exchange prices and transportation generalized costs. These flows of commodities are converted to transport demands that are loaded to transportation networks in order to determine congested transportation costs that influences the allocations of flows through time. Categories of developed space are 'commodities' that must be consumed in the zones where they are located. Developer actions give rise to changes in space quantities in zones over time, taking into account the exchange prices determined for developed space, construction costs and zoning rules – to the extent such rules are respected in a given context.

PECAS is a generalized framework, and its application in the development of a model of a specific region – like the MMR – includes the specification of the particular category definitions to use (called 'design' of a specific model) and the determination of the values for the parameters in the mathematical functions (called 'calibration' of a specific model). The intention is that the design process takes into account policy options and data availability, along with significant elements of the system and its behaviour. The Mumbai Model is the first application of PECAS outside of North America, and the very different context in this case has led to differences in both design and calibration.

This paper provides a status report on the development of the PECAS Model of Mumbai. It describes the model design and the considerations taken into account in the development of this design regarding policy options, data availability and system elements and behaviour. It discusses the development of data for model calibration, identifying particular opportunities and challenges arising in this context. It offers conclusions about the work that has been done and what has been learned thus far regarding the use of PECAS in this context, along with broader speculations regarding such work in the modeling of urban economic systems in developing countries more generally.

Keywords: Urban Development; Urban Systems; Land Use Transportation Economic Planning, Land Use Transport Modelling; Spatial Economic Modelling; PECAS; Developing Countries; Mumbai, India