The Seminary Valley Demand Simulation

A Pilot Agent-based Model of the Binghamton Political Economy

Launchpad Binghamton is a Binghamton University initiative to develop student-run businesses on the West Side. Our proposed work is to develop an agent-based demand model of West Side residents (including students) to support these new businesses. The work will also build the foundation for a larger agent-based model of the Binghamton political economy. This is an ideal project for the Sustainable Communities Transdisciplinary Area of Excellence (SCTAE) to support because the work will support local economic development, University undergraduate education, and, in the end, will result in a decision tool that can be used by community leaders, researchers from different fields, local business people, and students.

The proposed work will build a demand simulation using an existing agent-based model of Binghamton voters with Binghamton owner-occupied housing data. The model is geographically specific in that the agents are placed on a map and location matters. Agents in this model are 'case-based' reasoners, meaning that individual decision making operationalizes case-based decision theory, a model that has been validated against human behavior.[1] Housing data will be augmented with data about students on the West Side and used as a basis for a set of consumer agents. The preferences of these agents will be informed by demand estimates from the economics literature. This demand simulation will then be used by the Launchpad Binghamton businesses to help forecast demand. Agents' location will be key in determining their behavior, as agents' choices will depend in part on distance traveled.

The next phase of developing this demand simulation is to add the data from the student-run businesses. The businesses will be incorporated into the model as new independent agents, so the simulated market will have both a demand and supply side. We will add survey data from students to augment the demand side of the model, as well as find out what behavior is consistent with the data that this business sees. This demand simulation will ultimately be useful for these businesses in an ongoing way; they can use the interface to manage their business and track inventory and put that data into our simulation. Launchpad Binghamton also intends to be a repeatable project, in different parts of greater Binghamton and beyond.

This data-driven, geographic-specific, agent-based market simulation will be a tool for research. It will provide an opportunity to ask empirical questions about agglomeration effects (of building a neighborhood of businesses) and entrepreneurship. This is a long literature and the comprehensiveness of the model of this group of businesses and their environment is novel. There is also an opportunity to contribute to empirical literatures about the demand side; again, the comprehensiveness of this analysis is novel.

The simulation software itself will also be useful to these and future businesses; and increasingly so, as it is calibrated to more and richer data. Since the intent is to repeat the Launchpad Binghamton project in future years, this simulation will become increasingly useful for established businesses as well as the potential student entrepreneurs, who will be able to use the simulation to test out potential business ideas.

The SCTAE grant will cover major costs of developing the demand simulation. Doing so will set the stage for the Principal Investigators to build a more robust agent-based model of Binghamton's political economy. First, the existing model will be rebuilt on a new computing platform, Python. This platform has many advantages over the current platform, including a more efficient simulation speed. Python code can be maintained in separate components that can be maintained and modified by separate domain experts. This is a critical development since the ultimate goal is to have a model that is scientifically accurate and has modules contributed by multiple disciplines.

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[1] Pape, Andreas D and Kurtz, Kenneth J. "Evaluating Case-based Decision Theory: Predicting empirical patterns of human classification learning." Games and Economic Behavior 82 (2013): 52-65.

Second, student data would be added to the existing data on Binghamton property data and the model updated to reflect demand parameters from the economics literature. Over time, funding from this will be used to support on-going business planning for the Launchpad Binghamton project. Finally, funding would be used to purchase Binghamton University computing time on a computer cluster. Executing the model on a cluster will greatly improve the speed. The programming will be completed by a graduate student, supervised by the PIs.

The ten-year vision for this project is to have a city simulator to support local decision making. Researchers and community members who have questions and expertise in how communities work—whether that area is business-related, economic, anthropological, psychological, policy or government-related, about schools or police departments or fire departments, or environmental—can contribute their point of view and area of expertise, ask a question relevant to their interests, and receive an answer based on the simulation that is jointly produced by our common set of models. Questions such as: Would I get majority support for policy X? Would I be able to make a profit from this business? Would policy Y reduce the chances that a fire spreads from one house to nearby houses? Would policy Z reduce the crime rate? This common platform would be data-driven, empirical, and, most importantly, the fact that it is agent-based means its by its nature modular, bottom-up instead of top-down, and therefore lends itself readily to transdisciplinary collaboration though interacting modules corresponding to different domains (psychological theories of choice matched with sociological or economic theories of human organization, for example).

The principal investigators, with Dr. Pape as the lead, will build the comprehensive agent-based model of Binghamton's local political economy. It is important to stress that a 'comprehensive' agent-based model of a local area has never been done before.[2] As is typical in the social sciences, existing models are sometimes national or global in scale, but narrow in scope or topic. There are national agent-based models of electricity markets, for example, and global models of shipping containers. *Comprehensive and local* agent-based models, instead of *narrow and global*, have not been written for the reasons found in David Sloan Wilson's 'The Neighborhood Project;' while it is the norm for evolutionary biologists to study small populations in their natural habitats, that paradigm is unheard of in much of the social sciences, including those areas where Agent-based Modeling has been used. The ten-year vision can be thought of as applying the Neighborhood Project paradigm to agent-based modeling, and it is completely new.

To build this model, an existing model will be expanded to include new modules. The existing model has been used to determine how much freedom there is to raise funds to provide local public good.[3] A related model of a market's supply side[4] can serve as a foundation for the business-side of the demand simulation discussed above. Geographically specific physical attributes of the Binghamton community could be incorporated into the model as well. Previous work on groundwater flows[5] could be adapted to model Binghamton's physical resources.

Our proposed demand simulation work will support Binghamton University's Launchpad Binghamton initiative. This initiative is made up of university faculty (the investigators on this grant), two undergraduate students, Rafael Schulman and Elyssa Stewart, and Binghamton realtor Charlie Ackerman who will help develop student-run businesses on the Binghamton West Side. The first of these projects is starting in the Seminary Valley Neighborhood, in the heart of the Tree Street Overlay on the Binghamton West Side, a largely student neighborhood that is zoned for mixed-use. Launchpad Binghamton has identified groups of students who are interested in devel-

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[2]Of course, true 'comprehensiveness' is impossible to achieve and not an actual goal. Instead, it is to build a model which moves toward comprehensiveness.

[3]Anderson, Nathan B., Todd Guilfoos, Andreas D. Pape, and Jeffrey Schmidt. "Empirical Tax Price Variance and Support for Tax Ceilings." Working paper.

[4]Pape, Andreas, and Wei Xiao, "Case-based Decision Theory and the Cobweb Model," working paper.

[5]Guilfoos, Todd, Andreas D. Pape, Neha Khanna, and Karen Salvage. "Groundwater management: The effect of water flows on welfare gains." Ecological Economics 95 (2013): 31-40.

oping businesses, and will then have faculty and business people with relevant expertise help them develop their ideas and help them through the process of building and running the businesses, including developing a business plan and seeking loan money. We have had an initial meeting to solicit student interest, and ended up with 21 business proposals from the fifty students who were there. The executive committee of Launchpad Binghamton is narrowing the list right now.

Launchpad Binghamton is a public/private partnership. Local realtor Charlie Ackerman, who is part of the Launchpad Binghamton Executive Committee, has secured promises from landlords to offer subsidized rent to the new student-run businesses for two years. The Executive Committee will help the businesses secure loans. This demand simulation will be a valuable tool for business planning for the student businesses, and eventually other established businesses in this area, such as grocery stores, the health and hospital systems, and the University itself. The Launchpad Binghamton demand simulation as well as the model of Binghamton's political economy will also be useful for local municipal planning, and therefore useable by the City of Binghamton for strategic planning and policy forecasting. All of this amounts to a combination of visibility for the University and funding for this project: either through licensing of the software, or, more likely, offering professional services to help calibrate the model to these individuals' needs. Local businesses, such as Visions Credit Union, might find it in their own self-interest to provide charitable support for this project.

There are also a number of foundations that have an interest in this kind of work. The Lincoln Institute of Land Policy is an institution which offers research funds for work on real estate economics and property tax analysis. PI Andreas Duus Pape won a Disseration Fellowhip from this institute. The Decker Foundation may also be interested in providing support for this project. We will also seek funds from the Citi Foundation, which funds organizations like the Housing Policy Center in the Urban Institute. The MacArthur Foundation's grants for Policy Research: Fiscal Condition of States and Localities are designed to "help strengthen the case for social policymaking that is more firmly grounded in evidence-of-effectiveness and with complementary benefits to recipients and society" and are therefore also an appropriate target.

This project supports sustainable communities in all phases. Launchpad Binghamton will provide economic stimulus for the Binghamton West Side and provide a repeatable method for neighborhoods to be seeded in this way. The demand simulation will provide insight into how local economies function. The final phase of the ten year vision is to develop a model of small cities that can be used for policy forecasting and research on how communities work.

PI and Co-investigator Contributions:

Andreas Duus Pape is the primary agent-based modeler on this project and will oversee its implementation. He is an expert in agent-based modeling and will design the software, as he has the recent related models.

David Sloan Wilson leads Launchpad Binghamton, which grew out of his class "The Binghamton Microcosm" and his work with the Binghamton Neighborhood Project. He will also contribute to the direction and growth of the agent-based model of Binghamton's political economy.

Vishal Gupta is a professor of entrepreneurship in the School of Management. He provides expert direction and advice to the student businesses in Launchpad Binghamton and the business aspects of the demand simulation.

Jeffrey Schmidt is a PhD student in Systems Science who will execute the programming tasks described above and will be responsible for running analyses to support Launchpad Binghamton. Dr. Pape will supervise his work.

Charlie Ackerman is a real estate agent in Binghamton who specializes in investment properties, particularly ones which house BU students. He brings practical business experience and connections with landlords to Launchpad Binghamton.