ASSESSING THE MACROECONOMIC EFFECTS OF REACTIVE LAND USE CONTROLS: A SIMULATION STUDY

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ABSTRACT: This study assesses the macroeconomic effects of minimum-lot-size requirements and building permit caps that have been implemented by some of the suburban municipalities in the Chicago metropolitan area. This is accomplished by using the spatial regional econometric input-output framework, which overcomes the shortcomings of traditional top-down approach to vertical regional economy – land use integration. The model simulation results reveal that the reactive land use regulations (minimum lot size zoning and permit caps), which bind local housing supply and population growth within the jurisdictions, 1) dampen the pace of regional economic growth considerably, although the actions are sometimes favorable to the long-term prosperity of the individual implementing municipalities; 2) tend to generate disproportionate impacts on different sectors of the economy – i.e. local sectors, which heavily depend on household expenditures, are affected more strenuously; and 3) induce effects that vary substantially by location and timing of the implementation.

KEY WORDS: Land Use Regulation; Regional Economic Growth; Integrated Model

1. INTRODUCTION

The performance of a regional economy is likely to be influenced by interventions in land development, which significantly affect its property and labor markets as well as overall spatial structure (see e.g. Kim 2009). It seems that this issue, namely the macroeconomic effects of land use regulations, has attracted a great deal of attention by planning academics and the planning profession as a whole. Recently, even a greater deal of attention is paid to the issue, as policy makers explore the full vision of sustainable development by reconciling the potential conflicts among economic, environmental, and social goals (Campbell 1996).

How does a particular type of land use regulation affect a regional economy? How can we better assess the effects? In thinking about the issue, at least two very important dimensions of the subject need to be considered. The first one is the complexity and dynamics of regional economies. Generally, a regional economic system is structured by many sectors and components that are highly interrelated in multiple markets and also linked through non-market connections. Therefore, the impact of any event or intervention, including land use regulation, is inevitably system-wide, even if it is directly related to a part of the system (e.g. housing sector). Furthermore, the system's behavior is dynamic, so that a shock presenting one time period often generates long run consequences. For this reason, it would be desirable to use a simulation model that better characterizes the structure of a regional economic system and further describes the dynamic behavior of the system, in order to properly assess the effects of land use regulation on a regional economy.

Secondly, consideration needs to be given to the way in which land use regulations are implemented. In the U.S. context, land use regulations and public goods provisions are typically under the control of local authorities rather than region-wide planning agencies, although metropolitan-level or state-level involvement is not absent. Also, a large degree of heterogeneity is likely to exist within a region.[1] Thus, it is necessary to appropriately deal with the spatial organization of local decision-making and to consider the interaction between local and region-wide variables over hierarchy. If a simulation model is adopted because of its methodological advantages for the analysis, it needs to be designed to handle these spatial and multi-level aspects of the problem.

In the urban economics literature, there are a series of theoretical studies that analyze the economic consequences of zoning or growth controls by employing a spatial general equilibrium framework, in which land use and regional economy are interrelated (see e.g. Brueckner 1990; Engle 1992; Sakashita 1995; Sasaki 1998; Lai & Yang 2002; Sheppard 2004). These studies have contributed a great deal to improving our understanding of the economic effects of land use regulation. However, the complexity and dynamics of the problem are too often simplified in most of these theoretical studies, so their framework, as it stands, has limited usefulness in simulating the reality. In particular, it is difficult to examine the outcomes of policy options or to explore for the role of planning practice in complex metropolitan areas.[2] For example, many of the models posit a monocentric spatial structure and single government having the authority of land use control. Also, the models often lack consideration of detailed industrial structure, demographics, irregular physical characteristics, and so forth.

Although various operational urban and regional system models have been developed and are now available for policy and impact analyses, most of them have limited usefulness in analyzing the effect of local land use policies on regional economic performance, due to the top-down approach to regional – local integration. In a recent study (Kim & Hewings 2010a), an investigation of the integrated analytic frameworks of 26 large U.S. metropolitan areas' planning agencies was made and the results revealed that most of them, except Atlanta, Portland, and San Diego, adopted a strict top down approach to the vertical integration.

[1] Following Tiebout's (1956) pioneering examination, a voluminous literature has discussed the variance in local actions (see e.g. Ross & Yinger 1999 for a detailed summary). Also the presence of intraregional heterogeneity has been shown by some empirical studies, such as Heikkila (1996) and McDonald & McMillen (2004).

[2] A notable exception is the RELU-Trans model, developed by Anas and his colleagues through their long efforts to integrate regional economy, land use, and transportation within a general equilibrium framework (see e.g. Anas & Kim 1996, Anas & Xu 1999, and Anas & Liu 2007). Their model is considered as one of the most theoretically robust operational urban system models, because of its solid microeconomic foundation.

Therefore, this study assesses the macroeconomic effects of the reactive land use regulations (i.e. minimum-lot-size zoning and building permit caps), implemented by some of the suburban municipalities in the Chicago metropolitan area, by using an alternative analytic framework, that is a spatial regional econometric input-output model. As explained in the following chapter and Kim & Hewings (2010b) in detail, the model extends a coupling-type regional econometric input-output model (REIM), by incorporating local- and lower-level dynamics in a reciprocal interactive manner, as opposed to a top-down allocation process. The established bi-directional linkages between region-wide macroeconomic variables and intraregional conditions over hierarchy support the assessment of the economic impacts of the land use controls in the Chicago region.

2. THE CHICAGO SPATIAL REIM

The spatial REIM framework is built on a traditional coupling-type REIM, which is one of the advanced and widely used regional economic forecasting and impact analysis methods.[3] While traditional REIM focuses on the macro-economic variables, the spatial REIM also considers intraregional conditions and their effects on regional economic performance. The model is designed to generate simultaneously determined regional and sub-regional socio-economic forecasts and to provide expanded analytic capabilities for various planning and policy issues related to both region-wide and local concerns.

In terms of model structure, the spatial REIM is an integrated model which covers and links multiple layers over hierarchy. More specifically, it consists of three endogenous layers (i.e. region – municipalities – land parcel or cell) and an exogenous national economy level, which is essential for describing regional economic trajectories. One of the most important features of the model is that the three endogenous layers are linked in an interactive manner, unlike many existing frameworks adopting top-down approaches to the vertical integration (figure 1). More specifically, as explained in p.10~11 of Kim & Hewings (2010b), "the model is working across the hierarchy as follows:

1) Using national economic forecasts for year *t*, the potential (expected) regional economic growth rate by sector is first derived from the regional layer.
2) The cell-level information (i.e. lowest level conditions) at *t-1* for each municipality is quantified to be taken into account in local level forecasting and analysis at *t*.
3) Local level population and employment changes are tentatively determined with the consideration of a) the region-wide potential growth at *t*, b) the cell-level conditions at *t-1*, c) local socio-economic characteristics at *t-1*, and d) local level 'population – employment' interactions across space.
4) The tentative values of local population and employment changes are sent back to the regional-level to project macro-economic variables, which are systemically integrated with each other according to the REIM formulation.

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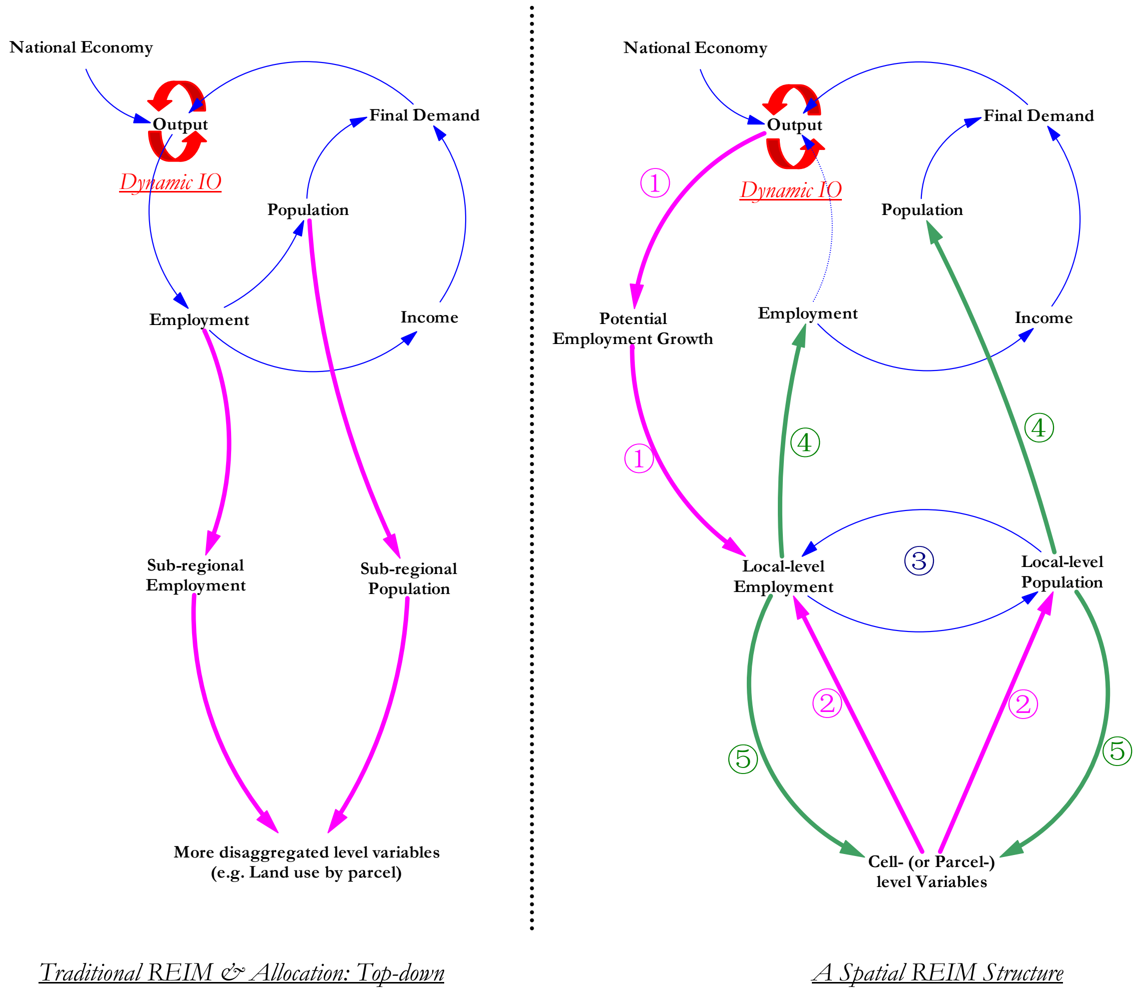
[3] For the detailed explanations about the REIM, see West (1995), Israilevich *et al.* (1997), Rey (2000), etc.

*) Then, the potential (expected) growth rate by sector is newly derived based on the new levels of final demands. (1) – (3) – (4) processes are iterated until convergence, with given (2).

5) Once the values of all regional and local variables for year *t* are finally determined through the iteration, cell level conditions are updated from *t-1* to *t* by employing a simple logic or a more sophisticated simulation method. The updated cell-level information is used in the next round (i.e. year *t+1*)."



Source: Kim & Hewings (2010b)

Figure 1. The Spatial REIM Structure, as Opposed to a Traditional REIM & Allocation

By establishing the linkages arising from the bottom or local layers to the region-wide level, the model reflects the probable supply constraints (e.g. land, housing, and labor supply) and the effects of spatial structure on the performance of a regional economy. "Suppose that a key sector of the study region is projected to grow very rapidly, according to the national economic forecasts. Under these national economic forecasts, the REIM tends to generate a rapid increase in regional employment in many others as well as the sector. If the conventional CREIM and consequent top-down disaggregation are used to project the future of the region, a large employment growth will be placed in the region regardless of local conditions. However, the spatial REIM checks the potential growth in individual sectors can be satisfied by the existing local and lower level conditions. The forecasts are determined with the consideration of local conditions such as site availability and spatial structure within the region rather than fully allocating all expected growth. [This means] if many firms in a particular industry are located in a very congested zone where physical expansion cannot be easily accommodated, sub-regional and regional employment forecasts for that industry are projected to be lower than the expected level.[4] This may be a better representation of the reality that the chance of attaining the potential growth within the region is influenced by the internal conditions." (p.15~16, Kim & Hewings 2010b). With the bi-directional linkages, as opposed to the top-down connection, over the hierarchy, the spatial REIM is also capable of assessing the effects of local or location specific actions on regional economic variables.

This framework is applied to the seven county Chicago metropolitan area (i.e. Cook, DuPage, Kane, Kendall, Lake, McHenry, and Will County in Illinois) where 296 municipalities have their own authorities of local governance, including land use control (figure 2). The applied Chicago framework employs a spatial econometric version of regional disequilibrium adjustment model (RDAM), developed by Boarnet (1994), to describe local level dynamics (i.e. the municipality level population and employment changes) with some modifications. By doing this, in the model, the municipalities are interrelated to each other via the spatial weight matrix, which is constructed based on journey to work data. It also needs to be noted that land use variables, such as availability of developable land and hinterland area, are used as explanatory variables for municipality level population and employment changes which eventually linked to the macroeconomic variables in the spatial REIM framework. These relationships are measured and established based on historical data. Kim & Hewings (2010b) provides a detailed explanation of the Chicago Spatial REIM, including the model formulation and calibration.

[4] One critical issue in modifying the regional growth trajectory may be whether the unmet potential growth will be deflected to another part of the metropolitan area or outside the region. The spatial REIM does not directly describe this behavior of the system. Rather, in the model, the modified trajectory is determined by solving the entire set of macroeconomic and the RDAM equations under given conditions through the iteration.

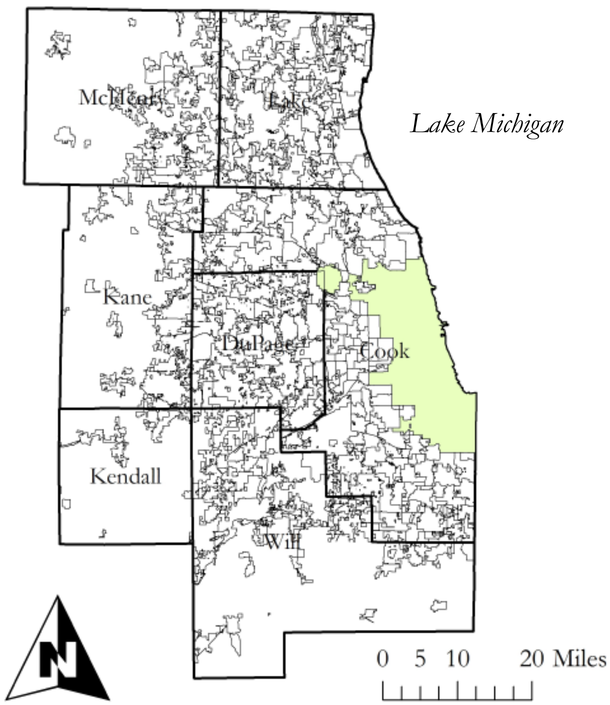


Figure 2. Study Area: Seven County CMAP Region

3. REACTIVE LAND USE REGULATIONS IN CHICAGO

Although the Chicago metropolitan area has been considered as a less regulated region compared with many other regions, a considerable number of suburban municipalities have implemented minimum-lot-size zoning ordinances or building permit caps. According to a recent survey conducted by the Wharton's residential land use regulation project in 2005 (Gyourko *et al.* 2008), among 98 municipalities surveyed (of total 296 entities in this area), 11 cities or towns have at least a two-acre-minimum-lot-size requirement somewhere within their jurisdictions; and another 5 communities have at least a one-acre-minimum-lot-size requirement (figure 3). Also, 10 municipalities have one or more explicit "statutory limits on the number of building permits for single family and multifamily product, on the number of single-family or multifamily units authorized for construction in any given year, on the number of multifamily dwellings permitted in the community, or on the number of units allowed in any given multifamily building" (p.701). Interestingly, there is no municipality having both restrictions – i.e. 1) two- or one-acre-minimum-lot-size requirement and 2) permit caps – together. This may suggest that the two types of regulations are functioning in a similar way, that may be limiting population increases as well as housing construction in the municipality.

The reactive land use controls directly affect housing supply and thus population growth within the jurisdictions; and building permit data shows this deterrent effect. Municipality-level building permit data provided by U.S. Census were compiled for the Chicago region between 2006 and 2008 to check the effect of the regulations, because the regulation information is for year 2005. Then, the number of permitted units divided by 2005 population (on the y-axis) was related to the projected annual population growth rate for the three years (on the x-axis) for two different groups: 1) municipalities with the minimum-lot-size requirements or permit caps vs. 2) municipalities without such reactive regulations (figure 4).[5] Consistent with the expectation, the group of municipalities having the more reactive regulations shows a flatter slope, which indicates that the number of building permits tends to be smaller in these communities, when population growth potential is controlled. In other words, the regulations may have a significant negative effect on local housing supply.

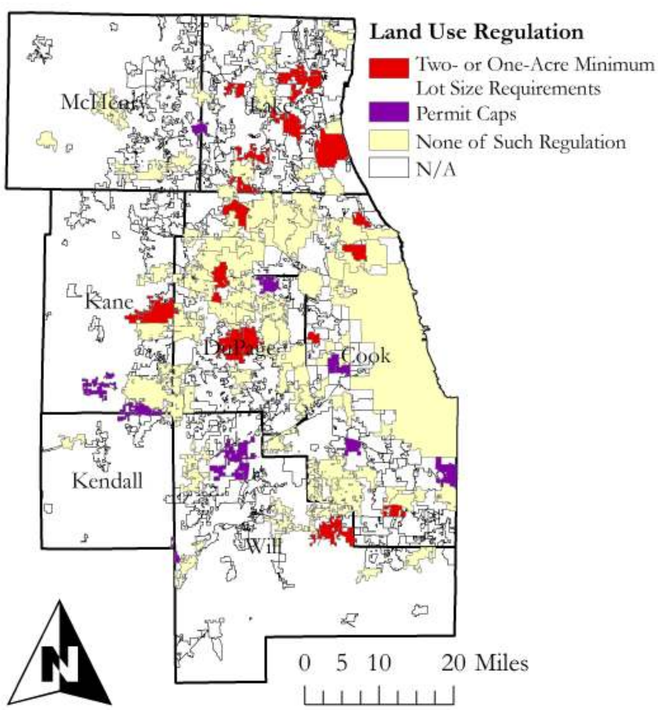


Figure 3. Reactive Land Use Regulations in Chicago

[5] Rather than using the number of permitted units as they stand, here we divide the number by the base year population and use the value to control the effects stemming from the size variance. It also needs to be noted that the figure excludes the municipalities where building permit or land use regulation information is not available or 2005 population is smaller than 5,000.

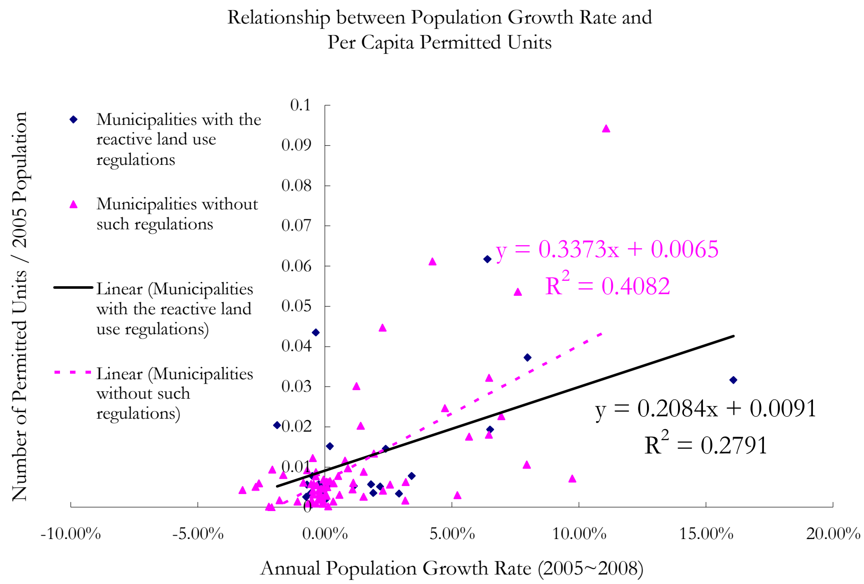


Figure 4. Building Permits & Reactive Land Use Regulations

However, the regulations may not always come into effect. There is no reason the regulations reduce local housing stock or population if there is no demand for new construction. Also, as far as the new construction plans satisfy the lot-size or permit cap requirements, the regulations will not limit housing supply and following population increase to that extent. This means that the presence of the regulations needs to be interpreted in the model as an upper limit of housing stock or population growth rate rather than a negative shock with a certain magnitude on the variables. Once the regulations are reflected in this way, mirroring reality, in simulation the potential negative shock will take effect conditionally with different amounts in different municipalities.[6] This issue also highlights that the effects of local land use regulations can be better analyzed by "modeling and simulation," particularly a simulation model like the spatial REIM, in which population by municipality is projected, so that it is possible to identify whether or not the actions come into effect in a particular locality at a particular time point.

4. IMPACT ANALYSIS OF REACTIVE LAND USE REGULATIONS

4.1. Experiments: The Effects of Negative Population Shocks

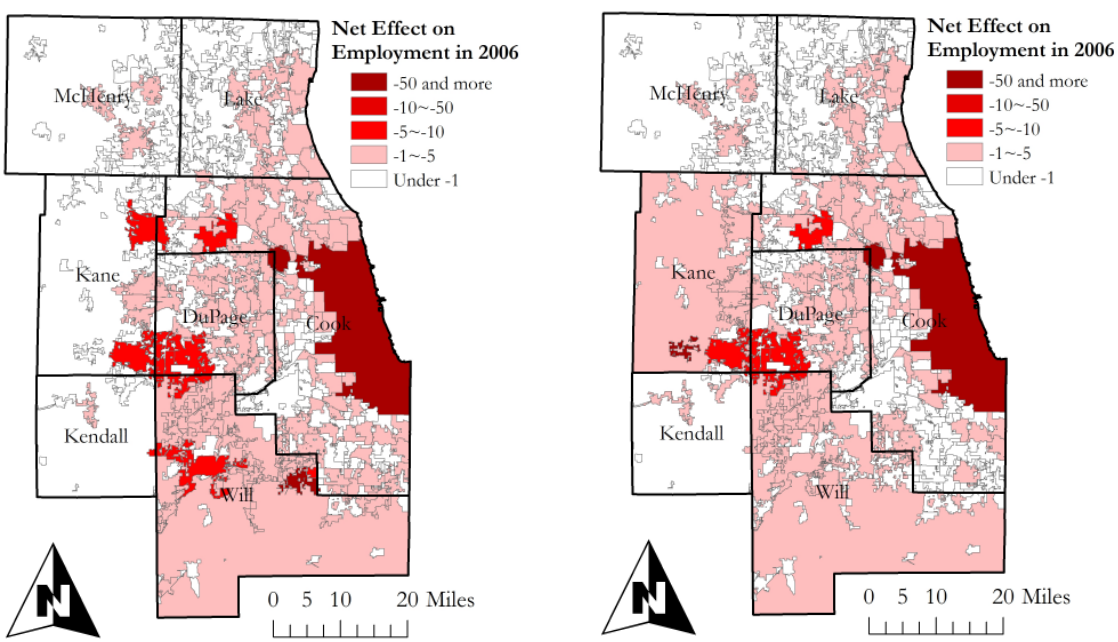
As noted, the impact analyses of minimum-lot-size requirements and building caps can be properly conducted by imposing the upper limit on population increase. However, before conducting the impact analyses, a simple negative population shock to two selected

[6] The shock will be zero, if a municipality does not satisfy both conditions: 1) the regulations are implemented and 2) population is likely to grow more rapidly than the given upper limit.

municipalities, one at a time, will be considered. These experiments will enhance the interpretation of the complicated simulation outcomes in the main impact analyses, which are a mixture of many different shocks in different places having the regulations.

More specifically, a negative population shock with the magnitude -1,000 is first given to the Frankfort village in year 2006; and then the same amount of shock is imposed on the Sugar Grove village in the same year. According to the Wharton survey, both towns implemented the reactive regulations as of 2005. At the same time, their population is estimated to grow very rapidly in the baseline spatial REIM projections.

Figure 5 demonstrates how the population shock affects employment across space in the two cases. Above all, it is evident that a greater employment loss occurs not only in the very municipality but also in the places which import the workers from the municipality with a shock, such as the cities of Chicago, Aurora, and Naperville, because the municipality-level employment change is linked to the population changes in the labor market areas captured by the spatial weight matrix based on the journey-to-work data. Furthermore, although small, many other municipalities will experience employment decreases, even though they have no interaction with the affected municipalities in terms of the journey-to-work flow. This is attributable not only to the indirect linkages through the power series of spatial weight matrix at municipality level but also to the systematic interconnections from a municipality to others via the regional layer. In other words, population and employment shock in any part of the region will alter macroeconomic variables (i.e. decreasing consumption, production, and inter-industry purchases) and then generate unfavorable effects on all parts of the regional economic system.



The Case of Frankfort Village *The Case of Sugar Grove Village*

Figure 5. The Effects of the Population Shock on Employment by Municipality in 2006

Table 1 presents the effects of the population shock on regional employment by sector in each case. First of all, the magnitudes of the impacts in Construction and Trade sectors are larger than the shares in the base year's regional employment, listed in table 2. In contrast, Manufacturing, which accounts for 9.5% of regional total employment in the base year, received just about 7.6% of the total impact in both cases. This is consistent with the intuition that generally a population shock more profoundly affects the local sectors, that heavily rely on household spending.

In addition, it is clearly shown that the magnitude and composition of overall impacts on regional employment vary by the location of the shock. Even though the same amount of shock is given to the population, the effect is greater in the case of Frankfort village than the Sugar Grove village, probably for two main reasons: 1) Frankfort is more highly interconnected to other places in the region as a labor supplier and 2) the population shock given to the Frankfort affects the sectors in a manner that generates a larger ripple effects on regional employment. The differences in the composition can be partly explained by the differences in the industry mixes between the two municipalities and their associated communities (i.e. the places which have tight connections with the municipality). In other words, the Frankfort's larger share of Trade sector (18.2%), compared to that of the Sugar Grove (7.7%) may partly cause the larger impact on Trade sector in the case of Frankfort village.[7]

Table 1. The Effects of the Population Shock on Regional Employment by Sector

	The Case of Frankfort Village		The Case of Sugar Grove Village	
	#	%	#	%
Construction	-63.9	11.5%	-54.1	11.3%
Manufacturing	-42.4	7.6%	-36.3	7.6%
Trade	-129.3	23.2%	-98.3	20.5%
FIRE	-46.5	8.4%	-37.5	7.8%
Service	-208.1	37.4%	-176.8	36.9%
All Other Sectors	-66.0	11.9%	-76.7	16.0%
Total	-556.2	100.0%	-479.7	100.0%

Table 2. Industry Mixes of the Region and the Two Municipalities

	Region as a Whole	Frankfort Village	Sugar Grove Village
Construction	5.6%	10.6%	12.5%
Manufacturing	9.5%	12.4%	12.7%
Trade	20.2%	18.2%	7.7%
FIRE	11.3%	8.5%	7.8%
Service	41.2%	40.9%	43.2%
All Other Sectors	12.2%	9.3%	16.0%
Total	100.0%	100.0%	100.0%

[7] But, for a more complete explanation, consideration needs to be given to the industry mixes of the associated communities and inter-industry linkages of the Chicago economy. In fact, a larger impact on Construction sector is found in the case of Frankfort village, even though the share of the sector is smaller there than the Sugar Grove.

Figure 6 demonstrates the long-run effect of the shock given in year 2006 on regional employment. The graph shows that the negative effect on regional employment will be quickly mitigated in several following years, when a shock is given to a single year (i.e. Year 2006 in this case) only. This may be because the regional economic growth is largely determined by the exogenous national growth trends, and these are assumed to be unchanged. However, it is found that approximately 20% of the immediate effect will be remaining in the long term. First, this suggests that the full recovery will be difficult to achieve, when growth momentum is once disturbed by any shock. In addition, this implies that the negative effects will accumulate, if the shock will be imposed for a longer period of time, as opposed to a single year.

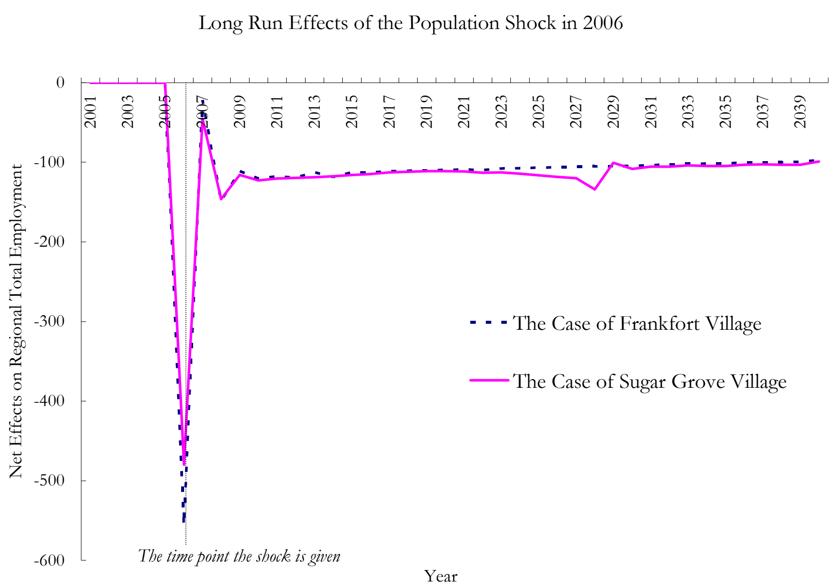
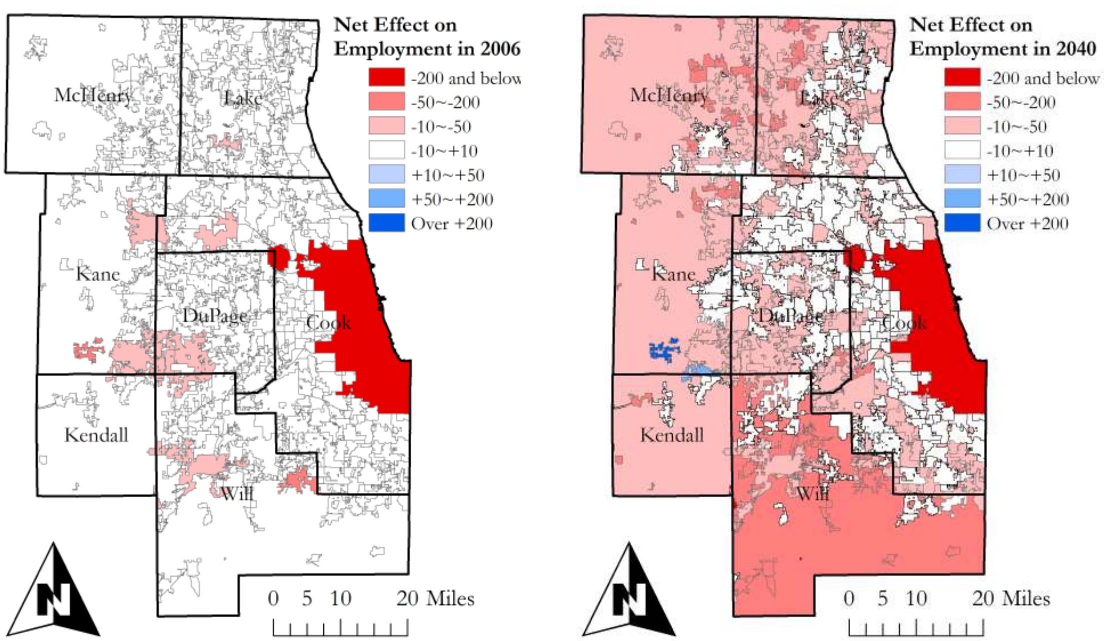


Figure 6. Long-run Effects of the Population Shock in 2006

4.2. Macroeconomic Impact Analyses of the Reactive Land Use Regulations

Finally, using the applied spatial REIM, the macroeconomic effects of the reactive land use regulations are assessed. As explained above, the minimum-lot-size requirements and permit caps are regarded as an upper limit of population growth, rather than a negative shock on population. In detail, to measure the effects, the upper bounds on year-by-year population growth rates are imposed in the 26 municipalities having such regulations according to the Wharton survey for all forecast years (i.e. between 2006 and 2040). Because detailed information about the degree of land use regulations in individual municipalities is not available, the model is run multiple times for different scenarios that represent different levels of the upper limits ranging from 5% to 10%. It is assumed that the level of the upper limit is same in all 26 municipalities in each scenario.

Figure 7 presents the effects of the regulations on employment by municipality, when the upper limit is set as 5% (i.e. population growth can be attained up to 5%/year in the municipalities with the regulations.). As shown, in 2006 (the first year with the restriction), the considerable negative impacts begin to appear in some municipalities, including Frankfort, Sugar Grove, Chicago, Aurora, Naperville, etc. As discussed in the previous section, these places are the villages where the projected rapid population growth is limited by the regulations or the cities that import the workers from the affected villages. Then, in 2040 (the last year in the simulation), it was found that the employment loss is dramatically expanded across space; most of the municipalities exhibit employment decline by more than 10 jobs due to the regulations implemented by a limited number of towns. This expanding negative effect is also clearly demonstrated in figure 8, that shows the long-run effects of the regulations on region-wide employment level. More specifically, net employment loss in the entire region will reach about 5,500 (approximately 0.1% of total employment) in 2040, if year-by-year population growth rates are bounded at 5% continuously in the 26 municipalities, due to the regulations. The figure also indicates that the magnitude of the effect depends on the degree of restrictiveness of the regulations.



The Net Employment Effect in 2006 *The Net Employment Effect in 2040*

Figure 7. The Employment Effects of the Regulations by Municipality

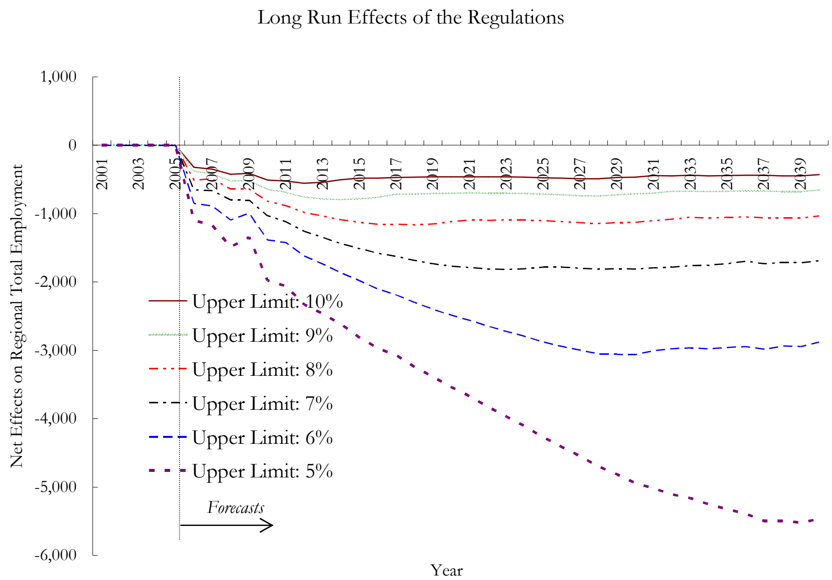


Figure 8. The Long-Run Effects of the Regulations on Regional Employment

Another finding to be noted is that some municipalities appear to achieve employment gains, compared to the baseline in 2040. Interestingly, the municipality, which achieves the largest job gain, is the Sugar Grove Village, one of the towns where population growth is limited by its land use regulation. As demonstrated in figure 9, although the village experiences a large negative effect in a short- and mid-term with a peak loss by about 1,500 in 2025, thereafter, the net effect starts to decline; and, at the end, its 2040 employment level with the land use regulation is greater than that in the baseline projection. This can be partly explained when attention is paid to the population growth trajectories of the village (figure 10). In the baseline scenario, its population rises very rapidly until 2025, but then is stagnant, perhaps due to the depletion of developable land which is found as an important determinant of local population increase in the model. Given this baseline trajectory, if the pace of population growth is controlled by the land use regulation, the village will be able to maintain the comparative advantage of larger developable land, which may be its major growth momentum, for a longer period of time and achieve extra population and employment growth in the long run. In this sense, the land use control can be a strategic action to enhance the long-run local growth. However, from the perspective of the region as a whole, such strategic behaviors of individual local governments may not be favorable, as confirmed by the found significant regional employment loss.

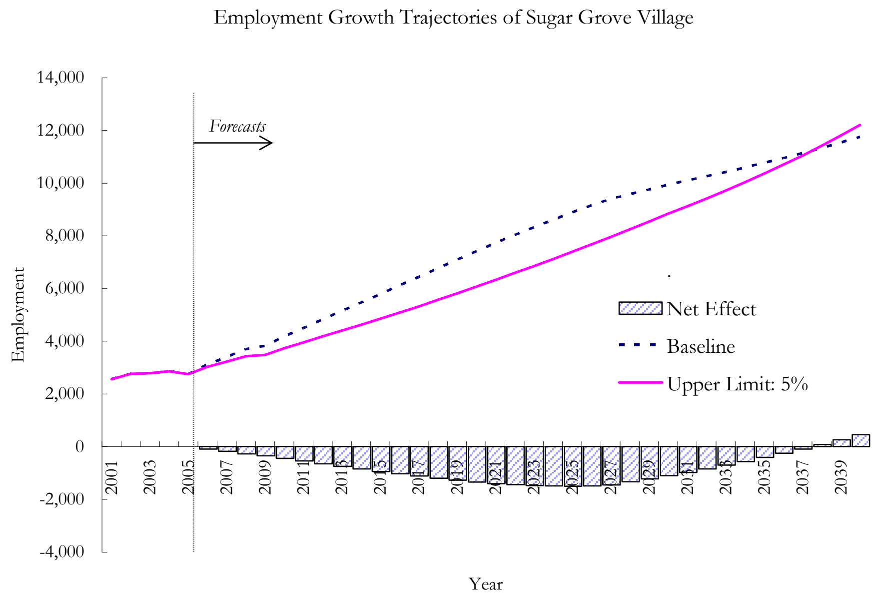


Figure 9. Employment Growth Trajectories of Sugar Grove Village

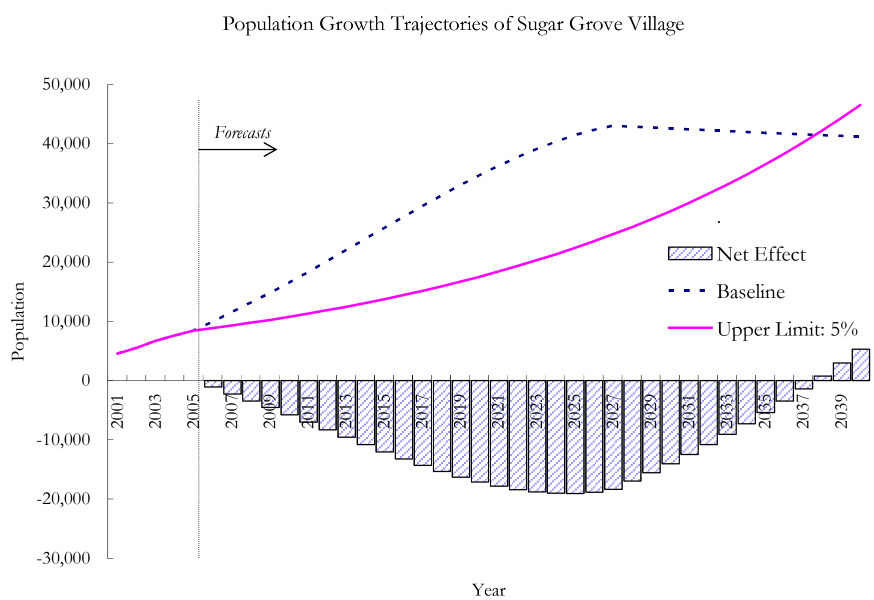


Figure 10. Population Growth Trajectories of Sugar Grove Village

Table 3 summarizes the effects of minimum-lot-size requirements and permit caps on main macroeconomic variables in the case of 5% upper limit. Consistent with the expectation, population, which is directly limited by the regulations, show the greatest percentage loss compared to the baseline. Although the magnitudes are smaller, the negative effects are found in all other variables, such as GRP, production, employment, and income. Particularly, as in the case of the prior experiments, local sectors' losses are larger than Manufacturing, which is relatively less dependent on household spending and local governments' expenditures. As demonstrated above, the regional economy will be affected more significantly if the regulations are implemented in a more restrictive manner. The larger impact is also probable, when a greater number of municipalities in the region use such reactive land use regulations for their own interests, as opposed to considering the overall region's prosperity.

Table 3. Macroeconomic Effects of the Regulations: Baseline vs. Upper Limit: 5%

	Year 2005	Year 2040			
		Baseline	Upper Limit: 5%	Net Effect	%
GRP	404,448	832,890	832,451	-438	-0.05%
Population	8,449,379	10,305,923	10,260,947	-44,976	-0.44%
Total Output	921,052	1,851,569	1,850,418	-1,151	-0.06%
Employment	4,813,568	6,309,561	6,304,096	-5,466	-0.09%
Construction	269,899	324,307	323,968	-338	-0.10%
Manufacturing	455,135	346,076	345,951	-125	-0.04%
Trade	974,122	1,169,071	1,167,585	-1,486	-0.13%
FIRE	541,939	752,546	752,246	-300	-0.04%
Service	1,983,305	2,877,071	2,874,330	-2,741	-0.10%
All Other Sectors	589,168	840,491	840,016	-475	-0.06%
Personal Income	362,000	682,226	681,945	-282	-0.04%

Note: All monetary values are in 2005 chained million dollars.

5. SUMMARY & DISCUSSION

In recent years, it has been suggested that restrict regulations on land use may hinder regional economic growth by constraining land supply for urban uses excessively, increasing the costs of housing significantly, and limiting not only housing but also labor supply. Although Glaeser (2006), Glaeser *et al.* (2006), Saks (2008), and other studies nicely highlight the possibility of such negative effects, they use a single index to represent land use regulations in each metropolitan area rather than considering the heterogeneity in land use controls, such as qualitative differences and local variances within a metropolitan area. Given that 1) the behavior of spatial economic systems is very complex and dynamic in nature, and 2) in the U.S. context, land use are typically regulated by local governments rather than a single region-wide government body, it would be more effective to use a simulation model (that is spatially explicit and also well describes the structure of a regional economic system) to analyze the effects of complicated real land use controls on regional economic performance than simply comparing highly regulated metropolitan areas with a contrasting group of regions in terms of economic indicators.

Therefore, this study uses a spatial REIM to assess the macroeconomic effects of a particular type of land use controls: reactive regulations, such as minimum lot size requirements and building permit caps in the Chicago metropolitan area. From the impact analyses, it was found that the regulations that bind local housing supply and population growth within the jurisdictions:

1) generate negative impacts, spread out over space and the economy through the labor supply chains and inter-industry linkages.
2) dampen the pace of regional economic growth considerably, although the actions are sometimes favorable to the long-run prosperity of the implementing, individual municipalities.
3) tend to induce disproportionate impacts on different sectors of the economy – i.e. local sectors, which heavily depend on household expenditures, are affected more seriously.
4) induce effects that vary substantially by the location of the implementation.

The findings provide planners and policy makers with a meaningful caution about their regulatory actions. Because land use controls in a particular municipality have significant effects on other places and the overall regional economy, land use planning practice and regulation enforcement at local level needs to be better coordinated and conducted with proper consideration of region-wide concerns. This is required not only for unregulated places but also for the municipality itself, because every locality as a part of the regional economic system, highly interrelated with each other, so that a negative effect spilling over to others is likely to return.

We also would like to stress the analytic needs for dealing with 'land use – regional economy' interactions. Although many operational urban simulation models are available, most of them adopt top-down approach to linking macro variables and sub-regional conditions, ignoring the implications of internal structure for regional economic performance. Without an analytic tool, in which the behavior of a multi-level spatial economic system is well described, it is difficult to assess the potential effects of various local policies and, consequently, hard to attain informed policy decision making that is essential not only for effective land use management but also for regional economic development.

The spatial REIM used in this study also requires improvements. As it currently stands, the framework does not explicitly consider some important factors, such as transportation costs, the efficiency in public service provisions, and other agglomeration benefits which 1) may be largely influenced by land use and 2) have significant effects on macroeconomic variables. Future research will strive toward extending the framework by including such components. This extension is particularly necessary to analyze proactive smart growth policies, which may result in countervailing effects: 1) on the one hand, they may achieve an efficiency improvement in public service provisions and induce other favorable economic consequences (see e.g. Nelson & Peterman 2000; Cervero 2001), whereas 2) on the other hand, they may cause the deterrent effects by controlling development process, like the reactive controls.

REFERENCES

Anas, A. and I. Kim. 1996. General equilibrium models of polycentric urban land use with endogenous congestion and job agglomeration. *Journal of Urban Economics* 40, 232-256.

Anas, A. and R. Xu. 1999. Congestion, land use, and job dispersion: A general equilibrium model. *Journal of Urban Economics* 45, 451-473.

Anas, A. and Y. Liu. 2007. A Regional Economy, Land Use, and Transportation model (RELU-TRAN©): Formulation, algorithm design, and testing. *Journal of Regional Science* 47, 415-455.

Boarnet, M. G. 1994. An empirical model of intrametropolitan population and employment growth. *Papers in Regional Science* 73, 135-152.

Brueckner, J. K. 1990. Growth controls and land values in an open city. *Land Economics* 66, 237-248.

Campbell, S. 1996. Green cities, growing cities, just cities?: Urban planning and the contradictions of sustainable development. *Journal of the American Planning Association* 62, 296-312

Cervero, R. 2001. Efficient urbanisation: Economic performance and the shape of the metropolis. *Urban Studies* 38, 1651-1671.

Engle, R., P. Navarro, and R. Carson. 1992. On the theory of growth controls. *Journal of Urban Economics* 32, 269-283.

Glaeser, E. L. 2006. The economic impact of restricting housing supply. Policy Briefs PB-2006-3, Rappaport Institute for Greater Boston, Harvard University. http://www.hks.harvard.edu/rappaport/downloads/policybriefs/glaeserhousing_final.pdf

Glaeser, E. L., J. Gyourko, and R. E. Saks. 2006. Urban growth and housing supply. *Journal of Economic Geography* 6 (1): 71–89.

Gyourko, J. Saiz, A. and A. Summers. 2008. A new measure of the local regulatory environment for housing markets: The Wharton residential land use regulatory index. *Urban Studies* 45, 693-729.

Heikkila, E. J. 1996. Are municipalities Tieboutian clubs? *Regional Science and Urban Economics* 26 (2): 203-226.

Israilevich, P. R., G. J. D. Hewings, M. Sonis, and G. R. Schindler. 1997. Forecasting structural change with regional econometric input-output model. *Journal of Regional Science* 37, 565-590.

Kim, J. H. 2009. Linking land use planning and regulation to economic development: A literature review. Regional Economics Applications Laboratory Discussion Paper 09-T-5. http://www.real.illinois.edu/d-paper/09/09-T-5.pdf

Kim, J. H. and G. J. D. Hewings. 2010a (*forthcoming*). Framing urban systems and planning concerns as a multi-level problem: A review of the integrated urban system models with an emphasis on their hierarchical structures. In N. Brooks, K. Donaghy, and G. Knaap, Ed. *Oxford University Press Handbook of Urban Economics and Planning*.

Kim, J. H. and G. J. D. Hewings. 2010b. Integrating the fragmented regional and sub-regional socio-economic forecasting and analysis: A spatial regional econometric input-output framework. Regional Economics Applications Laboratory Discussion Paper 10-T-6. http://www.real.illinois.edu/d-paper/10/10-T-6.pdf

Lai, F. and S. Yang. 2002. A view on optimal urban growth controls. *The Annals of Regional Science* 36, 229-238.

McDonald, J. F. and D. P. McMillen. 2004. Determinants of suburban development controls: A Fischel expedition. *Urban Studies* 41 (2): 341-361.

Nelson, A. C. and D. R. Peterman. 2000. Does growth management matter? The effect of growth management on economic performance. *Journal of Planning Education and Research* 19, 277-285.

Rey, S. J. 2000. Integrated regional econometric + input-output modeling: Issues and opportunities. *Papers in Regional Science* 79, 271-292.

Ross, S. and J. Yinger. 1999. Sorting and voting: A review of the literature on urban public finance. In P. Cheshire and E. S. Mills, Ed. *Handbook of Regional and Urban Economics* Vol. 3. New York: North-Holland.

Sakashita, N. 1995. An economic theory of urban growth control. *Regional Science and Urban Economics* 25, 427-434.

Saks, R. E. 2008. Job creation and housing construction: Constraints on metropolitan area employment growth. *Journal of Urban Economics* 64 (1): 178–195.

Sasaki, K. 1998. Optimal urban growth controls. *Regional Science and Urban Economics* 28, 475-496.

Sheppard, S. 2004. Land use regulation and its impact on welfare. In R. Capello and P. Nijkamp, Ed. *Urban Dynamics and Growth: Advances in Urban Economics*, Amsterdam: Elsevier.

Tiebout, C. M. 1956. A pure theory of local expenditures. *Journal of Political Economy* 64 (5): 416-424.

West, G. R. 1995. Comparison of input-output, input-output+econometric, and computable general equilibrium impact models at the regional level. *Economic Systems Research* 7, 209-227.