THE JOURNAL OF TRANSPORT AND LAND USE http://jtlu.org
VOL. 4 NO. 2 [Summer 2011] pp. 1–3 doi: 10.5198/jtlu.v4i2.197

JTLU

The coevolution of transport and land use

An introduction to the Special Issue and an outline of a research agenda

David Levinson
University of Minnesota[a]

Volume 4, Issue 2 of the *Journal of Transport and Land Use* focuses on coevolution: how transport drives changes in land use, and vice versa. The issue contains four research articles, examining different geographies, eras, and technologies. These papers present new findings, but as good science should, raise new questions, and help us set a research agenda to better understand the coevolution of transport and land use.

In "The impact of access to rail transport on agricultural improvement: The American Midwest as a test case, 1850–1860," Jeremy Atack and Robert Margo consider how the railroad in the nineteenth century enabled undeveloped land in the American Midwest to be converted to productive agricultural uses. About two-thirds of the increase in agricultural land in cultivation can be attributed to the railroad (Atack and Margo 2011). The debate about the influence of the railroad in American development has been long-standing (David 1969; Fogel 1964), and has recently been rejuvenated with proposals for new high-speed rail lines.

In "Developing densely: Estimating the effect of subway growth on New York City land uses," David King asks if subways led or followed land development in the early twentieth century. In London, the Underground both led and followed residential land development (Levinson 2008); its construction resulted in a great decentralization of the population while the center became increasing commercial (presumably to enable economies of agglomeration). In the Twin Cities of Minneapolis and Saint Paul, Minnesota, the streetcar led residential land development (Xie and Levinson 2010) and its backers aimed to promote the development of new suburbs. This suburbanization paid for the capital costs of the streetcar system, while fares paid for operations, a pattern which was sustained for many years. However, this model ultimately failed (leading to the collapse of the streetcar system) when the infrastructure needed to be recapitalized as the system approached 60 years of age with no new value-generating revenue sources at hand.

In the much larger city of New York, however, King finds that the Subway largely was indifferent to residential land development, but both led and followed commercial development between 1910 and 1950 (King 2011). In contrast with the Twin Cities case, real estate was not a driver of capital funding. Instead the competitive subway lines were self-financing.

Findings presented in the literature about leading and lagging processes have been mixed, and so the results are to be interpreted as case-specific unless some further underlying principle can be found. There are clear theoretical interests in determining causality, but this issue is also of practical importance. Claims about the effects of infrastructure investment abound. From a perspective of economic development, there are assertions that new infrastructure will generate growth, increase employment, increase GDP, etc. From an environmental perspective, there are concerns that new infrastructure will contribute to sprawl, raise the cost of pubic facilities, consume valuable land, depopulate cities, etc. While the directions of both of these trends are likely correct, their magnitudes are uncertain and contingent upon context. A new highway may have little effect in a context where there are larger forces at work and where marginally increased accessibility is of little import; or, the highway may unlock great value. The same kinds of claims are made about urban transit, with similar ambiguities.

In "Montréal's roots: Exploring the growth of Montréal's Indoor City," Ahmed El-Geneidy, Lisa Kastelberger, and Hatem Abdelhamid consider the growth of the city's underground pedestrian subway connections in the late twentieth century (El-Geneidy *et al.* 2011). Off-street pedestrian connections (skyways and tunnels) have been controversial in the planning community, as they keep foot traffic isolated from the "real city," diminishing business for street-fronting shops. Yet the logic of these connections for users and developers, es-

[a] dlevinson @umn.edu

pecially in climate-challenged cities, is apparent. The expansion of the Montréal network, due to the interaction of market opportunities enabled and encouraged by public policy, has increased retail accessibility throughout the Indoor City.

Whether these off-road networks are complements to, or substitutes for, at-grade networks remains to be tested. If they attract more business and people downtown, one imagines they are more complementary, but if they merely redistribute a fixed volume of traffic, than the substitution hypothesis may be borne out.

In "Does first last? The existence and extent of first mover advantages on spatial networks," David Levinson and Feng Xie consider several cases to test the notion of lock-in. Does the first station, link, port, etc. not only attract a great deal of traffic initially, but produce an interlocking set of environmental changes that enable this disproportionate traffic level to be sustained for years, decades, or even centuries after it was built? In some senses, cities are evidence of first mover advantages: the "center" of many cities today is quite near the center when that city was founded. The location must, of course, have been good (otherwise the city would never have grown), but that early location attracted transport, and that transport made that location more valuable, which attracted further investments of various kinds reinforcing its position. Similar processes may operate on some types of networks at the submetropolitan level, whereby individual stations or links attract development that locks in their value. On the other hand, the free market may "compete away" those initial advantages. The paper finds that there are first-mover advantages associated with the location of London Underground stations, but not strictly with being "first" apart from the fact that those stations that opened first had more central locations, which have relatively high traffic levels, which have persisted from the 1860s until today. In contrast, an empirical study of roads in the Twin Cities shows that more recent links have more traffic. A simulation model, which allows for the formation of places (local accessibility peaks) and the topological growth of networks, supports the logic of first mover advantage (FMA) (Levinson and Xie 2011).

Clearly, more evidence needs to be brought to bear. A finding that FMA exists would support the hypothesis that early decisions have profound long-term effects, and the idea that planning is very important in the location of facilities. On the other hand, if equilibrium washes out the effect of time, early mistakes can easily be buried, and planning is less critical.

We now know a lot about the interactions of transport and land use, but we also know very little. We know that transport can induce residential land development in some cases, commercial development in other cases. We know that existing residential and commercial land uses can attract transport facilities in some cases. The particulars of each case depend upon the magnitude of investment, the position of the development within an urban or national environment (system of cities), the technology being considered, and the stage within the lifecycle of that technology.

We need to understand not just growth but economic decline, as well as how changes in technology affect networks and how reductions in networks affect land use. These changes may be caused by general economic depression, or by differences in relative accessibility as new high-speed transportation modes render obsolete older networks (and the places they connected). While a few studies of this issue have been undertaken (e.g. Xie and Levinson 2007), the issue remains unsettled.

How does network structure affect land development and economic growth? There are many claims about the "optimality" of various network forms (dense vs. sparse connectivity, grid vs. radial topology, flat vs. hierarchical organization, etc.) but little evidence. Optimality depends on how various services (transit, taxis, trucks) use the network, as well as on the modal and vehicular mix; an optimal state for one set of services, modes and vehicles may be far from optimal with different provisioning.

How does ownership—i.e., public (and local vs. national governance) vs. private—and institutional organization affect network growth and decline? Politically driven decisions may overshoot what the market would provide (both on the upside and the downside). This question is intimately related to the concept of joint development of land and networks.

We need more case studies of particular networks in particular places, at a variety of scales (international, intercity, metropolitan, sub-metropolitan), for different technologies (pedestrian ways, roads, rails, maritime, and aviation), at different points in history. As in this special issue, these studies must be focused on time series, though the establishment of more consistent panel datasets is also highly desirable.

How far from "optimal" are real networks? That is, what is the welfare loss associated with *ad hoc* development and heuristic planning? Answering these questions requires measuring optimality—a research topic in itself, though there are standard measures in the network design literature. It may turn out this welfare loss is relatively small (much like the loss produced by allowing users to choose their own routes compared with the optimal routing of a central planner), or it might be quite large. Getting this right is important because changing the network is hard. Land use changes slowly; transport changes very slowly.

The answers to these questions are of more than historical interest. As urbanization continues apace in the developing world, cities are expected to absorb some two billion additional residents in the coming decades. These new city dwellers will occupy not just extant parts of existing cities, but new residential areas adjacent to the old, and even drive the construction of entire new cities. Urban expansion will require networks to serve activities dispersed over space, and these networks may be efficient or wasteful in terms of construction costs, user time, energy inputs, or the environment. How we choose to develop and manage these networks will depend on what we know.

Acknowledgments

The editors of the Journal thank the authors whose work appears in this Special Issue for their contributions to this introduction.

References

Atack, J. and R. Margo. 2011. The impact of access to rail transport on agricultural improvement: The American Midwest as a test case, 1850–1860. *Journal of Transport and Land Use*, 4(2):5–18. doi: 10.5198/jtlu.v4i2.188.

David, P. 1969. Transport innovation and economic growth: Professor Fogel on and off the rails. *The Economic History Review*, 22(3):506–525.

El-Geneidy, A., L. Kastelberger, and H. T. Abdelhamid. 2011. Montréal's roots: Exploring the growth of Montréal's Indoor City. *Journal of Transport and Land Use*, 4(2):33–46. doi: 10.5198/jtlu.v4i2.176.

Fogel, R. 1964. *Railroads and American Economic Growth: Essays in Econometric History*. Johns Hopkins University Press.

King, D. 2011. Developing densely: Estimating the effect of subway growth on New York City land uses. *Journal of Transport and Land Use*, 4(2):19–32. doi: 10.5198/jtlu.v4i2.185.

Levinson, D. 2008. Density and dispersion: The codevelopment of land use and rail in London. *Journal of Economic Geography*, 8(1):55. doi: 10.1093/jeg/lbm038. URL http://nexus.umn.edu/Papers/Codeploy.pdf.

Levinson, D. and F. Xie. 2011. Does first last? the existence and extent of first mover advantages on spatial networks. *Journal of Transport and Land Use*, 4(2):47–69. doi: 10.5198/jtlu.v4i2.197.

Xie, F. and D. Levinson. 2007. The weakest link: The decline of the surface transportation network. *Transportation Research Part E*, 44(1):100–113. doi: 10.1016/j.tre.2006.09.001. URL http://nexus.umn.edu/Papers/WeakestLink.pdf.

Xie, F. and D. Levinson. 2010. How streetcars shaped suburbanization: A Granger-causality analysis of land use and transit in the Twin Cities. *Journal of Economic Geography*, 10(3):453. doi: 10.1093/jeg/lbp031. URL http://nexus.umn.edu/Papers/Streetcar.pdf.