The macroeconomic structure of cities

indicators for sustainable urban infrastructure development

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Presentation to the conference
Regional Cycles: Regional Economy towards Sustainability
hosted by the
International Council for Local Environmental Initiatives
European Secretariate
Eschholzstrasse 86
D-79115 Freiburg, Germany

Roundtable 2: Indicators and standards for sustainable economic activities in regions
Leipzig, 1 November 2002

institute for sustainable futures

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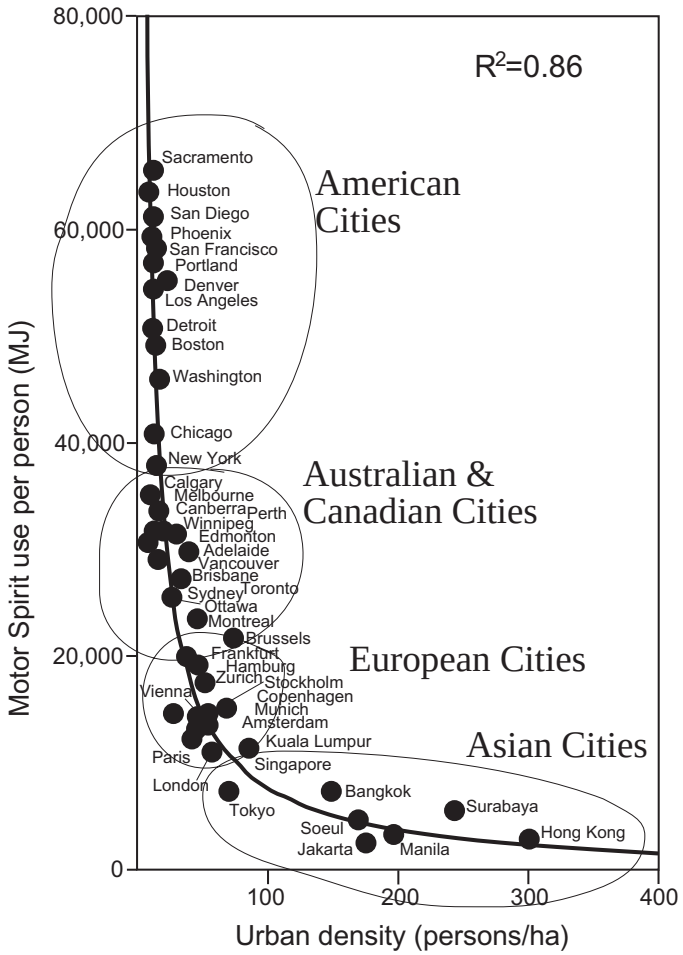
To begin this presentation I would like to paint a picture of the world economy.

Figure 1 Private motor vehicle fuel use vs. urban density for 46 international cities (1990)



Source: Kenworthy, JR. and Laube, FB. et al 1999, *An international sourcebook of automobile dependence in cities 1960-1990.* University Press of Colorado, Boulder.

The graph in Figure 1 shows per capita fuel use for passenger transport in 44 cities from around the world.

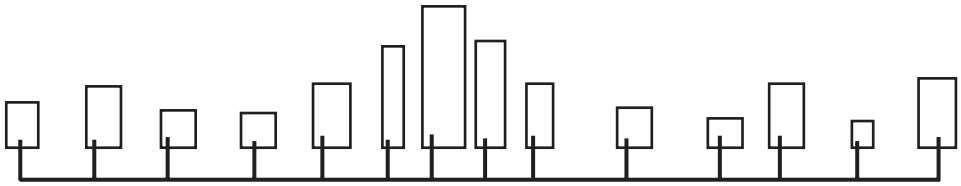
As you can see American cities consume more fuel on a per capita basis than any other group of cities. Following close behind them are Australian and Canadian cities. European cities consume less fuel than these and Asian cities consume less fuel again.

The indicator on the x-axis is urban density. Urban density is one of the better ways there is of numerically representing urban morphology or patterns of land use development. This basically refers to the way housing, commercial and industrial land uses are physically located in relation to one another as well as the type of transport infrastructure networks that logistically make the patterns possible.

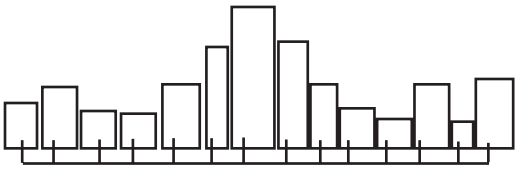
The point I wish to make with this graph is that if we think about the world as a complex network of cities all competing and trading with one another instead of nations competing with nations, then it is possible to see that by comparison with everyone else, American cities are at a distinct comparative disadvantage. This is because American cities consume more fuel than anyone else's and fuel is an input to economic production.

Figure 2 illustrates in a schematic way why the structure of American and Australian cities means they have to consume more fuel to operate than higher density cities like those in Europe and Asia.

Figure 2 Illustration of comparative spatial advantages and disadvantages of infrastructures costs in low and high density cities



Low Density City



High Density City

Source: Zeibots, ME. 1994, *The economic role of cities.* Honours thesis. Institute for Sustainability and Technology Policy. Murdoch University, Perth.

The reason why fuel use is high in low density cities is because the distances between the operating units are greater. In high density cities, distances are smaller so fuel use is less and modes of transport like walking and cycling are in many cases more convenient than using a car.

The relative distances between operating units in a city not only affects transport, but other hard infrastructures as well. Water and sewerage, gas and electricity grids all have higher per capita provision and operating costs in low density cities. More materials have to be used to bridge the gaps. The same occurs for soft infrastructures like health, education, civilian policing and emergency services.

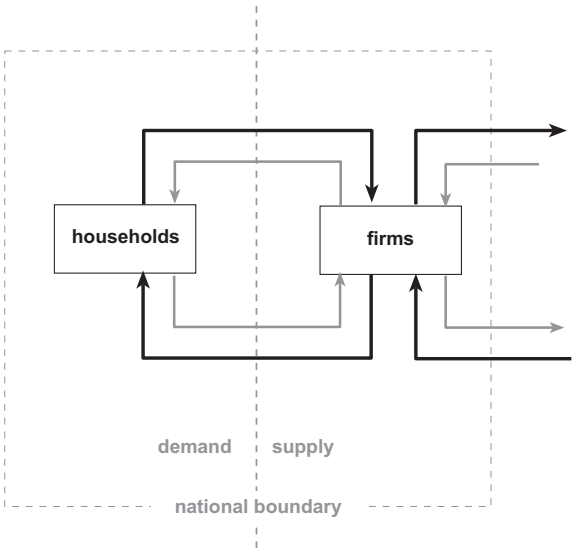
So if we go back to Figure 1 and think about the kind of relationship we might get if we had data for total infrastructure costs per capita, then we would probably get a relationship that is similar to that for fuel use. This is because infrastructure costs are to a large extent dependent on urban morphology as indicated by the urban density parameter.

A picture of the global economy based on cities competing with cities is different to the conceptualisation we get from mainstream economic theory. The physical aspects of economic structure that I have touched on here are not recognised in mainstream theory. The fact that all infrastructures are inputs to production in a general sense is not picked up. This is because economic structure in orthodox models is based on ownership relations.

The main point I want to emphasise here is: *If the unit of organisation used to define a macroeconomy is changed, a different conceptualisation of how an economic system is structured is achieved. This enables different relationships to be seen and of course a range of very different indicators is needed to understand and monitor the progress of the system.*

To demonstrate this point I'd like to briefly review the way mainstream theory defines what a macroeconomy is and how it works.

Figure 3 Circular Flow of Income and Expenditure



Firms: are production units that supply goods and services for export or consumption by domestic households.

Households: are consumption units that supply labour to firms.

Adapted from McDonald, IM. 1992, *Macroeconomics*. 2nd edition. John Wiley & Sons, Milton. p.42.

The way mainstream theory conceptualises the complex processes that make-up a macroeconomic system is outlined in what is called the *Circular Flow of Income and Expenditure.*

In this conception a national economy is broken down into two broad categories of decision making units. These are *households* and *firms*.

Households supply firms with the labour needed to operate production processes. In return labour is payed an income. Firms supply goods and services that are consumed by households and in return households spend a portion of their income to pay for the goods and services, the rest is either saved or invested back into firms. In this way there is a circular flow of labour, goods and services and in the other direction there are incomes and expenditures between the two groups. The consumption side of the arrangement becomes *aggregate demand* represented by households and the production side becomes *aggregate supply* represented by firms.

Now obviously mainstream economic theory is far more complicated than this. But the point I wish to draw out is that the notion of inputs and outputs—one of the most basic concepts in any systems theory—gets confused and muddled in the model. Let me explain how.

The indicators used to monitor this system are referred to as the *National Accounts*. They are designed to reflect what are perceived to be the major processes and flows occurring in the economy namely *production*, the *distribution of incomes*, *consumption*, *saving* and *investment*.

One of the key indicators arising from this set is the production indicator. Most of us know this as *Gross Domestic Product* or GDP.

There are three different ways GDP is calculated. One adds up all the receipts from the sales of goods and services to final domestic consumers, increases in stocks and exports minus imports. This is called GDP(E), where the E stands for *expenditure*.

The other way adds up all the costs of production like wages and the gross operating operating surplus from firms. This is called GDP(I), where the I stands for *income*.

The third way is to calculate an average of the two. This is called GDP (A).

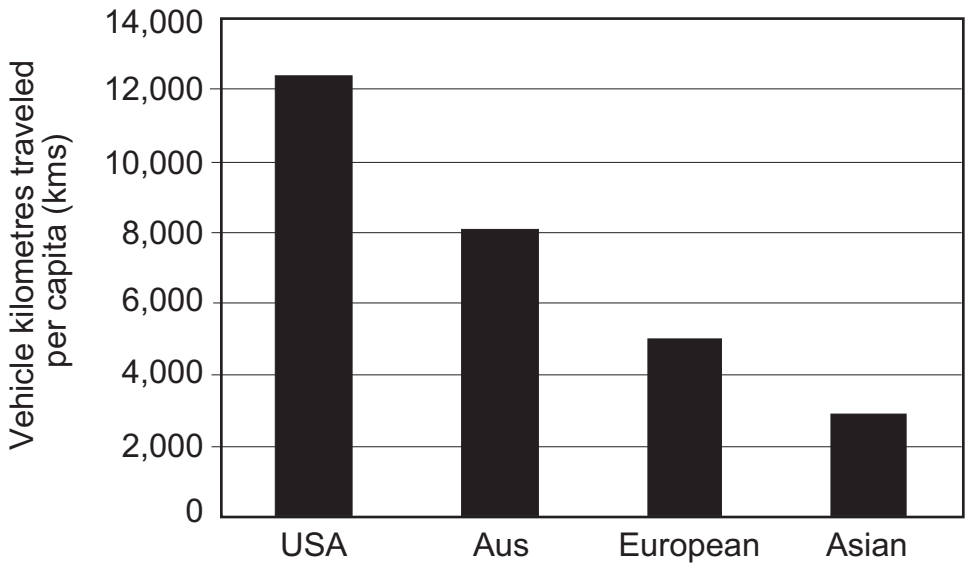
Conceptually, GDP(E) and GDP(I) should equal each other. In practice they don't because of all kinds of discrepancies but they are usually pretty close.

Most macroeconomists will tell you that an increase in GDP is a good thing. The reason why is because either way it means the economy is producing more. An increase in GDP per capita means that labour productivity has increased. Or at least that is how movement in this indicator is interpreted.

Now I want to make the point that not all processes within a macroeconomy that increase GDP are necessarily good. In some cases it means the economic system is becoming less efficient. And I'm going to argue that you can only see this when you start calculating GDP figures on a city or region basis rather than a national basis because this enables you to see the distinction between input and output activities.

Figure 4 shows average per capita Vkt values for American, Australian, European and Asian cities. Vkt is a transport indicator for kilometres travelled, in this case by car. These data are the averages for the city groups that were shown in Figure 1. Just as the residents of American cities consume more fuel than everybody else they also drive around in cars more. Asian cities have the lowest per capita Vkt figures and the biggest mode splits for walking.

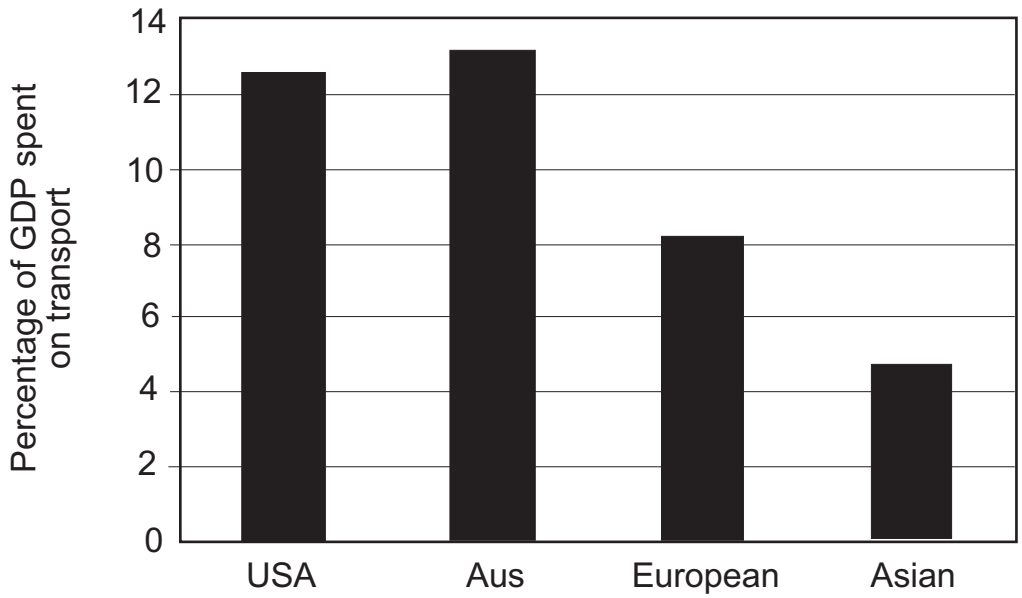
Figure 4 Average vehicle kilometres travelled for 32 international cities (1990)



Source: Kenworthy, JR. and Laube, FB. et al 1999, *An international sourcebook of automobile dependence in cities 1960-1990.* University Press of Colorado, Boulder.

In line with this trend, those cities with higher rates of car use also direct a larger portion of their domestic production towards paying for transport.

Figure 5 Average percentage of city based GDP spent on transport for 29 international cities (1990)



Source: Kenworthy, JR. and Laube, FB. et al 1999, *An international sourcebook of automobile dependence in cities 1960-1990.* University Press of Colorado, Boulder.

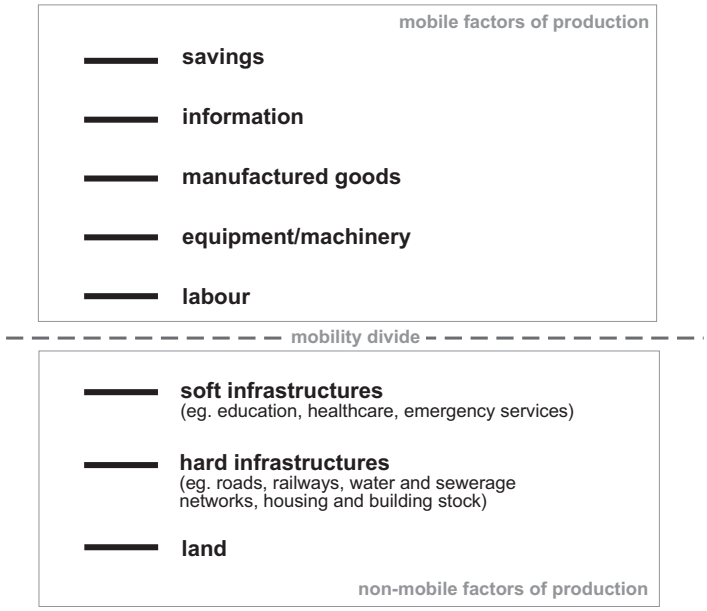
Now it's important to point out that the GDP figures calculated for the graph in Figure 5 are based on city regions and not national units. So in each case city based domestic production data were collected and then the transport costs for that year for all modes calculated as a percentage of city GDP. If we could calculate the costs of all the infrastructures of those cities as percentages of their total city GDP then the trend of American and Australian cities directing more of their production activity to infrastructures would more than likely continue because American and Australian cities generally sprawl more than everyone else's.

When domestic production is viewed on a national basis all sorts of activities are included. Mining and agriculture are big income earners for Australia for example so GDP per capita looks a lot higher than what it is if calculated on a city basis. There is also the obvious possibility that production activities taking place outside of these cities are subsidising the heavy investment in infrastructures. Take the supply regions away and these cities can't sustain themselves economically. Their infrastructure sectors are very inefficient.

To return to some of the points I made earlier, infrastructures are inputs to production. They can never be outputs in the sense that they can be exported and sold to earn an income for that city. If you build lots of roads and drive cars around on them, this will increase GDP. But it becomes difficult to seriously argue that an increase of this kind constitutes an increase in labour productivity. Driving cars around in and of itself is not productive.

When we start thinking about the activity of whole economies, or macroeconomies in this way then aspects of the system become clearer.

Figure 6 Ladder of mobility: factors of production ranked according to mobility



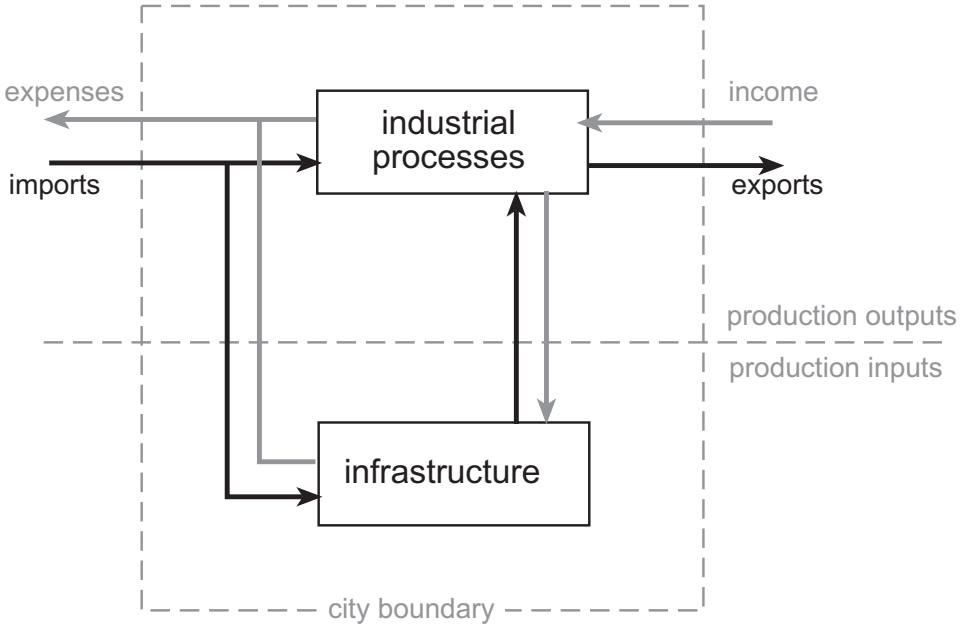
Adapted from Prud'homme, R. 1994, "On the economic role of cities" in *Cities and the new global economy*. An international conference presented by the OECD ad the Australian Government. 20-23 November, Melboune.

I'm going to finish by quickly outlining the sort of system conceptualisation that comes from thinking about a macroeconomy as a city or region rather than a nation.

Figure 6 lists the factors of production on the basis of their mobility characteristics rather than their ownership status. The factors listed below the line marked *mobility divide* are all immobile. They can't move. They can't be traded. They are basically all infrastructures. And because they cannot cross the boundary of the city system to become a potential export or income generating commodity, they can only ever act as inputs to production.

Figure 7 shows a conceptualisation that divides a macroeconomy into two different activity groups. I've called these *industrial processes* and *infrastructures*. Industrial processes do produce tradeable goods and services. Infrastructures support these industrial processes, but the structure and way they support industry can be orchestrated in many different ways.

Figure 7 Inverse Flow of Resources through industrail process and infrastructure sectors



The upshot of this is that if we collect production data and develop indicators that distinguish between investment and activity generated by these different sectors, then an understanding of the ratio of input sector activity to output sector activity is achieved.

From the perspective of those of us who are interested in sustainability and the protection of natural resources, it is obvious that if your inputs are much larger than your outputs, then even in a purely economic sense, your city or regional economy is unsustainable. How infrastructures are provided and operated begins to take on a new macroeconomic significance when thought about in this way, but a different model, like the one shown here is needed to realise this.

The indicators required to see this need to be very different to the ones we use at the moment, but they could show us more clearly what our economies are actually doing, but first we need to reorganise the theory we use to describe the way our economies work.

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