Decoupling Urban Car Use and Metropolitan GDP Growth

Jeff Kenworthy

Abstract:
Data for 1995 and 2005 on forty-two cities in the USA, Canada, Australia, Europe and Asia suggest that car use as well as total motorised mobility have decoupled from real growth in metropolitan GDPs. The car vehicle kilometres travelled per unit of GDP in thirty-nine out of the forty-two cities studied has reduced by an average of 24%. In thirty-five or 83% of the cities, total motorised passenger kilometres travelled per unit of GDP was lower in 2005 than it was in 1995, by an average of 26%. Decoupling of urban mobility from GDP can occur in the context of still rising car use or total mobility. However, in twelve out of the forty-two cities the actual car use per capita also declined by an average of over 6%. Overall, it is found that the average increase in car use in these forty-two cities from 1995 to 2005 was 7% or less than one-third of the level in the 1980s. This decoupling of car use from GDP growth is thus part of the 'peak car use' phenomenon. New data showing an improvement in the relative speed of public transport systems compared to general road traffic over many decades, which is being led by a strong global trend towards urban rail, may help to explain these results. Further research is needed to see if Chinese and Indian cities, with their heavy investments in rail, can also start to show a decoupling of passenger transport from GDP. Overall, the results suggest a possible future where wealth can continue to be created globally whilst reducing the use of cars, oil and their damaging global impacts.

Keywords: car use per capita, GDP per capita, decoupling, peak car use, motorised mobility, urban rail, relative speeds.

Road planning in Germany: an urgent need for reform

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Abstract:
In Germany in 1971 the basic plan for the construction of the federal road network was adopted. The existing planning procedures for motorways and roads since then only slightly changed: They oriented on paradigms as an ever-growing demand for transport and an optimal access to motorways for high speeds. The article looks at the processes and their implications for the future.

Keywords: planning process, planning of motorways, transport infrastructure and economy

Decoupling Urban Car Use and Metropolitan GDP Growth

Jeff Kenworthy

Introduction

It is common to see increasing car use linked to increases in wealth. This was referred to by Lave (1992) as an "irresistible force". In the light of the "peak car use" phenomenon that is now observable in many developed nations and increasingly in the cities of those nations (Newman and Kenworthy, 2011), it is interesting to look at the relationship between urban passenger transport, especially car use, and the development of GDP in cities. The significance goes well beyond the academic interest in something once considered virtually a law of transport (Schafer and Victor, 2000). The global agencies dealing with the difficult question of whether the world can adjust to meet the challenge of climate change, must find a mechanism to enable GDP and transport to be decoupled. Technological advances can play their part in reducing carbon for each kilometre of travel, but this is much more likely to be effective if at the same time the amount of kilometres travelled is also decreasing. Without this their global models will never be able to incorporate a valid way of achieving a future with a maximum of 2^{o} C of temperature rise (Fulton et al, 2013).

With the update of the Millennium Cities Database for Sustainable Transport (Kenworthy and Laube, 2001) being undertaken by the author, it is now possible to examine this point in more detail. Both car use per capita (vehicle kilometres) and GDP per capita for two years (1995/6 and 2005/6) for forty-two cities in the USA, Australia, Canada, Europe and Asia are now available on a consistent methodological basis.[1] These cities have 2005/6 GDPs per capita (in 1995 US dollars) between $55,070 (Washington DC) and $18,823 (Hong Kong).[2] As well, we can examine similar relationships between total motorised mobility in cities involving passenger kilometres of travel by cars, motorcycles and public transport.

There are two ways of undertaking this analysis. One is to express all GDPs for cities for both 1995 and 2005, in this case in real US dollars (pegged to 1995, since the initial set of data were for that year). This is particularly important if one is trying to make comparisons between cities in different countries, for example, which cities are higher or lower on particular variables related to wealth. In doing this, however, we also introduce factors into the analysis which are not consistent between countries. What affects the value of the US dollar on the international money markets may not be affecting, for example, the value of the Euro in the same way. Depending on the aims of the analysis, conversions between currencies can introduce distortions, which confuse the results. In this analysis the aim is to investigate the possible extent to which growth in mobility and especially car mobility may have decoupled from growth in wealth or GDP per capita. It is thus very important to ensure that both the mobility variables and the wealth data for these cities are kept within the same domain and are not affected by divergent external factors that can come into play in converting to a common currency. In the central analysis in this paper real GDPs in local currencies have therefore been used (pegged to 1995).

Car vehicle kilometres and growth in metropolitan GDP

In order to see how the development of car vehicle kilometres in this global sample of cities relates to the development of their GDP, this research has calculated the car kilometres driven to generate one unit of real GDP in local currency in 1995 and 2005 for each metropolitan area (e.g. for US cities this was car kilometres per real 1995 US dollar of GDP and in European cities using the common currency it was car kilometres per real 1995 Euro of

1 Note that some cities have 1995 and 2005 data and some have 1996 and 2006, depending on Census years. For simplicity the data are referred to as 1995 and 2005.

2 All comparisons in the paper, which refer to GDP in US dollars, are performed on the basis of real dollars ($US1995). Currencies are converted to US dollars in the appropriate year using the IMF's Standard Drawing Right found at: http://www.imf.org/external/np/fin/data/param_rms_mth.aspx. All conversions are done as at 31/12 of the relevant year or the date closest to that (e.g. 29/12). US dollars are converted to 1995 US dollars using the World Economic Outlook GDP Deflator for the USA found at: http://www.econstats.com/weo/V005.htm.

GDP and so on). To do this the per capita GDP for each metropolitan area was calculated based on the functional economic region or labour market area for each city and expressed in 1995 real local currencies. This was then divided into the per capita car vehicle kilometres for that year. Local currencies were converted to real 1995 values using the World Economic Outlook GDP Deflator found at: http://www.econstats.com/weo/V005.htm. for the country in which each city is located. The main aim here was not to compare the relative amount of car driving per unit of real GDP between cities, but how the amount of driving per unit of GDP has changed over the ten year period between 1995 and 2005 in each city. per unit of GDP (50% in Madrid) is shown first, with the last city being Berlin, which was one of only three cities that showed an increase in this factor (15%), the other two being Frankfurt and Vancouver, but the increase in both these cases was very small (1.3% and 2.1% respectively). Berlin was the only city in the analysis to experience a fall in real GDP per capita in local currencies (20,678€ to 20,463€), which when also combined with an increase in car use per capita, resulted in the 15% increase in car kilometres per unit of GDP. In the case of Vancouver, there was only a tiny increase in real GDP per capita (CAD$35,213 to CAD$35,511), while car use also grew a little. Frankfurt was similar.

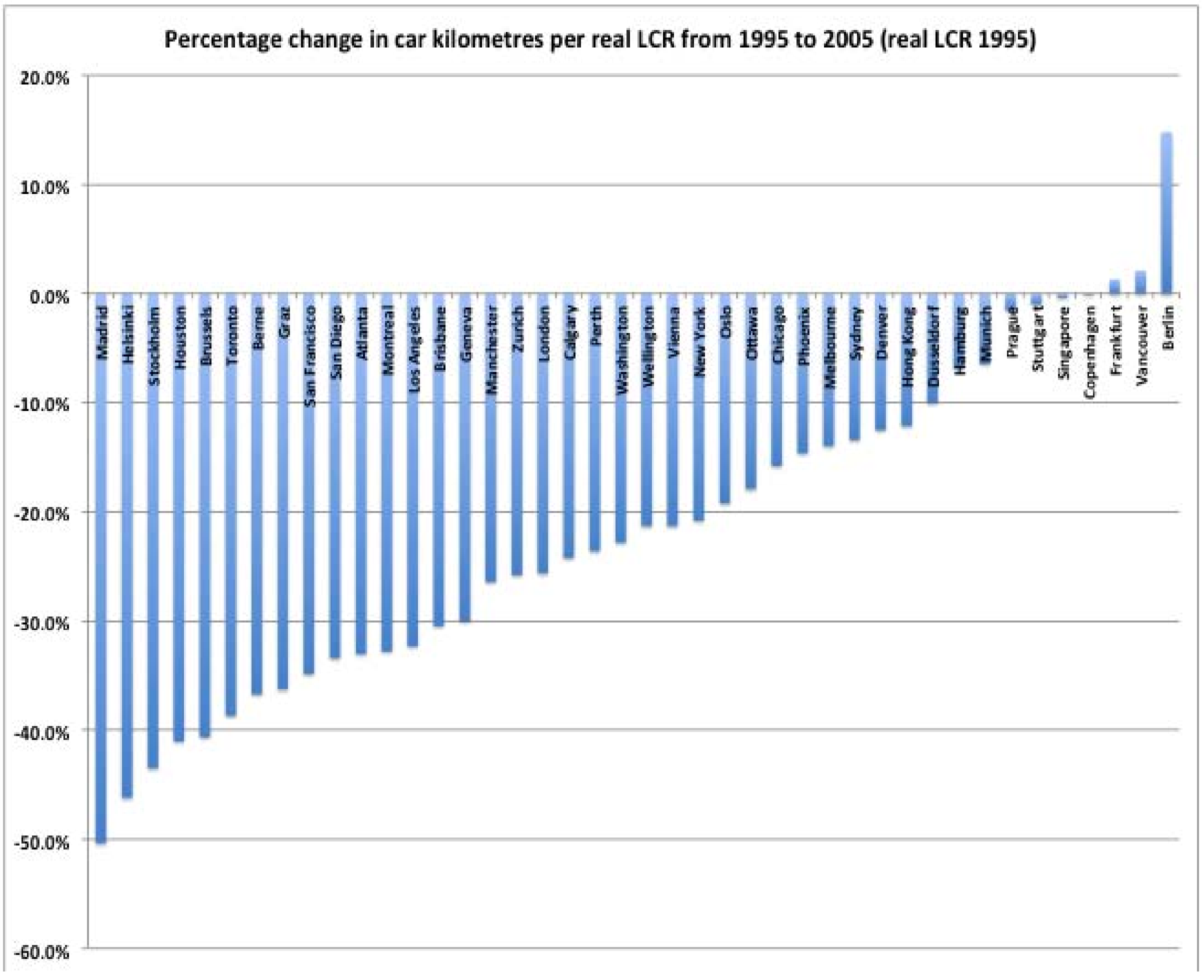

Figure 1. Percentage change in car kilometres travelled per unit of real GDP in forty-two cities (real local currencies).

This can be expressed as a percentage. Table 1 shows the results of this analysis for the forty-two cities under consideration. Importantly, it shows the decadal percentage change from 1995 to 2005 in the amount of car driving per unit of real GDP. The city with the biggest drop in car driving

Figure 1 shows the percentage changes in car kilometres per unit of real GDP for each city and reveals the extent to which car use decoupled from GDP over the 10-year period. It shows that thirty-nine out of the forty-two cities reduced in their car kilometres per GDP

City	Local currency	Passenger car kilometres per LCR, 1995 (real LCR 1995)	Passenger car kilometres per LCR, 2005 (real LCR 1995)	% change 1995-2005
Madrid	EUR	0.300	0.149	-50.3%
Helsinki	EUR	0.195	0.105	-46.2%
Stockholm	SEK	0.023	0.013	-43.5%
Houston	USD	0.558	0.329	-41.1%
Brussels	EUR	0.128	0.076	-40.6%
Toronto	CAD	0.207	0.127	-38.6%
Berne	CHF	0.109	0.069	-36.7%
Graz	EUR	0.207	0.132	-36.2%
San Francisco	USD	0.344	0.224	-34.8%
San Diego	USD	0.503	0.335	-33.4%
Atlanta	USD	0.651	0.436	-33.0%
Montreal	CAD	0.247	0.166	-32.8%
Los Angeles	USD	0.439	0.297	-32.3%
Brisbane	AUD	0.384	0.267	-30.5%
Geneva	CHF	0.110	0.077	-30.0%
Manchester	GBP	0.424	0.312	-26.4%
Zurich	CHF	0.093	0.069	-25.8%
London	GBP	0.285	0.212	-25.6%
Calgary	CAD	0.252	0.191	-24.2%
Perth	AUD	0.280	0.214	-23.6%
Washington	USD	0.339	0.262	-22.8%
Wellington	NZD	0.235	0.185	-21.3%
Vienna	EUR	0.141	0.111	-21.3%
New York	USD	0.236	0.187	-20.8%
Oslo	NOK	0.026	0.021	-19.2%
Ottawa	CAD	0.235	0.193	-17.9%
Chicago	USD	0.313	0.264	-15.8%
Phoenix	USD	0.422	0.360	-14.6%
Melbourne	AUD	0.265	0.228	-14.0%
Sydney	AUD	0.231	0.200	-13.4%
Denver	USD	0.354	0.310	-12.5%
Hong Kong	HKD	0.003	0.003	-12.1%
Dusseldorf	EUR	0.160	0.144	-10.0%
Hamburg	EUR	0.159	0.148	-6.9%
Munich	EUR	0.124	0.116	-6.5%
Prague	CZK	0.013	0.013	-1.6%
Stuttgart	EUR	0.189	0.188	-1.0%
Singapore	SGD	0.053	0.053	-0.4%
Copenhagen	DKK	0.023	0.023	-0.1%
Frankfurt	EUR	0.159	0.161	1.3%
Vancouver	CAD	0.192	0.196	2.1%
Berlin	EUR	0.149	0.171	14.8%

Table 1. Car kilometres travelled per unit of GDP in real local currencies, 1995-2005.

by an average of 24% (across the entire forty-two cities the decline was 21%).

These cities have thus been able to grow their economies while experiencing major reductions in the relative amount of car driving associated with this wealth creation (see further section on links to peak car use below). Overall, the data suggest that in the overwhelming majority of cases where real per capita GDP has grown, this wealth creation has decoupled from car use. Despite the issues that may be introduced in converting all currencies to a common one, it is still interesting to get an idea of counterparts. European cities needed less than half the car use to generate the same amount of GDP as in US cities. These have been the same patterns observed since we began collecting the city data from the 1960's (Newman and Kenworthy, 1989). The two relatively wealthy Asian cities of Singapore and Hong Kong had about one-fifth of the car use per GDP as the US cities in 2005. Similar patterns are evident in 1995, except that the gap between the Asian cities and the rest of the cities was much greater in 1995 than in 2005 (these Asian cities increased in their car kilometres per dollar of GDP while all the

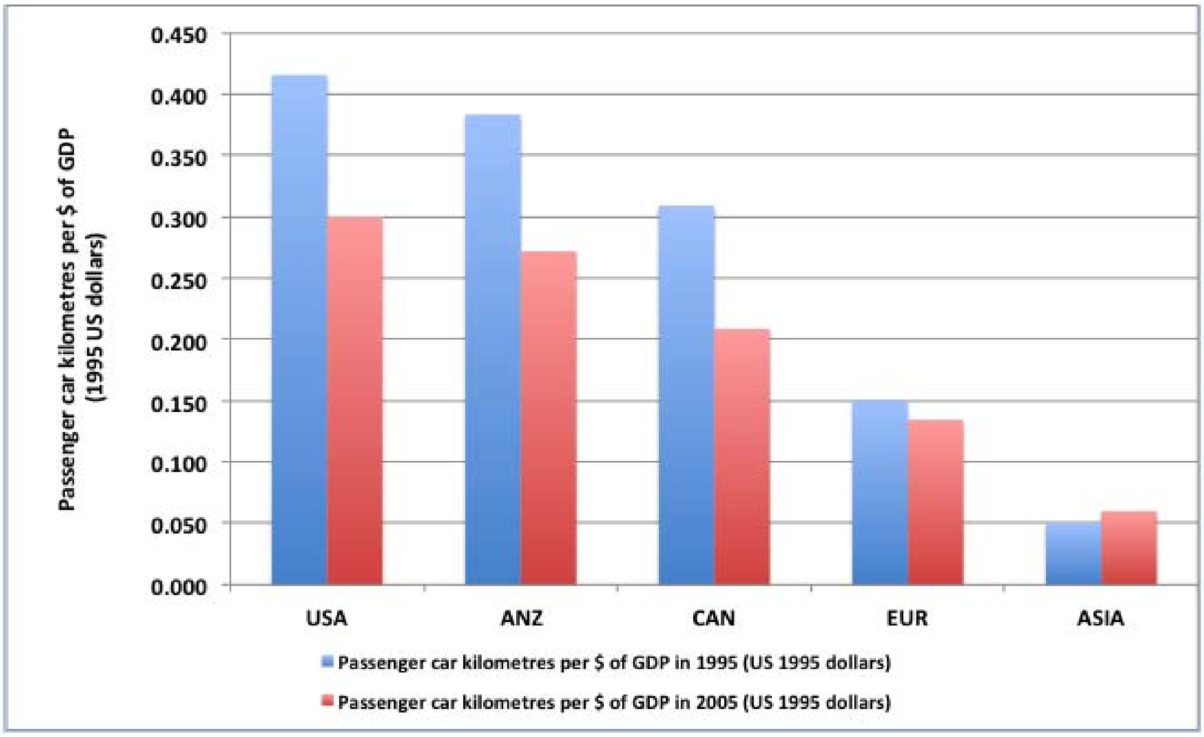

Figure 2. Car use (vehicle kilometres) per dollar of GDP in US, Australia/New Zealand, Canadian, European and Asian cities, 1995 and 2005 (using real 1995 US dollars).

the comparative amount of car driving per unit of real GDP between cities in different regions. In this case the GDPs were all converted to 1995 US dollars to enable these cross-city comparisons. Figure 2 provides these data averaged by region.

In all regions except Asia, the car kilometres driven dollar of GDP have declined from 1995 to 2005, with the European cities showing on average the least decline. Here we also see that in 2005, US cities experienced by far the most car use for every dollar of generated GDP, Australian cities were a little more efficient in this respect, while Canadian cities were clearly lower than both their US and Australian other regions declined). A similar situation is observable between the Canadian and European cities because of the small relative decline in car kilometres per dollar of GDP experienced in European cities.

In interpreting the results in Figure 2, there may also be specific economic circumstances, which could have relevance to the observations. For example, in the USA while national GDP per capita has risen considerably, the bulk of that economic growth has been within already very wealthy population segments. Meanwhile, the period from 1999 to 2009 saw a decline of 5% in real median household income and by 2011 real median household income in the USA was at the lowest level it has been since 1995 (http://www.profitconfidential.com/economic-analysis/american-real-incomes-fall-to-1995-levels/ accessed June 25, 2013).

If most economic growth is accruing to very high income people while the bulk of households are not really getting any wealthier in real terms, then one might expect that (a) these already very high income people are not needing to drive more just because they are now even more wealthy, while (b) the average person is roughly as rich in real terms as before and therefore possibly driving about the same as well. The net effect in both cases would be a decline in car kilometres per dollar of real GDP. The results thus do leave scope for more investigation and research.

Links to peak car use

Peak car use appears to be happening due to a combination of factors relating to the growth of the knowledge/services economy, the urban youth culture and use of social media, an increasing popularity of urban locations with rising urban densities and a revival in the use of transit, especially urban rail (Florida, 2010; Newman and Kenworthy, 2011). These can all be contributing to the decoupling of car use from GDP. Of course, it is possible that GDP and car use could be decoupled, but with both still growing, albeit with GDP growing more strongly to give the effect of lower vehicle kilometres per unit of GDP. Figure 3 explores this in more detail by examining the actual changes in car vehicle kilometres per capita for each of the forty-two cities in this analysis between 1995 and 2005. The data are sorted from lowest to highest according to the 1995 values.

A close examination of the chart reveals that twelve out of the forty-two cities did in fact not only achieve relative reductions in the amount of car driving associated with their GDP growth, but also absolute declines in per capita car kilometres of driving (Atlanta, Houston, San Francisco, Los Angeles, Oslo, Toronto, Montreal, Zürich, Stockholm, London, Vienna, Graz). The average decrease in per capita car use for these twelve cities was 6.4%.

Furthermore, sixteen of the cities experienced per capita increases in car vehicle kilometres of less than 10% over a decade, suggesting a significant slow down in the growth rate of per capita car kilometres. The average increase between 1995 and

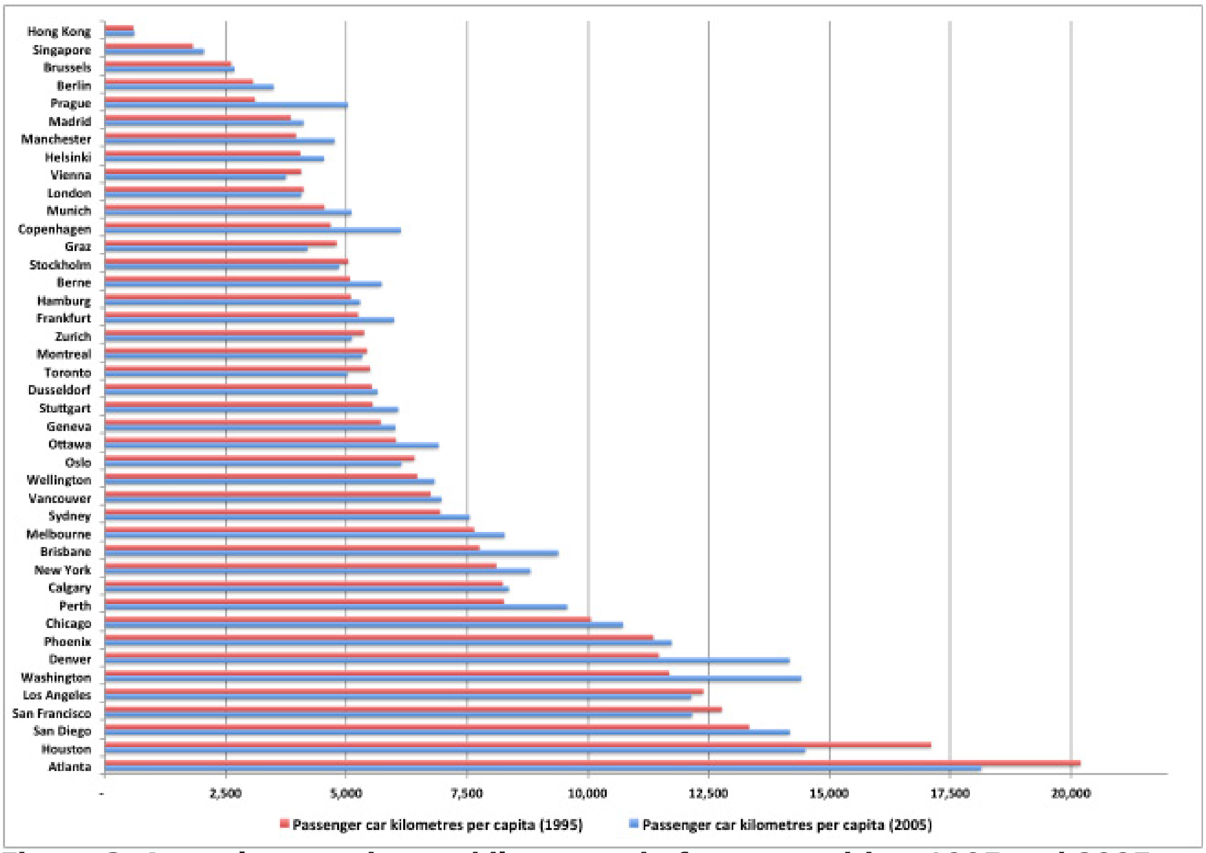

Figure 3. Annual per capita car kilometres in forty-two cities, 1995 and 2005.

2005 was 5.4% for San Diego, Phoenix, Chicago, Calgary, New York, Melbourne, Sydney, Vancouver, Wellington, Geneva, Stuttgart, Düsseldorf, Hamburg, Madrid, Brussels and Hong Kong. The remaining fourteen out of the forty-two cities in this analysis grew in car use per capita between 1995 and 2005 by an average of 20.8%.

We have shown elsewhere that the average decadal percentage increase in car vehicle kilometres per capita in cities from 1960 to 1970 was 42%, from 1970-1980, 26% and 1980 to 1990, 23% (Newman and Kenworthy, 2011). Overall, in this analysis of forty-two cities from 1995 to 2005, those that increased in car vehicle kilometres per capita did so by 12.6%, or about half the 1980 to 1990 figure. For the forty-two cities as a whole, car use per capita increased on average by only 7.2%, or less than one-third as was typical for the 1980s in similar cities.

As mentioned at the beginning, one of the persistent ideas in the literature is that car use is strongly related to GDP. In our previous research on whole cities we found little relationship between wealth and car use (Newman and Kenworthy, 1999). For 1995 no statistically significant correlation between GDP per capita and car kilometres travelled per capita could be seen in the fifty-eight higher income cities with a GDP per capita over $11,000 (US$1995). For the twenty-six lower income cities with GDP per capita less than $11,000 there was a significant relationship, with car use increasing with GDP per capita (Kenworthy and Laube, 2001).

If we examine the correlation between annual car kilometres of travel per capita and GDP per capita using the later 2005 data for the forty-two wealthy cities here, there appears to be a very weak positive relationship, but with a huge amount of scatter in the data. As a result, GDP per capita, at least in wealthier cities, is an extremely poor predictor of car use per capita. For example, at $40,000 GDP per capita, Figure 4 shows car use ranging from less than 3,000 kilometres per capita up to over 18,000 km, with a number of cities lying somewhere between these extremes. This question of the relationship between mobility and GDP is returned to later in the discussion section.

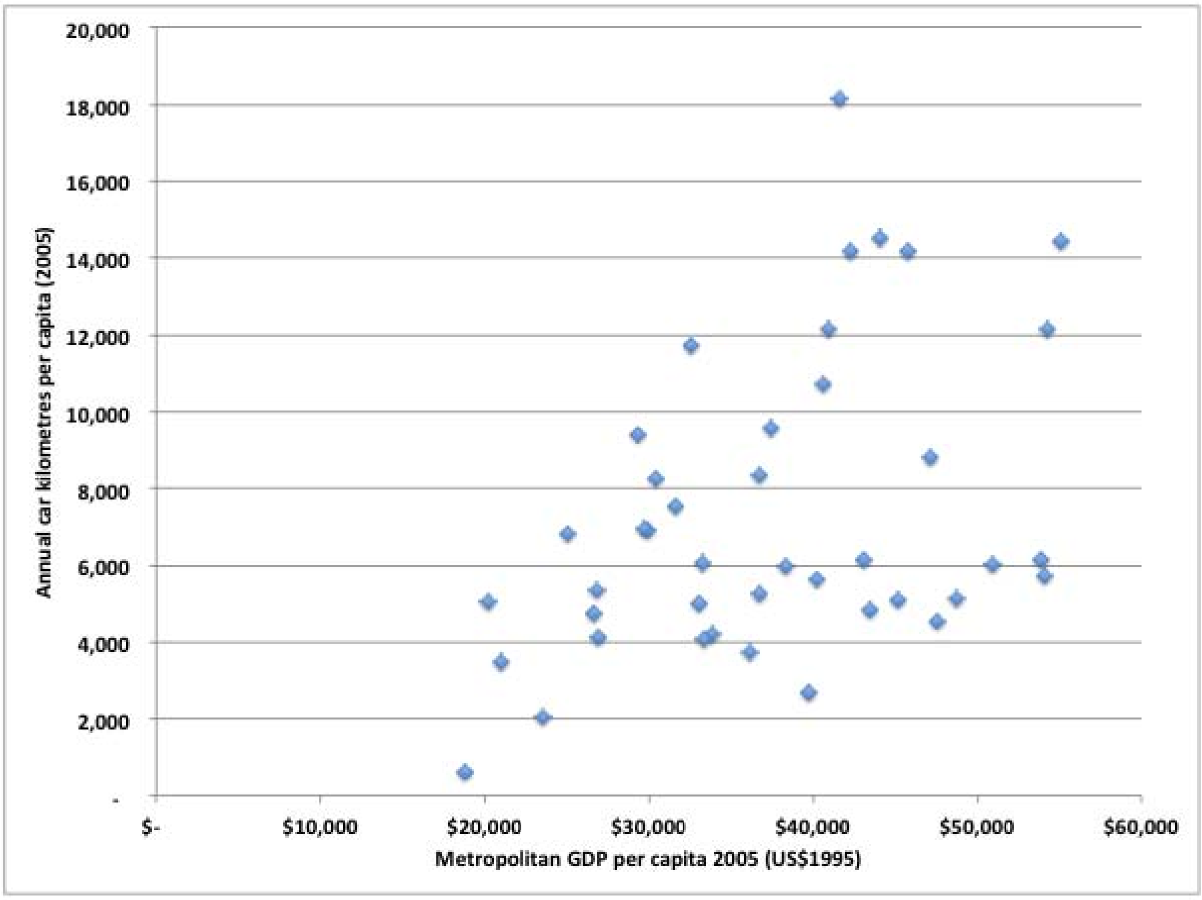

Figure 4. Relationship between per capita metropolitan GDP and annual car kilometres per capita for forty-two cities in 2005.

Total motorised personal mobility and GDP

With the reducing amount of car use (vehicle kilometres) associated with every real unit of GDP, it is interesting to see whether this also applies to the total amount of personal motorised travel that people have to undertake to meet their needs in cities. In other words, is car use simply being replaced by other forms of mobility in generating the GDP of an urban region? In this case we combine annual car, motorcycle and public transport passenger kilometres and express this per unit of real GDP in the local currency. The annual public transport passenger kilometres for each city is for the entire system (all modes and all operators collected carefully from the relevant organisations).

City	Local currency	Total motorised pkm per LCR, 1995 (real LCR 1995)	Total motorised pkm per LCR, 2005 (real LCR 1995)	% change 1995-2005
Helsinki	EUR	0.362	0.181	-50.1%
Stockholm	SEK	0.049	0.026	-46.4%
Madrid	EUR	0.503	0.290	-42.3%
Houston	USD	0.832	0.481	-42.2%
Montreal	CAD	0.392	0.238	-39.2%
Brisbane	AUD	0.662	0.405	-38.8%
Brussels	EUR	0.246	0.156	-36.5%
Toronto	CAD	0.296	0.188	-36.5%
San Diego	USD	0.715	0.467	-34.7%
Graz	EUR	0.331	0.219	-33.7%
Perth	AUD	0.483	0.324	-33.1%
Los Angeles	USD	0.627	0.427	-31.9%
Berne	CHF	0.224	0.154	-31.4%
San Francisco	USD	0.487	0.348	-28.6%
Atlanta	USD	0.806	0.590	-26.8%
Manchester	GBP	0.644	0.472	-26.7%
Washington	USD	0.526	0.391	-25.6%
Ottawa	CAD	0.358	0.268	-25.0%
Geneva	CHF	0.148	0.111	-24.9%
Calgary	CAD	0.371	0.280	-24.5%
Copenhagen	DKK	0.047	0.036	-23.7%
New York	USD	0.400	0.308	-23.0%
Zurich	CHF	0.183	0.142	-22.5%
Melbourne	AUD	0.450	0.350	-22.4%
Wellington	NZD	0.393	0.314	-20.1%
Chicago	USD	0.513	0.432	-15.9%
London	GBP	0.527	0.449	-14.7%
Phoenix	USD	0.566	0.485	-14.3%
Sydney	AUD	0.401	0.344	-14.2%
Prague	CZK	0.036	0.031	-14.2%
Denver	USD	0.557	0.485	-12.8%
Hamburg	EUR	0.303	0.269	-11.1%
Dusseldorf	EUR	0.248	0.222	-10.5%
Singapore	SGD	0.173	0.159	-7.8%
Vienna	EUR	0.229	0.224	-2.2%
Stuttgart	EUR	0.288	0.300	4.1%
Oslo	NOK	0.038	0.040	5.1%
Munich	EUR	0.235	0.248	5.6%
Hong Kong	HKD	0.026	0.028	6.0%
Frankfurt	EUR	0.244	0.261	7.1%
Vancouver	CAD	0.287	0.309	7.4%
Berlin	EUR	0.295	0.350	18.7%

Table 2. Total motorised passenger kilometres per unit of GDP in real local currencies, 1995-2005.

Table 2 shows the result for 1995 and 2005 for the forty-two cities ordered according to the largest reduction in total motorised mobility per unit of GDP (Helsinki, -50%) to Berlin with a 19% increase. It demonstrates again that the large majority of cities needed significantly less total personal motorised mobility in 2005 relative to the amount of real GDP they generated, compared to 1995. There are only seven out of the forty-two cities that increased in this factor. Overall, in the thirty-five cities that reduced in this factor, the average reduction was 26% over the ten years, while across the entire sample, including those cities that increased, the overall reduction in motorised mobility per unit of GDP was 20%.

Figure 5 presents the percentage changes for each city. The seven cities to have increased in total motorised mobility per unit of GDP from 1995 to 2005 were, Stuttgart, Oslo, Munich, Hong Kong, Frankfurt, Vancouver, Berlin and. In the case of Hong Kong the mobility increase per capita was all in transit, with combined car and motorcycle passenger kilometres per capita declining. In the other six cities that increased, all the forms of passenger mobility per capita rose. In fact, only eight cities out of the forty-two cities actually declined in per capita total motorised mobility from 1995 to 2005 (Graz, Stockholm, Melbourne, Montreal, Toronto, Atlanta, Houston, and Los Angeles).

In summary, in 83% of the cities in the analysis, total motorised mobility relative to GDP reduced or decoupled between 1995 and 2005.

Figure 6 groups the cities into their respective regions and uses real 1995 US dollars for cross-city comparisons. It shows that in 1995, Australian cities had the highest level of overall personal mobility per dollar of GDP. This was followed closely by the US cities, then the Canadian cities with a big drop in this factor, then the European cities with another big drop and finally the Asian cities which were lower again,

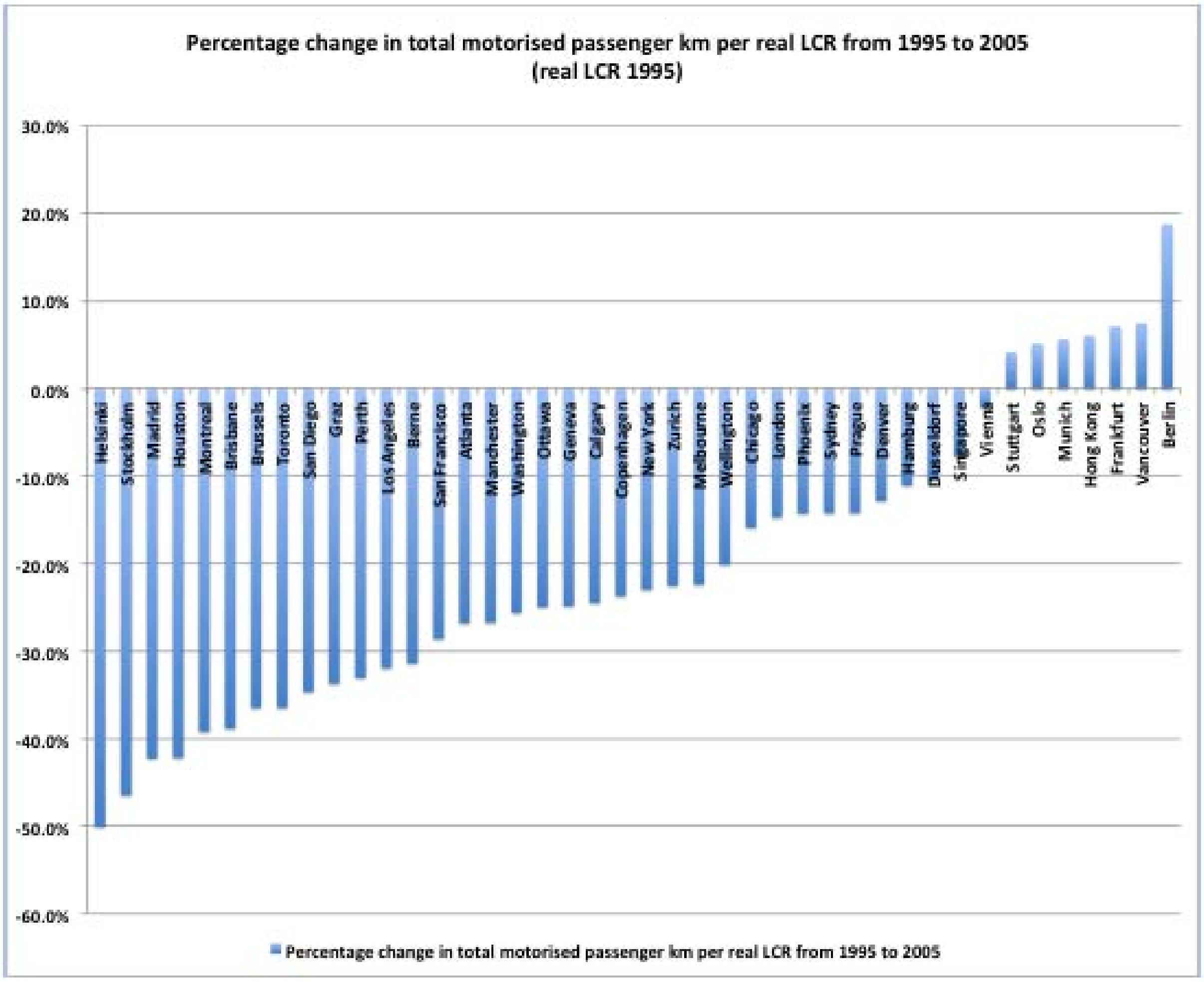

Figure 5. Percentage change in total motorised passenger kilometres travelled per unit of real GDP in forty-two cities (local currencies).

but by a lesser margin than the other differences. By 2005, all the groups of cities had reduced their personal mobility requirements relative to GDP, except the Asian cities, which went up. This meant that by 2005 the two Asian cities of Singapore and Hong Kong on average had more personal mobility per dollar of GDP than the European cities and were almost equal to the Canadian cities. Also the US cities overtook the Australian cities in 2005 by a tiny margin to become the leading cities in this factor, but the remainder of the comparative differences were similar to 1995. In general, in comparing 1995 and 2005 there seems to be a "flattening" process at work so that the differences in motorised personal mobility levels relative to GDP are becoming less pronounced.

Discussion

This paper provides a global perspective on the important topic of whether urban economies can grow whilst reducing the overall mobility and especially car mobility associated with that growth. It does this through a snapshot for only two years of data for each city, albeit separated by a period of ten years. However, research by Kooshian and Winkelman (2011) also supports the proposition that GDP has in fact decoupled from private mobility, certainly in the United States, by showing a perspective dating back as far as 1945. They suggest that the strength of this decoupling is likely to continue into the future. Figure 7, taken from their work, shows the national index of Vehicle Miles Travelled (VMT) against GDP for the USA from 1950 to 2010. It can be clearly seen that 1995 was the point where GDP in the US separated from its almost perfect correlation with VMT growth in the post-World War 2 period.

They go further in their analysis by showing the VMT per dollar of real GDP from 1945 to 2010 in the USA, as well as a projection out to 2030 (Figure 8). It is again clear that 1995 was essentially the peak in the travel intensity of the US economy and from that year on, notwithstanding some small variations, less vehicle travel was needed for every dollar of GDP generated. Based on Figure 8, between 1995 and 2005 there was approximately an 8% drop in the VMT per dollar of GDP in the

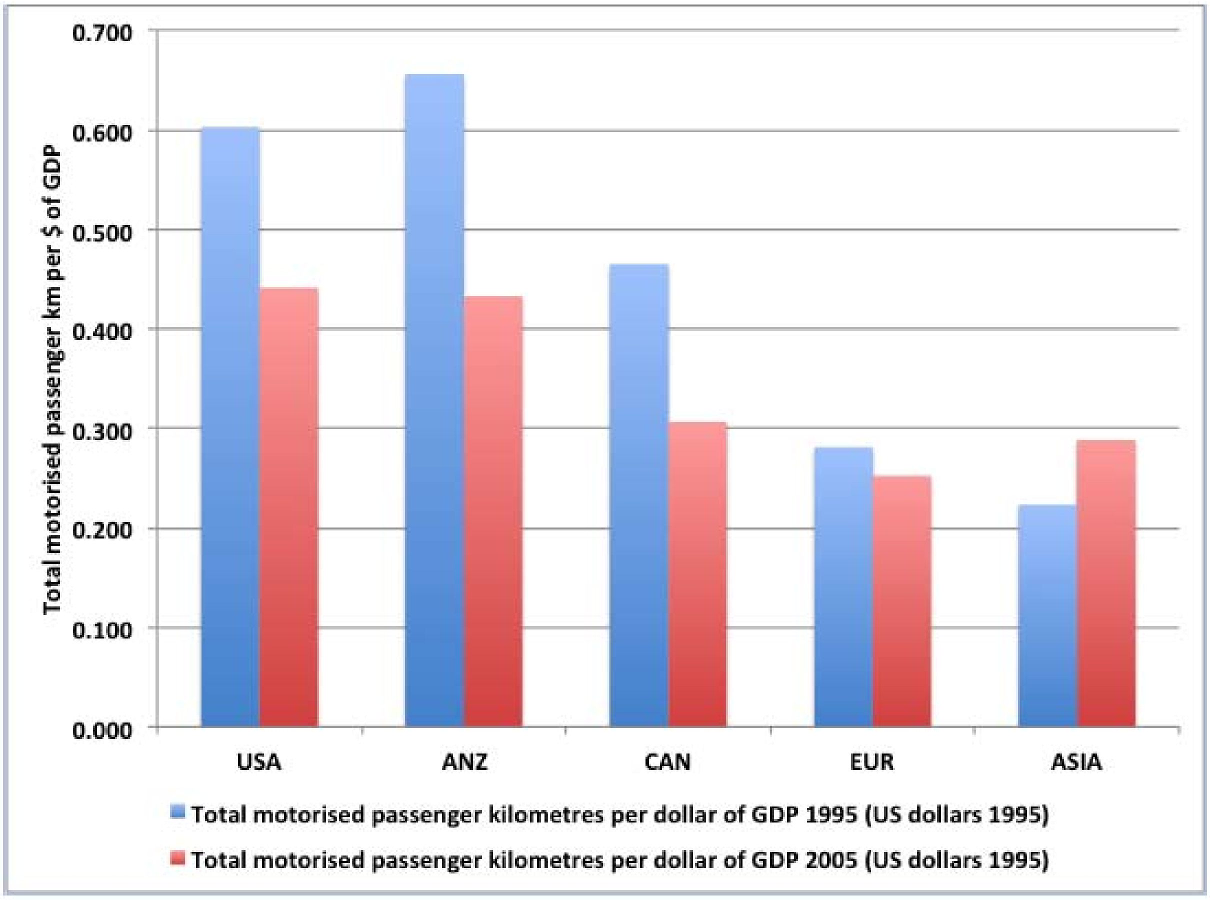

Figure 6. Total motorised mobility (passenger kilometres) per dollar of GDP in US, Australia/New Zealand, Canadian, European and Asian cities, 1995 and 2005 (using real 1995 US dollars).

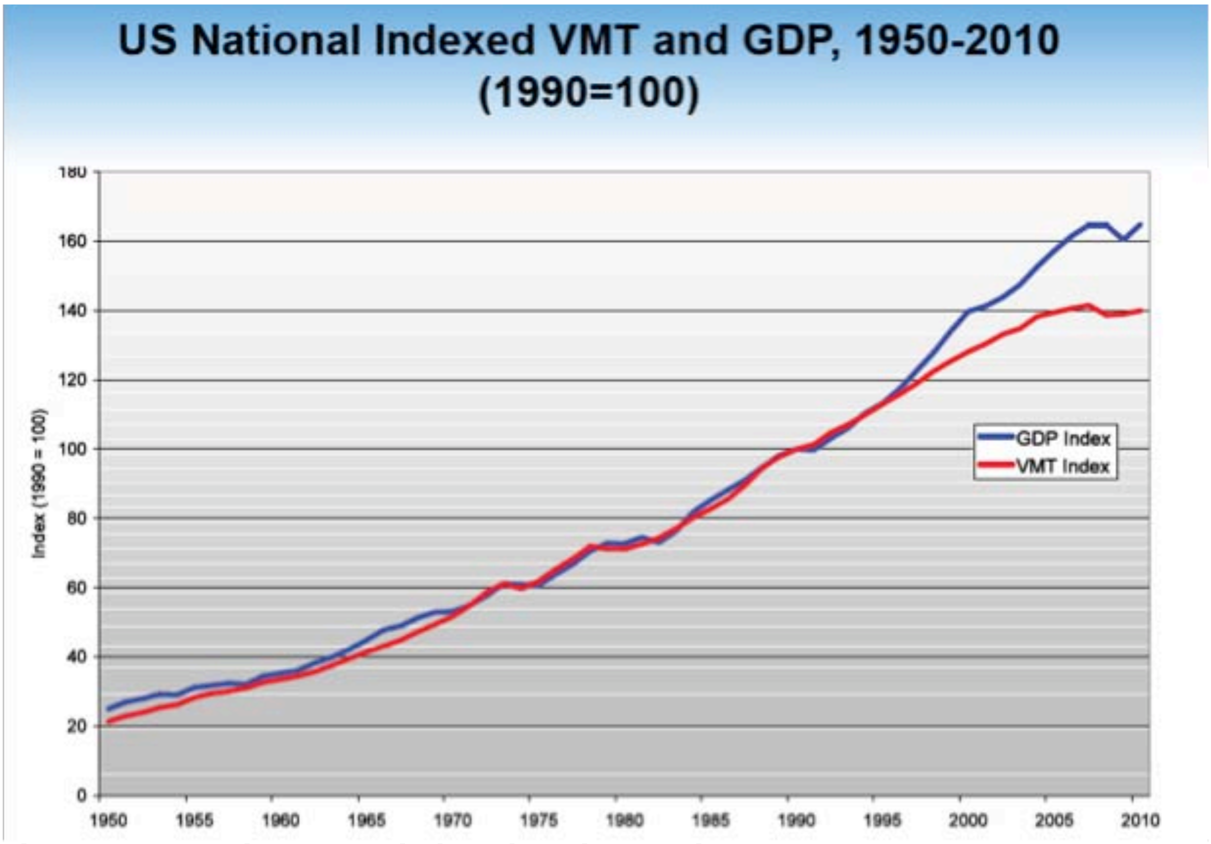

Figure 7. US national VMT indexed against national GDP, 1950-2010.
Source: Kooshian and Winkelman (2011)

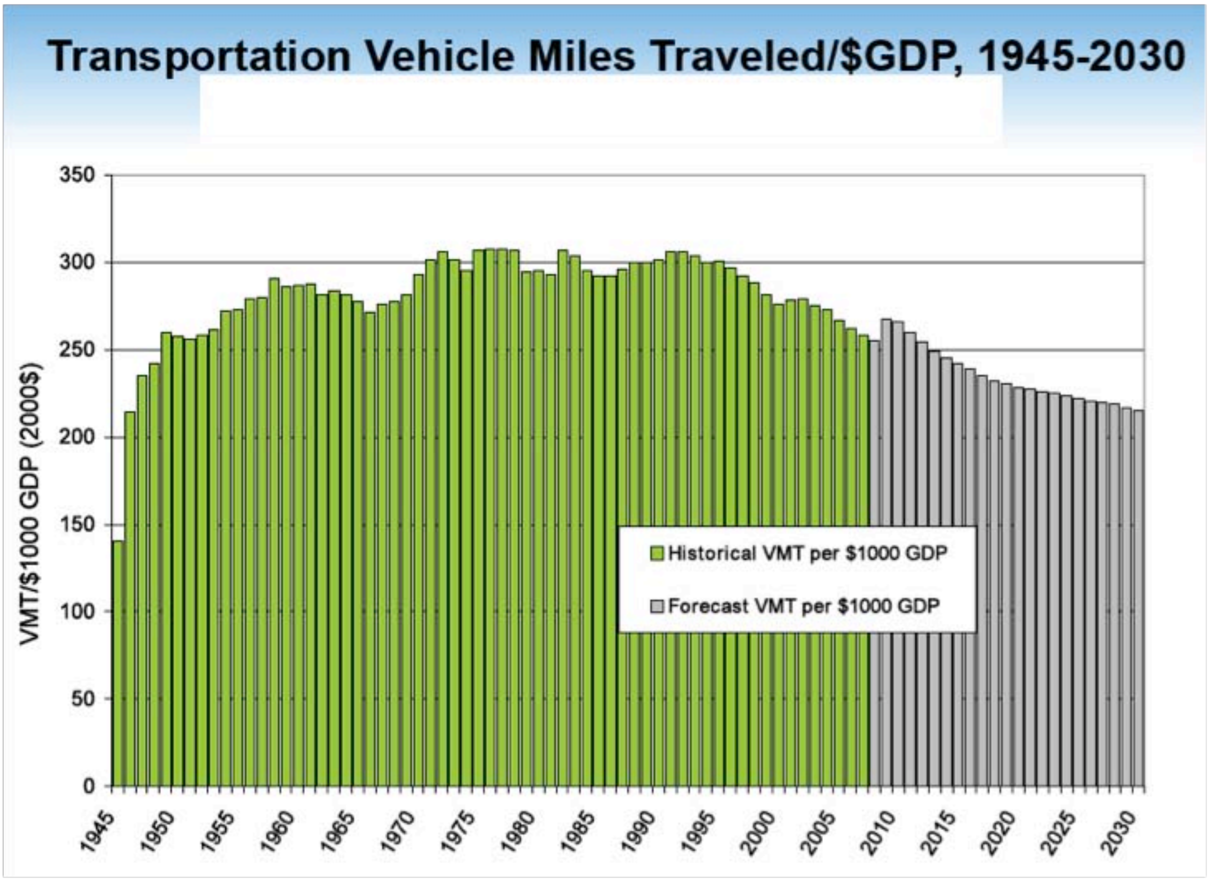

Figure 8. Vehicle Miles Travelled per dollar of GDP in the USA from 1945 to 2030. Source: Kooshian and Winkelman (2011)

USA. By comparison, the data on the ten US cities in this study showed a 26% decline. The data used by Kooshian and Winkelman represent total VMT, not just private passenger vehicles, so it seems that:

(a) the decoupling effect is less when freight and commercial traffic is factored in and,
(b) the effect is more pronounced in cities. However, one major underlying factor not captured in their work is likely to be the reductions in comparative investment in infrastructure for freeways compared to public transport, which seem to be propelling a rise in public transport patronage across all these cities (Newman et al, 2013). Figure 11 shows the increase in public transport passenger kilometres per capita by region for these cities from 1995

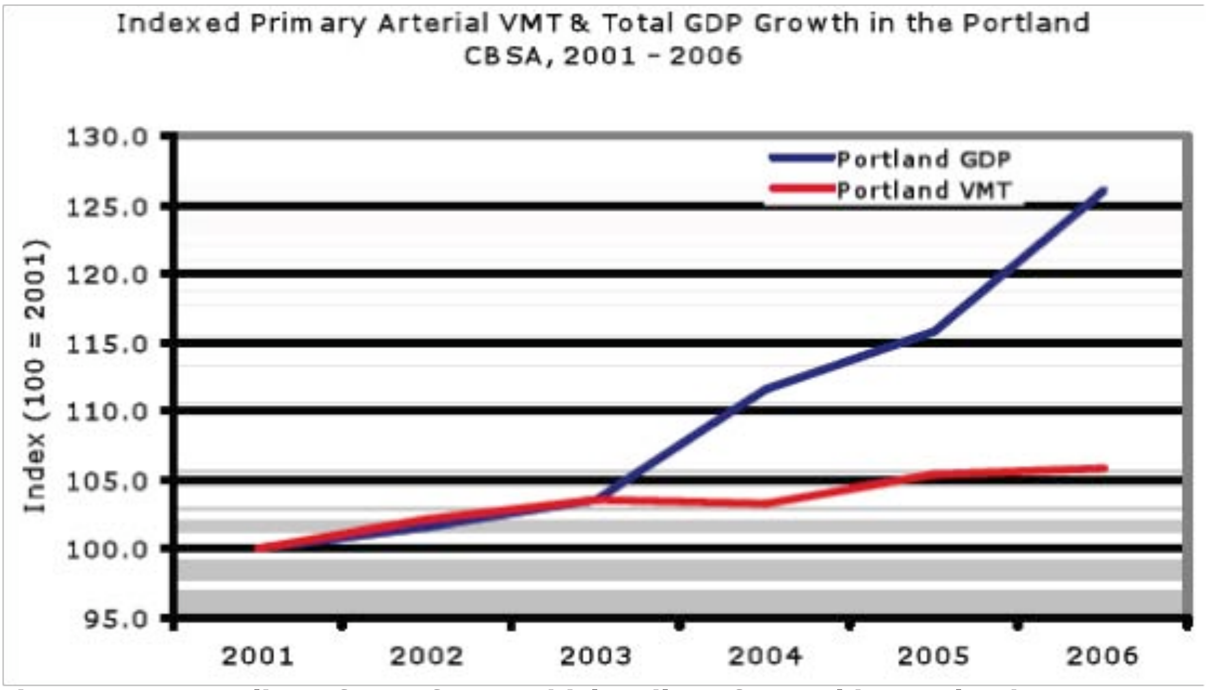

Figure 9. Decoupling of GDP from Vehicle Miles of Travel in Portland, Oregon.
Source: Kooshian and Winkelman (2011)

to 2005 (US cities rose 16%, Australian cities 11%, Canadian cities 12%, European cities 22% and Asian cities 19%).

Their own data for cities (e.g. Figures 9 and 10) also show a stronger decoupling effect, in the case of Portland (26%) and Washington DC (20%). Furthermore, the modelled national projection in Figure 8 shows a sustained and steady decline in the total travel intensity of the US economy, as far out as 2030. The research in this paper covering forty-two cities in seventeen countries, suggests that this decoupling of car use and total private motorised travel from GDP growth, which is so clear in both the USA as a whole and within its individual cities, is likely to be a more widespread global phenomenon, in at least the developed world. The mechanisms underlying the results reported here are likely to involve a complex array of factors. Kooshian and Winkelman (2011) mention factors such as demographic shifts, fuel prices, congestion, growth of the service sector and telecommuting and e-commerce as important in understanding the trend. How-

The key data seem to be an improvement in the relative speed of public transport to traffic (average road speed) and especially rail speed, as shown in Figure 12.[3]

It is clear from these data that the rise in importance of rail in cities is largely behind this increase in the relative speed of public transport compared to general traffic. In

3 These public transport data have been carefully collected for all modes and operators for all the cities in the sample in each year and the speeds weighted by the number of passenger hours spent in each mode (see Newman et al (2013) for details of cities involved). The average road speed is the 24 hour/7days road network speed mostly derived from computer models in each city. These data are the results of my and my colleagues' comparative research on cities over the last 30 years (e.g. Newman and Kenworthy, 1989; Kenworthy and Laube, 1999; Kenworthy and Laube, 2001), including ongoing updated data for 2005, in the process of being progressively published at present.

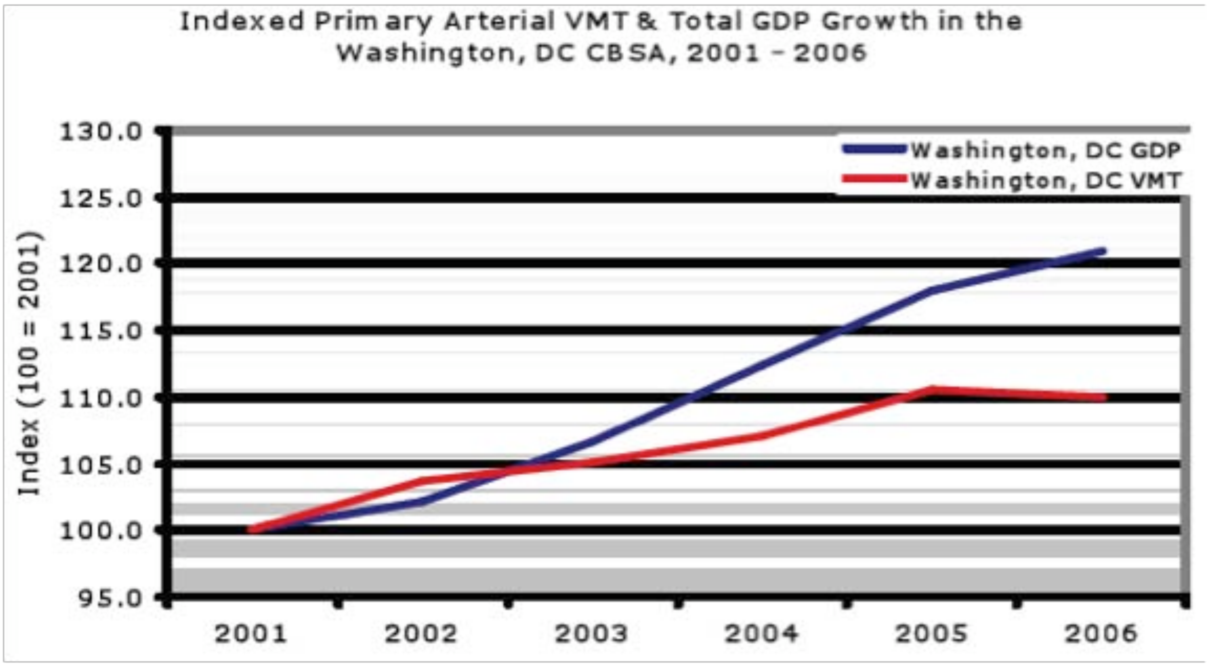

Figure 10. Decoupling of GDP from Vehicle Miles of Travel in Washington DC.
Source: Kooshian and Winkelman (2011)

the absence of any area-wide congestion control in any city this is hardly surprising, because buses suffer a worse fate than cars in congested conditions in terms of providing a speed-competitive mid-level public transport option. Yet it is the unrestrained use of cars in peak periods, which causes the congestion that so damages bus competitiveness. An even greater improvement in the relative speed of public transport could be gained by controlling congestion in a systematic way so that buses could compete effectively in speed terms with cars (Bradley and Kenworthy, 2012).

It should also be noted that when public transport travel rises, it is not simply that one passenger kilometre by public trans-

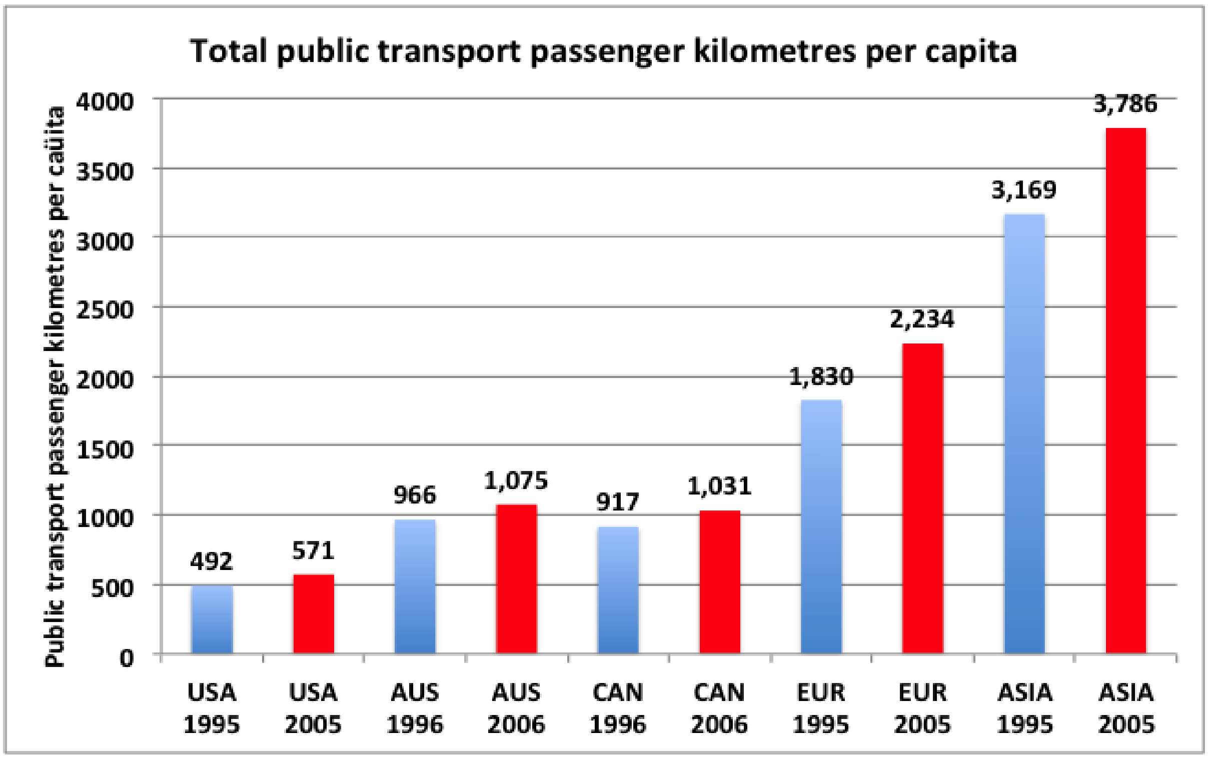

Figure 11. Public transport passenger kilometres per capita by region, 1995 and 2005.
Source: Author's own data from update of Millennium Cities Database for Sustainable Transport.

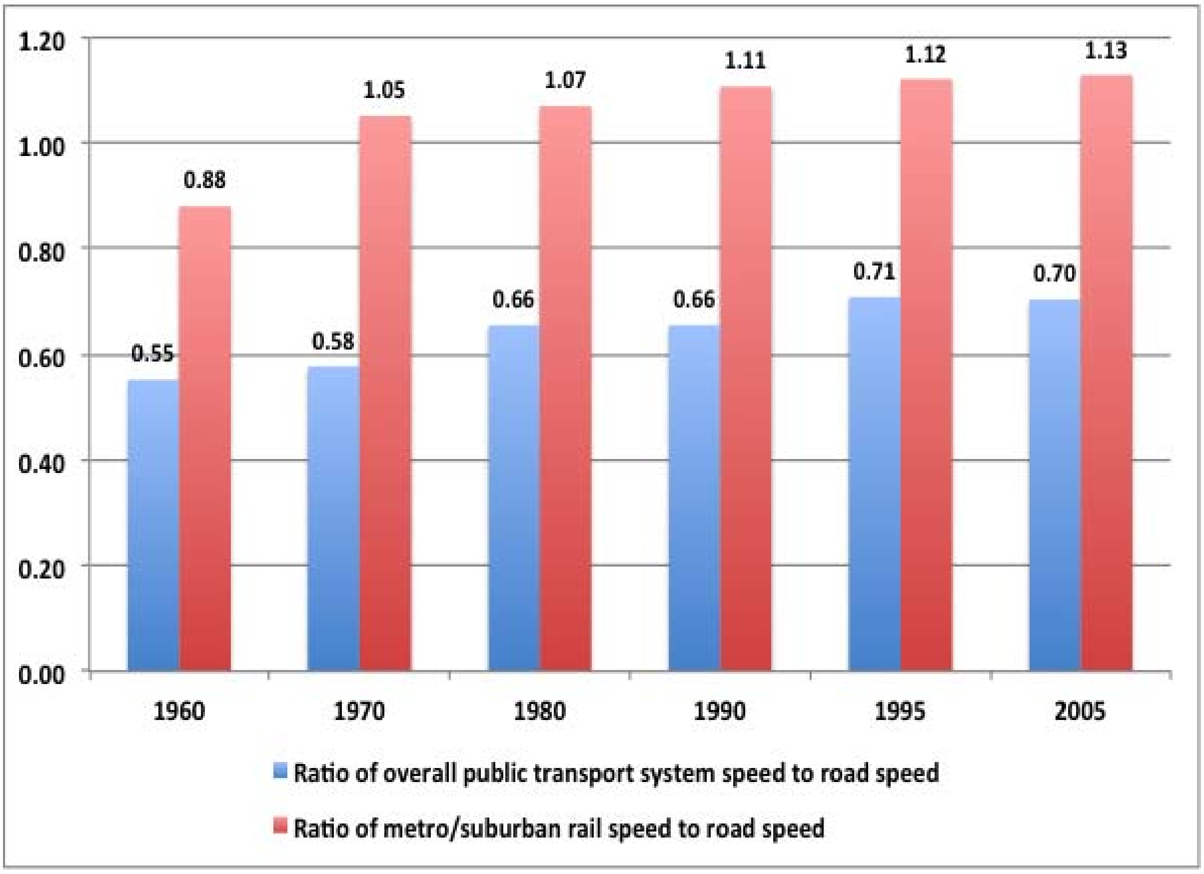

Figure 12. The relationship between overall public transport system speed and rail system speed in cities compared to their general road traffic speed, 1960 to 2005.
Source: Author's own data from update of Millennium Cities Database for Sustainable Transport and Kenworthy and Laube (1999).

port replaces one passenger kilometre driven by cars. Neff (1996) and our own work (Newman and Kenworthy, 1999) has shown that there is a "transit leverage effect" whereby one passenger kilometre by public transport replaces multiple passenger kilometres by car. It can be suggested then that as public transport gains in relative importance in urban mobility we might expect that the decoupling effect between GDP and car travel should actually strengthen. Essentially, public transport is a much more efficient and cost-effective way of providing urban mobility needs. Even if public transport mobility increases, it is quite possible that both car mobility and total motorised mobility per dollar of GDP can decline due to public transport's ability to replace multiple kilometres of car travel.

This change in priorities, as cities recognise the greater value in public transport investment as well as the need for congestion control, enables us to see a major policy direction that could be the driving mechanism to enable cities of all kinds to continue their growth in wealth whilst decoupling from car use growth.

Conclusion

The data presented in this paper suggest that in general, personal mobility in relatively wealthy cities, and in particular car vehicle kilometres of travel, have decoupled from GDP growth. This trend is supported by independent research from the USA at both a national and city level. The results also appear to be in line with the idea of peak car use in these more prosperous cities around the world, with evidence that many cities experienced a decrease in car vehicle kilometres per capita from 1995 to 2005, while many others increased by an average of only around 5% in the 10 years, a major reduction on growth rates in previous decades. The amount of total personal motorised mobility (car, motorcycle and public transport passenger kilometres) associated with generating one unit of real GDP appears to be also diminishing in the majority of cases, and the differences between wealthy cities in this factor are also declining. American and Australian cities, however, remain significantly higher than cities in Canada, Europe and Asia. Further research is needed to better understand these observed phenomena and their implications. This would include more detailed examination of Indian and Chinese cities to see if they too may be beginning to decouple transport from GDP as they move to significant investments in rail over roads. The 'peak car' phenomenon may well therefore be helping us to imagine a future where wealth can continue to be created globally whilst reducing the use of cars, oil and their damaging global impacts.

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