

*The End of Traffic and the Future of Transport.*

# The End of Traffic & the Future of Transport

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Figure 1.2 Roadways per Capita in US (m)

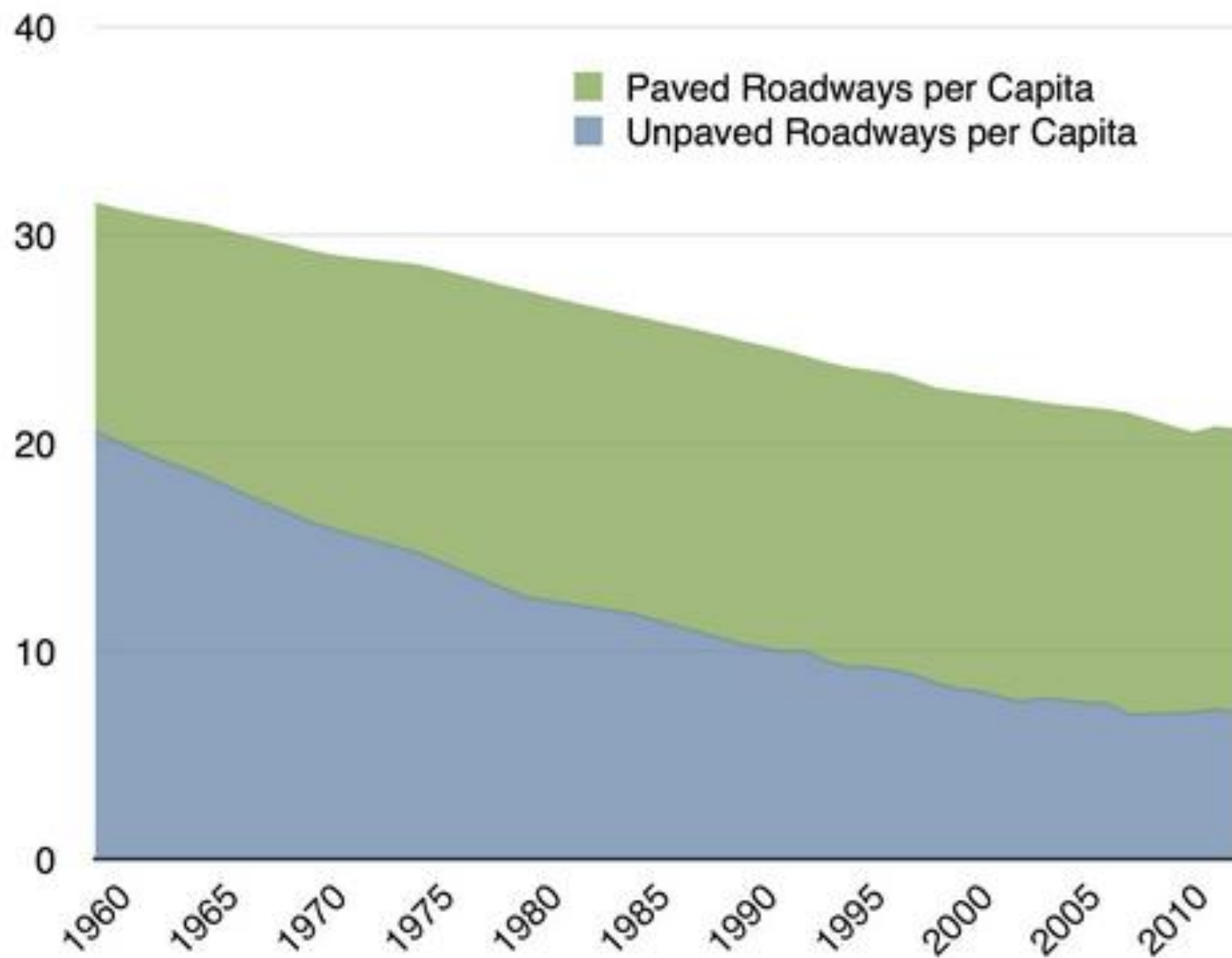


Figure 1.1: Climbing Mount Auto

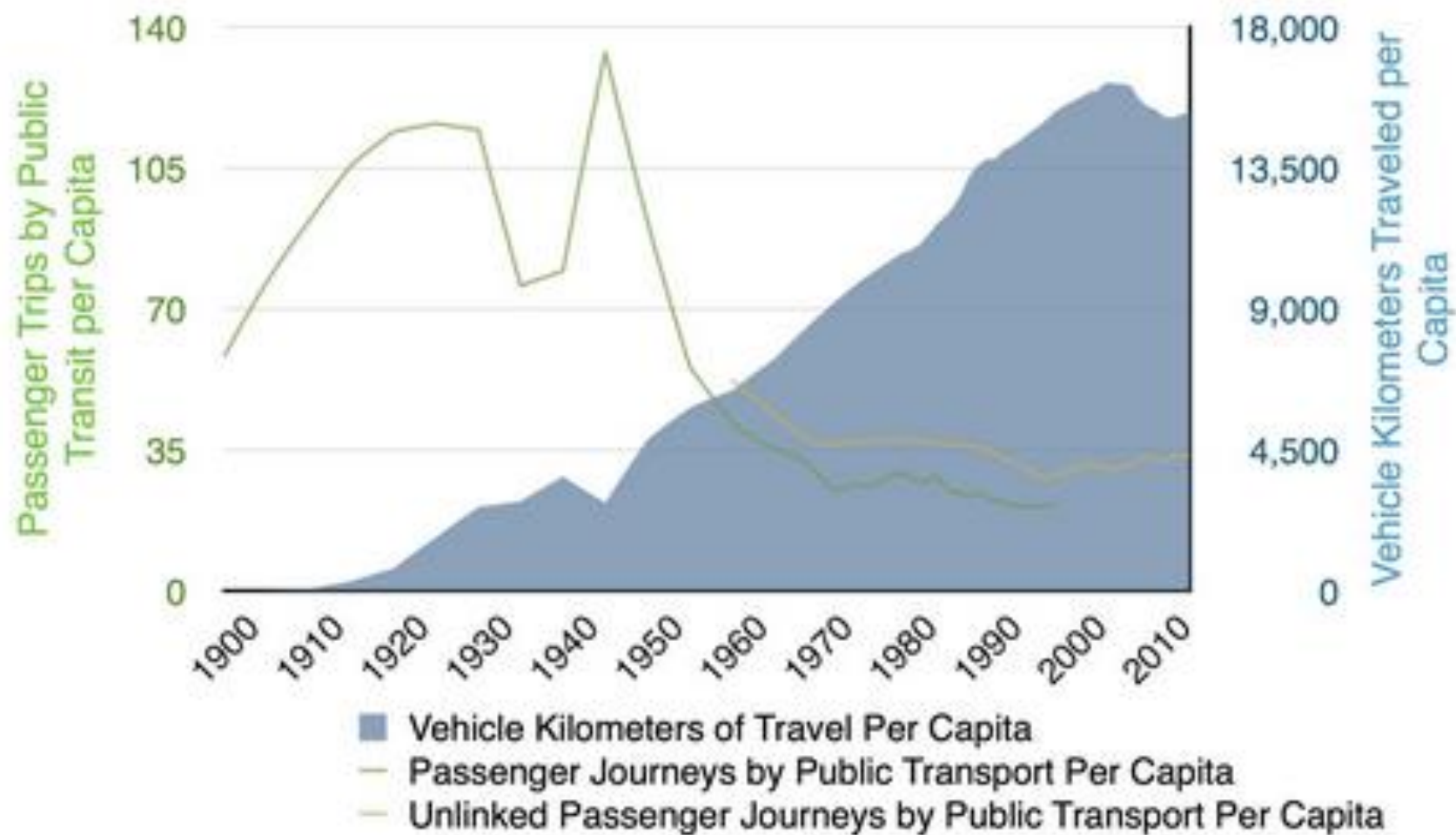
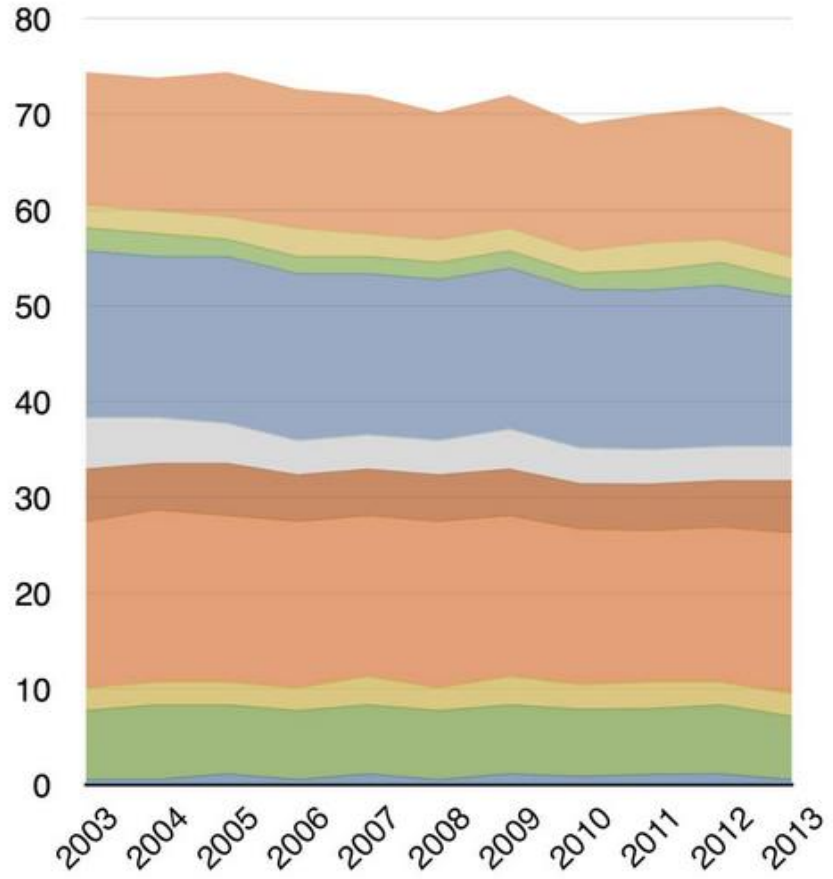
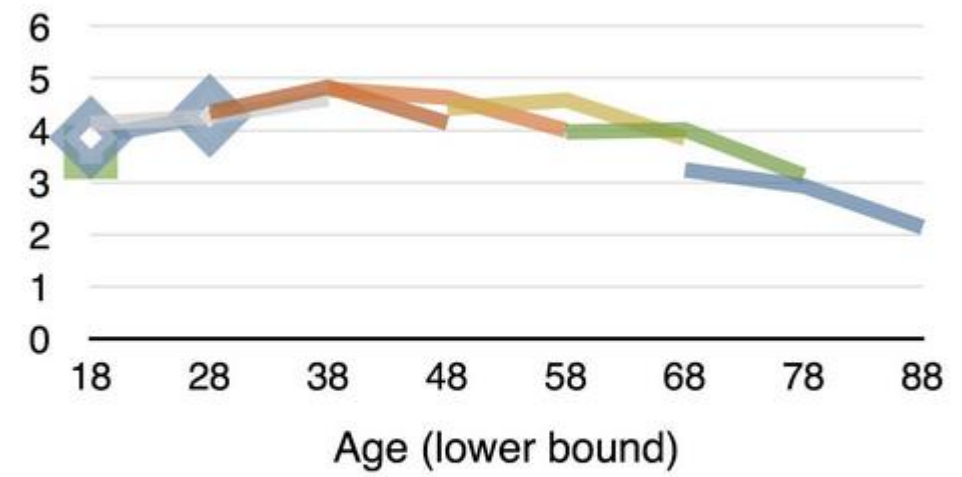


Figure 1.4 Total Time Spent Traveling per capita (minutes)



- Leisure and Sports
- Organizational, Civic, and Religious
- Education
- Work
- Care and Help Non-household Members
- Care and Helping Household Members
- Goods and Services
- Household Activities
- Eating and Drinking
- Personal Care

Figure 1.5 Person Trips per Day by Age and Year of Birth



- Born Before 1924
- 1924-1933
- 1934-1943
- 1944-1953
- 1954-1963
- 1964-1973
- 1974-1983
- 1984-1993

Figure 1.3 Registered motor vehicles in US

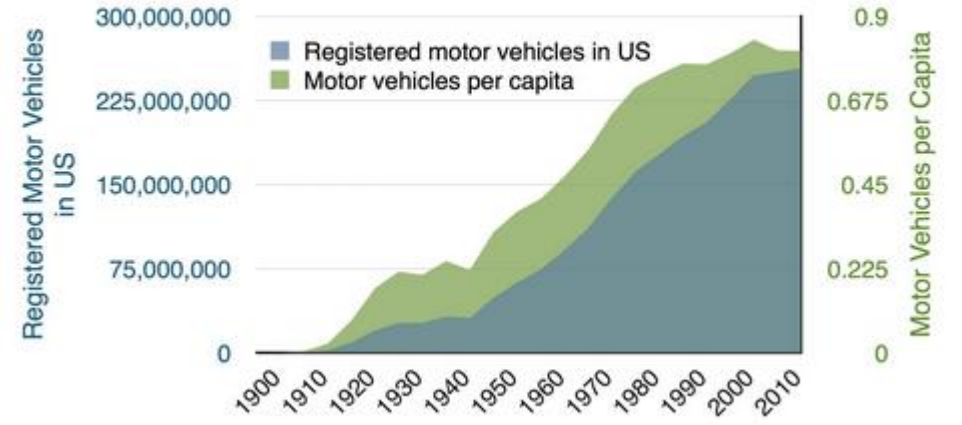


Figure 1.6 Average Trip Distance by Age and Year of Birth Cohort (Miles, All Purposes)

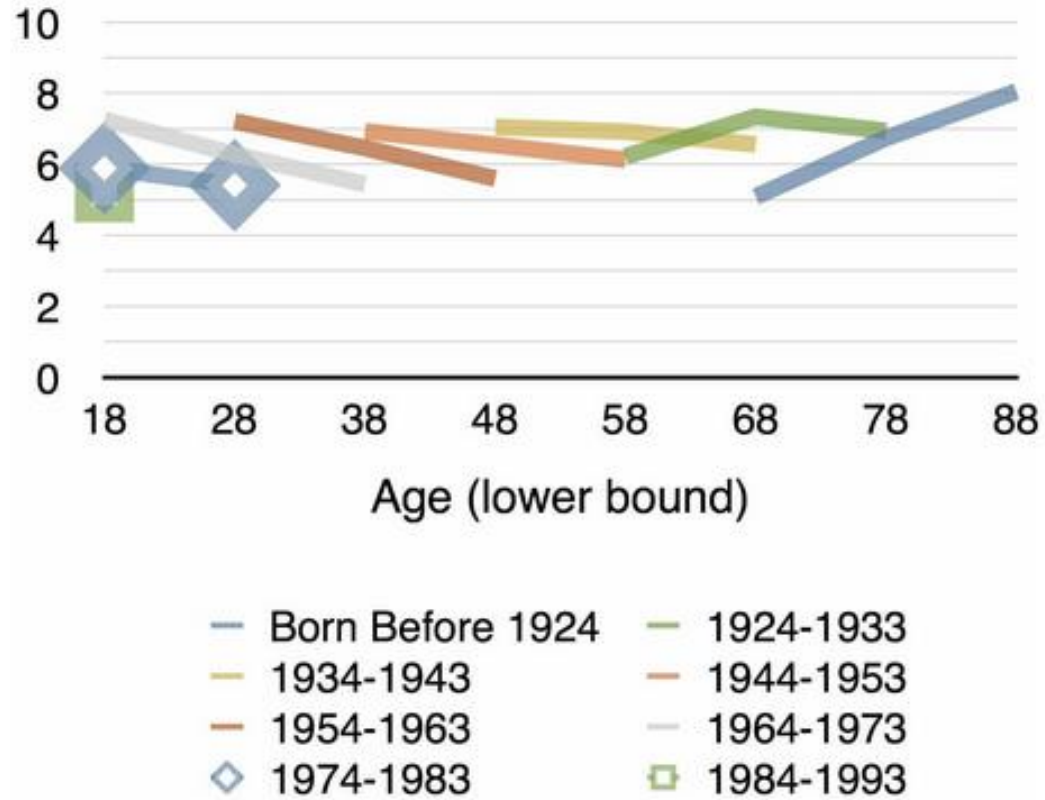


Figure 3.1 Age Groups in US 2014

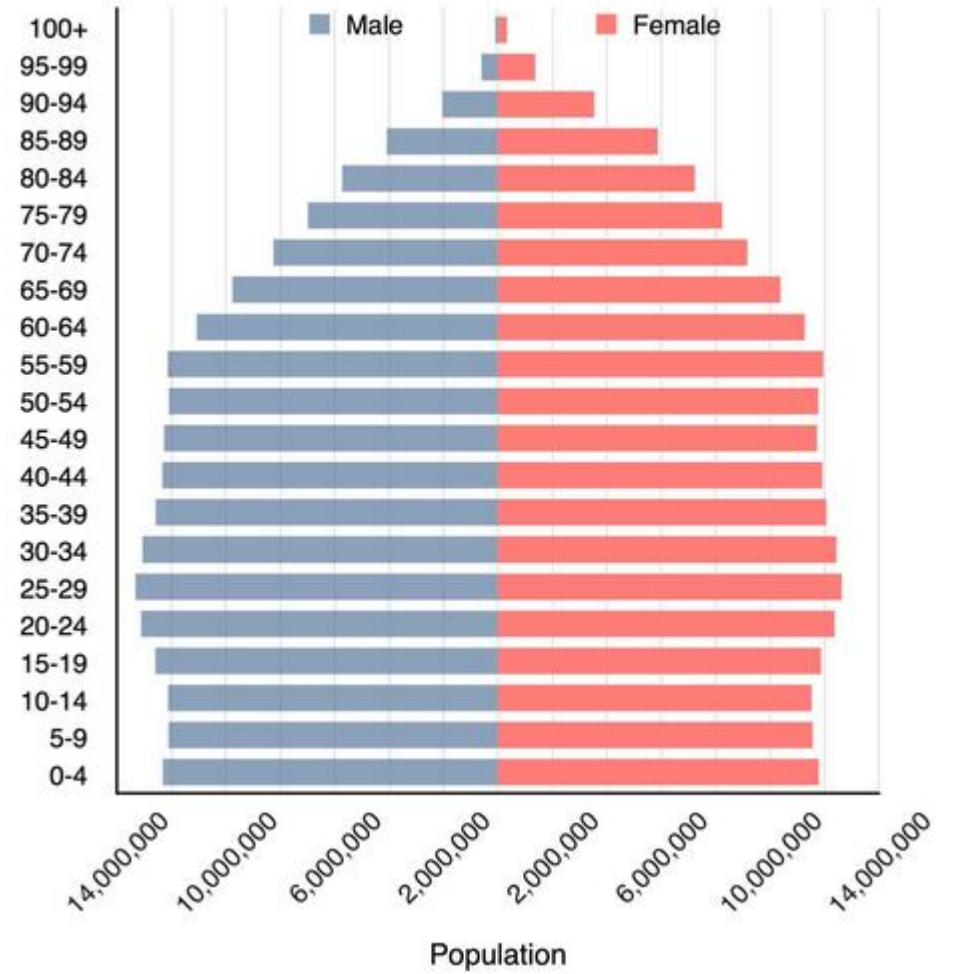


Figure 3.2 US Labor Force Participation Rate: 1948-2015

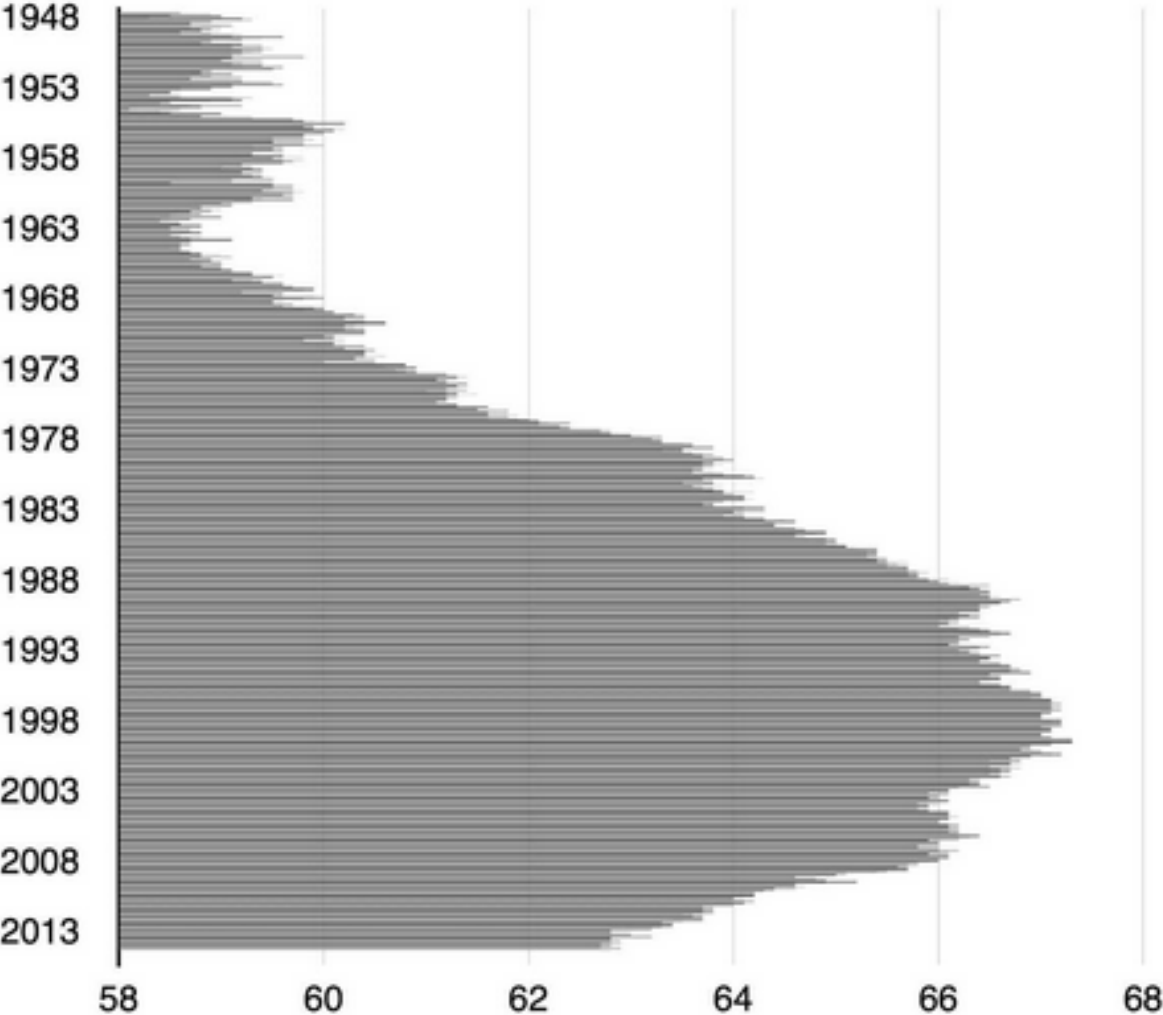
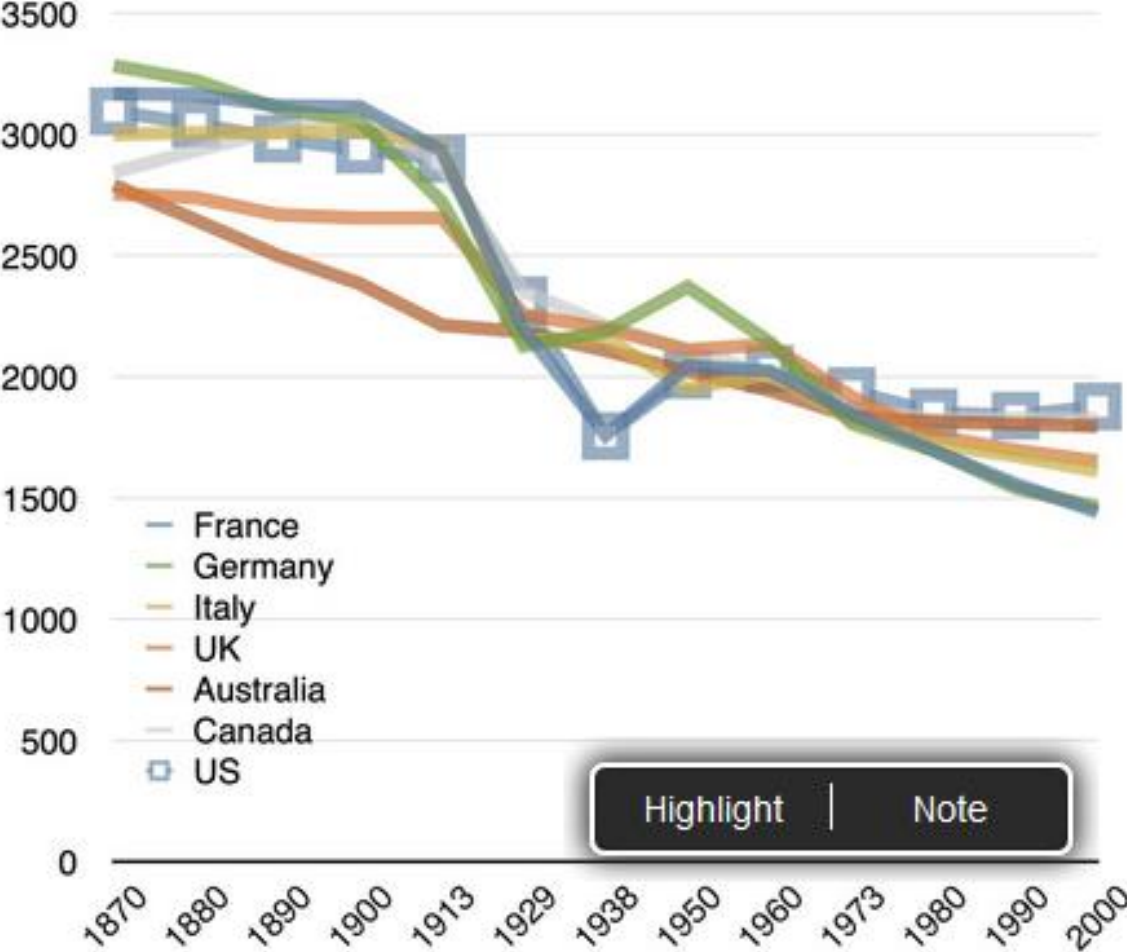


Figure 3.3 Annual Hours of Work: 1870-2000

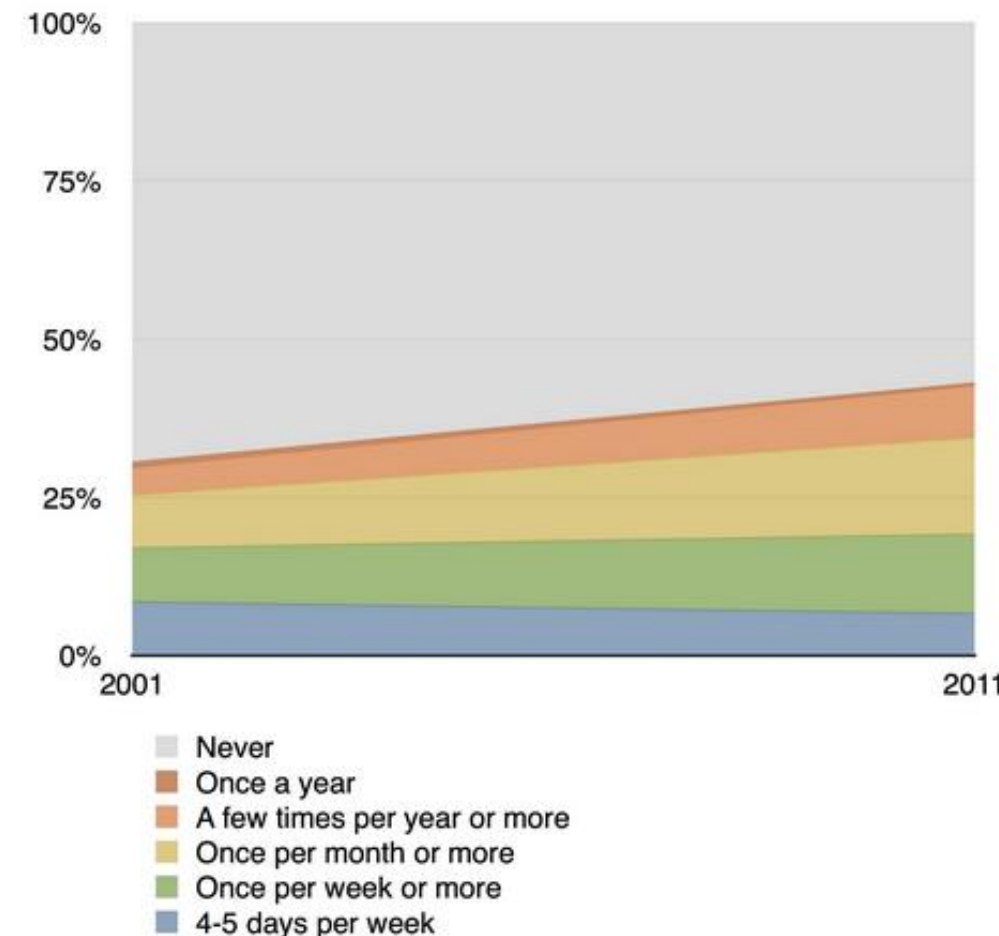


Highlight | Note

"In 2014, on days they worked, 23 percent of employed persons did some or all of their work at home, and 85 percent did some or all of their work at their workplace, ... In 2003, the first year for which comparable data are available, 19 percent of employed persons did some or all of their work at home, and 87 percent did some or all their work at their workplace on days worked."<sup>64</sup>

Thus video-conferencing has yet to cause at-home work to overtake commuting for even the majority of office workers. It is not expected that these technologies will have much effect for most non-office workers (about half the US workforce), though other technologies may.<sup>66</sup> Nurses, construction workers, teachers, factory workers, farmers and the rest of the non-office workforce may get disrupted by robotics, information technology, and the like, but since their job is not simply pushing bits (though that is certainly part of it), being somewhere in particular will remain important.

Figure 3.4 Telecommuting in Minneapolis- St. Paul Region



In the mid 2010s, food and grocery delivery has turned into a hot sector receiving huge investments from venture capital.<sup>80</sup> As the Wall Street Journal says "There's an Uber for Everything: Apps do your chores: shopping, parking, cooking, cleaning, packing, shipping and more."<sup>81</sup> The article cites startups (mostly Bay Area) with apps that dispatch someone for flower delivery (BloomThat), delivering anything in town (Postmates), package pickup (Shyp), healthy meals (Sprig, SpoonRocket, Munchery), less healthy meals (Push for Pizza), washing your clothes (Washio), washing your car (Cherry), parking your car valet-style (Luxe), packing your suitcase (Dufl), babysitting (UrbanSitter), dog sitting (Rover), medical house calls (Heal), self-medicating alcohol (Saucey), medicinal delivery (pot) (Eaze), and in-home massage (Zeel). Sadly, we don't expect most of these (or their customers) will survive the revolution. There is even a Twitter account [@uber\_but\_for] mocking such services that auto-retweets posts that say things "like Uber for ...".<sup>82</sup> As we will discuss later (Chapter 8), there are lots of "Uber fors ..." in the transportation sector. As we also discuss, replacement of many activities by delivery will create demands for new and different out-of-home activities.

In the 1980s people mocked the idea of ordering a pizza from a (very large) "car-phone" and then having it delivered to you in your car while moving. Today, pizzas are routinely ordered from mobile phones or apps, often sparing the need to talk to a clerk with the associated mis-order. While airplanes can refuel in mid-air, the consumerist nirvana of synchronized in-motion pizza delivery has yet to be realized outside of television ads.

Figure 3.5 Time Spent Shopping per Day in Minneapolis St. Paul Region (minutes)

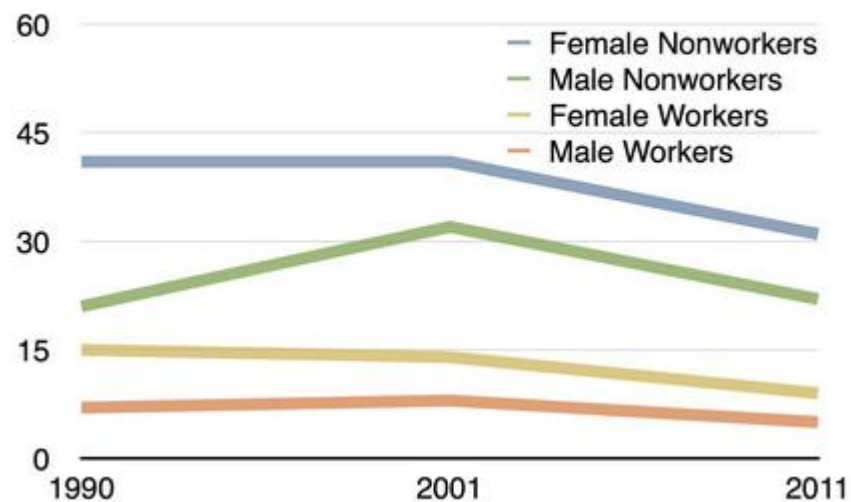
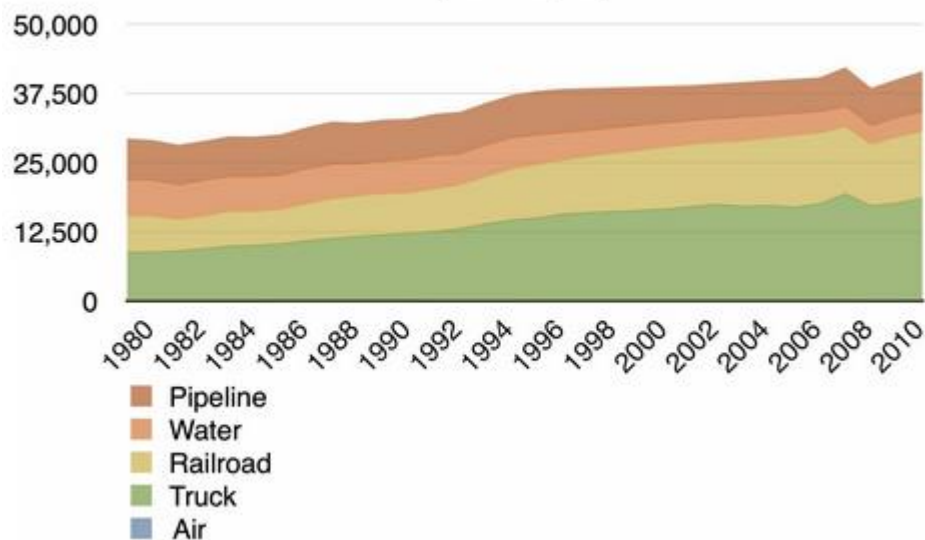


Figure 3.6 US Ton-km of Domestic Freight by Mode (Per Capita)

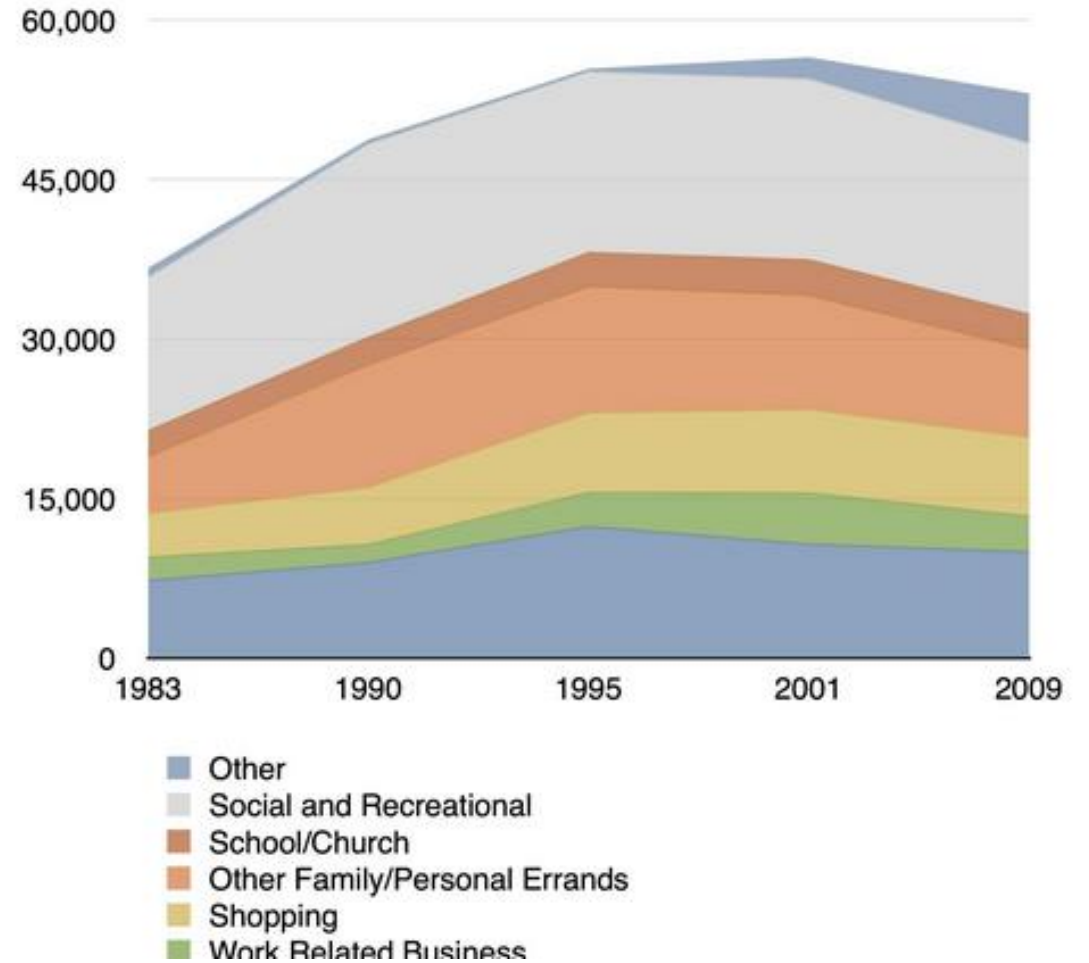




# Virtual Connectivity

We don't claim face-to-face interaction is entering the dust-bin of history. But the changes are real; and they are large enough to measure statistically, but not so profound they are obvious to everyone. Technology is not (yet, if ever) a full substitute for the environment and benefits that in-person sharing of the same physical space can achieve. People still like to talk to others with human heartbeats in presence. New wearable devices like the Apple Watch, with "taptic feedback" have virtualized that too.

Figure 3.7 Travel by Purpose per capita (km)



# A License to Roam

Despite living less than 20 yards from Kevin's 6th grade classroom, he set the school record with 33 tardies. Some call it lack of parental guidance; others call it free-range child rearing. Life in the 1970s (and earlier) was different. In kindergarten both David and Kevin meandered their neighborhood alone. By 3rd grade, they cycled across town. By 5th they rode the public bus to the local mall. Parents in a suburb of Washington, DC were recently accused of child neglect for allowing their 6 and 10 year old kids to roam free; the children were taken into the custody of Child Protective Services after another citizen reported them as vagabonds.

Free range kids<sup>86</sup> are thwarted because such freedom has vanished and the prison of home is much more enticing. Pulling kids home, television, video games, and the Internet provide far more and far better at-home entertainment options than were available when there were only ABC, CBS, NBC, PBS, and an independent UHF channel visible through the static. Pushing kids away from freedom, practicing pop sociology, one can attribute to living in a more fear-based society. Nine doors down the street from Kevin's current home in Boulder (in the opposite direction from the partying student population) lies the famed JonBenét Ramsey house. The Ramsey event, in addition to the Atlanta Child Murders, the Missing Kids on the back of milk boxes, Adam Walsh, and Amber Alerts, make child kidnapping appear more common than it was before or than it really is. Couple this with the decreased number of children per family, we observe children, in contrast with material goods, are far less disposable than they were in our grandparents generation.<sup>87</sup>

When both of our parents schlepped us to Sears or Montgomery Wards, we sat in the front seat of the car. If our car was old enough, maybe—just maybe—we wore lap belts because the three-point seatbelt (the shoulder-belt) had yet to hit the American auto market.<sup>88</sup> Today children sit in the back seat because of the rise of so-called 'child safety seats' and air bags.<sup>89</sup> Today's back seat kids have a much diminished independent range,<sup>90</sup> and are more likely to be driven by a parent or school bus to their school.

But we contend there are things, tacit knowledge, one can learn about driving just by riding in the front seat, which today's kids are slower to experience (laws of the road, etiquette, and defensive driving). Both of us received our driver's licenses upon turning 16 (not a day after). After a few weeks of restricted driving we were on our own. Today it is more complicated for young people to get driver's licenses, and less valuable since they need more supervision. More teenagers are deferring licensure and auto acquisition.<sup>91</sup>

Boys will be boys. Getting a license is also less valuable since it is harder to get away with driving drunk, the way George W. Bush and Dick Cheney did in their younger years. Driving While Intoxicated

(DWI) was as recently as 15 years ago not considered severe enough a crime to keep someone out of the White House, we suspect such poor judgment is now. It certainly can affect employment prospects at jobs society takes more seriously.

Ad Age reports<sup>92</sup> "In 1978, nearly half of 16-year-olds and three-quarters of 17-year-olds in the US had their driver's licenses, according to Department of Transportation data. By 2008, the most recent year data was available, only 31% of 16-year-olds and 49% of 17-year-olds had licenses, with the decline accelerating rapidly since 1998."<sup>93</sup>

A recent study by the Center for Disease Control reports "three out of four US high school students aged ≥16 years drove at least once during the 30 days before the survey."<sup>94</sup> This number fell from about 85 percent who drove in an average week in 1996.<sup>95</sup>

Our own analysis, shown in the Figures, finds licensure notably lower for the most recent demographic cohorts in the Minneapolis-St. Paul region compared with earlier groups at the same age. Vehicles per household is higher for the youngest demographic, which we attribute to the youngest cohort being more likely to live with their parents than earlier cohorts which left home never to return. Total vehicles per capita (Shown in Figure 1.3) is off the peak in the US.

When you go through life as a back-seat passenger rather than a driver, we contend your motivation for driving is lower, since you are not modeling driving yourself as you would watching through the front windshield. Thus you defer licensure. Further, your quality of driving is lower since you lack experience from sitting "shotgun"<sup>96</sup> and looking out the front instead of side window growing up.

These two factors feed on each other, as people like doing what they are good at. Drops in licensure are in part related to less value associated with licenses, and there may be other causes as well, including the factors described elsewhere in this chapter.

Figure 3.8 US Retail Gasoline Price (Dollars per Gallon)

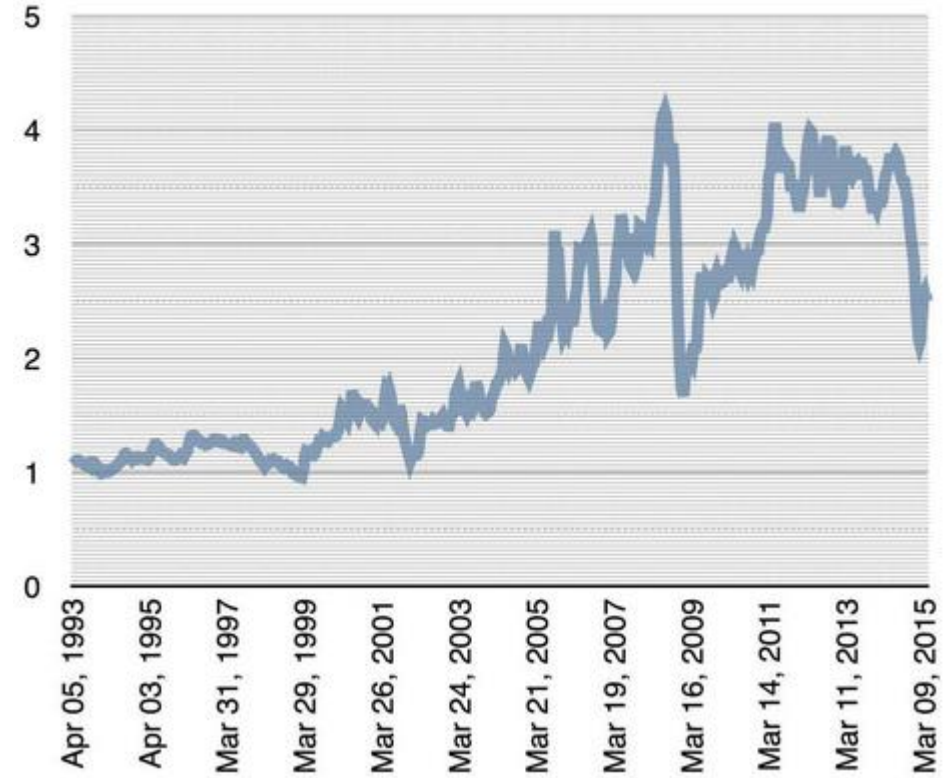
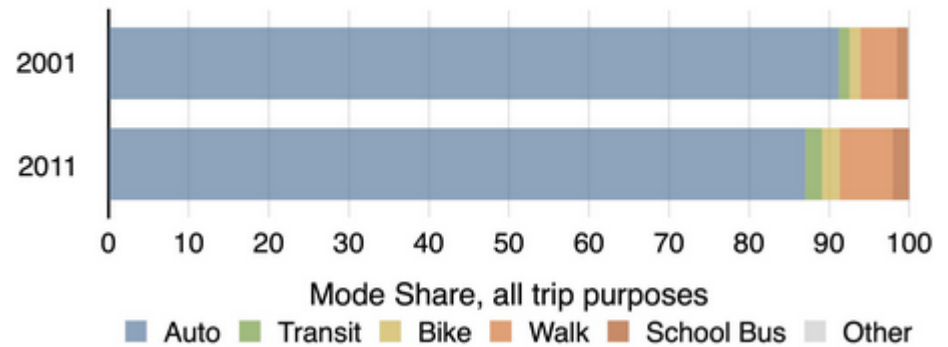


Figure 3.9 Mode Shares in Minneapolis - St. Paul Region, Summer 2001 vs. Summer 2011



# Discussion

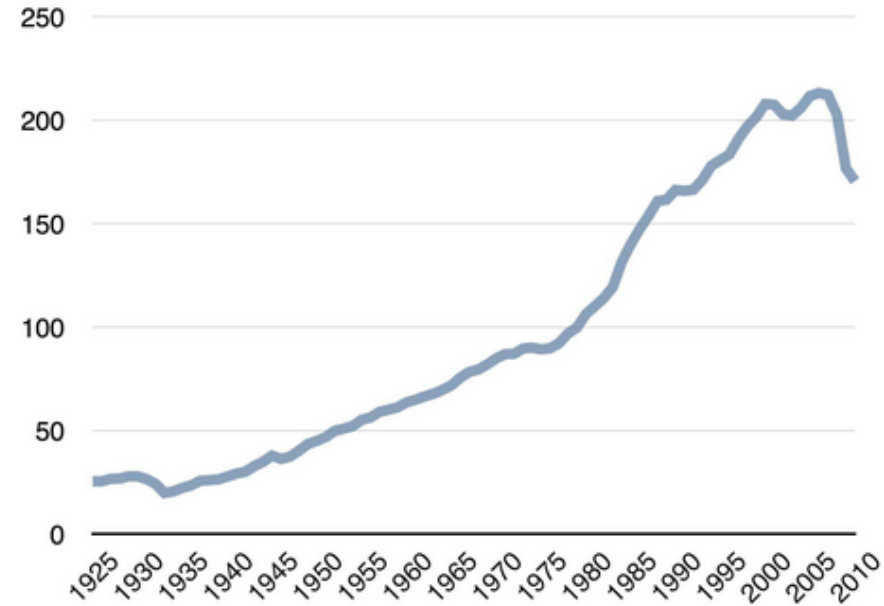
It is hard to say which, if any, of these explanations have the fewest assumptions, thereby satisfying Occam's Razor.<sup>101</sup> Instead, like Agatha Christie's novel, the guilt is spread over many shoulders. None of these explanations can be single-handedly responsible. As matters unfold over the upcoming years, more characters will be added and the specific role of any one culprit might become more pronounced. But for the time being, traffic is suffering a slow death by a thousand cuts. Interestingly, almost none of them can be attributed to conscious public policy aimed at traffic reduction.

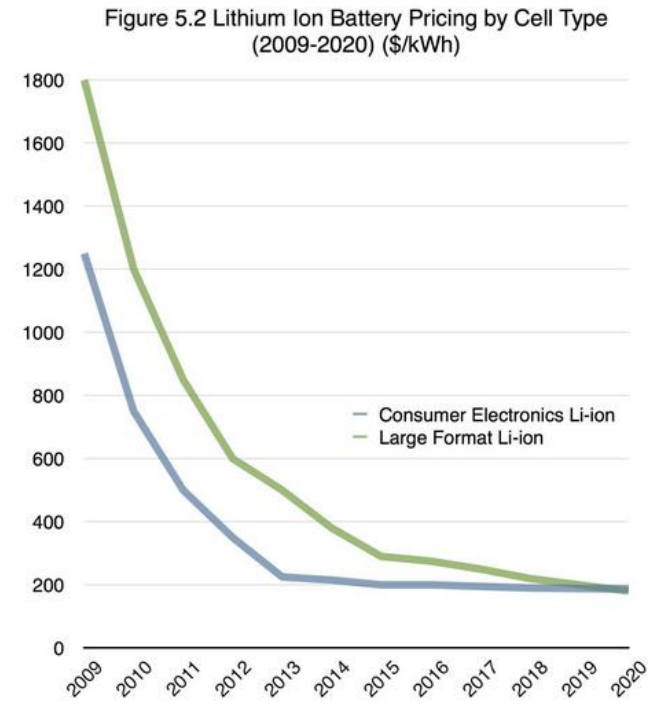
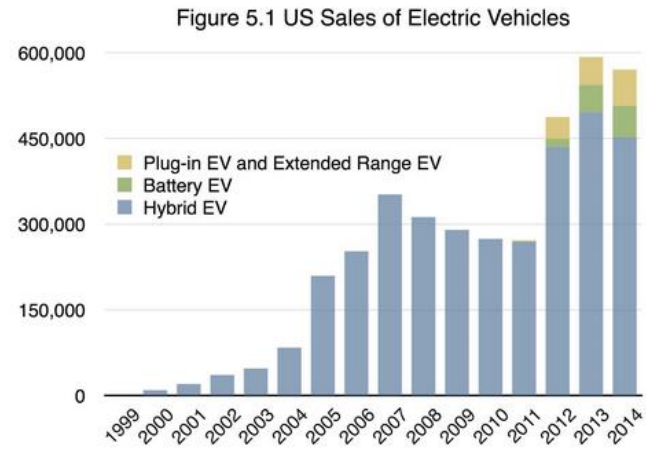
Furthermore, charging one culprit is less important than waking up to the reality that *transport operates differently these days*. People seek convenience in their daily routes. They seek not having to pay attention when they drive. They definitely seek not having to drive in traffic. Seek and ye shall receive. Convenience, safety, and inattention are hallmarks of future mobility.

Such anticipation, however, needs to be tempered. All technologies have a lifecycle associated with them—which can be graphed with an "S-shaped" curve. Things start off, they grow slowly, there's a period of steady, rapid growth and an eventual leveling off. Something new happens and the S-curve begins to move in the other direction as the technology declines.<sup>102</sup>

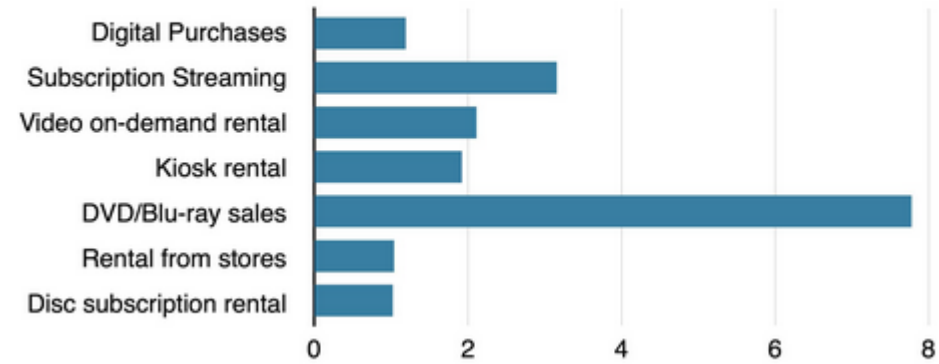
For example, as shown in Figure 3.10,<sup>103</sup> US mail volume increased for decades upon decades until the 1990s. And it started to level off in the 1990s (forming an S shape from 1926 to 1999) with the rise of email and the Internet, and then, since the early 2000s has fallen off a cliff (the beginning of a reverse S). Nobody today expects the number of letters delivered to rise in a decade's time. This same pattern could confront the conventional automobile as we know it today.

Figure 3.10 Billions of Pieces of Mail Handled Per Year: US Post Office (1926-2009)





**Figure 6.1 US Home Entertainment Revenue (2013 \$B)**



# Discussion: Thought Experiment: "Ze Car, Ze Car."

*"My dear guests, I am Mr. Roarke, your host. Welcome to Autonomy Island. Yes, here on Autonomy Island, all of the cars are autonomous. Your adventure will be to ride and drive and walk and bike in a place without fear of a human running you over."*

An automaker (or collective of automakers, or government, or Google) could buy all the cars on an island (and perhaps rent the government), replace them with new autonomous vehicles, and see what happens ... to safety, to travel behavior, etc.

This is the kind of real-world laboratory experiment that would be highly useful to understand the implications, the unintended side effects, the bugs and so on of robotic cars.<sup>167</sup>

The US Virgin Islands collectively have between 10 and 20 auto fatalities annually. At an official USDOT value of statistical life of \$9.1 million, that is at least \$91M per year. In 11 years, the experiment would pay for itself if in fact it eliminates fatal crashes the way autonomous vehicles are expected to, leave aside any other potential benefits.

The advantages of an island are that it is a closed system, it can be fully mapped, and no one can drive on or off. A real island with real people would demonstrate how these interactions occur in use.

Easily done in Bermuda... But what about the cab driver?

## 8. MaaS Transport

First published in 1988, Robert Fulghum's book *All I Need to Know I Learned in Kindergarten* explains how the world would be improved if adults adhered to the same basic rules as children (i.e. sharing, being kind to one another, cleaning up after themselves, and living "a balanced life" of work, play, and learning). But the first one, sharing, is relevant for transport infrastructure, the way it is used now, and how it will likely be used in the future.<sup>168</sup>

# Discussion

Sharing—be it cars, bikes, boats or information—has strong network effects driven by convenience (a characteristic the time-starved seem particularly mindful of). But, macro versus micro transit discussions in the following chapter bring up matters of economies of scale versus economies of scope. There's a role for both.

For example, one is more likely to use carsharing if more neighbors use it, since that makes it more likely there will be a car in front of one's house, workplace, or wherever, when it is desired. Reducing vehicle access time from 10 minutes to 5 minutes, or 5 minutes to 2 minutes is significant, especially when most trips are only 20 minutes long. The Car2Go model has not yet put in enough capital, nor has enough demand, so there is a car waiting on every block. To do so is no small step, and may require automation.<sup>204</sup>

As with any social network, it is not clear in advance which if any will take off. As with many networks, there needs to be a large up-front capital investment. But unlike rail transit systems, carsharing is dealing mostly with mobile capital. If the program doesn't work in place A, cars can be redeployed to place B, or at worst, sold in a used car lot. Further the programs are privately funded, which is more suited to innovation and adaptation, and accepting of failure, than publicly funded transit agencies.

The economics and environmental benefits<sup>205</sup> of renting rather than owning are clear, but the sociology and the the role of regulation<sup>206</sup> remain unclear. People willingly use hotel rooms, or bikes, or library books that have been used by others before, but not, typically, cars. How do cars get transformed from an owned good to a rented service? In part this is generational. If you have never owned a car, new habits can be formed. But that type of change is very slow, perhaps as slow as generational shift. Early adopters and the carless may be quick to join. Some/many/most Americans use their cars often enough, in places remote enough, or customize their cars sufficiently that MaaS will not be advantageous in most circumstances. The question is: What is the winning fraction? We suspect the answer is related to land use patterns. Where people live in apartments, MaaS will be successful if not dominant. Where people live in single family homes, MaaS will be far less successful, though not nonexistent.

Figure 8.2 North American Carsharing Growth

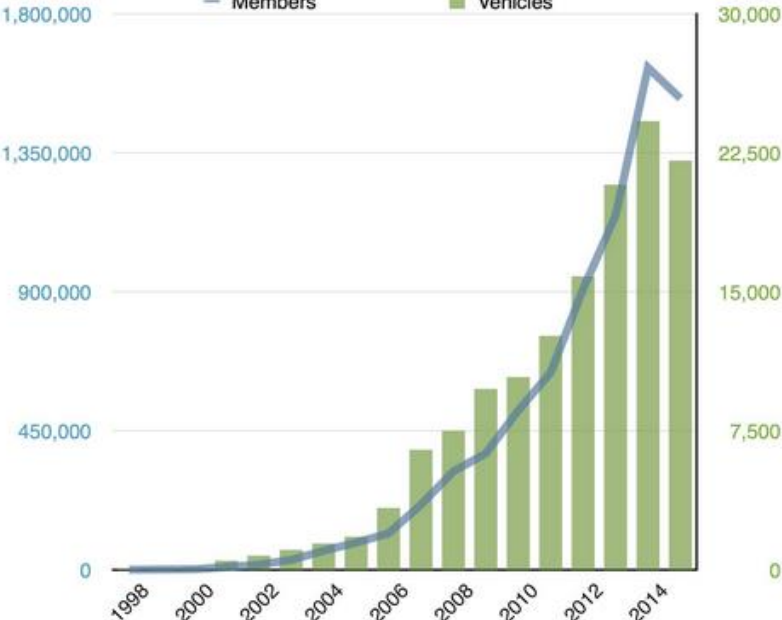
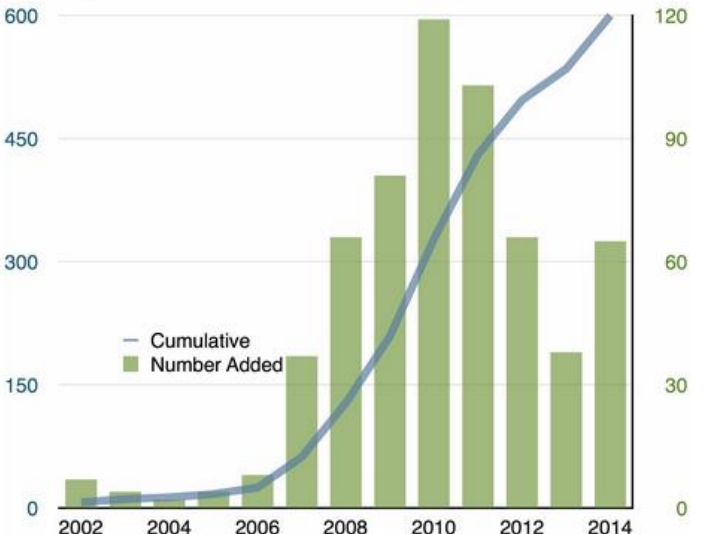


Figure 8.3 Growth of Bike Sharing Systems Globally



# 9. Transit

From the 1880s through the early 1920s, transport explorers in the US spent their time climbing Mount Transit. It was not until the mid 1920's that they switched routes to persevere Mount Auto. At the turn of the century, transit was the most important mode of travel (after walking) in large and medium-sized US cities. Transit's ascent was enabled by the electric streetcar, first deployed in Richmond, Virginia in 1887 by Frank Sprague. It's widespread distribution was as a product of electricity harnessed by Thomas Edison, Nikolai Tesla, George Westinghouse and others, and the modern railroad, developed beginning in 1825 with George Stephenson's steam-powered Stockton and Darlington Railway. The transport climbers in the US came upon false summit of Mt. Transit in the 1920s; the real one was discovered two decades later with transit's peak during World War II when oil and rubber were rationed, crimping the automobile's use, shown in Figure 9.1.<sup>207</sup>

## Macro-Transit

A feature that distinguishes the far end of the spectrum of (non-human powered) mobility lies in the onset of a fixed route. These systems usually come in the form of grade-separated metros (as found in roughly 150 cities across the globe<sup>211</sup>), tram systems, exclusive busways, or even high frequency commuter train service (as found in countless European contexts).

Differences are notable and important, but most elements about these macro systems are *high*. High costs invoke high stakes; they require high development intensity (to be successful) and high frequency of service with high capacity to invoke high ridership to pay for them. When these systems are appropriately placed within the urban fabric, they do wonders for mobility. These systems will retain their prominent role in large central cities.

But many questions and challenges also surround macro-transit systems—issues which vary for existing versus future systems—which differ from system extensions. Rail transit is rigid. Recognizing that rail can help influence development patterns, fixed rail's lack of flexibility limits its ability to adapt to uncertain futures. In the absence of new cost-saving tunneling technologies and changes to environmental and planning review regulations, *rail will not have the ability to quickly and suitably address transport problems in emergent corridors.*

**Automation.** It is surprising that, in 2015 in the US, outside of airports, most modern, grade-separated rail systems fail to all have automatic train operation (ATO). Administering organizations might still be licking their wounds from previous mishaps.<sup>223</sup> <sup>224</sup> *Eventually, trains and buses will be routinely driverless.* However, given the general technological torpor, and institutional rigidity, along with public union strength, in the macro-transit sector, this is likely decades away from full deployment.

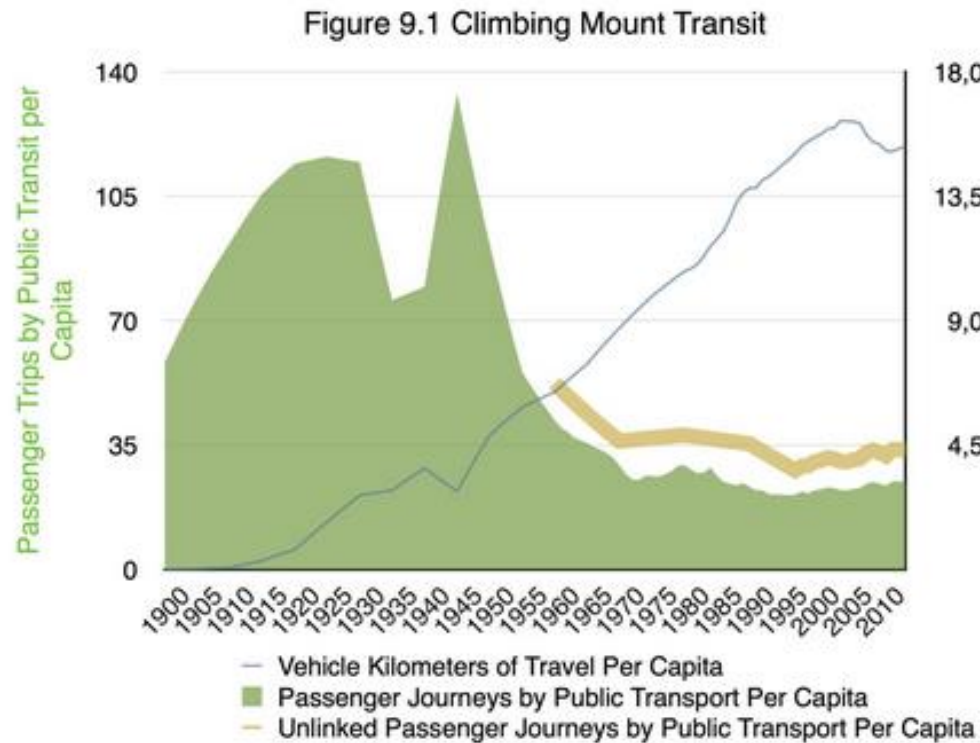


Figure 11.2 Food and alcohol expenditures (by share)

