The Economics of Shared Mobility Series

The Present, Part II

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Consumer Debt, Spatial Economics, and the Shock of Technology

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January 2018

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Series Introduction

This essay is one in a series of papers dedicated to providing critical context and analysis on the economics of shared mobility. The rideshare, carshare, e-hail, and mobile fleet industries that comprise the shared mobility market have achieved extraordinary growth in the last decade or so. Culturally resonant companies such as Uber and Lyft are increasingly integrating within the fabric of established urban transportation networks, while more conventional firms such as Ford and General Motors are committed to entering the market as well. Meanwhile, around the globe startup companies are emerging to fulfill market needs and overcome transportation inefficiencies. Put simply, it seems as though we are living through a transportation revolution.

The growth of shared mobility comes on the heels of significant innovations in the tech industry. As semiconductor prices steadily plummeted since the 1960s, the pace with which mobile technology diffused into economies only increased.[1] These innovations, coupled with data telematics' integration with Geographic Information System features in phones and the spread of mobile internet connectivity, allowed for the formalization of typically disorganized markets. Informal activities such as ridesharing that had existed for over a century could now be scaled exponentially. The results of these changes have been economy defining. Growth in the industry has continued annually, and is expected to rise still more over the coming years. Any company tied to transportation has likely already been affected by these changes.

As part of Arity's mission to revolutionize transportation, it is not only critical to grasp how this growth has arisen, but also to prepare for the future by investigating the factors that affect the mobility market today. Written from a macroeconomic perspective, these papers take a long-run, theoretical approach to examining these factors. Real-world data will be woven together with abstract economic concepts to paint a clearer picture of the typically chaotic world of shared mobility. Divided into three subseries (I: Past, II: Present, and III: Future), each essay will work to answer fundamental questions such as: how did the shared mobility market form; what economic concepts are critical to understanding the shared mobility market; and, in which direction is the market likely to head in the future? At minimum, these papers should function to inform any and all members of the Allstate family why traditional approaches to mobility and risk are changing. At their best, these papers could act as a resource upon which Arity relies when making economic decisions in the shared mobility market.

[1] Dale W. Jorgenson, *The Economics of Productivity* (Cheltenham: Elgar, 2009), 173.

Executive Summary

The Automobile in Society, Past and Present

How has the economic history of the automobile set a precedent for the interpretation of the modern economy?

- The first personal credit-lines were offered by General Motors in the 1920s. Payment periods were typically very short.

- The public quickly began to take advantage of these schemes, amassing great debt for the ability to drive. With the increased demand for vehicles, "backward linkages" were established in new industries such as trucking, repair shops, and tire manufacturing.

- The government engaged in systemic road construction projects for the first time, connecting rural and urban areas. Rural markets could now sell to urban markets more cheaply than ever.

- The economy and stock market began to boom commensurate with the spread of credit to other products and an increase in labor productivity.

- Insatiable brokers desired more credit with which to buy stocks; available credit was shifted to the stock market, reducing consumption rates among the public. Granted more credit, brokers bought more stocks, increasing their prices and the perception of their worth.

- Soon risk-averse brokers could no longer handle the pressure; they began to sell stocks. Learning about their sell-out, others became nervous, and began to sell stocks too. Soon too few institutions were willing to buy stocks from brokers, devaluing stock prices further, causing the Stock Market Crash of 1929.

- The Stock Market Crash of 1929 had socioeconomic consequences on the public's consumption behavior. Worried about future income, having amassed great debt, the public feared the results defaulting on loans (material repossession) more than reducing their spending habits. Most people began to tighten belts, and spend less. This behavior contracted the economy and helped to cause the Great Depression.

Takeaways

1. **Consumers are not just incentivized by what they stand to gain, they are perhaps as (if not more) incentivized by what they stand to lose.**

2. **Risk and uncertainty are two sides of the same coin, and as uncertainty rises consumers can react by attempting to reduce risk in unexpected and even economically unfavorable ways**

3. **The effects of debt on consumer behavior should never be underestimated.**

4. **The public's means of transportation and the effects it has on the economy can act a barometer of the current macroeconomic state of a nation.**

5. **The adoption and sudden prominence of shared mobility services may be symptomatic of deeper socioeconomic patterns occurring at the consumer level.**

The I.T. Revolution, Jobs, and Millennial Debt

According to survey data, millennials are the biggest cohort of rideshare users.

- As of 2015, millennials became the most populace US generation at 75.4 million individuals.
- Most rideshare users are located in urban areas; the median age of ridehail users is 33 years old (YO).
- 28% of rideshare users are 18-to-29 YO; 20% of rideshare users are 30-to-49 YO.
- Millennial users are likelier to rely on an ecology of transportation options including taxi services, trains, bikes, and walking.
- Users are 18-to-29 YO are 7x more likely to engage in rideshare than users 65 YO+.
- Users 50 YO+ only make up 12% of the rideshare market.
- The missing 41% of the market is likely comprised of users 17 YO and younger; more research should be done on this cohort of users.

What is it about millennials that makes them suited to use rideshare?

- Millennials are the most indebted US generation.
- As of 2017, millennials owed 30% of consumer debt in the US—$1.1 trillion of $3.6 trillion owed.
- Millennials are more price-conscious and conservative in their spending than previous generations; they are the only age cohort spending less daily since the Great Recession.
- 52% of those worried about defaulting on a loan in the next year are between 21 and 34 YO. 54% of millennials over the age of 30 worry about their ability to repay their loans.

- A majority of millennials experience high-to-moderate anxiety about losing their jobs, about their level of savings, and nearly 70% worry about future income (wage) loss.

- Based on historical precedent (see abridging section), there is reason to believe that the state of consumer health can be reflected through individuals' transportation habits. The debt millennials have accrued has had adverse socio-psychological effects on their spending habits, causing them to be averse to the purchase of risky assets such as cars.

Why are millennials so indebted and how does their debt correlate to the growth of shared mobility usage?

- The grow of shared mobility and millennials' debt have accrued are both the consequence of a "technological shock" wrought by the Information Technology (IT) Revolution.

- Technological shocks are shifts in the consumption and production behavior of economies by the adoption of systemically-significant technological innovation.

- Technological unemployment is a symptom of technological shocks. Technological unemployment is the gradual obsolescence of once-established jobs through adoption of new technology and innovative practices.

- Over the last 20+ years, IT has been responsible for the reshaping of western economies. Manual, routine-oriented jobs have been particularly vulnerable to obsolescence.

- The technology shock of the IT revolution has shifted job prospects, and therefore the consumption behavior of millennials.

- Millennials have demonstrated concerning levels of price inelasticity (insensitivity to price change) to education costs. Despite an 81% increase in nationwide, enrollment-adjusted tuition costs over the last decade, education rates did not shift in any state.

- Millennials are more likely to hold a degree than any previous generation. Among millennials 35 and younger, the percentage of household heads with outstanding student debt more than doubled between 1989 and 2010.

- The growth in debt among millennials has been a response to society's (and firms') increased integration of IT. The rapid growth of the shared mobility market is a production response to the IT Revolution, as well. Consequently, modern transportation practices are intimately related to the indebtedness of millennials, the share economy's largest cohort.

<u>Takeaways</u>

1. **How will the motivations behind millennials' use of rideshare shift in the future?**

2. **Will the continued shift of manual labor into automation dissuade mobility use?**

3. **Does this imply risks for the sustainability for rideshare in the long term?**

Spatial, Urban Economics and Shared Mobility

Millennial debt may encourage consumers to move to suburban areas.

- As wage growth continues to stagnate (see previous report), those with high debt levels may move into the suburbs in search of cheaper rent costs.

- "Bid Rent Theory" is a simplified model which explains that the cost of rent will decrease in proportion to distance from central business districts (CBDs). Suburban rent, by nature, is less costly than urban rent.

- Suburban areas afford less "mobility access" in proportion to their distance from CBDs. As distance increases, the availability of public transit decreases. Mobility Access is composed of two parts:

    (1) Accessibility
        a. The location of opportunities within an urban area.
        b. The right to use those opportunities.

    (2) Mobility
        a. The means and efficiency of intro- and intra-urban movement.

Who will choose to live in suburban areas and what travel behaviors occur within them?

- As the most indebted generation, millennials are the most likely to move into the suburbs.

- Those millennials who choose to move into the suburbs will do so, not only because the price of rent may be cheaper, but also because they value mobility access less than the benefit of saving on rent.

- Evidence also exists to that suburban growth is and has been greater than urban growth for some time.

- Since at least the 1980s the United States has seen a shift in employment from urban areas to suburban areas. The percent of jobs in outlying, non-urban areas grew by 70% compared to 40% within CBDs.

- US census data indicates that of all commuters, most (44%) is *intra-suburban* (beginning and ending in suburban areas), while second (29%) is *intra-urban* (beginning and ending within urban areas).

- Because both urban and suburban workers tend to work locally, this seems to support the notion that those who choose to live within cities do so to avoid extensive travel costs.

- Social activities account for 30% of all travel behavior. Were millennials to continue to both prioritize social activities *and* continue the rate of suburbanization, *then aggregate travel distances by car would increase due to the increase of space between accessible opportunities in suburban places*.

Urban spacing patterns predict that the increased suburbanization of millennials poses risks to the sustainability of shared mobility in its current form.

- Regions of sparser population such as suburbs tend to impose spatial-temporal costs to transportation. Due to their high population density areas of high mobility access provide more efficient means of transportation.

- Four economic relationships in particular increase the efficacy and efficiency of shared mobility services in urban areas:

    (1) The relationship of scale and space.
        - Firms in cities have access to a greater number of sectors that produce inputs key to running their businesses, *a marginal increase to production output requires a less-than-proportional marginal increase in inputs to production.* Consequently, cities attract more jobs and workers, increasing the volume of economic activity more efficiently.

    (2) The relationship of shared inputs and space.
        - Shared inputs to production are the available supply of workers, whose increased popularity in cities reduces the search costs for businesses. Shared mobility services such as rideshare heavily rely upon this feature.

    (3) The relationship of transactional costs and space.
        - The availability of information between consumer and producer helps set prices to their equilibrium or "natural" state. Information both indirect and direct is typically more available in urban areas.

    (4) The relationship of risk space, which relies on the Law of Large Numbers.
        - The Law of Large Numbers indicates that as a sample size grows, there is a tendency for its average to converge on the average of the population upon which it is sampled. Urban risk spaces rely on the Law of Large numbers because, as the population increases, the likelihood that someone will want to be transported increases. To consumers, urban environments tend to increase the number of transportation options they can rely on when traveling.

Important predictive insights:

- Human travel tends to be made of short trips; as distance increases, trip frequency decreases.

- Transportation behavior and urban activity can be predicted to a high degree of accuracy using "power law" relationships.

- The growth or scalability of urban spaces tends to increase predictably by the following the mathematical relationship $Y = aX^{\beta}$, where β is the power law exponent which scales a relevant variable, Y and X are said relevant variables, and a is some expressed constant.

- Power law relationships can predict the relationship between city populations and the number of gas stations and car dealerships it will have as well as the length of roads, electric lines, and water and gas lines. Infrastructural relationships tend to operate at a sublinear (economy of scale) ratio of 1-to-.85, where the doubling of population requires only 85% more infrastructure.

- Whether a good or service is private, common, club, or public, largely determines its scalable behavior.

- As opposed to infrastructural goods, socioeconomic goods or products, such as restaurants, museums, theatres, colleges, patents, crime, disease, professional rates, and much more, tend to increase over-proportionally, or superlinearly, at a 1-to-1.15 level. The doubling of a city's population will likely result in a 15% increase in patents.

- Evidence indicates that travel behavior such as miles driven tends to scale superlinearly; miles driven increases faster than built road-miles. Cities encourage scaled usage of roads beyond their intended capacity in a process called the "Induced Traffic Effect."

- Urban scaling laws occur *irrespective of nation or environment* so-long as patterns are analyzed intra-nationally.

<u>Takeaways</u>

1. **Highly granular insights can be gleaned from the analysis of urban sub-populations.**
    - For instance, given any urban location, the number of people that travel to it will scale as a power function (of exponent negative two) of both distance and visitation frequency. This is called "The Inverse Square Law." Using it analysts can determine that *the number of visitors should scale inversely as the square of both the distance traveled and the frequency of visitation*.

2. **The possibilities for practicable and effectual insights are potentially numerous when urban transportation and urban scale are analyzed. Increased conversations and investigation into the usefulness of spatial economics and analysis should be called for.**

- One area of further research might be whether, as population density decreases, the frequency distribution of travel behavior shifts as well.
- Another area of research should be the consumption patterns of `shared mobility users under the age of 18.
- The limited mobility access of the socio-economically disadvantaged also demands further research and action. It is likely that the majority of future transportation connections will be in "transportation deserts"—areas close to CBDs with asymmetric mobility access comparable to areas of high median incomes.

3. **It may be wise to anticipate transportation shifts to suburbs areas, rather than simply cities, and to develop useful insights for the natural transportation inefficiencies these areas incur.**

<u>The State of Regulation and Litigation in Shared Mobility</u>

The regulatory and litigative debates surrounding rideshare and shared mobility are well-known.

- According to Pew survey data, close to half of those familiar with ridesharing are also familiar with the regulatory and litigative debates that surround it.

- As of 2015, Uber faced over 170 lawsuits in the US; as of 2016, it had paid over $62 million in fines and settlements. Today, Uber faces perhaps hundreds more lawsuits, having added four additional high-profile lawsuits to its dockets in November 2017 alone. The company now faces penalties in the *billions* of dollars.

- Fines stand to do less harm to Transportation Network Companies (TNCs) like Uber, than the regulations, legal precedent, and injunctions that may ensue.

These legal battles are not unique. Regulatory battles in the transportation industry have been fought for almost a century regarding the assignment of vicarious liability and *respondeat superior* property rights.

- The US legal system operates under common law doctrine; the interpretation of present and future cases by the court are set by the precedent of past cases.

- Many historical cases exist in which transportation companies argued they could not be held "vicariously liable" for the personal injury or damage ("tort") passengers or employees have experienced.

- An organization that is vicariously liable is one that must bear legal responsibility for the actions or suffering, inadvertent or otherwise, workers encounter while under its employ. *Respondeat superior* ("let the master answer") is a legal stipulation that establishes whether

an organization legally owns the labor of some potential employee. The concept of *respondeat superior* grant employees the freedom to enter employment without the risk of being made culpable for the actions of their labor.

- Hyper-aware of legal precedent, rideshare TNCs define workers using their as independent contractors to avoid the costly status of *respondeat superior*. Critically, *respondeat superior* status would also make TNC platforms culpable to establishing standard employment benefits.

Economically, these legal battles are simply a means to establish rights. Once these rights are assigned, both employers and laborers can negotiate an exchange of these rights to the party that values them most.

- Many of the current legal battles against TNCs are attempts to properly define who owns the property rights of their labor. Many drivers argue that, because they are managed by TNCs, they *do not* own their labor outright and therefore should not hold pure responsibility for their employment costs. TNCs argue oppose this view.

- In a perfect world, once legal cases are established, resources will be efficiently allocated between the parties concerned.

- Unfortunately, most often rights and entitlements *are not* exchanged freely. In the absence of the free flow of information many market transactions are costlier than they need to be, resulting in market failures.

- Market failures are the consequence of: "use-based market failures" and "exchange-based market failures." Use-based market failures (a.k.a. externalities) occur when individuals and firms have not taken into account the costs of their activities on third parties. Exchange-based market failures occur due to the misallocation of economically relevant information between parties.

The emergence of shared mobility platforms has helped to reduce the transaction costs and inefficiencies of transportation services.

- Market failures generally occur when intermediary institutions hold a monopoly on producer-to-consumer transactions. These intermediaries raise costs higher than they otherwise would be. Taking a taxi has traditionally meant not knowing how much one would pay before one arrived. Shared mobility services tend to usurp that practive.

- Technology platforms can disintermediate informational asymmetries (one-sided informational awareness between drivers and passengers) by providing all parties inexpensive information about the transaction they will be making.

- Until the emergence of mobile telematics and data analytics, socio-political means were used to mitigate market failures. Often two economic approaches are taken to address market failures: laissez-faire economics and regulatory economics.

- Laissez-faire economic thought (from the French "let do") is often associated with "free-market" ideology. Proponents tend to believe that markets will naturally adjust to reach price equilibria (efficiency) given enough time.

- Proponents of regulatory economics generally believe markets to be inefficient and that oversight mechanisms are needed to prevent needless socioeconomic costs.

- Most western economists fall somewhere between the extremes of these two modes of thought. Most markets are thought to reach equilibrium naturally. But some socially beneficial goods and services cannot inherently reach equilibrium without oversight or a market mechanism to price them. Examples include: Traffic congestion, pollution, and market irrationality.

- Economists determine whether markets should be regulated by the amount of available competition or if prices are artificially high/low.

Competition in the shared mobility market is high, but prices are artificially low. Consequently, the regulatory landscape around shared mobility TNCs can be narrowed to two narratives: regulatory fairness and technological internalization.

- Regulatory fairness is the belief among many academics, legislators, and traditional transportation companies, that a two-tiered regulatory system favors shared mobility TNCs over traditional transportation networks.

- Taxis are regulated by size, age, color, volume, and distribution, to name just a few; each of which raises costs for both consumer and producer. By comparison, rideshare drivers are regulated far less for operating essentially the same service.

- Technological internalization is the notion that transportation inefficiencies can be ameliorated through self-regulatory innovation rather than government oversight.

- Almost all of the market-failures taxis were once regulated for can be ameliorated now through technological internalization. The only problem that has yet to be solved, which may be the ultimate prize of the next few decades, is a market mechanism for reducing traffic congestion

- Rideshare companies are also artificially lowering prices and incentivizing drivers. Uber has invested billions of dollars in subsidies, Lyft has invested hundreds of millions in subsidies. This could compel anti-trust investigations.

<u>Takeaways</u>

1. **By subsidizing rideshare services, will TNCs bankrupt taxi companies, then simply raise prices and reduce subsidies to drivers? Will this be sustainable for them? If not,**

is this why there is great investment in autonomous vehicle technology? Is this even legal?

2. **If protests have occurred due to unfair pricing and cumbersome regulation, what will be the effect of the wholesale disruption of the transportation industry?**

3. **Traffic congestion is one of the most prevalent systemic issues in modern transportation. Telematics companies are likely to be the industry to best solve these issues.**

4. **If taxi companies are not deregulated, there is reason to believe that politicians, taking the middle ground, will begin to regulate shared mobility companies more harshly.**

Useful Definitions[2]

Urban Areas – A densely developed geographic area of residential, commercial, and non-residential land use of over 500 people per square mile and a population above 2,500 people (and less than 50,000 people). As of 2000, there were 3,756 urban areas in the United States.

Urban Populations – People who live within urban areas. As of 2000, 79 percent of the total population live in urban areas.

Rural Areas – Rural areas encompass all populations, households, and territories not included within an urban area or metropolitan areas.

Metropolitan Areas – (Also known as Metropolitan Statistical Areas (MSAs)) Centrally developed economic zones with substantially consolidated populations. Significant economic communities tend to become established adjacent to metropolitan areas. Metropolitan areas must have populations of at least 50,000 people. There were 361 metropolitan areas in the United States as of the year 2000. The word "city" is often used interchangeably with metropolitan area.

Urban Economics – The exploration of the geographical or locational choices of utility-maximizing households and profit-maximizing firms in densely populated landscapes.

Spatial Economics – The exploration of the efficient and optimal allocation of scarce resources over geographic space or by location. Spatial economists differ from urban economists in the assumptions they make about the effects of space on economic activity. Both fields tend to arrive at similar conclusions despite beginning from different perspectives. Throughout this report, these fields will be used interchangeably.

Routine (Non-Routine) Labor – **Routine labor** activities are repetitive, formulaic, or predictable in nature. Examples of routine activities include technical support and stock trading jobs. By contrast, **non-routine labor** activities are dynamic and ephemeral—they are jobs comprised of situation-based, non-repetitive tasks. Non-routine labor includes business management, governance, and the creative arts.

Cognitive (Manual) Labor – **Cognitive labor** activities require mental creativity and problem solving skills. Cognitive labor tends to require specialized education and/or technical training to address problems that the average, untrained person would not otherwise be able to solve. Cognitive labor includes programming, engineering, and legal work. **Manual labor** activities are primarily physical. They require endurance and stamina as well as the mental fortitude to continuously overcome stressors. Manual labor includes healthcare support, public works, and fire protective services.

[2] Definitions from: "Urban and Rural," US Census Bureau, *US Department of Commerce* (2016) https://www.census.gov/geo/reference/urban-rural.html; Arthur O'Sullivan, *Urban Economics* (New York, N.Y.: McGraw-Hill/Irwin, 2012).

Introduction

In the previous report on the economics of shared mobility, present developments in the shared economy were analyzed. A central objective of that report was to explain just why it was that the shared mobility market has expanded in the way it has. Using property rights theory coupled with theories of labor, capital allocation, and rational incentives, much, but not all, of this objective was accomplished. This current report reflects the attempt to complete the task of comprehensively analyzing the shared mobility market. Throughout this report, many of the insights developed from the theories and assumptions established in the part one of this series will be relied upon, if not expanded. However, whereas the previous report leaned into developing a theoretical foundation for the analysis of rideshare, part two of the present analysis is far more reliant on socioeconomic data trends.

Three phenomena will be stressed in this report: the effects of technology and debt on consumer choices, the effects of urban spaces on transportation, and the state of transportation regulation. As will be seen, the narrative of the automobile in America first presented in the initial report of this series was fundamentally incomplete. Whereas originally it was useful to show that shared mobility services have existed since at least the early 1900s with the jitney, such a narrative did not fully illustrate the fundamental relationship consumers have with transportation technology, nor did it fully illustrate what the consumption of transportation can tell us about the state of the economy. By completing the narrative of the automobile, a foundation will be created upon which to better understand contemporary macroeconomic developments on consumptive behavior.

In our modern, western understanding of the world, geographic considerations often get short shrift when it comes to socioeconomic developments. In the second section of this report, it will be shown in compelling detail just how poor an oversight this may be. When paired with population data, for instance, spatial and temporal factors become predictive enough to accurately model the frequency with which certain urban areas will be visited in a given month. The potential tools telematics companies could develop from these insights are legion.

Finally, a brief but telling review of transportation regulation will be provided. Studies indicate that the regulatory debate surrounding rideshare is one of its most recognizable features. As transportation network companies such as Uber face hundreds of lawsuits, this should come as no surprise. The real question is whether or not the issues TNCs face today are even that unique. In the third section, queries such as this, and whether current regulatory arrangements are sustainable, will be answered. Still, before addressing any of these concepts can be more fully engaged, perhaps it will be more helpful to first review the findings of the previous papers.

Summary of Series Findings[3]

In the first paper of the economics of shared mobility series, a comprehensive review of the history rideshare use was provided. The motivation underlying this effort lay in the desire to

[3] As with any summary, the findings mentioned here are merely a representative sample of previous writings. For more on the history and economics of rideshare and shared mobility, see Benjamin Labaschin, "The Economics of Shared Mobility: The Economic History of Rideshare" *Arity* (2017a) and "The Economics of Shared Mobility: Property Rights, Shared Economies, and Market Disruption," *Arity* (2017b).

understand the past experiences of ridesharers and ridesharing providers since the activity's inception in 1914. The theory was that if Arity is to be an organizational leader in the blossoming shared mobility market it would need to anticipate and invest in solutions to present and future transportation obstacles. Whereas Arity excels in robust data analysis, it was also understood that superior business solutions are rooted in deep, interdisciplinary market understanding. Just so, by evaluating rideshare's century-plus history it became clear that particular socioeconomic variables regularly altered the adoption-rate and growth-level of ridesharing among Americans. Three factors in particular continually emerged to influence rideshare use: the costs and benefits of transportation and car ownership, the cultural and civic perceptions of rideshare risk and safety, and the effects of technological innovation on travel habits. The analysis of these three factors has led to compelling insights about the dynamics of the shared mobility market.

First and foremost, the history of rideshare participation can be thought of as one of commuter sensitivity to price and travel convenience. For example, during the early 1900s it became cheaper to hail a wayward "jitney"—a kind of informal citizen-operated taxi—than to pay for a streetcar ride that was, in all likelihood, overcrowded with commuters. With its capacity to take passengers precisely where they wanted to go for cheap, the jitney had a competitive advantage over other commuting options. So abundantly clear was this advantage to travelers that the concentration of urban transit activity in the early 1900s briefly shifted towards ridesharing, attracting the attention of the nation's media outlets in the process.

Throughout the country, newspapers could be found radiating laudatory stories in commemoration of the American entrepreneurial spirit. The attention that newspapers drew to ridesharing likely increased its appeal to the general public, effectively spreading the activity into only more American cities. By 1915, a year after its inception, ridesharing had spread from California to Maine, and many ways in between. But the great zeal for ridesharing also attracted to it great regulatory hindrances.

For their part, state and local municipalities that had relied upon revenue accrued from the taxation of transportation services felt shorted by the mass movement to rideshare. To the government, every marginal increase in rideshare use brought with it a marginal decrease in rail and streetcar use and, therefore, in public tax revenue. It is therefore easy to see why both local and state governments felt affronted by the ridesharing phenomenon. Ridesharing itself was not an issue *per se*, but rather it was the inability of regulators to generate revenue that was of concern. This left ridesharers and regulators in quagmire that, to this day, they have not managed to escape from. Yet, taxing ridesharers was antithetical to the very meaning of the practice; after all, a "jitney" was a colloquialism for the five-cents consumers could expect to pay for travel. Any marginal tax applied to the practice would be felt by consumers and suppliers both.

Rising safety concerns only suppressed the adoption of ridesharing. Like taxi medallions today, in the early years of the jitney phenomenon local governments required rideshare providers to pay thousands of dollars for insurance liability bonds to mitigate risk and collect taxes. These bonds did have their place. With a surge of drivers emerging, the risk of danger, and therefore of claims loss, only increased to insurers. They were not the only ones to take notice either; the public took notice of these changes too. Newspapers throughout the country, ever-mercurial in their allegiances, began to print stories and opinion pieces that raised concerns among the public about the safety of ridesharing. All told, in the nascent years of rideshare's ascendency, regulatory requirements would have the sole effect of pricing most independent drivers out of the market and relegating the jitney phenomenon to the annals of history.

As the century progressed, memories of the jitney era began to fade and any efforts to promote ridesharing were outshone by the incentive to own a car. Whereas ninety-five percent of Americans travelled by rail for intercity trips in 1895, by 1970 personal automobile travel accounted for ninety percent of all intercity travel.[4] American travel habits had changed significantly, and to many onlookers the change seemed permanent. During the 20th Century it became clear that if drivers could afford to own a car, there was great reason to do so. Beyond mere cultural significance, auto-ownership granted drivers the freedom of personal transportation. To many, this was reason enough to dissuade them from relying upon mass transit for their travel needs. Even the prospect of carpooling to the office with co-workers seemed limiting. The psychological toll of social organization and collective inter-reliance was all too inconvenient. Only when monetary costs became prohibitively high for both consumer and producer did rideshare participation grow. In the 1970s, for example, gas prices rose steadily for consumers. Meanwhile, rising land costs compelled employers to limit the amount of parking they provided to their workers. Taken together, the cost of personal transportation rose for both the supplier of parking and the consumer of travel. Notably, employers that organized transportation matching *for* their workers saw the greatest rideshare adoption rates; an organizational sign, perhaps, that holds greater significance in hindsight.

Today, it is clear that the idea of personal transportation as it was practiced in the 20th Century was not as enduring as it once had seemed. Technological innovations made in the latter half of the previous century have now manifested themselves in unique, economy-defining ways. New markets have emerged to internalize or reduce the cost of transportation inefficiencies that have existed since time immemorial. Transportation platforms which had little traction in the late-20th Century, gained stark momentum in the early years of the 21st Century thanks in large part to the dispersal of cheap mobile phone technology. The ubiquity of this technology allowed travelers consistent, real-time access to transportation capital at the tap of a finger. As a consequence, the seemingly immutable benefits of car ownership that at times appeared absolute have now come into question. Established explanations that have fueled the 20th Century economy no longer seem sufficient. There now seems to exist a divide between classical expectations of western markets, and the empirical market behavior that is developing.

The second iteration in these series of papers reflected the attempt to address this divide. By interpreting incentives based on the theories of property rights theories and the economics of rational human behavior, an analytic approach was built with which to understand contemporary shifts in consumer preferences. Specifically, the second paper endeavored to explain why the benefits of capital ownership, traditionally assumed to be absolute, seem to have become increasingly outweighed by its inherent burdens. By briefly revisiting the foundations of economic thought, explanatory tools were established to help investigate these trends.

Since the time of Adam Smith, western economic theory has been based upon the notion that efficient societies allow private citizens the right to the exclusive ownership of capital (e.g. land, cars, one's own labor, etc.). Based upon theories of individual rationality and property rights promulgated by the 17th Century political theorist John Locke, Smith demonstrated that at their best individuals are motivated by incentives. To the individual, private capital ownership has traditionally allowed for the optimal exploitation of these incentives. For example, someone who rents out moving trucks can take heart in knowing that they own the exclusive right to the

[4] The remaining ten percent of intercity travel was composed of plane and bus travel, and with one percent allocated to the train "Regulatory Reform in Transportation" p 49 Hilton 1972

revenue their trucks generate. This person is therefore incentivized to maximize their revenue by renting out trucks as often as possible.

The benefits of exclusive ownership are also manifest in the ability to prevent others from the use of private capital. The power to exclude or limit others from capital use *minimizes the risk of capital investment and ameliorates uncertainty about the future state or usability of capital.* In other words, there is a high present value in the knowledge that no others have the right to use or misuse capital for which its future use is anticipated. As will soon be explained, regulatory structures are in place for those times in which rights or incentives are asymptotic. For now, suffice it to say that the dominant paradigm or theoretical viewpoint among western economists is that it is socially optimal to allow for exclusivity in capital ownership.

But major shifts in ownership trends are challenging this widely-held assumption. Today, the multi-billion-dollar "share economy"[5] is invariably defined by the benefits of shared capital access rather than exclusive ownership. Shared mobility technology platforms in particular are finding great success in this alternative business model. Companies like Uber and Lyft offer app-based taxiing services, while companies like Turo allow users to rent out their underutilized transportation capital (their cars) for a fee. Crucially, today it would seem that the benefits of capital ownership are, for many, becoming outweighed by costs both monetary and otherwise.

Technology platforms seem to be stressing the costs of car ownership by disintermediating transportation connections between people. Whereas historically mass transit has acted as the primary alternative to car ownership, today city-goers can rest assured that they have access to relatively cheap and immediate transportation options.[6] The availability of these options has the indirect effect of reducing or delaying investment in car ownership.[7] Though perhaps not a direct substitution to auto-ownership, shared mobility options do emphasize the costs once considered unavoidable. These "burdens of ownership" include direct and indirect costs such as car maintenance expenditures and insurance payments, as well as intangible costs such as the responsibility one feels towards protecting one's investments. To many price-sensitive individuals, the advent of alternative, dependable transportation options make these costs seem increasingly unnecessary and cumbersome.

The shared mobility market has also created additional opportunities for employment and revenue generation. Thousands of citizens in cities throughout the globe have been recruited to drive for rideshare companies that subsidize steep dividends for their drivers. For instance, one study sponsored by Uber claims its American drivers revenues of over 16 dollars an hour. Unfortunately, these figures do not seem to take into account operational costs. One insight gleaned from this analysis was that, like the Uber study, many drivers do not seem to take into account these costs when continuing to drive for shared mobility platforms. The term "cost illusion" was created to refer to the trend among shared mobility drivers to misjudge or ignore the costs of performing their labor.[8]

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[5] The term "share economy" is widely believed to be a misnomer. To share traditionally connotes an activity wherein profitability is not sought after by the sharer—a reality not reflected in this market.

[6] Certainly, other options such as the taxi industry have existed for quite some time. Later within this paper the interplay between rideshare and taxi services will be explored.

[7] Julie Beck, "The Decline of the Driver's License," *The Atlantic*, January 22, 2016, accessed December 18, 2017.

[8] Many drivers, in order to earn greater revenue, lease their vehicles from shared mobility platforms. As a consequence, some drivers have become beholden to drive for these platforms simply to pay off the leasing fees in a process Karl Marx called *Entfremdung* or estrangement.

As with labor, companies facing new opportunities for revenue generation in the shared economy must also contend with new obstacles, namely in the form of additional risk. Carsharing companies are particularly vulnerable to the type of adverse selection and moral hazard that traditional ownership paradigms are thought to protect against. No longer beholden to the burdens of car ownership, studies have already indicated that carshare users are more likely to mistreat and abuse the cars to which they are given access. A consequence of what is known as the "tragedy of the commons," this is a singularity within traditional property rights theory. When exclusivity cannot be established and socioeconomic culpability does not exist, shared capital will be used to its maximum potential by rational economic actors, resulting in the acceleration of capital depreciation. Said another way, if exclusive use is uncertain, then the future state of capital is also uncertain. Therefore, it is most cost-effective for individuals to take maximum present advantage of items of given value. Though each individual is said to be acting rationally, in totality this is a socially suboptimal result of capital use. The tragedy of the commons elegantly demonstrates the difference between individual efficiency and social optimality. While in general, individualized rational decision-making is efficient, in certain instances where costs are not properly priced or bounded, the market will not internalize the undesirable social consequences, so-called negative externalities, of various economic decisions.

Traditionally, insurance has been relied upon as one method of indemnify individuals against the risk of unmanageable negative externalities. By paying small, regular installments to a provider, the insured avoid the risk of paying one large, lump-sum which they cannot afford. By definition, the insured are defined as risk-averse consumers. Beginning in the early 1900s, a quite novel development emerged, however, to allow consumers to avoid even more risk by transferring it to transportation providers. With the onset of the jitney, consumers could be driven to where they wanted to travel without having to own vehicles outright. To consumer, because jitneys charged less than traditional railcar services, while providing an even more direct route, the benefits were clear. For jitney drivers, this arrangement eventually became untenable. Soon these early rideshare entrepreneurs were compelled by municipalities to purchase liability bonds to protect the public against injury and property damage. Unfortunately, as any economist knows, if the pool of insurance purchasers is small, the cost of indemnification will be high. The high cost of these bonds pushed jitney drivers out of the market, making it only more difficult for other drivers continue.

From the very beginning, consumers have benefitted from the shared mobility market by relying upon it as an alternative form of insurance, while suppliers have had to shoulder the costs. In today's shared mobility market, it is often independent drivers and fleet managers who bear these risks and costs. As traditional ownership behaviors continue to shift, it remains to be seen how insurance costs and the risks hedge against will shift in relation to the growth of rideshare. What is certain is that if current use-trends continue, companies operating traditional business models will be required to reduce the costs of car ownership and/or leverage their position as market leaders and engage in the shared economy.

In the most recent paper of this series, the growth of the shared economy and the shared mobility in particular was explored at length. Great attention was made in particular to modeling the effects of market expectations on preexisting sectoral allocations of capital (see "Section II: Market Disruption, Market Mechanics, and The Shared Economy"). Though proving the logic behind this model requires more technical detail than this space allows, the conclusions generated by the model itself are intuitive. First, the historical allocation of capital within a sector can hinder efficient shifts in the market. In other words, past investments can bias market

action *against* efficient change. For example, historical investments made in road infrastructure might encumber efforts to incorporate mass transit into growing cityscapes, as has been the case in the Los Angeles area. Behavioral economics states that when past investments cause one to forego present investment, even if future gains are likely, one is subject to the ***sunk cost fallacy***. Mutually independent investment decisions should not influence each other, even though they often do.

A second conclusion generated from this model indicates that mushrooming expectations of capital returns will likely affect the allocation of current and future capital investments. The economist John Maynard Keynes described this process eloquently when writing,

> Most, probably, of our decisions to do something positive, the full consequences of which will be drawn out over many days to come, can only be taken as a result of animal spirits—of a spontaneous urge to action rather than inaction, and not as the outcome of a weighted average of quantitative benefits multiplied by quantitative probabilities.[9]

Less eloquently stated, according to Keynes investment decisions are the consequence of positive and negative outlooks, or animal spirits, derived not as much from mathematical consideration as from emotional intuition. These animal spirits, moreover, are vulnerable to the effects of social systems, personal dispositions, and financial factors. In other words, contemporary economists believe that people and the markets they come to encompass are more than the classical interpretation of incentives would make them out to be; they can also be highly influenced by their social environment. For many, it is often difficult to see the forest for the trees. When wealth opportunities or obstacles emerge, this is especially the case. Socioeconomic factors can easily stimulate or anesthetize market activity. The effect of social stimuli on economic behavior is called *priming*, and in perhaps no other area is priming of more consequence than in times of great market growth, such as that which is occurring in the shared mobility market today. In the next section of this paper, the priming effects of the financial market on investment and consumptive behavior will be analyzed. By doing so, it will become clear that the present state of the shared mobility market may be the indirect result of rising debt and risk-averse behavior among millennials, the rideshare market's largest demographic.

The Automobile in Society, Past and Present

In "The Economic History of Rideshare" a brief review of the automobile revolution of the early 1900s was provided. Beginning in 1913, it was explained that innovative solutions to the automobile assembly process adopted at Henry Ford's manufacturing plants helped establish the ubiquity of the American automobile. By drastically improving upon production efficiencies, the price of Ford's cars fell precipitously, from $850 in 1908 to $250 in 1927.[10] The decline in

[9] John Maynard Keynes, *The General Theory of Employment, Interest, and Money* (Prometheus Books: Amherst 1997), Ch. VII, 161-162.

[10] Adjusting for the real price of these cars in 2017 dollars would not accurately depict their actual and perceived costs at the time. CPI inflation calculators do not comprehensively represent for the change to the Gold Standard in 1934 and 1971, nor can they reflect the effects of price magnitude on consumer psychology. Suffice it to say, that in the early 1900s, automobiles were steeply priced goods.

car prices reverberated throughout the economy and the nation over automobile purchases surged. Over just eight years the country's most ubiquitous car, the Ford Model T, went from selling 5896 models in 1908 to selling 377,036 models in 1916.[11] Yet, as significant as these innovations were, the true extent of their effect was not revealed completely. Intentionally omitted from the review of the early automobile in America was the unforeseen technological shock, or unexpected socioeconomic impact, the automobile had on the economy as a whole. In truth, the automobile revolution led by the likes of Ford and similar market purveyors played a major role in riling up the animal spirits that triggered the Great Depression. By completing the review of the automobile revolution that began in an earlier report, the socioeconomic effects of technology and debt on public movement habits will be demonstrated.

* * *

As the automobile became a staple of modern American life in the early decades of the 20th Century, the socioeconomic pressure to own a car mushroomed. Some of the country's most esteemed characters celebrated a new era of scientifically-driven efficiency. Advertisements and marketing schemes encouraged each person to chase the car of their dreams, and with new innovations in finance, even the average consumer could gain access to transportation once reserved for the most elite. Local, state, and federal governments heavily subsidized infrastructure investment, issuing bonds and reallocating World War I-era equipment for the use of road construction. For the first time, rural America had personalized access to the rest of the country in a manner once monopolized by the railroad industry. Mesmerized were the masses by the fast-paced change occurring in 1920s America. And, while not every industry and person rode the "prosperity bandwagon," the benefits afforded to those that did far outweighed and *outshined* the despair of those left behind.[12] But, in this exuberant, "new era" America, innovation would soon become conflated with invincibility. Speculative animal spirits would soon overtake the growth warranted by scientific and methodological advancements to production and lead the country to total economic collapse.

The economic factors that led to the Great Depression are complex; to this day there does not exist a consensus on the matter.[13] On average, however, these disagreements are differences of magnitude rather than effect. For instance, it is known that the explosion in consumption of durable goods like the automobile was built on the availability of easy credit.[14] Before the advent of personalized credit lines, car ownership was an elitist activity achievable only by the rich. The first cars to find a market in America were imported from French manufacturers in the 1890s to well-to-do urban elites. Instead of driving these vehicles themselves, these wealthy northeasterners would hire chauffeurs to shuttle them around the semi-paved urban streets of the time; a precursor that is perhaps analogous to the egalitarian sentiments fueling autonomous vehicle (AV) development today.

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[11] Labaschin (2017a), 5.

[12] D. L. Isenberg, "Is There a Case for Minsky's Financial Fragility Hypothesis in the 1920s?," *Journal of Economic Issues* 22, no. 4 (1988): 1048; Frederick L. Allen, *Only Yesterday* (New York: Harper and Brothers, 1931), 160.

[13] Ellen R. McGrattan, Patrick J. Kehoe, and V. V. Chari, "Accounting for the Great Depression," *Federal Reserve Bank of Minneapolis* (Quarterly Review 2721, 2003).

[14] Robert Z. Aliber and Charles P. Kindleberger, *Manias, Panics, and Crashes: A History of Financial Crisis* (7th ed.) (New York: Palgrace Macmillan, 2015), 99.

By 1901, the German Wilhelm Maybach had revamped the existing French automobile to a more streamlined version he called the Mercedes. With a price tag of $12,450, the cost of the car was surely beyond the means of most Americans. Despite this fact, the existence of such an innovative car was significant in itself. With the ability to travel as fast as a railroad train, the Mercedes seized control of the public's imagination.[15]

Americans had already become acclimated to the idea of personal mobility by the time of the Mercedes. The ubiquity of the bicycle allowed the average person to understand the benefits of personal transportation. As one individual of the time put it, "The cycler need think of no one but himself: he is the perfection of selfishness—the real Ruskin on tour." [16] The comparison of the average cycler to John Ruskin, a lauded Victorian-era art critic, should not be lost upon the reader. Evidently, the technologically innovative sentiments of the time were diffusing sociologically; technological improvements accessed by some seemed to affect the perceptions of what was achievable by all.

Enter the American auto manufacturer who, perhaps more than any other, was aware of the budding attitudes behind personalized transportation. For some time, the American auto industry had attempted to provide cheap alternatives to cars like the Mercedes. According to Professor Peter Hugill of Texas A&M University, the "American automobile manufacturers were convinced from the outset that the future of the automobile lay with the average person, not the elite." Unfortunately, the cost of automobile production was still too high. As Hugill attests, "What was required was an automobile that was less expensive than the Mercedes derivatives but retained their advantages of comfort, speed, and reliability." As if on cue, Henry Ford seemed to provide an answer; first with the durable Model T, then with the adoption of vertical integration and labor specialization at his manufacturing plants.[17] As traditionally told, the result of Ford's innovations was the reduction in car prices. On a national scale, the average consumer could afford to own cars just like the elites. But this was only part of the story.

In development economics, ***backward linkages*** occur when the emergence of one market catalyzes an increase in demand for the products of another market. Backward linkages are traditionally perceived as an ideal market phenomena in that they are said to bolster many associated markets. In so many words, they are the manifestation of the aphorism "a rising tide lifts all boats." In the case of the automobile market, backward linkages were established with the rubber industry for tires, with spare part manufacturers and vehicle repair shops for car maintenance, and in the development of the nation's roads by state and federal entities. The development of roads in particular was arguably one of the most significant and transformative effects of the automobile revolution. A particularly unappreciated truth of this revolution is that the construction of modernized road systems connected urban and rural America as never before.

The America of the late-19th Century could be geographically and socioeconomically divided into two societies: an isolated and undeveloped rural society and a dense, highly connected urban society.[18] While urban America had decent roads on which to travel, the roads

[15] Peter J. Hugill, "Good Roads and the Automobile in the United States 1880-1929," *Geographical Review* 72, no. 3 (1982), 330.

[16] Ibid, 328.

[17] Ibid, 336.

[18] Ibid, 328.

in rural societies were seldom more than muddy trails compacted by use.[19] In fact, one of the primary reasons Henry Ford's Model T was successful was its three-point suspension system that functioned more robustly on otherwise uneven roads, making car-ownership a highly sought-after investment in rural society. For more than any other group, the automobile's ability transport people and goods on uneven roads changed the lives working class Americans. For example, in the anthropologists Robert and Helen Lynd's classic 1923 *Middletown* study on the residents of Muncie, Indiana, they found that of twenty-six particularly run-down houses, only five had bathtubs, while all twenty-six had cars.[20] Though certainly exaggerated, Figure One depicts a picture from a 1915 publication that illustrates the perception of the divide that existed between these two worlds. Compared to the isolated and savage ruralism the world of "Bad Roads" represented, in the world of "Good Roads" rural America could be "civilized" into a state of be cultured religiosity, contemporaneous hygiene, and social enlightenment.

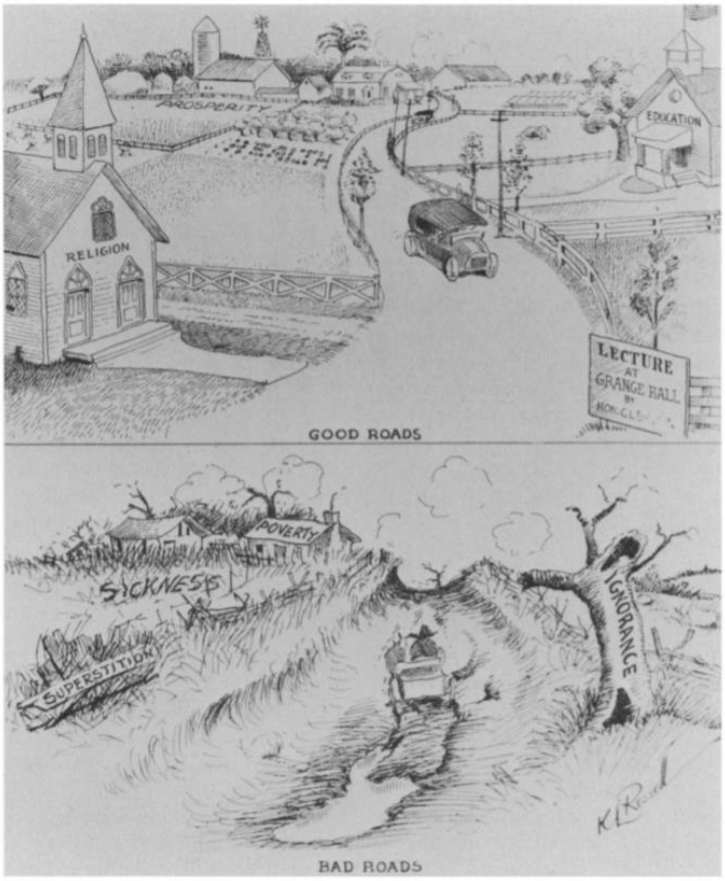

Figure One: Idealized Illustration of Good and Bad Roads in Rural America.[21]

[19] "America on the Move: Americans Adopt the Auto (Better Roads)," *National Museum of American History, Behring Center*, 2012. Accessed December 10, 2017. http://amhistory.si.edu/onthemove/exhibition/exhibition_8_3.html

[20] Hugill (1982), 347; Robert. S. Lynd and Helen M. Lynd, *Middletown* (New York: Harcourt, Brace, and World, 1929): 253-263.

[21] Hugill (1982), 329; W. A. McIntyre, "The Concrete Road and its Proper Construction," *Better Roads and Streets* 5, no. 9 (1915).

Social stereotyping notwithstanding, rural folk truly did stand to gain from the construction of better roads. Farmers organizations such as The Granges in particular lobbied heavily for more and improved road system. By their economic estimation, improved access to markets for rural America would reduce transportation costs as much as sixty percent.[22] They were not alone either. A 1900 publication of the Farmers Bulletin, a serialized farming missive by the United States Department of Agriculture (USDA), argued in its introduction that:

> [b]ad roads constitute the greatest drawback to rural life, and for the lack of good roads the farmers suffer more than any other class. … Suffice it to say, that those localities where good roads have been built are becoming richer, more prosperous, and more thickly settled, while those which do not possess these advantages in transportation are either at a standstill or are becoming poorer and more sparsely settled. If these conditions continue, fruitful farms may be abandoned and rich lands go to waste.[23]

The idea that population density and ease of transportation were associated with wealth was not a unique argument made by the USDA. As will be explained, since the early-19th Century theorists had determined that low transportation costs are key factors influencing the efficiency of societies. As a consequence of poor roads, farmers had high costs of transporting their goods to major urban centers. The advent of railroad systems did not alleviate these costs either. By 1917 railroads were used to capacity for the war effort. So much so that by December of that year, the federal government requisitioned all mainline steam railroads for the transportation of matériel.[24] It was at this time that trucks, previously deemed costly and inefficient means of freight transit, were first used for interstate commerce.[25] Besides rail-use in America could not diffuse as easily as in other regions. Whereas most people lived within ten miles of a railroad by the end of the 19th Century in Europe, such density-distance ratios were unachievable in America.[26] With railroads at max capacity and with a surge in the growth rates of automobile and truck use (see Figure Two), infrastructural investment in private and commercial automobile transit in became an increasingly tenable option for state and federal governments.

By 1926, the state of American roads was vastly more improved than just a decade before. During the 1920s, America doubled the total length of its road system from 396,000 miles of roadway in 1920, to 852,000 miles or roadway by 1929.[27] The upsurge in road construction in 1920s was a far cry from that of the preceding decade. The first federally mandated act of road construction, The Good Roads Act of 1916, allocated just $75 million for

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[22] Hugill (1982), 329; Office of Road Inquiry, "Proceedings of the Good Roads Convention of Texas," *U.S. Department of Agriculture* (1895).

[23] Maurice O. Eldridge, "Good Roads for Farmers," *U.S. Department of Agriculture* (1900), 3.

[24] Hugill (1982), 340

[25] Truck use had a paradoxical effect. At one end, their use demonstrated the practicality of trucking. At the other end, their size largely tore up American roads, requiring only greater investment in infrastructure.

Richard F. Weingroff, "Moving the Goods; As the Interstate Era Begins," *Federal Highway Administration* (2017). https://www.fhwa.dot.gov/interstate/freight.cfm

[26] Hugill(1982), 330.

[27] S. Mintz and S. McNeil, "The Consumer Economy and Mass Entertainment," *Digital History* (2016). Accessed November 29, 2017.

the development of the nation's infrastructure. By comparison, well-endowed, industrialized states like New York had already allocated $100 million in bonds for road construction. The difference in road state-by-state (and region-by-region) road allocation was made clear in 1926 when the first national road atlas was published (see Figure Three). Whereas the northeastern portion of the country was well-endowed with road infrastructure, barring California and Texas, any movement south and west implied a gradual deterioration in road quality.

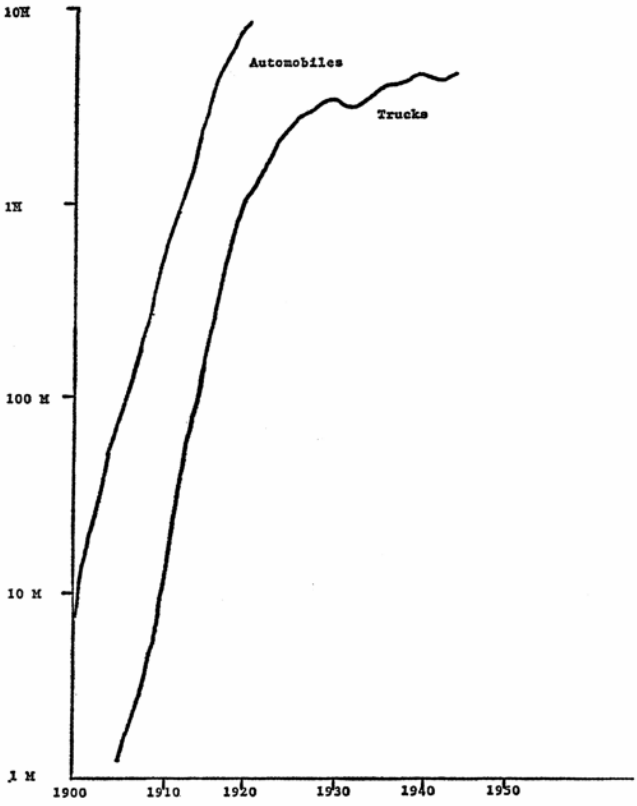

Figure Two: Logarithmic Rate of Automobile and Truck Registration, 1900-1950.[28]

By the early 1920s, the federal government corrected its past efforts by passing the far superior Highway Act of 1921, which now funded road construction at a per-mile-cost of $15,000. In 1922 alone the federal government built 10,247 miles of highway, three and a half times more road than the previous five years combined.[29] Great momentum in American interconnectivity had been made by the mid-1920s. Heavy machinery, including over 25,000 trucks, leftover from World War I war efforts were reallocated to states by population in a federal effort to stimulate road construction and provide employment to veterans. The transfer of capital led to a surge in state construction efforts. Macadam roads previously made of pulverized

[28] Anthony F. Herbst and Joseph S. K. Wu, "Some Evidence of Subsidization: The U.S. Trucking Industry, 1900-1920," *The Journal of Economic History* 33, no. 2, (1973), 416.

[29] Hugill (1982), 342-343.

and flattened stone were now gilded with tar to make for smoother, less costly movement.[30] The trucking industry saw particularly profound growth. From approximately 700 road-bound trucks in 1904 to 1,107,639 in 1920, truck-use grew at annual rate of 63.4 percent, almost twenty percent greater than automobile-use.[31] By the end of the decade the country had spent close to $2 billion ($25.56 billion in 2017 dollars) annually on road construction and maintenance.[32] Evidently, the confluence of war, novel transportation technology, and infrastructural investment had greatly shifted the American economy, linking societies and industries as never before.

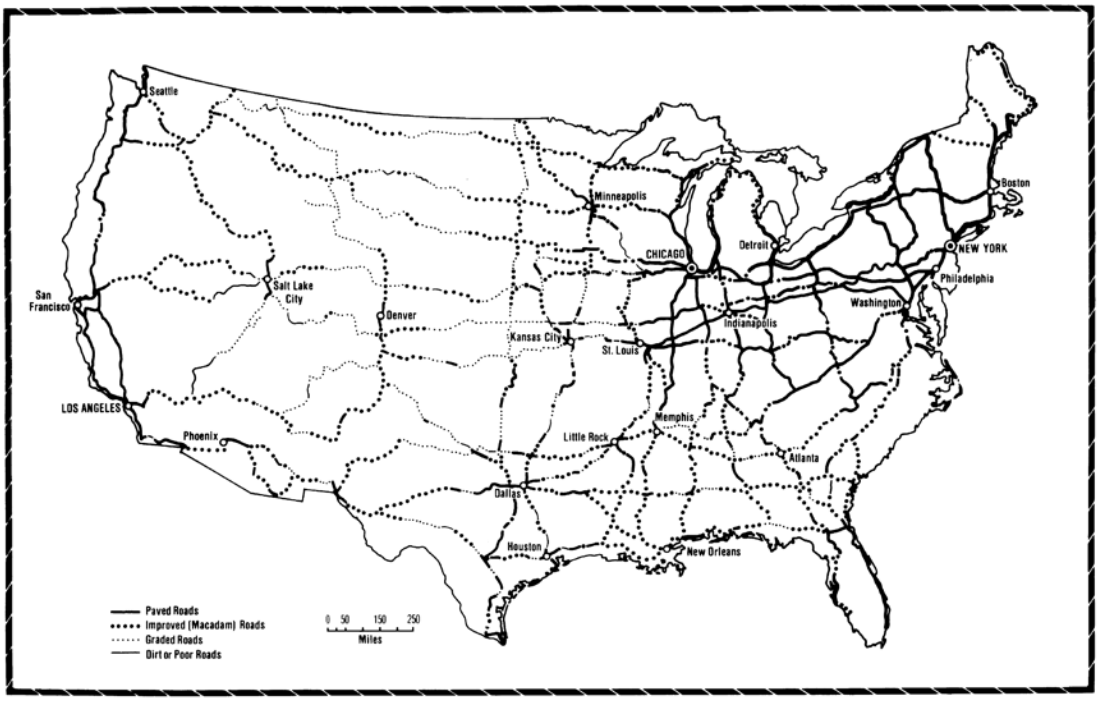

Figure Three: First Atlas of America's First Roadway System, 1926.[33]

With substantial backward linkages reverberating throughout the economy, and with newly built interstate road systems bridging access between rural and urban America, the automobile only increased in economic importance. Indeed, studies indicate that merely building transportation infrastructure such as roads incites their use in a process called ***induced traffic***.[34]

[30] Hugill (1982), 343; H. L. Bowlby, "Distribution of War Materials for Road Building," *Public Roads* 2, no. 24 (1920), 23-28.

[31] Herbst and Wu (1973), 417.

[32] $1 dollar = 12.78 in November 2017 dollars. "CPI Inflation Calculator," Bureau of Labor Statistics, December 13, 2017. bls.gove/data/inflation_calculator.htm; S. Mintz and S. McNeil (2016).

[33] Rand McNally Road Atlas (Chicago: Rand McNally, 1926).

[34] Robert Puentes, "Rethinking Urban Traffic Congestion to Put People First," *The Brookings Institution*, August 27, 2015. Accessed December 15, 2017. https://www.brookings.edu/blog/the-avenue/2015/08/27/rethinking-urban-traffic-congestion-to-put-people-first/

And used these roads were. In 1919, there were an estimated 6.7 million cars in operation. Ten years later, that number would quadruple to 27 million.[35] In 1910, nearly one out of every two hundred Americans, or one half of one percent of citizens, were registered car owners. Twenty years later, about one of every five individuals, twenty percent of Americans, were registered to own a car.[36] In contrast, less people owned radios than cars by 1930.[37] Even at the state level, car ownership had been widespread. By the end of the 1920s, over ten percent of every state's citizens were registered vehicle owners. Yet, despite the automobile's rapid integration into American society, to many the cost of ownership remained too expensive.

America's first consumer credit agency was designed by Alfred Sloan, president of General Motors (GM). It was Sloan's intention to make the unaffordable accessible, to make the luxury car a realistic option to the average consumer.[38] Whereas Henry Ford's business philosophy was one of utilitarianism and practicality, Alfred Sloan's business philosophy was one shrewdness and promotion.[39] In Sloan's own words, "The primary object of [General Motors] was to make money, not just to make cars."[40] Sloan's business model was based on the belief that consumers desired luxury and prestige in their vehicles. Sloan had a number of strategies to persuade consumers of this belief, marketing his cars as status symbols and introducing the annual vehicle model change in order to entice car-owners into becoming yearly customers. But arguably it was Sloan's 1919 creation of the General Motors Acceptance Corporation, a financial branch of GM, that set the greatest precedent.

Before 1919 the typical American family had to save for years to afford a car. Now, with a down payment of thirty-five percent and regular installments over a year, those earning a fraction of the cost of a car could achieve ownership. [41] And since customers only needed a fraction of the total cost of a vehicle, there was no need to settle for lesser models. By the end of its first decade of conceptual existence, sixty percent of annual vehicle purchases were financed through the novel investment opportunity of consumer credit.[42]

Buoyed by the blossoming options available to consumers through credit, new-era growth rhetoric was quickly disseminated to every consumer sphere. At one end was the emphatic adoption of scientific management, or Taylorism, by market influencers like Henry Ford. Named for the esteemed social engineer Frederick Wilson Taylor, scientific management was the strict organizational analysis of the workplace with the express goal of increasing productivity and efficiency. Taylor's influence on productivity cannot be understated. On the magnitude of

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[35] S. Mintz and S. McNeil, "The Consumer Economy and Mass Entertainment," *Digital History* (2016). Accessed November 29, 2017. http://www.digitalhistory.uh.edu/disp_textbook.cfm?smtID=2&psid=3396

[36] See "Table II," Hugill (1982), 340.

[37] The Gilder Lehrman Institute of American History, "The American Economy During the 1920s," accessed November 29, 2017. https://www.gilderlehrman.org/history-by-era/roaring-twenties/resources/american-economy-during-1920s

[38] Ibid.

[39] To Ford is famously attributed the quote, "Any customer can have a car painted any color that he wants so long as it is black." In Henry Ford and Samuel Crowther, *My Life and Work* (New York: Garden City, 1922), 72.

[40] Mintz and McNeil (2016).

[41] Stephen Smith, "The American Dream and Consumer Credit," *American Public Media* (2017). Accessed November 29, 2017. http://americanradioworks.publicradio.org/features/americandream/b1.html

[42] Mintz and McNeil (2016).

scientific management's impact, Taylor's biographer Robert Kanigel wrote, "After Ford and Taylor got through with them, most jobs needed less of everything—less brains, less muscle, less independence." In reducing in the cost of production, Taylor reduced the price of goods. Lauded alongside Sigmund Freud and Charles Darwin as a progenitor of the modern age, Taylor's word was gold. In 1911 his *The Principles of Scientific Management* became the first bestselling business book.[43] A veritable Elon Musk,[44] Taylor was a purveyor of the future, claiming that while "[i]n the past the man has been first; in the future the system must be first." [45] Backed by tangible evidence of his success, Taylor's scientific management was a buzzword that symbolized the common person's advancement into the future.

With scientific management practices widely distributed and production efficiency up, companies began to market their cheaper wares using innovative advertisement practices. For the first-time advertisers employed psychologists to design marketing schemes. Notable names such as JB Watson, father of Behaviorism, and Edward Bernays, nephew of psychoanalyst Sigmund Freud, were hired to contribute to the initial schemes. Car manufacturers like GM sought to encourage drivers to purchase the car of their dreams, [46] while banks marketed new opportunities in the personal credit market. All told, by 1929 American companies were spending $3 billion dollars a year to convince citizens of the merits of consumption. [47]

Though consumption seemed to be rising at every level, those that benefitted from this growth did not seem to question it. For example, in the 1920s the physical store saw its ascendency. Serialized brands began to replace independent vendors by guaranteeing a standard of service that consumers would come to rely on. Corner stores such as Woolworths and A&P became household names. A&P alone had 17,500 store locations by 1928.[48] By comparison, the drugstore chain Walgreens had 8,100 American locations as of August 2017.[49] With fewer states and an even smaller population, the American retail culture of the 1920s displayed more exuberance than would be familiar in the modern world. Underpinning this modernization was an implicit reliance upon credit-based consumption. By applying their signature to legally binding contracts, consumers could gain access, but not ownership, to goods. Upon completing their installment payments, only then would consumers achieve full title of their purchases. Payment timeframes were brief. Consumers that were thirty-days delinquent on their installments risked defaulting on their credit and could expect total repossession of their purchase, *resulting in a net loss of household wealth*.[50] Said another way, defaulting on credit was expensive.

Even though household debt was at its highest rate since the war, investors on Wall Street seemed to concentrate solely on the rise in the price of assets. Purchases of durable goods had

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[43] Tim Hindle, *Guide to Management Ideas and Gurus* (London: The Economist 2012).

[44] Like Musk, Taylor too was trained as an engineer.

[45] Frederick Winslow Taylor, *The Principles of Scientific Management* (Mineola, N.Y.: Dover Publications, 1911).

[46] Mintz and McNeil (2016).

[47] Ibid

[48] Ibid.

[49] "Store Count by State," *Walgreens* (2017). Accessed November 29, 2017. http://news.walgreens.com/fact-sheets/store-count-by-state.htm

[50] Households were not reimbursed for the surplus which remained on the good, where surplus is the difference between the resale value of the good, and its remaining payments. Martha L. Olney, "The Role of Credit in the Consumption Collapse of 1930," *The Quarterly Journal of Economics* 114, no. 1 (1999): 320.

reached an eight-year high by 1929,[51] and stock prices rose accordingly. Had brokers paid attention, they might have noticed that since June of that year, the production efficiencies that had been a defining feature of the time had plummeted. That month the industrial production index, a measure of manufacturing and utility output, fell from a laudable 127 to below its normalized level of 100. Evidently American production was stagnating. Monthly automobile production declined from 660,000 units in March of 1929, to 92,500 in December.

According to economic historian Charles Kindleberger, these shifts are best explained by the decline in the supply of credit to purchases of durable goods like automobiles. As the asset prices of investments rose, available credit was shifted to the stock market. In his own words:

> As stock prices increased in the first ten months of 1929, funds were channeled to the call-money market; the volume of call money rose from $6.4 billion at the end of December 1928 to $8.5 billion in early October 1929. Moreover, first the New York banks and then banks headquartered in other US cities became more cautious lenders to stock market participants and to other borrowers. When the stock market crashed, the credit system suddenly froze.[52]

In less technical terms, stock prices *increased* throughout 1929 despite a *reduction* in industrial productivity growth. Evidently, the concept of productivity was fueling investment more so than its reality. Heartened by consumption growth, and blind to its precarious roots, investments continued to be made into automobile manufacturers, which were themselves reliant upon the maintenance and growth of the consumption *status quo*. The closed-loop of self-investment only increased the prices of goods more, making it seem as though demand was higher than it really was. From retailers to regular citizens, the psychological effects of growth induced Keynesian animal spirits. As prices increased, exuberant investors sought more leverage, or debt-fueled investment funds, to purchase assets they assumed would only rise in price. Banks would fuel the investor desire for money through on-demand bank loans that could be "called-in" in as little as a week's time. But this credit had to come from somewhere. As it happened, the credit schemes to which regular consumers had become accustomed were reallocated to investors, reducing the market potential for consumption. This process continued until late September when, fearing an inexorable decline in the market, an increasing number of investors began to cash-out their investments.[53] As other investors saw their peers pulling out of the market, they too sought to sell their assets. But to sell an asset, there must exist willing buyers. Inundated by requests, stock purchases became unsure of the value of their assets, catalyzing only more cash-out behavior in what would become known as a "run on the market." As the willingness of the market grinded to a halt, the estimated value of stock prices plunged, leading to the Great Crash of 1929.

The stock market crash of 1929 was not the cause of the Great Depression. Relatively speaking, few households had money directly invested in the stock market. Econometric analysis has demonstrated, however, that the crash *did* increase the income uncertainty of households.[54]

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[51] Olney (1999): 323-324.

[52] Aliber and Kindleberger (2015), 99.

[53] To properly empathize with the sudden shift in investment, imagine have invested $100 in Bitcoin in its infancy. Today your investment would be valued at over $1 million. It is possible Bitcoin will rise in price still. But it is also possible it will drop at a moment's notice. Would you wait?

[54] Olney (1999): 324; Paul Flacco and Randall Parker, "Income Uncertainty and the Onset of the Great Depression," *Economic Inquiry*, XXX (1992), 154-171.

In perhaps the most significant consequence of the crisis, households facing increased income uncertainty did not generally default on their debt, *they simply reduced their consumption habits*. To consumers, the prospect of a net loss pf wealth due to repossession made default an *expensive* option. *The fear of debt changed the economic behavior of the market.* Instead of maintaining consumption trends, consumers fearing the inability to pay future installments simply decreased demand. Fear of income loss led to a fifteen percent decrease in transportation expenditures alone—accounting for nearly a quarter of the total decline in demand in 1930. Over just a few months, consumer demand fell as much as four percent.[55] In total, it was the decline in aggregate consumption catalyzed by *paralyzing economic uncertainty* that led to the Great Depression.

There are many parallels between the market of the 1920s and the market of the 2010s. In the 1920s, the economy was emerging from a decade of war and recession. So too today's economy. In the 1920s, larger-than-life characters and corporations crafted and believed in their own enthusiastic portents of a society driven by technology and scientific progress. So too today's economy. And in the 1920s, automobile production and highway development led to great expectations of profit. Coupled with the newfound ability to borrow and become a member of the growing transportation society, these factors helped lead to greater economic exuberance.[56] Today, the hyper-growth of the shared economy has convinced businesses to expect billions of dollars in future profit. Meanwhile, as will be explained, the exponential integration of information technology (IT) into society may also be casting doubt on the dependability of traditional sources of income. As IT rises, jobs requiring less education are becoming increasingly obsolete, therein pushing millennials, the primary user base of shared mobility, to take on more debt for educational purposes. This, in turn, may be a primary source for the change in consumption habits of this newest generation. In the next section of this report, the influence of technology on jobs and consumption habits will be explored at length.

The I.T. Revolution, Jobs, and Millennial Debt

In the previous paper, the paradigm of car ownership was explored through property rights theory. Left unexplored was the distinct parallel between the demographics of those participating in the rideshare market and their borrowing and consumptive habits, two factors that have just been shown to have been shaped by the transportation sector. This is all to say that, although these correlations do not make equivalent such distinct periods in history, humanity has not suddenly become immune to itself or its predilections. The millennial generation is fueling the growth of the rideshare market. It is also a generation socioeconomically affected by the integration of information technology (IT), a generation of historically exacerbated indebtedness, and, as a result, a generation far thriftier than others.

The most recent data on ridehailing use indicate that young people comprise the largest demographic of the shared mobility market. According to a first-of-its-kind Pew research study, the median age of ridehail users is 33 years old. At 28 percent of the market, users 18-to-29 years old are seven times more likely to engage in ridehailing than persons 65 years of age or older. Due to their urban concentration, these users are also likelier to rely on an ecology of

[55] Olney (1999): 329, 333.

[56] Tobias Rötheli, *Business History Review* 87 (2013): 309–327. doi:10.1017/S000768051300041X

transportation options including taxi services, trains, bikes, and walking.[57] Users 30-to-49 years old take up nearly twenty percent of the market.[58] Together, 47 percent of ridehail users are between 18 and 49 years old. What is more, since users 50 years and older only make up 12 percent of the market,[59] the Pew study implies that 41 percent of the market is made up of users 17 years old or younger. Said another way, the most recent data imply that nearly 70 percent of ridehail users are 29 years of age or younger. Thus, the primary users of the ridehail market might, for convenience sake be defined as millennials.[60]

The socioeconomic habits of millennials have been widely scrutinized over the past few years. Perhaps it is because they are spending less. As shown in Figure Four, data from a recent Gallup poll indicates that, compared to older U.S. adults, individuals 18 to 29 years old are spending less daily since the Great Recession. The fact that millennials are spending less is no small matter. Two-thirds of American gross domestic product (GDP) is comprised of consumer spending and, as of 2015, millennials became the most populace US generation at 75.4 million people.[61] As in the past, any decrease in spending habits among millennials will have adverse psychological and social effects on the economy.

	2008	**2016**	**Change**
U.S. Adults	$96	$92	-4
18- to 29-year-olds	$93	$74	-19
30- to 49-year-olds	$108	$110	2
50- to 64-year-olds	$95	$95	0
64-year-olds or older	$75	$78	3

Figure Four: Self-Reported Daily Spending Habits of U.S. Adults by Age, 2008 and 2016.[62]

Though no one reason can be said to have caused the reduction in spending among them, evidence clearly indicates that millennials are more price-conscious and conservative in their

[57] User base at 65+ YO: 4%. Unsurprisingly, ridehailing use is concentrated in urban areas. This fact will be addressed in a later section. See: Aaron Smith, "Shared, Collaborative, and On Demand: The New Digital Economy," *Pew Research Center* (2016): 5-6.

[58] Ibid: 18.

[59] Ibid.

[60] The definition of "millennial" is often vague and distorted. Pew defines the millennial generation as having been born 1981 to 1997. But can it truly be said that the consumption habits of those born in 1997 are markedly different from those in 1999? In truth, the boundary dividing those born before 1981 and those after is of far more consequence to this report. As such, millennial will be defined simply as anyone being born after 1981.

For definition, see: Richard Fry, "Millennials Overtake Baby Boomers as America's Largest Generation," *Pew Research Center*, April 25, 2016. Accessed December 5, 2017. http://www.pewresearch.org/fact-tank/2016/04/25/millennials-overtake-baby-boomers/#

[61] Ibid.

[62] Reformatted graph from: Sean Kashanchi and Jeffrey M. Jones, "In U.S., Young Adults Report Spending Less Than in the Past," *Gallup: News*, August 8, 2017. Accessed December 5, 2017. http://news.gallup.com/poll/215618/young-adults-report-spending-less-past.aspx

spending than previous generations.[63] Changes in spending habits among millennials are probably best attributed to the historically high levels of debt they have amassed.[64] As of 2017, millennials owed the most debt of any age cohort in the US. According to UBS, of the $3.6 trillion dollars owed in consumer debt, $1.1 trillion, or thirty percent of debt, is owed by millennials. The results of consumer surveys reflect the priming effect debt is having on millennials. For instance, a UBS survey found that 52 percent of those worried about defaulting on a loan in the next year were respondents between the of ages 21 and 34.[65] A 2017 study out of Northwestern Mutual has tracked the relative effects of this financial stress. According to the data, a majority of millennials experience high-to-moderate anxiety about losing their jobs and about their level of savings, while almost seventy percent express worry about income loss.[66] This anxiety has far-reaching effects. The financial anxiety millennials face is nearly two times more likely to affect job performance and make them physically ill compared to the general population.[67] Clearly millennials are profoundly affected by their indebtedness and their socioeconomic mobility.

Officials have taken note of the budding trend in millennial indebtedness. New York Federal Reserve President William Dudley has expressed concern that the "continued increase in college costs and debt burdens could inhibit higher education's ability to serve as an important engine of upward income mobility" among millennials.[68] Indeed, a July 2017 report out of the New York Federal Reserve concluded that between 2001 and 2009, despite an 81 percent increase in state average (enrollment-weighted) public college tuition costs, "no meaningful change in college enrollment, years of schooling, or BA receipt [was made by students] in response…."[69] Said another way, even adjusted for enrollment volatility, increased tuition costs do not dissuade students from attending public college in any state. Such findings seem to contradict a fundamental corollary to the Law of Supply and Demand which states that as price increases, demand will decrease. This has led some to claim that it may be too easy for prospective students to amass credit they are not be able to repay.[70]

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[63] Raul Hernandez, "Millennials Owe a Record Amount of Debt, and It Could Become a Huge Drag on the Economy," *Business Insider*, April 29, 2017. Accessed December 6, 2017. http://www.businessinsider.com/record-millennial-debt-a-drag-on-the-economy-2017-4

[64] Between 2005 and 2015, student loan debt rose to historically high level among college-aged individuals. Jesse Bricker, et. al., "How Much Student Debt is Out There?" *Board of Governors of the Federal Reserve System*, August 7 2015. Accessed December 6, 2017. https://www.federalreserve.gov/econresdata/notes/feds-notes/2015/how-much-student-debt-is-out-there-20150807.html

[65] Hernandez (2017).

[66] According to the study, "More than half (53%) of Millennials experience high to moderate anxiety about losing their job, compared to less than a third of Gen Pop (29%). The same is true for level of savings (67% Millennials vs 50% Gen Pop) and income (69% Millennials vs 48% Gen Pop)."

See: Northwestern Mutual, "2017 Planning & Progress Study: Millennials," *Northwestern Mutual Life Insurance Company* (2017). http://news.northwesternmutual.com/planning-and-progress-2017

[67] Ibid.

[68] Hernandez (2017).

[69] Zachary Bleemer, et. al., "Echoes of Rising Tuition in Students' Borrowing, Educational Attainment, and Homeownership in Post-Recession America," Federal Reserve Bank of New York Staff Reports, no. 820 (2017): 0, 27.

[70] Fox Business, "Is It Too Easy to Get Student Loans?," June 11, 2014. Accessed December 6, 2017. http://www.foxbusiness.com/features/2014/06/11/is-it-too-easy-to-get-student-loans.html

In any event, the consumption behavior of millennials, rideshare's primary consumer-base, is markedly different than other generations. Millennials seem to have an increasingly inelastic relationship with education. Millennials are more likely to hold a degree than any previous generation,[71] and they will apparently amass whatever debt is necessary achieve one. As a consequence of this inelasticity, they seem to be holding on to debt for longer periods of time, as indicated graphically by Figure Five. Between 1989 and 2010, the percentage of household heads with outstanding student debt more than doubled among those 35 years old and younger.[72] But even among those 35-to-44 years old, student debt has increased substantially. This observation is consistent with research that suggests 54 percent of millennials over the age of 30 worry about their ability to repay their loans.[73] So what is different about this generation that causes them to be so indebted for so much longer?

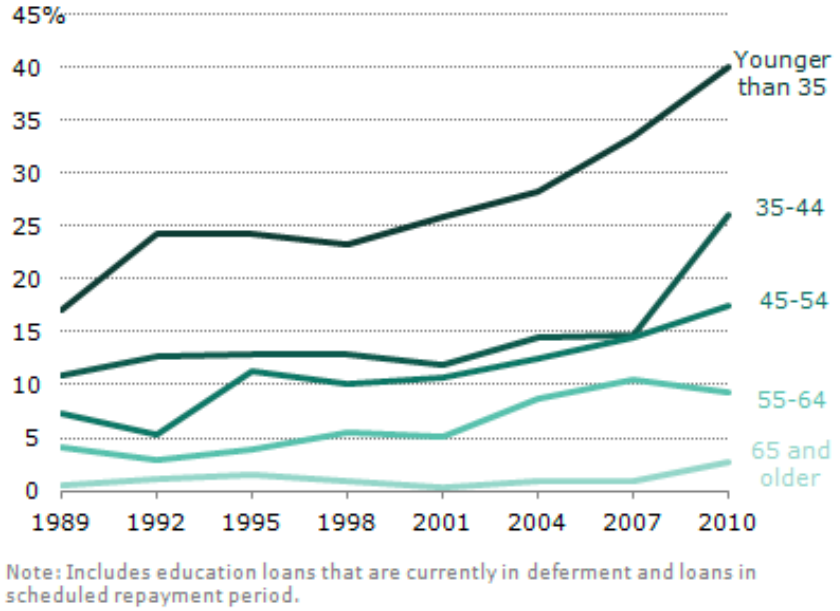

Figure Five: Percent of Households with Outstanding Student Debt, By Age of Head, 1989-2010.[74]

[71] Nikki Graf, "Today's Young Workers Are More Likely Than Ever to Have a Bachelor's Degree," *Pew Research Center*, May 16, 2017. Accessed December 6, 2017. http://www.pewresearch.org/fact-tank/2017/05/16/todays-young-workers-are-more-likely-than-ever-to-have-a-bachelors-degree/

[72] Rising student debt beginning in the 1980s is correlated with the Reagan administration's switching from grant-based education funding, to loan-based education funding.

[73] Annamaria Lusardi, "The Alarming Facts About Millennials and Debt," *The Wall Street Journal*, October 5, 2015. Accessed December 7, 2015. https://blogs.wsj.com/experts/2015/10/05/the-alarming-facts-about-millennials-and-debt/

[74] Richard Fry, "A Record One-in-Five Households Now Owe Student Loan Debt: Burden Greatest on Young, Poor," *Pew Research Center*, September 26, 2014. Accessed December 6, 2017. http://www.pewsocialtrends.org/2012/09/26/a-record-one-in-five-households-now-owe-student-loan-debt/2/

The growing indebtedness of millennials may actually be a symptom of the same macroeconomic changes stimulating the rideshare phenomenon. Economic historian Charles Kindleberger coined the term ***technology shock*** for an exogenous shift in economic production possibilities that significantly affects socioeconomic decision-making. To Kindleberger, the innovations that precipitated the Great Depression—the automobile, road construction, and the dissemination of electricity—were technological shocks that changed the choices and expectations of economic behavior. Similarly, many businesses and businesspeople today are ardent believers in the technological changes they predict will spread throughout society. And while some may fear disruption,[75] such feelings are outshined by the profits expected to be afforded to those who will benefit from this change. Indeed, among many transportation businesses there is a pervasive belief that change is inevitable and so many have invested millions of dollars into new markets hoping to reap the rewards.

Students too have invested millions of dollars, but into the business of themselves as human capital. Much of this investment, whether consciously or otherwise, is likely a response guided by macroeconomic technology trends. There is historical evidence to support this hypothesis. Take the automobile. As the automobile became more popular and the ability to purchase vehicles became easier, demand declined for transportation substitutes and the jobs associated with them. Suddenly one invention began to threaten industries that had existed for centuries before it. Progenitor-products such as horse-drawn carriages, trains, and boats that had formed the basis of transportation society became unceremoniously antiquated. Blacksmiths, wainwrights, drovers, canalmen, and railroad workers, titles which sound discordant to modern ears but shaped the identity of entire families, were just as brusquely set aside.[76] Unexpectedly to many, demand for their services shifted, and with it so too their employment. The 20th Century economist Joseph Schumpeter called this bleak process of labor obsolescence ***technological unemployment***. To Schumpeter, technological unemployment represented the "perennial gale" of the capitalist system to, like an evolutionary process, streamline prevailing job structures.[77]

Though it may not seem it, technological unemployment has been a prevalent economic force over the last two decades. Compelling evidence to this effect comes from a convincing paper out of Deloitte shortlisted for the Society of Business Economists' Rybczynski prize. Using data spanning back to 1871, economists Ian Stewart, Debapratim De, and Alex Cole sought to glean whether the effects of technology on employment were predictable. The impetus behind their study addresses a primary concern voiced in the concluding paragraph of the "Economic History of Rideshare." According to the authors, though generally technology is perceived as being a net positive to society, historically "this narrative has been punctuated by fears about the job-destroying effects of technology. From the Luddites of the eighteenth century through the technological Jeremiahs of today, the theme persists, of machines impoverishing and destroying opportunity for humans." As voiced in the first paper of this series, the authors of this study believe once again that this current period has been disrupted by a consumer caution

[75] See Labaschin (2017b).

[76] The commonality of surname Smith lends credence to this notion. See also: W. Michael Cox and Richard Alm, "Creative Destruction," *The Concise Encyclopedia of Economics* (2008) Accessed December 5, 2017: http://www.econlib.org/library/Enc/CreativeDestruction.html

[77] Joseph A. Schumpeter, *Capitalism, Socialism, and Democracy*, 3rd ed. (New York: Harper and Brothers, orig. pub. 1942), 84; W. Michael Cox, "Schumpeter in His Own Words," *Economic Insights* 6, no. 3, (2001).

fearing the automation of jobs.[78] As their data show, there exists persuasive evidence to indicate why the public might feel this way. As demonstrated by the table in Figure Six, while over a

Occupations	Employment in		Change since 1992
	1992	2014	
Total employment	24,746,881	30,537,415	23%
Nursing auxilliaries and assistants	29,743	300,201	909%
Teaching and educational support assistants	72,320	491,669	580%
Management consultants and business analysts	40,458	188,081	365%
Information technology managers and above	110,946	327,272	195%
Welfare, housing, youth and community workers	82,921	234,462	183%
Care workers and home carers	296,029	792,003	168%
Actors, dancers, entertainment presenters, producers and directors	47,764	122,229	156%
Financial managers and directors	88,877	205,857	132%
Footwear and leather working trades	40,715	7,528	-82%
Weavers and knitters	24,009	4,961	-79%
Metal making and treating process operatives	39,950	12,098	-70%
Typists and related keyboard occupations	123,048	52,580	-57%
Company secretaries	90,476	43,181	-52%
Energy plant operatives	19,823	9,652	-51%
Farm workers	135,817	68,164	-50%
Metal machining setters and setter-operators	89,713	49,861	-44%

Figure Six: Fastest Growing and Fastest Shrinking Occupations Since 1992 in UK.[79]

twelve-year period jobs in the United Kingdom (UK) grew by 23 percent, among the fastest growing fields of work (light blue), most required some sort of education. Meanwhile, the fastest shrinking jobs in the UK, almost all were physical trades work or jobs that require minimal formal education. Indeed, it is telling that of the fastest growing professions, most are related to human care or human education. Figure Seven illustrates this pattern more directly.

Employment was divided by the authors into primarily cognitive or manual labor practices. These categories are then subdivided into routine- and non-routine-based occupancies. According to the data, technology can have a complementary or substitutionary effect on employment. In the U.K., routine occupations, no matter the nature of their occupancy, were far

[78] Michael Osborne and Carl B. Frey, "Technology and People: The Great Job-Creating Machine," *Deloitte, LLP* (2014): 1; PEW Foundation, *Future of the Internet* (2014).

[79] Ibid, 4

more likely to be replaced than non-repetitive or socially intricate occupations. Non-routine, mentally intricate tasks were especially marked to researchers. In these tasks, technology only increased the demand for this labor. It follows then that, depending on the nature of the technological shock, different labor stands to be effected.

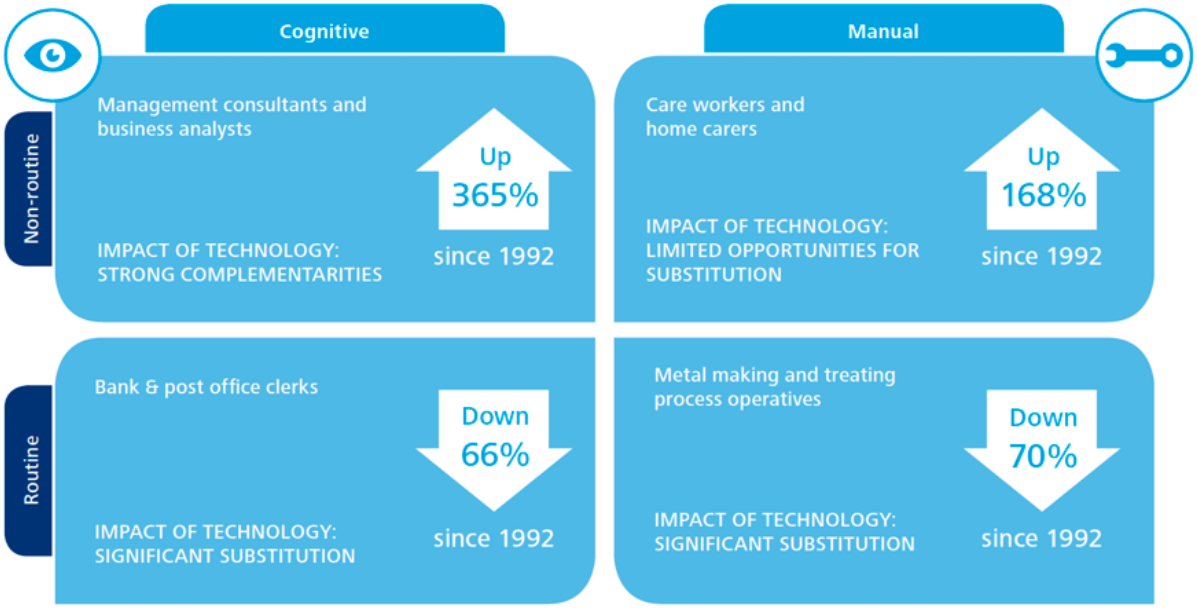

Figure Seven: Examples of the Effect of Technology on Employment by Nature of Occupation.[80]

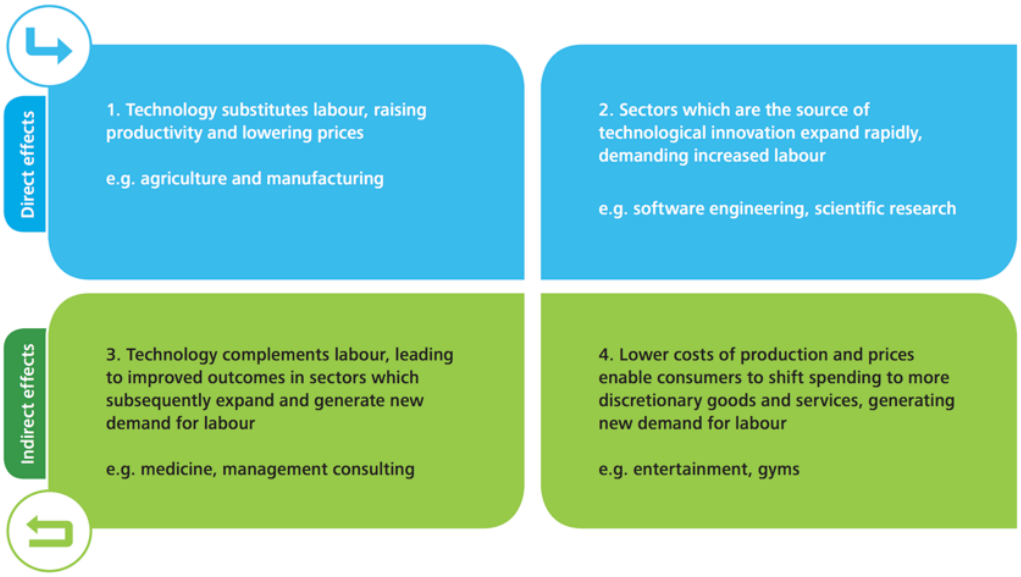

Figure Eight: Four Mechanisms Through Which Technology Affects Employment.[81]

[80] Ibid, 5.
[81] Ibid, 2.

Like Taylorism of the past, by increasing efficiency and reducing the cost of production information technology has increased the demand for goods and lead to increased employment. The authors come to similar conclusions, as demonstrated by Figure Eight. According to the authors, technological unemployment can occur when technology acts as a direct substitution to labor. It can act as an indirect complementarity to labor, lead to improved productivity and generating more demand for labor. The innovation of technology can itself lead to more demand for associated labor.

Being a western capitalist economy, there is little reason to believe that the patterns revealed by the U.K. study have manifested differently in the United States. Indeed, their results seem to correlate robustly with existing data on the inelasticity of demand for college education out of the Federal Reserve Bank of Cleveland. In that 2017 study, nationally representative data was used to track the employment share and hourly real wages of those with varying levels of educational attainment over the past thirty-five year. Figure Nine represents the data gathered from that study. Panel A and B are divided into five categories ranging from No Degree to

	Panel A: Employment share					
	(1) 1980	(2) 1990	(3) 1992	(4) 2000	(5) 2010	(6) 2015
No degree (<12 yrs. education)	0.197	0.130	0.115	0.099	0.082	0.077
High school degree	0.371	0.368	0.358	0.314	0.280	0.256
Some college	0.205	0.238	0.259	0.280	0.280	0.278
College only (4-year)	0.158	0.183	0.177	0.205	0.232	0.247
Graduate Degree	0.069	0.081	0.090	0.103	0.126	0.143
Graduate degree by type						
Master's			0.068	0.075	0.094	0.107
Professional			0.012	0.014	0.016	0.016
Doctoral			0.010	0.013	0.016	0.019
	Panel B: Real Hourly Wage (2015 $) (averages by group)					
	(1) 1980	(2) 1990	(3) 1992	(4) 2000	(5) 2010	(6) 2015
No degree (<12 yrs. education)	14.19	12.84	12.47	13.03	13.22	13.56
High school degree	16.33	15.99	15.87	17.20	17.77	17.98
Some college	18.80	19.29	19.16	20.84	21.47	21.59
College only (4-year)	22.85	25.32	25.18	28.98	30.49	30.93
Graduate Degree	27.27	31.43	31.66	36.40	39.70	39.48
Graduate degree by type						
Master's			29.94	33.99	36.85	36.83
Professional			38.32	45.01	50.75	50.51
Doctoral			35.83	41.44	46.43	45.70

Figure Nine: Employment Share and Real Hourly Wages of Current US Population, 1980-2015.[82]

[82] Data from Current Population Survey monthly earning files are used for Panel A and monthly outgoing rotation groups or MORG data are used for Panel B, both between the years 1979 and 2015.

Graduate Degree. Panel A data can be read as a percent of total employment by education level, Panel B data can be read as average, inflation-adjusted wages by education level in 2015 dollars. In both panels, the Graduate Degree category is subdivided into Master's (MBA, JD, etc.), Professional, and Doctoral subsections, the sum of which in Panel A equals the category head, and the weighted average of which in Panel B equals the category head.

Clear longitudinal patterns emerge from the study. Beginning in Panel A, the share of employment among individuals with less than a college education has consistently decreased since 1980. Among the high school educated in particular, whereas four in ten workers held a high school degree in 1980, by 2015 that number had decreased to one in four. At the same time, according to Panel B wages grew only marginally for those without a higher education. Those employed with a High School Degree earned about a dollar sixty-eight more than their peers in 1980s. For the non-degreed employed, real wages actually fell. Meanwhile, higher education in any amount brought with it a commensurate increase in real wages. In particular, those employed with Graduate Degrees earned far more than those without one. So, there has been a clear trend among the educated to be paid more over time, as one might expect.

But the data allow for still more granular analysis. By differentiating data by employment type (Cognitive, Manual, Routine, Non-Routine) employment patterns among the educated seem follow similar trends to those found in the U.K. Figure Ten, for instance, shows the proportion of

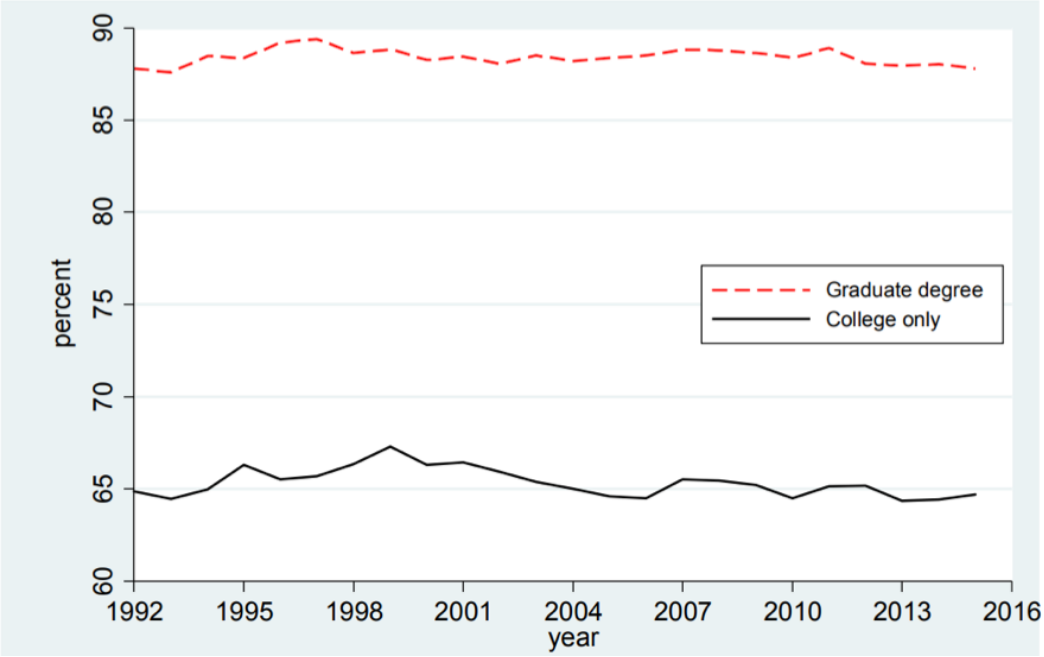

Figure Ten: Share of Non-Routine Cognitive Employment
by Education Attainment, 1992-2015.[83]

See: Robert G. Valletta. 2016. "Recent Flattening in the Higher Education Wage Premium: Polarization, Skill Downgrading, or Both?" *Federal Reserve Bank of San Francisco* (Working Paper 2016-17), 31. http://www.frbsf.org/economic-research/publications/working-papers/wp2016-17.pdf

[83] Non-Routine Series listed represent jobs as a share of employment within each educational group. Jobs categories used were retrieved from Standard Occupational Classification (SOC) 2010

college educated and graduate educated individuals with non-routine cognitive employment. Among those employed with a college degree, a majority, around sixty-five percent, hold non-routine jobs. Far more markedly, among those employed with a graduate degree, a vast majority, close to ninety percent, hold non-routine jobs.

To be sure, jobs are less routine than they were thirty-five years ago. As illustrated by Figure Eleven, non-routine jobs in both cognitive and manual categories grew annually, with a non-routine cognitive never diving below point five percent growth. Routine jobs, both cognitive and manual, have not fared nearly as well, however. Not only has growth shrunk among them, but over the last decade and a half growth has actually contracted, leaving little room for those with less than a college education. Clearly the I.T. Revolution has affected the composition of jobs in America. With fewer routine-based jobs available, and with the payment prospects among those jobs lower for the less well-educated, there is every incentive among American millennials to increase their debt and attain an education. This socioeconomic choice to accumulate more debt is the veritable definition of a technological shock.

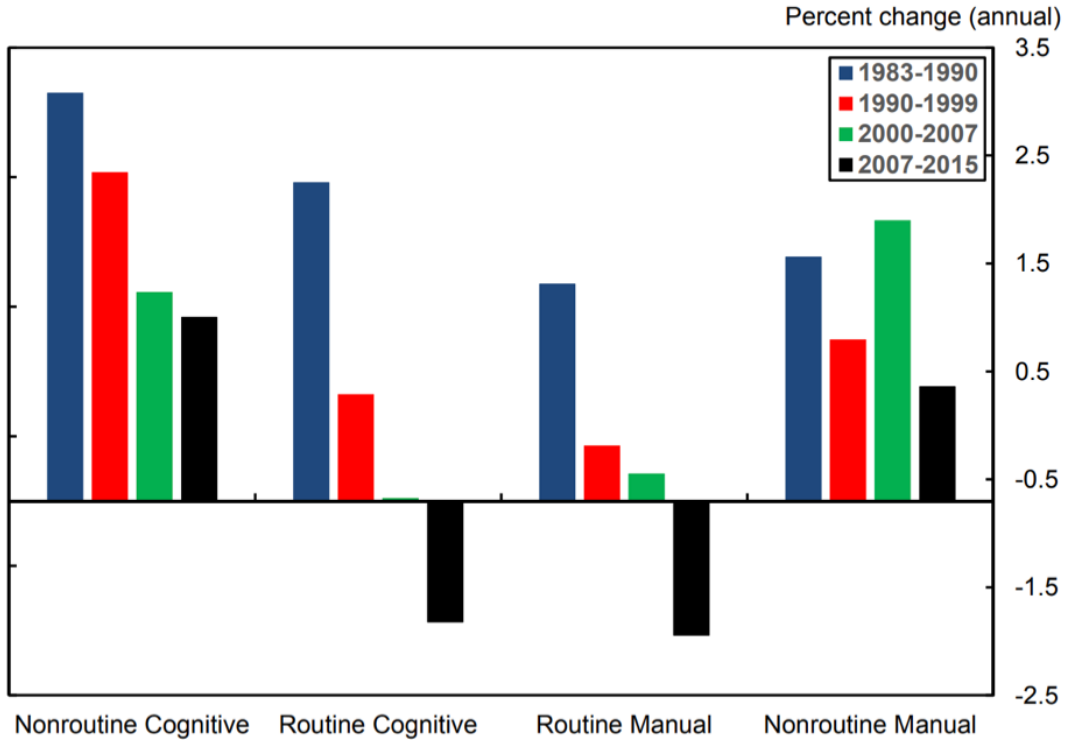

Figure Eleven: Employment Growth by Broad Occupation Category, Sub-Periods from 1983-2015, by Percent.[84]

coding. **Non-Routine Cognitive Jobs**: Management Business and Financial Operations (SOC 11, 13), Professional/Technical (SOC 15-29); **Routine Cognitive**: Sales and Related (SOC 41), Office and Administrative Support (SOC 34); **Routine Manual**: Construction and Extraction (SOC 47), Installation, Maintenance, and Repair (SOC 49), Production (SOC 51), Transportation and Material Moving (SOC 53); **Non-Routine Manual**: Healthcare Support (SOC 31), Protective Services (SOC 33), Food Preparation and Serving (SOC 35), Building and Grounds (SOC 37), Personal Care and Service (SOC 39). Ibid, 40.

[84] Calculations from Bureau of Labor Statistics Data. See: Ibid page

So, what conclusions can be made of the effect of the I.T. Revolution on shared mobility use? The results are mixed. At one end, the I.T. Revolution has significantly reduced transit search costs for travelers. Wait times for pickups in particular have been perceived as shorter for rideshare users than for taxi users.[85] And while the relative cheapness of rideshare may depend on time and place,[86] shared mobility options are particularly attractive to urban millennials, who themselves are less likely to own cars.[87] A reduction in the burden of car ownership, both through direct and indirect costs, is likely the reason compelling millennials to delay car ownership. At the same time, these trends are relatively new and are likely in response to technology shocks, phenomena which often have indirect and inexplicable priming effects on socioeconomic decisions.

Approached economically and examined through a lens of incentives, the reasons stimulating rideshare use among millennials may also function to dissuade them. Said differently, there is reason to believe that the benefits of travel convenience, variable cost, and ownership burden avoidance inherent to shared mobility use among millennials are the same factors that may hinder market growth. According to the most recent data, for the first time in the modern era the most common living arrangement among young adults eighteen to thirty-four is to be living with a parent.[88] Significantly more millennials are living at home than previous generations, and for longer periods too. This shift in living arrangements cannot be attributed to unemployment either. Whereas in 2010 ten percent of millennials were unemployed, that number decreased to five percent by 2016. Over that same period, the proportion of young adults living at home rose from twelve to fifteen percent, and this trend remains consistent among all levels of educational attainment.[89] Three reasons seem to be associated with the shift in living

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[85] According to 2014 survey data on travel in the San Francisco area, ninety percent of users waited ten minutes or less for rideshare rides, compared to thirty five percent for taxi users. Interestingly, respondents did not perceive rideshare services to be more reliable or cheaper than taxis—simply more convenient. More recent, nationally representative data may show a shift in these perceptions.

See: Rayle, Shaheen, Chan, et. al., "App-Based, On-Demand Ride Services: Comparing Taxi and Ridesourcing Trips and User Characteristics in San Francisco," *University of California Transportation Center (UCTC)* (Working Paper, 2014), 11, 15.

[86] The evidence and literature on rideshare pricing is varied. One commonly cited statistic is that rideshare is cheaper for longer trips above thirty-five dollars. This may be true, but this data is New York City-centric. A Wall Street Journal survey, for instance, found ridesharing services to be cheaper in five of six cities, the exception being New York. When factoring in convenience costs, however, ridesharing does seem to be cheaper.

See: Geoffrey A. Fowler, "Testing UberX, Lyft and Sidecar Against a Cab in Six Cities," *Wall Street Journal*, March 12, 2014. Accessed December 10, 2017. https://www.wsj.com/articles/testing-uberx-lyft-and-sidecar-against-a-cab-in-six-cities-1394585026. Also, Aimee Picchi, "Uber vs. Taxi: Which Is Cheaper?" *Consumer Reports* June 10, 2016. Accessed December 10, 2017. https://www.consumerreports.org/personal-finance/uber-vs-taxi-which-is-cheaper/

[87] One-in-five urban residents, and one-in-seven suburban residents, have used ridesharing services, compared to only three percent of rural residents. Smith (2016).

[88] Richard Fry, "For First Time in Modern Era, Living with Parents Edges Out Other Living Arrangement for Eighteen-to-Thirty-Four-Year-Olds," *Pew Research Center*, May 24, 2016. Accessed December 10, 2017. http://www.pewsocialtrends.org/2016/05/24/for-first-time-in-modern-era-living-with-parents-edges-out-other-living-arrangements-for-18-to-34-year-olds/.

[89] According to the report, "Among 25- to 35-year old [m]illennials, who were living at home in 2016, 91% reported that they resided at the same address one year earlier." Compared to previous

arrangements among millennials compared to previous generations: delays in cohabitation and marriage, increased debt and decreased earnings, and the Great Recession.[90] In totality, it seems likely that the shift in living arrangements among millennials is symptomatic of their desire to save on costs.

A significant correlate to this trend is that American millennials are increasingly moving to the suburbs. The high price of urban living is pushing millennials to suburbanize, and even invest in houses.[91] The implications of this shift on the shared mobility market are noteworthy. By nature, transportation costs are higher in suburban areas. Suburbanized millennials, ever-itinerant and already encumbered by debt, may therefore be incentivized to rely on personal vehicle ownership and car-sharing schemes rather than rely rideshare options. More broadly said, if millennials continue to be priced-out of urban markets, continue to live with their parents for longer periods of time, and if suburbanization continues, the market model upon which shared mobility has operated might need to be considerably refined. To understand why this is so, in the next section spatial economic theories will be used to explain the relationship between population density and physical geography on travel costs, habits, and mobility incentives. By investigating the nature of spatial economy, crucial insights will be presented on the optimization of shared mobility transportation costs.

Spatial, Urban Economics and Shared Mobility: Agglomeration, Location Choice, and Transportation Costs

Just as psychology, sociology, and law have their own sub-disciplines, so too does the field of economics. In recent years, some of the most familiar of these disciplines, micro- and macro- economics, have found companionship with relatively new disciplines like behavioral economics. One field of economics that is sure to grow in recognition in the coming years is the centuries old field of spatial economics.

To best understand spatial economics, it is helpful to compare it to a more familiar field. Microeconomics, the field of economics most are at least casually familiar with, can be defined as being concerned with the efficient and optimal allocation of scarce resources.[92] Microeconomics can be thought of as the foundational discipline of economics in that it is concerned with the economic decisions and exchanges that take place at individual- and firm-level. Spatial economics makes a subtle but, as it turns out, critical jump from microeconomics to its own separate field by expanding the definition of microeconomics. ***Spatial economics*** is

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generations, this represents a rise in stationary living among millennials. These results are consistent with similar studies.

See: Richard Fry, "It's Becoming More Common for Young Adults to Live at Home – And for Longer Stretches," *Pew Research Center* May 5, 2017. Accessed December 10, 2017. http://www.pewresearch.org/fact-tank/2017/05/05/its-becoming-more-common-for-young-adults-to-live-at-home-and-for-longer-stretches/

[90] Fry (2016).

[91] https://www.zillow.com/blog/trends-zillow-group-research-206775/ and https://www.zillow.com/blog/millennials-in-denver-194784/

[92] It is imperative in any definition of economics to include the notion of scarcity for if resources, goods, and services were not scarce, they would not be valued.

concerned with the efficient and optimal allocation of scarce resources *over geographic space and location*.[93]

Such a slight distinction may seem arbitrary to some. Presumably, since space and location are ubiquitous concepts, distinguishing among them should not yield insights that merit a unique field of study. Yet empirically the opposite appears to be true. In the following paragraphs, the subtle area of spatial economics in the urban space will be explored. By the end of this section, it should become clear that firms that appreciate the significance of economic space will be able to provide far better insight than those who fail to account for it.

* * *

Over the last few decades, researchers have found space to be a significant predictor of development. While just under two percent of the land area in the United States was developed by the early 1990s, almost all new infrastructure subsequently built was within a kilometer of existing development.[94] Over the course of that same decade, approximately four percent of US land area produced half of the nation's GDP.[95] In essence, spatial economists have determined that relatively small pockets of land have become responsible for an ever-greater proportion of economic prosperity.

Urban and metropolitan spaces in particular seem to the primary generator of wealth throughout the globe. The disproportionate wealth generation stemming from urban environments has a great deal to do with population. In the United States, for instance, as of 2013 over two-thirds of the US population lived in metropolitan (urban and suburban) areas.[96] As of 2016, the ten most populous US metropolitan areas produced thirty-four percent of its total national GDP (Figure Twelve on the following page). At $5.724 trillion, or 7.6 percent of the of the world's GDP, this is an amount greater than combined GDP of the bottommost 157 countries on the World Bank's economic productivity list.[97]

Clearly, unique and exponential economic benefits manifest from the use of clustered spaces. For these spaces to be most economically efficient, each must possess effective transportation ecosystems as dynamic and multifaceted as the urban centers within which they operate. Evidence indicates that the current America's current transportation systems are not

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[93] Economics can also be defined as concerning maximizing utility, optimal decision-making, incentives and information, and supply and demand. For a brief introduction on spatial economics, see: Gilles Duranton, "Spatial Economics," *The New Palgrave Dictionary of Economics* (2nd Ed), edited by Steven N. Durlauf and Lawrence E. Blume, *Palgrave Macmillan* (2008).

[94] Gilles Duranton and Diego Puga, "Micro-Foundations of Urban Agglomeration Economies," *National Bureau of Economic Research*, Working Paper 9931, (2003), 1.

[95] Indermit S. Gill and Chor-Ching Goh, "Scale Economies and Cities," *The World Bank Research Observer* 25, no. 2 (2010), 235; Easterly and Levine, "What Have We Learned from a Decade of Empirical Research on Growth? It's Not Factor Accumulation: Styled Facts and Growth Models," *World Bank Economic Review* 15, no. 2, (2001).

[96] Darryl T. Cohen, Geoffrey W. Hatchard, and Steven G. Wilson, "Population Trends in Incorporated Places: 2000 to 2013," *US Census Bureau: US Department of Commerce*, P25-1142 (2015).

[97] Manual calculations from data provided by World Bank Group. Total GDP of 198 recorded countries in 2016 Dollars as of 2017 was $74,575,841,000,000. Divide by total GDP of ten most populace US metropolitan areas. Bottommost countries between Vietnam (45th) and Tuvalu (198th) country. World Bank Group, "Popular Indicators: GDP (Current US$)," 2017, accessed December 15, 2017. http://databank.worldbank.org/data/downloads/GDP.pdf

economically efficient. To illustrate this point, one need only consult the world's largest-ever study on global traffic congestion.

Rank	Metropolitan Area	2016 GDP (Est.)	Population
#1	New York-Newark-Jersey City, NY-NJ-PA	$1.43 trillion	20.1 million
#2	Los Angeles-Long Beach-Anaheim, CA	$885 billion	13.3 million
#3	Chicago-Naperville-Elgin, IL-IN-WI	$569 billion	9.5 million
#4	Dallas-Fort Worth-Arlington, TX	$471 billion	7.2 million
#5	Washington-Arlington-Alexandria, DC-VA-MD-WV	$449 billion	6.1 million
#6	Houston-The Woodlands-Sugar Land, TX	$442 billion	6.7 million
#7	San Francisco-Oakland-Hayward, CA	$406 billion	4.7 million
#8	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	$381 billion	6.1 million
#9	Boston-Cambridge-Newton, MA-NH	$371 billion	4.8 million
#10	Atlanta-Sandy Springs-Roswell, GA	$320 billion	5.8 million
	Top 10 Metropolitan Areas	**$5.7 trillion**	**84.3 million**

Note: figures in chained 2009 dollars

Figure Twelve: Top 10 Most Populace Metropolitan Areas and GDP Contribution.[98]

In 2017 a survey was taken of 1,064 cities spanning 38 different countries. The question these surveyors wished to answer: which cities have the worst traffic in the world? Of the many cities surveyed, 240 US metropolitan areas were included. After compiling the data, a pattern became clear: US cities generate some of the world's worst traffic. Of the ten most congested cities on earth, half are located in the United States (10th: Miami, 8th: Atlanta, 4th: San Francisco, 3rd: New York, 1st: Los Angeles). Of the ten most congested metropolitan areas in the US (Figure Thirteen on the next page), Los Angeles accounted for the most time spent commuters spent sitting in traffic on average at 104 hours per commuter per year. These inefficiencies cost businesses and consumers directly, through time and fuel inefficiencies, and indirectly, through increased business costs that are passed on to consumers. In Los Angeles alone, the costs of congestion were estimated at $9.7 billion, or $2,408 dollars per driver. In total, of 240 cities surveyed in the US, it is estimated that congestion accounted for $300 billion in consumer costs, or $1400 per driver. Despite its high urban-productivity, the data indicate that the US is the most congested developed nation in the world.[99]

[98] Jeff Desjardins, "The US Cities with the Biggest Economies," *Business Insider*, September 27, 2017. http://www.businessinsider.com/us-cities-with-the-biggest-economies-2017-9

[99] Inrix, Inc. "Los Angeles Tops INRIX Global Congestion Ranking," February 20, 2017. Accessed December 15, 2017. inrix.com/press-releases/los-angeles-tops-inrix-global-congestion-ranking/

Rank	City / Large Urban Area	2016 Peak Hours Spent in Congestion	Percentage of Total Drive Time in Congestion (peak and non-peak hours)	Total Cost Per Driver in 2016	Total Cost to the City in 2016 (based on city population size)
1	Los Angeles, CA	104	12.7%	$ 2,408	$9.7bn
2	New York, NY	89	12.8%	$ 2,533	$16.9bn
3	San Francisco, CA	83	12.8%	$ 1,996	$2.5bn
4	Atlanta, GA	71	10.0%	$ 1,861	$3.1bn
5	Miami, FL	65	8.7%	$ 1,762	$3.6bn
6	Washington, DC	61	11.3%	$ 1,694	$3.0bn
7	Dallas, TX	59	6.6%	$ 1,509	$2.9bn
8	Boston, MA	58	13.4%	$ 1,759	$2.9bn
9	Chicago, IL	57	10.2%	$ 1,643	$5.2bn
10	Seattle, WA	55	12.6%	$ 1,590	$2.0bn

Figure Thirteen: Ten Most Congested Urban Areas in US.[100]

Evidently, the transportation infrastructure of the United States must be improved. But to improve upon the transportation system of urban environments, the underlying mechanisms that induce intro- and intra-urban travel must first be understood. To that end, it is useful to ask a simple, yet infrequently considered question: Why do cities exist at all? Though it may seem as though cities are natural phenomena, practically speaking, cities are at face value more of a danger than anything else. In concentrating resources and capital within a relatively small area, the risk of disaster only increases; this is one of the reasons hurricanes seem so destructive in metropolitan areas. Yet, despite the risk of centralizing capital and resources, cities exist.

To the economist, the rationale for the existence of cities is multifaceted. Indeed, upon studying the economics of space and location, four relationships arise that are of particular interest to the transportation sector (see Figure Fourteen on next page): the relationship of scale and space, the relationship of shared inputs and space, the relationship of transactional costs and space, and the relationship of statistics and space, the last of which will be called for this paper "risk space." Together these four relationships comprise the theoretical foundation upon which ***agglomerated*** societies, otherwise known as cities, form. Throughout this section, the relationship between transportation and these concepts with be explained.

[100] Inrix, Inc. (2017).

Agglomeration Factors	Examples	
	Production	Consumption
Scale Economies	Plant Size	Golf Courses, Ice Rinks, **Cities**, Sports Arenas
Shared Inputs	Repair Shops, Accounting Firms, **Shared Mobility**	Theatres, Restaurants, **Roads**
Transactional Costs	**Market Matching**	Shopping Districts
"Risk Space"	Resale for Market Assets	**Substitute Goods/Services**

Figure Fourteen: Four Agglomeration Factors in Production and Consumption.[101]

First and foremost, economists contend that cities exist and are sustained by the advantage of ***scale***,[102] which itself can be thought of as a specialized form of the concept of ***growth***. Economically stated, by sharing a wider variety of distinct intermediate inputs produced by monopolistically-competitive firms, clustered firms have an advantage to production resulting in aggregate increasing returns to scale. Less technically stated, because firms in cities have access to a greater number of sectors that produce inputs key to running their businesses, a marginal increase to production output requires a *less-than-proportional marginal increase in inputs to production*. Said another way, firms in clustered spaces rely on *imperfect markets* to excel.[103] These imperfect markets are contingent upon on the so-called ***Spatial Impossibility***

[101] Adapted from Table One in John M. Quigley, "Urban Diversity and Economic Growth," *The Journal of Economic Perspectives* 12, no. 2 (1998), 131.

[102] Aggregate returns to scale should not be confused with the previously introduced concept of economies of scale. Where economies of scale refers to average production costs, returns to scale refers to production *rates*. See Duranton and Puga (2003), 5, 7.

[103] To become convinced of this framework, assume that in a relatively homogenous area consumer preferences are the same. By homogenous space, it is meant that: natural resources are equally diffuse at all locations, preferences are the same at all locations, and the production sets of firms are the same in all locations. Assume also that both consumers and producers hold the same "convexities" of consumption and production. By convexities it is meant that to consumers some combination of goods is preferable to any one good and to producers it is meant that some combination of production inputs is used to produce goods and no firm has an advantage. Finally, assume that the transportation of people and goods between locations is costly. Then according to these three assumptions, within a finite area containing a limited number of firms and consumers, no equilibrium (no natural balance or stability of affairs) will involve transportation.

If people, goods, and space are similar and there is a cost to moving, then no one will move and, by extension, no one will trade. This is called the ***Spatial Impossibility Theorem*** (SIT) and it is key to understanding the relationship between transportation efficiency and distance from city centers. (Though alternative theories such as trade theory models exist, which argue that non-convexities in local production can explain these matters, these explanations are wanting.) Since trade *does* exist, one of the other assumptions within SIT must be relaxed. As it is already empirically clear that transportation is

Theorem (SIT) which states that, because transportation is costly, some market areas must have an advantage over others. This advantage must come in the form of the *increased returns of scale* (for a detailed explanation see fn. 101). The consequence of SIT, that fewer inputs are needed for increasing outputs (increased returns to scale) in denser areas, is fundamental to understanding urban transportation because as one theorist puts it, "without some form of increasing returns we cannot reconcile cities with trade." [104] If cities did not yield more output per capita, if trade and commerce did not yield exponentially, cities would not exist.

Urban commerce is therefore highly dependent upon transportation efficiencies and the dynamism of movement within cities. To the transportation networkers whose focus is the efficiency of movement, this is especially the case. One central concept to effective urban movement is what will be called ***mobility access***. There are two constituent parts to mobility access. First is ***accessibility***, which will be defined as: (a) the location of opportunities within an urban area and (b) the right to use those opportunities.[105] Second is ***mobility***, which is the means and efficiency of intro- and intra-urban movement.[106] Joined together, mobility access becomes the means of intro- and intra-urban movement to locations of opportunity which the transported have the right to use.

Mobility access is constrained by spatial-temporal costs,[107] and spatial-temporal costs are themselves constrained by the mode of one's travel. For instance, the relative costs of travel to the city by car are different than the relative costs of travel to the city by train. Each mode of transportation presents distinct economic costs to consumers; the amount expected to be paid and the speed by which travel is accomplished are both contingent upon mode of travel. By that same token, location and travel distance also determine the cost of accessibility. Both are determined by individuals' *relative point of destination* and *relative point of embarkation*. Walking to a corner store in the city is far less costly than walking to the corner store in a rural community. Each situation engenders separate cost considerations. Mode of travel and travel distance are therefore distinctly interrelated. For this reason, when considering travel costs, distance and time can be considered as interchangeable once modes of mobility are taken into account.[108]

Mobility access is highly bounded by the topology of existing transportation infrastructure.[109] At its best, cities with better, more dynamic mobility access allow commuters greater room for where they choose to live. Those who can travel more efficiently and reliably can afford to live further away from urban opportunities.[110] Mobility access need not be

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costly, one of the other variables, homogeneity of space or production and consumption convexities, must not exist. Spatial economists tend to believe that differences in production advantages between firms, so-called "non-convexities," explain why economic activity tends to cluster in certain areas. These clusters are called "agglomeration economies," or cities, and are themselves explained by the four conceptual relationships posted in Figure Thirteen.

See: Jean-Francois Thisse and Gianmarco Ottaniano, "On Economic Geography in Economic Theory: Increasing Returns and Pecuniary Externalities," *Journal of Economic Geography* (2001), 4; Duranton (2008): 2-3.

[104] Duranton and Puga (2003), 1.

[105] Haracio Samaniego and Melanie E. Moses, "Cities as Organisms: Allometric Scaling of Urban Road Networks," *Journal of Transport and Land Use* 1, no. 1 (2008), 21.

[106] Puentes (2017).

[107] Samaniego and Moses (2008), 21.

[108] Ibid, 32.

[109] Ibid, 22.

[110] Samaniego and Moses (2008), 22.

determined at a city-by-city basis either. Empirical studies of urban systems indicate that the transportation solutions applied to some cities should be effective in others as well. This is not to say the financial and infrastructural obstacles cities face are uniform; many pervasive socioeconomic issues, such as the availability of affordable housing and access to quality public transportation, effect commuters' mobility access.[111] But, at a macroscopic-level, evidence indicates that urban growth patterns are surprisingly unvarying despite city size or location.[112]

Such a statement likely underemphasizes just how consistent patterns of urban growth truly are. In a pattern that travels across economic disciplines, many socioeconomic relationships including income distribution, wealth, and firm size and density, all tend to scale logarithmically. That is, the growth rates between these relationships tend to scale-up predictably by so-called ***power laws***. Power laws are scaling rates that follow the mathematical relationship $Y = aX^{\beta}$, where β is the power law exponent which scales a relevant variable, Y and X are said relevant variables, and a is some expressed constant.

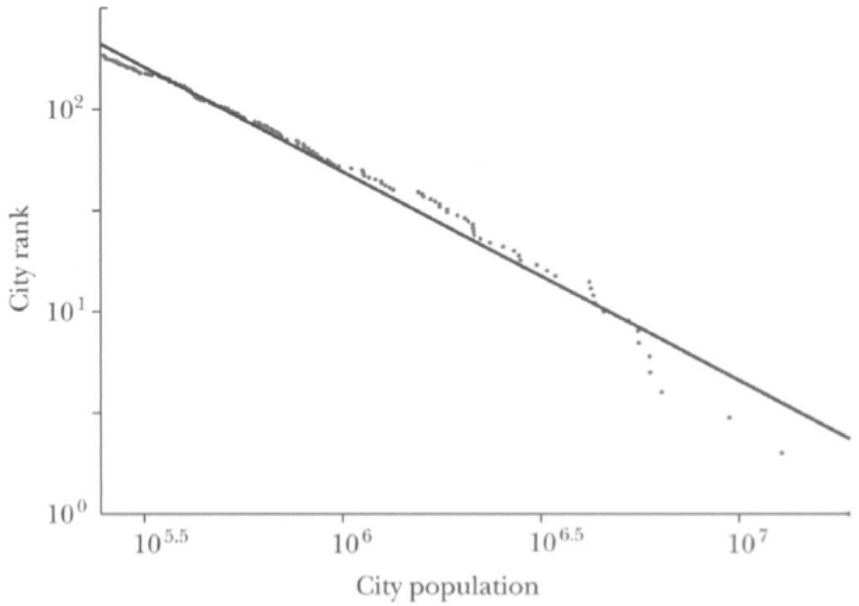

Figure Fifteen: City Rank Versus Size
U.S. Cities of Population 250,000 People and Over, 2010.[113]

Among the socioeconomic patterns that tend to follow power laws, city growth (scale) seems to exhibit this trait. Figure Fifteen illustrates this point. Researchers ranked US cities with populations of 250,000 and over from in descending order of population (i.e. New York = 1, Los Angeles = 2, etc.). After testing a sample of 184 cities and plotting this data, they calculated an R^2 of .98 of logarithmic robustness. In other words, the data scales extremely well along a

[111] Puentes (2017).
[112] Michael Batty, "The Size, Scale, and Shape of Cities," *Science* 5964, no. 319, 769.
[113] Data plotted from *2012 Statistical Abstract of the United States*. Xavier Gabaix, "Power Laws in Economics: An Introduction," *The Journal of Economic Perspectives* 30, no. 1 (2016), 186-87.

predicted logarithmic trend line. This is significant because there is no clear reason that the data should exhibit these tendencies, yet astoundingly they do.[114]

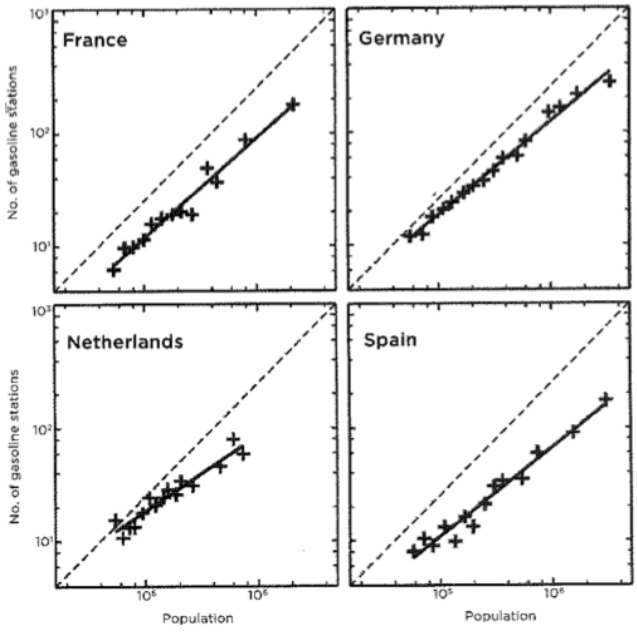

Figure Sixteen: Number of Gasoline Stations Plotted
Logarithmically Against City Sizes of Four European Nations.[115]

The logarithmic trend does not end with city rank either. Power law relationships are also pervasive in the relationship between city population and the number of gas stations, as shown in Figure Sixteen. When the logarithmic relationship between the number of gas stations and population was tested in four European nations, the data indicated a striking sublinear relationship, where sublinearity is demonstrative of gains to efficiency achieved by increasing output to larger agglomerations. When the logarithmic relationship between the number of car dealerships was tested against city populations, there too was demonstrated sublinear tendencies. For that matter, when the logarithmic relationships for road length, electric lines, water and gas lines, were all tested against city population, there was also a sublinear relationship for all variables tested. In other words, the transportation infrastructure of urban areas across the globe such as gas stations, car dealerships, and roads, all grow with populations by economies of scale.[116] Specifically, these relationships tend to operate at a global ratio of 1-to-.85. So, for instance, doubling the population of Los Angeles would require an increase of

[114] Gabaix, "Power Laws in Economics: An Introduction," *The Journal of Economic Perspectives* 30, no. 1 (2016), 186-87.

[115] Ibid, 273.

[116] Dirk Helbing, et. al., "Power Laws in Urban Supply Networks, Social Systems, and Dense Pedestrian Crowds," in *Innovation and Social Change*, eds. D. Lane, et. al. (Springer: 2009): 436-37.

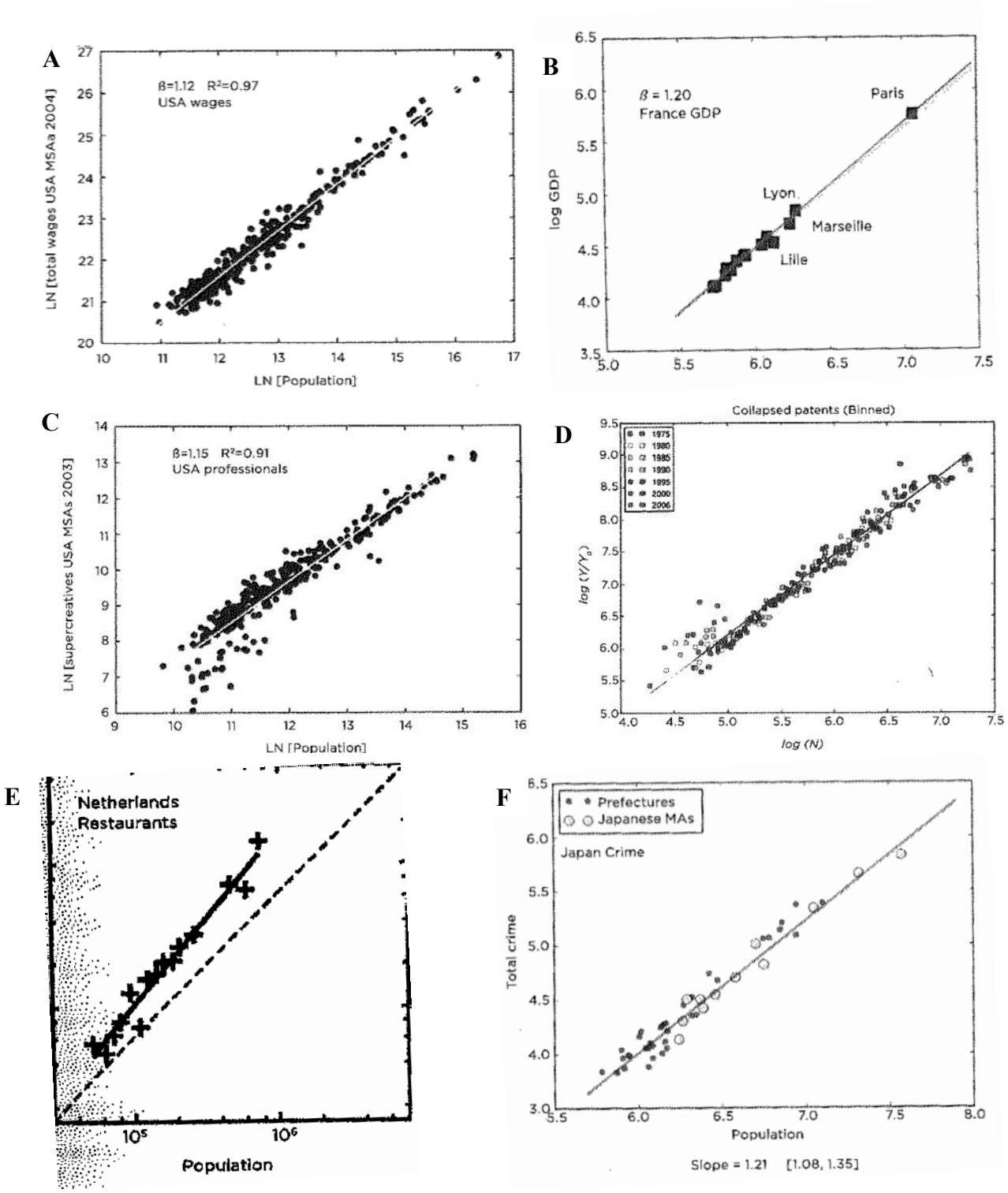

Figure Seventeen: Logarithmic Trends in US Wages (A), GDP of French Cities (B), US Professionals as Logarithm of Population (C), Number of US Patents (D), Restaurants in the Netherlands (E), and Crime in Japan (F).[117]

[117] West (2017), 276-77.

only 85 percent more gas stations.[118] Practically speaking, cities on average save approximately 15 percent on transportation infrastructure.

As can be seen, not all urban growth relationships operate at a 1:1 logarithmic scale. The purpose of a good or service largely determines its scalability. For instance, socioeconomic supply nodes such as restaurants, museums, theatres, and colleges tend to increase over-proportionally, or superlinearly, to population.[119] In other words, there tend to be more restaurants, museums, theatres, and colleges per capita than linear predictions would expect. The superlinearity of these socioeconomic structures may be the consequence of the value societies place on social gathering and information access. As to the scalability of transportation, the evidence consistently indicates the logarithmic relationship it holds with local population. In one example, researchers wanted to test the relationship between city centrality (attractiveness) and transportation behavior. Designing two predictive models, a centralized-model and a decentralized-model, the logarithmic relationship between urban population size and miles driven was tested for 425 US metropolitan areas. After superimposing the data onto both predictive models, the data indicated that miles driven increases faster than built road-miles.[120] Said another way, the data seem to imply that cities encourage scaled usage of roads beyond their intended capacity; evidence reflecting the concept of induced traffic.

By now it should be clear that there are deep underlying patterns permeating the behavior of clustered human populations that are more profound, perhaps, than the wildest conceits of the most emphatic urban planner. As can be seen above in Figure Seventeen, the population of a city can tell researchers much of what they need to know when it comes to income, productivity, innovation, crime, food, and specialization. For transportation networkers, whether it is the induced traffic effect of urban roads, the number of gas stations, or car dealerships, *evidence indicates that there is a reliably predictable ratio between population and transportation use*. Therefore, those looking to improve upon the transportation infrastructure of urban landscapes should expect to see a relatively similar ratio between large-population and mobility *irrespective of nation or environment*. If for some reason the ratio does not exist, this may be due to inefficient population-size or even an underlying transportation inefficiency. There is every reason to believe, moreover, that highly granular insights can be gleaned from urban sub-populations. The possibilities for practicable and effectual insights are potentially numerous when urban transportation and urban scale are analyzed.

The potential insights of urban economic analysis do not end there, either. Evidence indicates that the vast majority of human travel tends to be made of short trips.[121] But the nature of these trips depends on where travel begins and where it ends. Take travel patterns within New York city, for instance. According to an analysis of Yellow Taxi data (see Figure Eighteen on next page) the frequency distribution of travel tends to be heavily skewed to the right. As distance increases, trip frequency largely decreases. One interesting area of further research might be whether, as population density decreases, the frequency distribution of travel behavior shifts as well. Might it be that as the space between accessible areas increase, so too do distance frequency distributions normalize in suburban areas, or even skew-left in rural areas?

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[118] Geoffrey West, *Scale* (Penguin Press: New York, 2017), 272.

[119] Helbing et al (2009): 438.

[120] Samaniego and Moses (2008), 31-2.

[121] Marta C. Gonzalez, Cesar A. Hidalgo, and Albert-Laszlo Barabasi, "Understanding Individual Human Mobility Patterns," *Nature* 7196, no. 453 (2008).

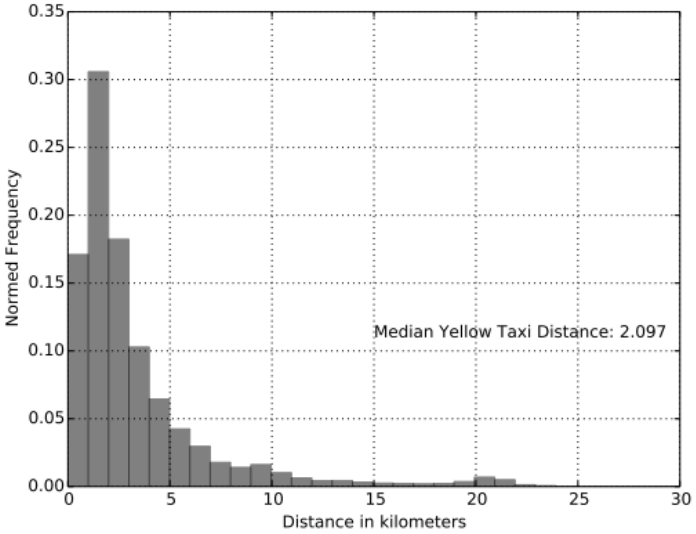


Figure Eighteen: Frequency Distribution of (Geographic) Distances Between Pick Up and Drop Off in New York City, 2013.[122]

There are real-world conclusions to be gleaned from the analysis of economic space and frequency of travel. Using mathematical topography, complex systems analysts have discovered an almost universal rule of transportation; one from which novel and even predictive insights can be made. Professor Geoffrey West of the Santa Fe Institute is one of the leading thinkers on the science of cities. In his recent book, *Scale*, West describes the ***Inverse Square Law*** of urban movement, writing:

> Consider any location in a city; this could be a central place such as a downtown area or street, a shopping mall or district, but it could just as well be some arbitrary residential area such as where you live. The mathematical theorem predicts how many people visit this location from any distance away and how often they do it. More specifically, it states that the *number of visitors should scale inversely as the square of both the distance traveled and the frequency of visitation*.[123]

The mathematically inclined may note that the Inverse Square Law that West described above is a version of the power law expressed consistently through this section. For everyone else, West's law can be phrased even more clearly: for any given urban location, the number of people that travel to it will scale as a power function (of exponent negative two) of both distance and visitation frequency.[124] This is an *incredibly powerful* pattern of transportation behavior that has great potential ramifications. Even as an approximation, which is how most theories should be taken, theories allow for great potential insights to be created. A telematics organization need

[122] Vsevolod Salnikov, et. al., "OpenStreetCab: Exploiting Taxi Mobility Patterns in New York City to Reduce Commuter Costs," *Cornell University* (arXiv:1503.03021 [cs.SI]) (2015), 2.

[123] Italics added. West (2017), 347.

[124] Ibid.

only gather enough data over time, say six months to a year's worth, to smooth over the variance of behavior, and transportation behavior patterns can be illustrated.

Data confirms these claims extraordinarily. The following graphs in Figure Nineteen show trends of people visiting Boston, Singapore, Dakar (Senegal), and Lisbon from varying distances to some location within respective cities. Graph A demonstrates the Inverse Power Law in the fluctuation of travel into Boston as a function (q) of location visits varied by distance (r) and affixed with frequencies of (f) times a month. The results of Graph A are represented more powerfully in Graph B. By plotting the same data as a function of a single variable (v) (visitation frequency x distance by month) the underlying logarithmic pattern of the data is shown to collapse into a single predictive line. Taken further, these results are shown to expand from Boston to cities across the globe in Graph C. Evidently, travel behavior in non-American cities still show similar patterns.

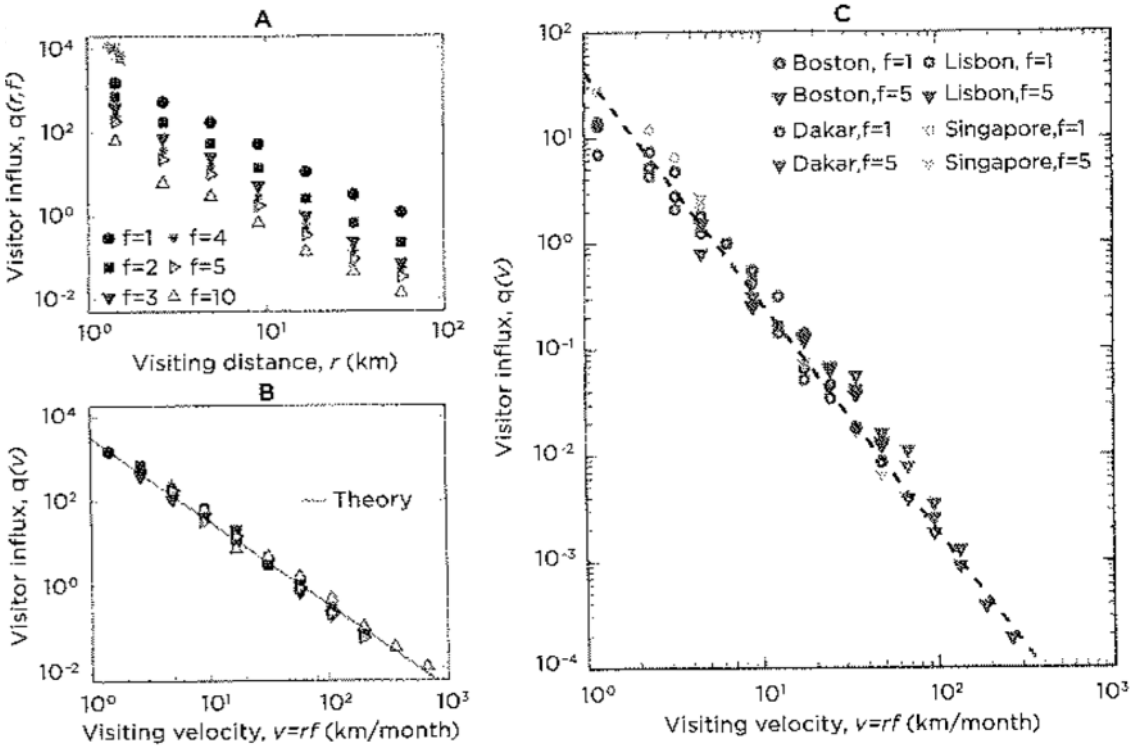
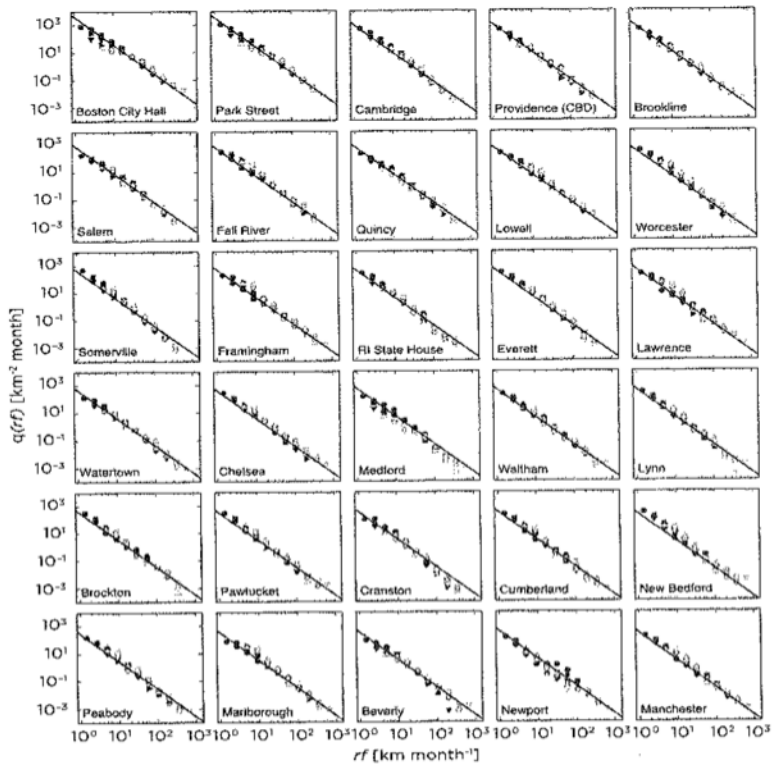


Figure Nineteen: Visitation Flux into and Around Boston (Graphs A, B), Data Expansion to Dakar, Lisbon, and Singapore (Graph C).[125]

These insights can be taken more granularly, however. Figure Twenty demonstrates the same conclusions generated from Figure Nineteen, Graphs (A-C), by location *within* specific locations in Boston (above) and Singapore (below). For each location, the same function (q) was used to demonstrate the number of visits a location can expect to receive per month. Upon inspection, some may notice that minor fluctuations are shown to occur on these graphs.

[125] West (2017): 347. t

Boston



Singapore

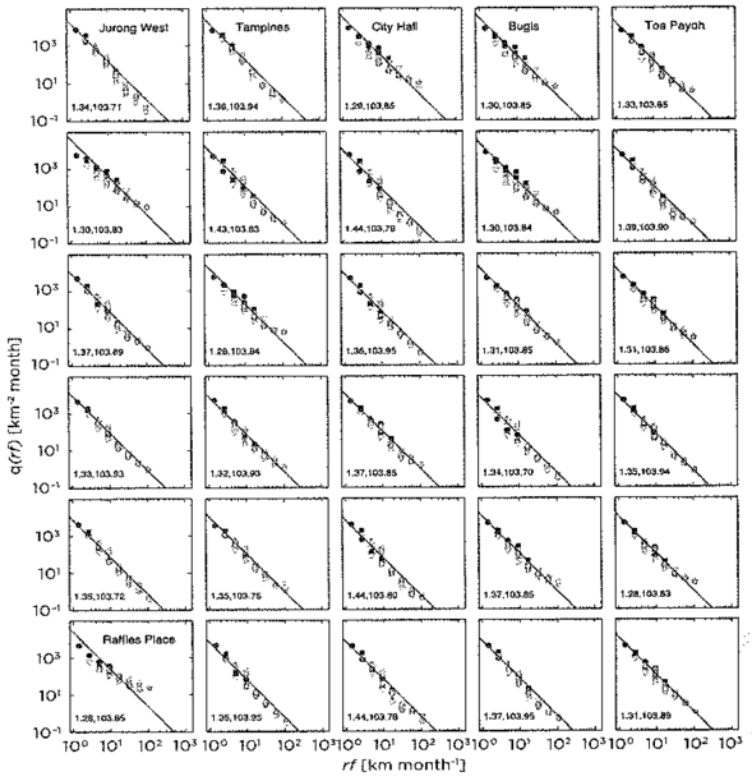


Figure Twenty: Flux of Visits Within Areas of Boston (above) and Singapore (below).[126]

[126] West (2017): 348.

Curiously enough, areas that tend to see clustered points are *travel terminals* such as airports and train depots which tend to experience less predictable frequency distributions.

That travel behavior would shift based on the relative location of individuals would be consistent with existing theories of the economics of space. The ***bid-rent theory of space*** (BRT) provides a helpful, if simplified, method of understanding the distribution of space in and around cities. Fundamental to BRT is the so-called "central business district" (CBD). CBDs form from the interaction of two countervailing forces: ***market-crowding forces*** and ***market-access forces***. When an area is perceived as valuable enough for multiple firms to locate near it despite fiercer competition, this is called a market-crowding force. Many firms choose to cluster around the CBD of Manhattan, for instance, despite many competing businesses and the high price of real estate; this is an example market-crowding force. Similar to the induced traffic effect, by building around a CBD, firms therein attract employees and the greater demand of space. For those people who value being close enough to work as to purchase an apartment near a CBD, this is an instance of market-access force. Combined, these two effects act as a kind of "gravitational" force around the CBD of cities, attracting more firms and workers, therein decreasing the marginal cost of production, and thereby increasing economies of scale. By their very nature then, the closer a firm or household is to a CBD, the higher the cost of land rent.

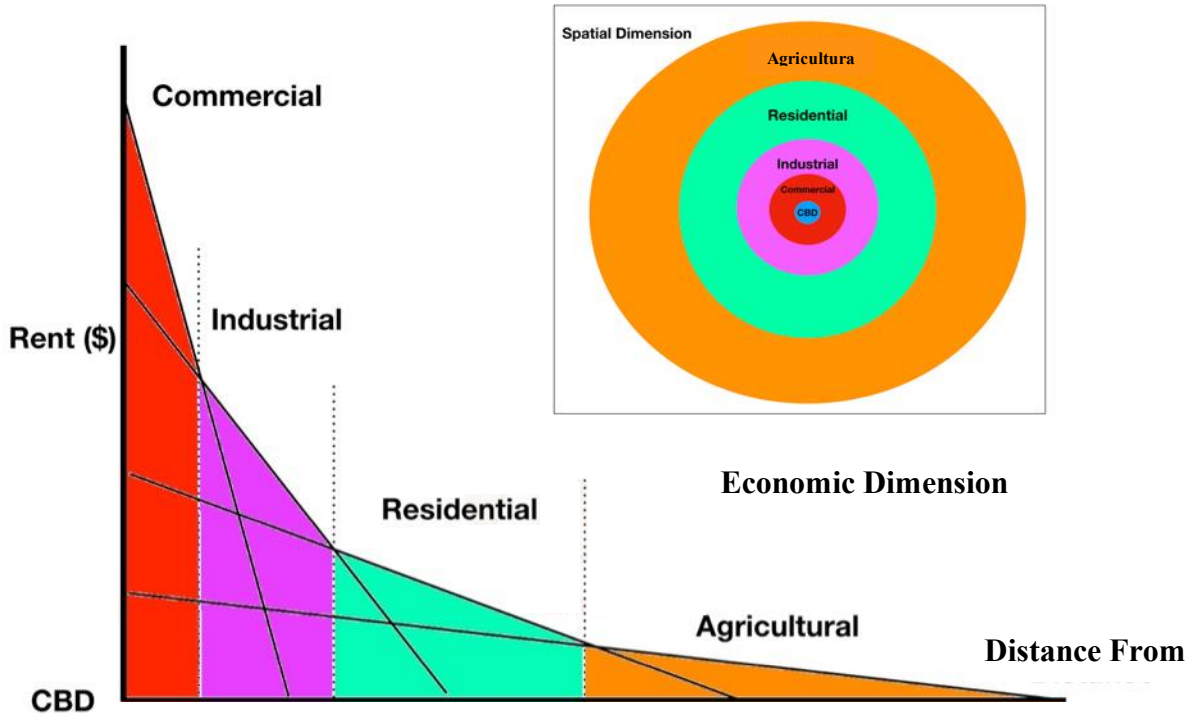


Figure Twenty-One: Bid-Rent Space from Central Business District (CBD).

The dynamics of BRT are illustrated by Figure Twenty-One. The rent curves of four canonical "zones" (commercial, industrial, residential, and agricultural) are represented in both economic and spatial dimensions as functions of market-crowding and market-access forces in relation to a CBD. As distance increases, the proportion of space within each zone widens, but the rent curve, the amount which zones can afford to pay, decreases. The area of the colored zones represents the total rent-space each category can afford and is willing to pay. As can be

seen, as zones close in around the CBD, the amount of building space they can afford to own is smaller, *but so too are the costs of transportation to accessible areas*. Said another way, *as distance from the CBD increases, land costs decrease in proportion to transportation costs*. In other words, the high cost of rent paid by those who live closer to the CBD is some function of the transportation costs they *do not pay* by travel to the city. As a function of distance then, suburbanites can naturally afford larger living spaces. By the same token, land is cheaper still for agriculturalists who themselves need more space to produce goods.

Consequently, BRT helps to explain the modern dynamics of ***location choice***, the economics of where individuals choose to live and congregate. Specifically, it helps to explain why between the 1980s and the early 2000s suburban growth rates consistently outpaced urban growth.[127] And, though it is true that between 2000 and 2015 urban growth outpaced suburban growth, that trend has since reversed.[128] To explain suburbanization, a spatial or urban economist would look to socioeconomic gravitational forces such as where employers locate. According to employment data from the US Census Bureau shown in Figure Twenty-Two, since at least the 1980s the United States has seen a shift in employment from urban areas to suburban areas. While the percent of jobs in CBDs grew by approximately 40 percent, from 35.21 million to 49.03 million, the percent of jobs in outlying areas grew by 70 percent. Whereas in 1980 there were 10 percent more jobs in urban areas, by 2000 municipalities essentially reversed the proportionality of employment.

The evidence of the suburbanization of employment may seem counterfactual to those who have been exposed to those of us who have been inundated with new headlines reporting that most corporations are moving to cities in search of talent and relevance.[129] These headlines may be deeply misleading. Overall, such reports tend to focus on notable Fortune 500 companies such as McDonalds, Marriott, and General Electric, rather than on the aggregate employment trends among the nation's employers. Indeed, according to the US Census Bureau, small businesses (firms of under 500 people) account for 51 percent of private, non-farm of jobs in America (about 60 million jobs).[130] Further, BRT stipulates that most businesses will not be able to afford to move into centralized urban locations. Competition is so high for urban spaces that real estate prices tend to be rise to such a point that only those who value agglomeration factors most will tend to move to the cities. For those who remain doubtful, it bears repeating that the highly publicized trend of urban-migration largely occurred in the early years of the millennium, and have since reversed, as for now.

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[127] William H. Frey, "Population Growth in Metro America since 1980: Putting the Volatile 2000s in Perspective," *The Brookings Institution* (2012), 1.

[128] William H. Frey, "City Growth Dips Below Suburban Growth, Census Shows," *The Brookings Institution*, May 30, 2017, accessed January, 2018.

[129] See, for example: Jonathan O'Connell, "As Companies Relocate to Big Cities, Suburban Towns Are Left Scrambling," *The Washington Post*, July 16, 2017, accessed January 10, 2018.

[130] These numbers are subject to vigorous debate. Why are small businesses capped at 500 people? What makes a small business what it is? Depending on their definitions, some even go as far as to say 81 percent of jobs are under small businesses. The take-away should be, however, that most people do not work for Fortune 500 companies. For more, see: Steve King, "How Many Small-Business Employees Are Out There?" *US News and World Report*, July 17, 2009. Accessed January 10, 2018.

Employment Inside and Outside Central Cities 1980-2000	1980	1990	2000	Change 1980-2000 (in percent)
In Central Cities (in millions)	35.21	46.47	49.03	39.25
In Other Municipalities (in millions)	31.58	43.75	53.75	70.20
Difference (in percent)	10.31	5.85	-9.63	---

Figure Twenty-Two: Employment Inside and Outside Central Cities, 1980-2000.[131]

As a consequence of the decentralization of living patterns, the move from central urban areas to adjacent suburban areas, we should expect a concomitant shift in transportation patterns. The census data presented in Figure Twenty-Three indicate that most commuting is not to the city, but *within* the suburb. Said another way, the frequency distribution of distance traveled in suburban areas appears to be, as posited above, parabolic and decidedly *intra-suburban*. For its part, *intra-urban* travel appears to be prevalent too, at 29 percent. Wherever households choose to locate, travel patterns tend focused around them. If intra-suburban travel comes as a surprise, intra-urban should not. Such data only helps to support the notion that those who choose to live within cities do so to avoid extensive travel costs. Thankfully, there is no need to speculate as to why individuals travel. Survey data from the US Department of Transportation revealed in Figure Twenty-Four clearly shows that commuting only represents approximately a fifth of the

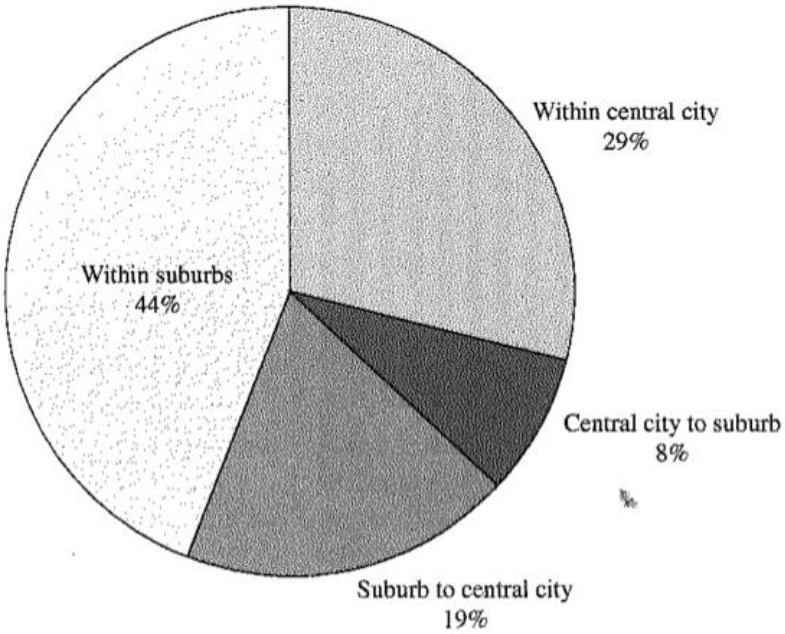

Figure Twenty-Three: Metropolitan Commuting Patterns, 2000.[132]

[131] Adapted from US Census Data and Arthur O'Sullivan, *Urban Economics* (New York, N.Y.: McGraw-Hill/Irwin, 2012), 162.

[132] US Census Bureau and O'Sullivan (2012), 172.

travel behavior of motorists. The drive to and from social and recreational activities comprises 30 percent of travel for motorists. Such data creates an interesting dilemma for the future travel patterns of millennials. Were millennials to continue to both prioritize social activities *and* continue the rate of suburbanization, *then aggregate travel distances by car would increase due to the increase of space between accessible opportunities in suburban places*.

	Share of Travel (percent)	Average Trip Length (miles)
Social and recreational	30	11.36
To/from work	19	12.11
All other family and personal business	19	7.84
Shopping	14	7.02
Work-related business	9	28.26
School/church	6	6.00
Other	4	43.08

Figure Twenty-Four: Purpose of Travel (by Automobile).[133]

To fortify this point, observe in Figure Twenty-Five the travel behavior of US commuters as a function of their mode of travel. Among the 128 million-plus US workers who were 16 years of age and older in 2000, 87.9 percent relied on cars for commuting. Of this group, a full three-quarters traveled to work alone, while the remaining 12.2 percent carpooled. This data is not surprising; historically Americans prefer not to limit in their travel by relying upon or waiting for co-commuters. Turning to public transportation, of the 6 million workers (4.7 percent) who relied on mass transit to commute, half used buses (3.2 million), about a third used the subway (1.8 million), and a tenth used railroad (.65 million). Interestingly enough, more people in the United States seem to work from home (4.1 million) than walk to work (3.7 million).

Because raw numbers may not properly portray commuter travel behaviors, Figure Twenty-Six is included in graph-form below to complement these numbers. As can be seen, of the commuters who relied upon cars, trucks, or vans to travel to work, the vast majority (75.7 percent) drove alone. After this, the proportion of shared or non-automotive travel plummets. At 12.2 percent carpooling, the closet means of commuting remains automotive in nature. Taken together, the data represented in Figures Twenty-Four through Twenty-Six indicate that most travel is non-urban, individualized, and is social, rather than work-based, in intent. Evidently, while intra-urban mobility access is important, present patterns indicate that *there is every reason to believe improving efficiencies in suburban travel might be just as if not more important in the future.*

[133] US Department of Transportation, "Summary of Travel Times." *2001 National Household Travel Survey* (2004); O'Sullivan (2012), 258.

Travel Mode	Number of Commuters	Percent
Workers 16 years and over	128,279,228	100
Car, truck, or van	112,736,101	87.9
Drove alone	97,102,050	75.7
Carpooled	15,634,051	12.2
Public transportation	6,067,703	4.7
Bus or trolley bus	3,206,682	2.5
Streetcar or trolley car	72,713	0.1
Subway or elevated train	1,885,961	1.5
Railroad	658,097	0.5
Ferryboat	44,106	
Taxicab	200,144	0.2
Motorcycle	142,424	0.1
Bicycle	488,497	0.4
Walked	3,758,982	2.9
Other means	901,298	0.7
Worked at home	4,184,223	3.3

Figure Twenty-Five: Means of Travel to Work.[134]

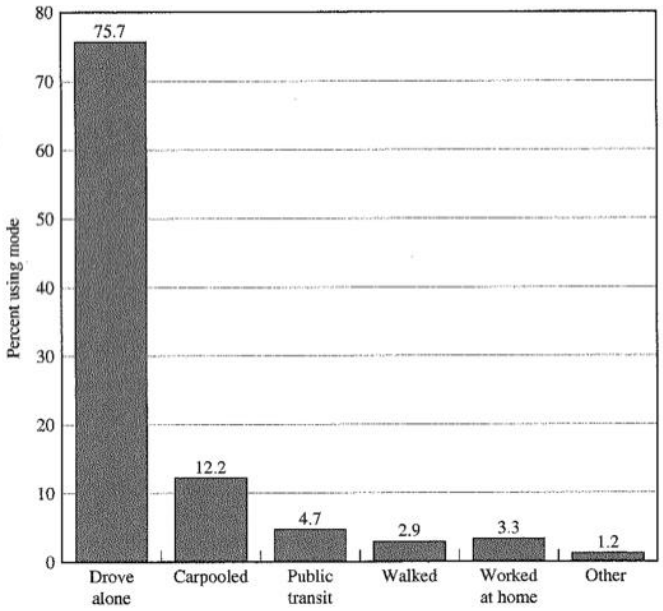

Figure Twenty-Six: Modal Travel Choice for US Commuters.[135]

Equipped with a contextual understanding of BRT, we are now prepared to return to the millennial problem posed earlier. According to BRT, millennials that opt to live in the suburbs will choose to do so not only because the price of rent may be cheaper (or even free if they live

[134] US Census Bureau, *Journey to Work: 2000* (Washington, DC: US Government Printing Office, 2004); US Department of Transportation (2004); O'Sullivan (2012), 291.

[135] US Census Bureau, (2004); US Department of Transportation (2004); O'Sullivan (2012), 258.

with their parents) but also *because they value mobility access less than the benefit of saving on home prices*. As the price of urban living continues to rise, those millennials who are cost-sensitive will suburbanize, and even invest in houses.[136] Because BRT also helps determine which millennials move to the suburbs (those who value access less than the cost of rent), it is no longer useful to retain a singular idea of "millennial." Only some millennials will move to or stay in the city. Consequently, the ability to determine individuals' likely ***price elasticity***, the sensitivity to price change, becomes imperative to those shared mobility analysts who wish to model future mobility trends. For their part, elasticity preferences will likely depend on income, wage increases, inflation, job availability, debt levels, and the fixed and variable costs of transportation. For current purposes, however, it is enough to point out that, just as distance and time costs can be interchangeable, transportation use too is intimately related to location choice.

Scaled distance is not the only consideration illustrated by BRT. Take a look at Twenty-One once more. The height of each rent-space can also be viewed as representative of the density of space, where more people live or work within a unit of space (usually a square mile. Highly compact spaces can provide advantages called ***economies of density***, the cost savings and production efficiency suppliers gain through the concentration of resources and people in space.[137] According to BRT, as distance from CBDs increase, so too do economies of density decrease. For example, the pf doubling population density has been associated with a 6 percent increase in output per productivity, while a 1 percent increase in distance from city centers has been associated with a .13 percent decline in productivity. Make no mistake, distance can cut into business profitability. One study found that doubling the distance to a regional center lowered auto-part manufacturing and agricultural production efficiencies by 6 percent, while another found doubling commuter travel time reduced productivity by 15 percent.[138]

Economies of density and economies of scale both implicitly rely on an advantageous characteristic of urban environments: ***shared inputs***. Shared inputs to production are the available supply of workers, and particularly specialized workers, whose existence reduces the search costs for businesses.[139] A typical example of shared inputs to production would be lawyers and accountants. Chart C in Figure Seventeen illustrates this example well in that the availability of specialized workers tends to scale logarithmically with urban population.

Another less-typical but increasingly-prevalent shared input to production comes as the availability of shared mobility drivers in urban environments. Like lawyers and accountants, drivers will actively travel to urban environments to find work. This was made apparent in the last paper with the narrative of Walter Howard, a full-time Uber driver who drives from the suburbs into Chicago for better business; a driver who opts to sleep in parking lots rather than drive home due to high transportation costs.[140] Some further examples of the advantages of shared inputs include trains, taxis, rentable bikes, and perhaps even carshare capital like ZipCar; all operate more efficiently, and cost less, due to economies of density and scale.

As has been alluded to, ownership rights effect accessibility and the production of goods or services. These effects are manifest in shared inputs to production. For instance, if the use of a

[136] This has been a trend in recent years. See: https://www.zillow.com/blog/trends-zillow-group-research-206775/ and https://www.zillow.com/blog/millennials-in-denver-194784/

[137] These savings are parabolic relative to density. Increased density is not always associated with benefits. See: Gill and Goh (2010), 241.

[138] See Table 2, Gill and Goh (2010), 245.

[139] Quigley (1998), 131.

[140] Labaschin (2017b), 16.

good cannot be excluded, that is if property rights are not allocated or known and the cost of exclusion is high, that good will elicit demand different to that of other exclusive goods. In cases where the cost of exclusivity is high, some goods or services will not be provided; in other cases, where there is a large social benefit to production, the government might fund their creation. Examples of high cost, high-value social goods include post offices, libraries, and museums.

To predict the production cost or availability of a commodity or service ultimately depends on two categories: ***indivisibility*** and ***rivalry***. A good is indivisible if it has a minimum size or point below which its purpose or function would undergo an economically significant negative change.[141] For example, ice rinks, sports arenas, and roads are commonly considered indivisible goods because they generally require a minimum potential user-base and because they hold standard operational sizes. Non-rivalrous (as opposed to rivalrous) goods are commodities which will still exist during and after use by consumers and are not individually allocated. In other words, one person's use of a non-rivalrous good is not *singularly preventative* of another's usage, though, as will be seen, complications do arise.

Consumer Good Types	Excludable	
	Yes	No
Divisible/Rivalrous: Yes	Private Goods Cars, Houses, Food, Clothes	Common Pool Goods Resources (Fish, Water, etc.)
Divisible/Rivalrous: No	Club Goods Buses, Shared Mobility, Toll Roads	Public Goods Cities, Public Roads, Parks

Figure Twenty-Seven: Excludable, Divisible, and Rivalrous Good Types for Consumers.

Figure Twenty-Seven differentiates the four types of goods that exist among consumer categories: ***private goods***, ***common pool goods***, ***club goods***, and ***public goods***. Private goods are rivalrous, excludable goods, their use is highly divisible, individualistic, and prohibitive. Common pool goods are often thought of as natural resources but, strictly speaking, are rivalrous goods with few naturally efficient means of exclusion to regulate their consumption. Club goods are communal goods in which their use can be priced. Most public transportation or shared activities can be thought of as club goods including country clubs, ice rinks, and shared mobility services. Finally, public goods are those goods in which divisibility and excludability do not exist, but which nonetheless have a social purpose greater than their cost.

Roads are a prime example of public goods, and rivalry in particular. Because they are not generally priced by use, rational individuals will drive on roads whenever the utility of their use is higher than their disutility. At a micro-level, this is an efficient outcome. But at a macro-level, where thousands of rational individuals are acting efficiently, rush hour traffic forms. Traffic is therefore the sub-optimal outcome of thousands of individualistically efficient choices to use a public good. Moreover, there is no rivalry in the use of the public good as no one person's road use prevents the road use of others; only in aggregate does traffic occur. Non-

[141] William J. Baumol, "Indivisibilities." *The New Palgrave Dictionary of Economics* (2nd Ed.), Editors Steven N. Durlauf and Lawrence E. Blume (2008). Accessed December 15, 2017. doi:10.1057/9780230226203.0783

rivalry is therefore to explain why in urban environments public goods are subject to crowding effects. As has been indicated, the optimization of public roads in particular remains one of the ultimate problems to urban transportation. More generally stated, relative to space and population, all non-divisible or non-rivalrous goods, including buses, roads, parks, and even cities can attract crowding. A contemporary example might help.

The Chicagoland area has its roots in rail-based transportation. The 1850s brought to the region the largest expansion of railroad infrastructure in American history. All rails led to Chicago. Where lines from the east terminated in the ports of Chicago, lines to the west began again.[142] This historical allocation of capital has benefited the area in the long run. Chicago sports three major commuter rail-lines: the CTA, the Metra, and Amtrak. Of these lines, the CTA line in particular is relied upon by Chicagoland commuters for transportation. It is therefore a useful medium to illustrate themes of inefficiency inherent to urban transportation club goods.

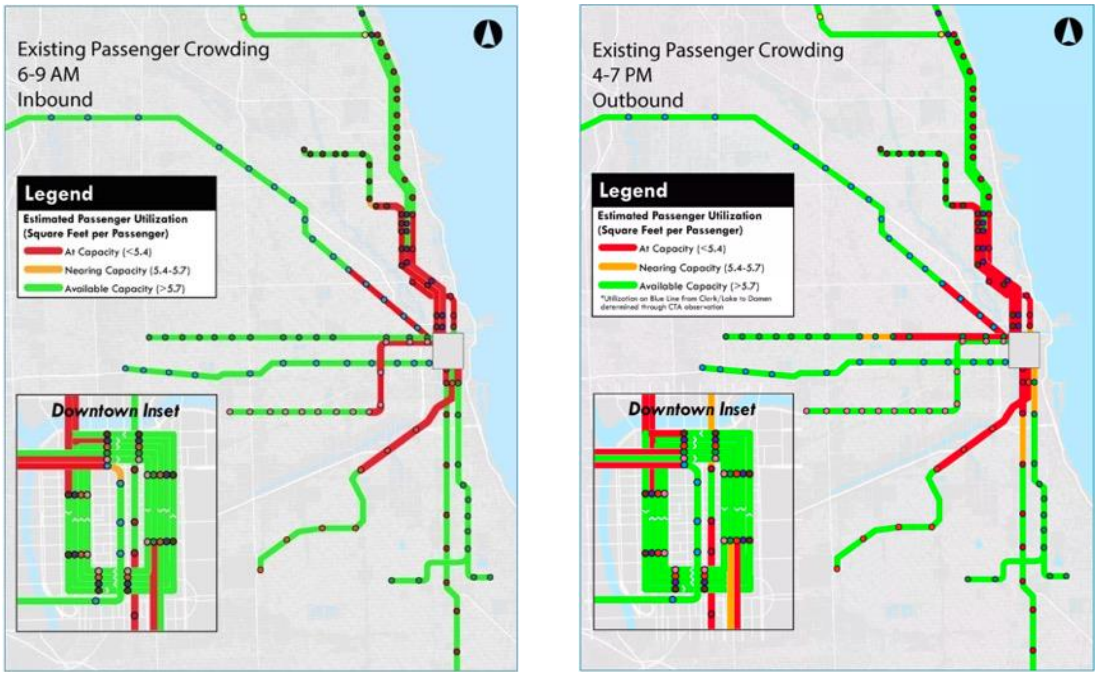

Figure Twenty-Eight: Passenger Crowding by Time of Day and Location Along CTA Lines.[143]

Take, for example, the maps in Figure Twenty-Eight. They depict commuter traffic temporally, illustrating commuter traffic at morning and evening rush hour periods. On the left is a map of inbound CTA traffic, on the right is a map of outbound CTA traffic. The green-yellow-red color scale represents the descending quantity of personal space or "crowding" commuters experience in a given area during a high-capacity commuting period. Here, crowding is defined as having less than 5.4 square feet of space between each passenger, based on Federal crowding definitions.[144]

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[142] For more on spatial economics, the influence of nature on transportation, and a classic history of Chicago, see William S. Cronon, *Nature's Metropolis*

[143] AJ LaTrace, "Where the 'L' Is Experiencing Passenger Crowding," *Curbed*, July 10, 2017, accessed December 20, 2017. https://chicago.curbed.com/2017/7/10/15945694/cta-crowding-capacity-

[144] AJ LaTrace (2017).

It is worthwhile to note here as well that from an economic perspective, rail-based traffic contrasts distinctly from automobile-based traffic. Rail-traffic is a club good and is therefore indivisible. Consequently, the nature of economic inputs entered into rail supply and consumer demand functions, as well as the considerations urban engineers make to ameliorate traffic, differ inherently from that affect travel using private goods. For instance, based on the empirical data that the CTA collected, the locations *closest* to city center experience the most rail-crowding; as distance increases, crowding decreases. These results should seem familiar. The frequency distribution of movement presented in Figure Eighteen already indicated that, at least when it comes to taxi-travel in New York, urban movement patterns are highly skewed to the right. Evidently, so too does the Chicago CTA data seem to support these findings. Using BRT, we can interpret these movements thusly: Many commuters living near the CBD of Chicago (the Loop) value accessibility more than the low cost of rent. Many therefore use indivisible public transportation to travel relatively short distances to and from work (why drive when public transit is so ubiquitous?) Once these commuters leave the train, crowding diminishes noticeably. This result indicates that a disproportionate number of commuters use rail-travel during rush hour in Chicago for relatively short periods of travel.

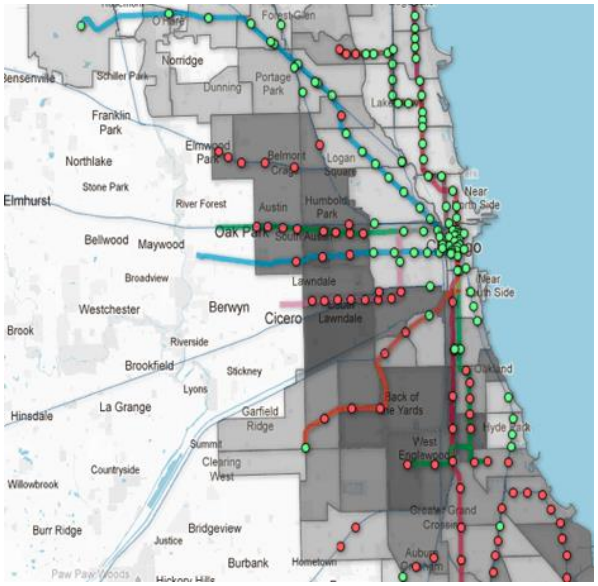

Figure Twenty-Nine: Hardship Index Over Chicagoland Area and CTA Route Map.[145]

Thanks to the repertoire of theories developed in our economic tool belt, the economic assessment of the CTA data can be expanded further still. Figure Twenty-Nine above represents CTA lines overlain upon a map of seventy-seven districts within the Chicagoland area. The white-to-grey coloring of each district represents the functional analysis of per capita income, poverty, employment, and household crowding along CTA lines. While the depth of greyness in each district depicts the area's socioeconomic endowment, each transit station represents an

[145] Nate Berg, "The Chicago Transit Authority Map of Economic Hardship," *City Lab*, July 26, 2012, accessed December 21, 2017. https://www.citylab.com/transportation/2012/07/chicago-transit-authority-map-economic-hardship/2726/

area's median poverty-line status.[146] The red dots signify locations where the median household income of families of four is less than $23,000 annually; green dots signify the opposite.[147] Lastly, the color of the lines themselves signify designated CTA transit routes.

Called the "Hardship Index" by its authors, the map above illustrates the stark relationship between location choice, urban transportation, and socioeconomics.[148] But the map becomes only more suggestive when it is crossed-referenced with the traffic data illustrated by the maps in Figure Twenty-Eight.[149] First, note the correlation within the Hardship Index between green-dot areas (above median poverty lines) and lighter district shades. When contrasted with the maps in Figure Twenty-Eight they clearly indicate that areas immediately surrounding the CBD are more affluent and crowded during rush hour. For particularly well-endowed areas such as northern Chicago, this is especially clear.

For the most part, these three maps seem to confirm the brunt of interpretations made about distance and crowding on CTA lines. But why is it that as distance increases in the south and west direction, similar crowding does not occur? Unfortunately, sufficient explanatory data was not readily at the time of this writing. But, if one were to infer, one might be justified in concluding that there is a significant correlation between socioeconomic status and distance to the south and west from the Loop. Perhaps poorer households are less likely to travel to the Loop during rush hour for work because there is less work available to them, and therefore less opportunity for socioeconomic ascension. Were this the case, it would explain the directional contrast of crowding on CTA lines.

Urban transportation networks, and therefore urban environments themselves rely on two final characteristics of agglomeration that are closely related: reductions in ***transaction costs*** and the benefits of ***risk space***. Transaction costs are all *additional* direct and indirect monetary (and non-monetary) costs incurred through socioeconomic transactions. Risk spaces are reductions to uncertainty provided by agglomerated economies. Fundamentally, both concepts rely on what in probability and statistics is called the ***Law of Large Numbers***.[150] Technically speaking, the Law of Large Numbers indicates that as a sample size grows, there is a tendency for its average to converge on the average of the population upon which it is sampled. In the economics of urban spaces, the law of large numbers affects transaction costs to production and consumption. Transaction costs to production and consumption can be thought of as a firm or individual's search cost for qualified human capital or service. It has already been mentioned that workers

[146] The calculation of poverty line is a highly specialized endeavor. Determinants include household versus individual poverty, absolute versus relative poverty, expenditure-based or itemized calculations, and temporary versus chronic poverty. This is to say nothing of headcount, income, and poverty gap ratio considerations. In the United States, federal poverty guidelines are developed by the Department of Health and Human Services, while the calculation of the poverty threshold, originally developed in the 1960s, are calculated annually by the Census Bureau for statistical purposes. For more, see: Dabraj Ray, *Development Economics* (Princeton, NJ: Princeton University Press, 1998)

[147] Christopher Whitaker and Josh Kalov, "Poverty in Chicago as a Transit Map," *CTAHardship*, 2012, accessed December 21, 2017. http://ctahardship.herokuapp.com/; LaTrace (2017).

[148] The terminology of "location choice" may be deeply misleading. "Location options" may be a more representative terminology that of the socioeconomic realities and hardships many households face as a function of race, income, and education, among other variables. Still, to economists, it is generally understood that the notion of choice is itself constrained by these variables.

[149] Maps in Figure Twenty-One are not in one-to-one correspondence to map in Figure Twenty-Two. The maps in Figure Twenty-One are slightly magnified in comparison to the Hardship Map.

[150] Quigley (1998), 132.

such as lawyers and accountants tend to scale with population. For firms who desire a workforce of certain or differentiated skillsets, the law of large numbers makes it more likely they will find the type of professional they seek in a shorter period of time. For companies such as Lyft and for consumers hoping to use their service, the law of large numbers therefore makes it more likely that in any given period there will be people willing to drive for them and people willing to be driven. For this same reason, transaction costs in suburban and rural societies must be more expensive due to the smaller population of workers to choose from.

Intimately correlated to transaction costs, are statistical economies, or ***risk spaces***. Because economic activity fluctuates (relatively few transactions are consistently made at the same time and place), delays between purchases made outside of urban centers are likelier to be larger than those made within urban spaces. Conversely, the inventory of a firm is more liable to be to be purchased in an urban environment due to the law of large numbers. To consumers, urban environments reduce uncertainty due to the increased number of purchasing options they have. An obvious example is urban transportation. Say an urban car owner discovers upon turning keying their ignition that their battery died overnight. Whereas a rural car owner would have fewer options for travel, an urban consumer has high mobility access, and can still use subway, metro, taxi, rideshare, carshare, rent-a-bike, or even horse trolley. The transportation space of urban environments is therefore "less-risky" for consumers than in other environments. Of course, when it comes to true risk, not simply the availability of transportation options, many to this day remain skeptical of taxi safety. With the growing market share of TNC services, this skepticism has become only more heightened. In the next section, the regulatory and safety concerns of academics, government officials, and taxi drivers will be explored from an economic perspective.

The State of Regulation and Litigation in Shared Mobility

No review of the shared mobility market would be complete without a comprehensive summary of the regulatory and litigative environment affecting it. The pervasiveness of the controversy surrounding ridesharing in particular is perhaps one of its most notable features. Of those familiar with ridesharing, close to half have also heard about the regulatory and litigative debates which surround it.[151] The widespread familiarity of these debates should not be surprising. As of 2015, Uber faced over 170 lawsuits in the US; and as of 2016, it had paid over $62 million in fines and settlements.[152] Today, Uber faces perhaps hundreds more lawsuits, having added four additional high-profile lawsuits to its dockets in November 2017 alone. The company now faces penalties in the *billions* of dollars.[153] Still, with a purported valuation of

[151] According to a Pew survey, 33 percent of Americans have heard "a little" about the debate, while 15 percent have heard "a lot." Smith (2016): 22.

[152] For more on the number of lawsuits see: Reuters, "Legal Troubles—Including 173 Lawsuits in the US—Threaten Uber's Global Push," *Business Insider*, October 5, 2015, accessed November 21, 2017. https://tinyurl.com/npau4hs. For a summary on payments see: Sam Levin, "Uber Lawsuits Timeline: Company Ordered to Pay Out $161.9m Since 2009," *The Guardian*, 13 April, 2016, accessed November 21, 2017. https://tinyurl.com/jsh9bw9.

[153] The most high profile lawsuit comes from Google's parent company Alphabet and its rideshare service Waymo. The company alleges, among other things, that Uber stole trade secrets, had a department dedicated to the practice, and even hired agents to infiltrate competitor companies. Alphabet seeks restitution of over $1.9 billion dollars from Uber.

close to $70 billion, fines stand to do less harm to Uber, or for that matter any TNC,[154] than the regulations, legal precedent, and injunctions that may ensue.

In these final paragraphs the legal, regulatory, and litigative landscape shared mobility TNCs face will be reviewed. Two themes will be expounded upon throughout the review: ***regulatory fairness*** and ***technological internalization***. A largely social phenomenon, regulatory fairness is the inescapable conviction among many academics, legislators, and hitherto established companies, that there now exists a two-tiered system favoring TNCs over traditional transportation networks. As will be seen, there may be truth to this perception. But the palliative measures to be taken may be far easier to swallow for TNCs than it may seem.

The second theme, technological internalization, is one grounded in practicality. It is the notion that whatever issues have manifested in transportation, whether as the consequence of TNCs or otherwise, these issues should be ameliorated through self-regulatory innovation rather than government oversight. While the former theme can only be affected indirectly through lobbying and education efforts by technology companies, the latter theme is directly addressable by companies like Arity. By focusing upon and providing market solutions to the problems which regulators wish to address, companies like Arity can anticipate regulatory obstacles and provide market solutions to the existential threats plaguing TNCs.

Of the four high-profile lawsuits in November 2017:

(1) The state of Colorado fined Uber $8.9 million in November for, among other things, allowing disqualified criminals, the unlicensed, and escaped convicts to drive for its service.

(2) A class-action lawsuit was filed by aggrieved female customers who claim Uber's background checks and screening procedures are insufficient. Claimants assert women among them have suffered rape, sexual assault, and "other gender-motivated violence or harassment" by Uber drivers. Claimants seek an injunction against Uber to change its background check procedures, also seek remuneration.

(3) In the case Flores v. Rassier LLC, claimants filed a negligence suit against Uber Technologies Inc. hours after it admitted that the phone numbers and email addresses of 50 million Uber cusomers and the personal information of 7 million Uber drivers was hacked the previous year. According to the suit, "Uber failed to implement and maintain reasonable security procedures and practices appropriate to the nature and scope of the information compromised in the data breach."

(4) Attorney General Bob Ferguson of the State of Washington filed a multi-million dollar consumer protection lawsuit against Uber, arguing that of the stolen data, 10,888 Washingtonians' rights were violated when Uber did not promptly notify them of the breach. "Under a 2015 amendment to the state's data breach law requested by Ferguson, consumers must be notified within 45 days of a breach… Washington law is clear: When a data breach puts people at risk, businesses must inform them…There is no excuse for keeping this information from consumers," said AG Ferguson.

See: (Google) Peter Henderson, "US Judge Deals Setback to Waymo Damage Claim in Uber Lawsuit," *Reuters*, November 2, 2017, accessed November 21, 2017. https://tinyurl.com/ybu8ewlj; (1) Andrew J. Hawkins, "Uber Hit with $8.9 Million Find for Letting Unqualified Drivers on its Platform," *The Verge*, November 21, 2017, accessed November 21, 2017: https://tinyurl.com/y9rtu8s4; (2) Johana Bhuiyan, "Uber is Facing a Class Action Lawsuit from US Riders Alleging Assault," *Recode*, November 14, 2017, accessed November 21, 2017: https://tinyurl.com/y74ydztv; (3) Edvard Pettersson, "Uber Sued for Negligence After Disclosing Massive Data Breach," *Bloomberg*, November 21, 2017, accessed November 21, 2017: https://tinyurl.com/y9zab7hv; (4) "AG Ferguson Filed Multi-Million Dollar Lawsuit Against Uber For Failing to Report Massive Data Breach," *Washington State Office of the Attorney General*, November 28, 2017, accessed December 20, 2017: https://tinyurl.com/yc7uquty.

[154] Transportation Network Company (TNC): Any company using an internet-based platform to connect travelers with drivers using their own vehicles for transportation.

* * *

It should come as no surprise that if economists maintain theories of urban space and cities, they also have much to say about the economics of regulation. In fact, it is a point of pride among economists that the most cited law review in history, Ronald Coase's, "The Problem of Social Cost," was written by an economist.[155] As it so happens, it is to this same review one should turn if one is to understand the economics of regulation. What made this paper so influential? In his paper, Coase argues that in a perfect world where transaction costs were non-existent—that is, in a world where all market exchanges were made directly between consumer to producer who each had perfect information—resources would flow to where they were most valued no matter their previous allocation.

Just as the assumptions in the Spatial Impossibility Theorem reflected an idealized, impossible world, so too does the ***Coase Theorem*** stress the contradiction of these circumstances. In the real world, high transaction costs often cause the misallocation of resources. Using legal precedent, Coase illustrates this point: no matter the winning legal party, in a perfect world consumers and producers would always end with the same allocation of goods. Each party would be just as well off because—and this was Coase's major contribution—*to Coase legal battles are simply attempts to properly define property rights and once these rights are defined transactions can be made more efficiently*. From the viewpoint of the efficiency-concerned economist, the historical allocation of rights and legal entitlements are inconsequential so long as these rights and entitlements can be re-allocated to those who most value them.[156]

A historical example may help to illustrate this point. In the early 1930s, the Try Me Cab Company engaged in a marketing campaign to advertise its phone-to-curb taxi-service. Swayed by this campaign and seeking a taxi, in 1933 Elizabeth Rhone made a call to the number Try Me Cab had advertised. Unfortunately, en route to her destination Miss Rhone was injured by what she claimed was the operational negligence of her driver. Consequently, Miss Rhone sued Try Me Cab Company for her injuries. But, perhaps surprisingly to Miss Rhone, the cab company responded to the suit by arguing it was not at all "engaged in carrying passengers for hire." As it turned out, the Try Me Cab businesses structure was such that it merely oversaw for "its members a telephone service" and solely provided "the advantages offered by [the] use of the corporate name [Try Me Cab Company]" to its drivers without actually owning or operating any cabs. While the Try Me Cab Company did own a license to operate cabs, it argued the drivers themselves were independent contractors and therefore it could not be held ***vicariously liable*** for the harm done to Miss Rhone.[157] To those well-acquainted with TNC politics, Try Me Cab Company's legal response should sound compellingly familiar. Seventy-five years later, a similar dissociative argument has been presented by companies like Uber.[158]

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[155] "The Problem of Social Cost," *The University of Chicago*, 2017. Accessed December 24, 2017, 2017. https://www.law.uchicago.edu/lawecon/coaseinmemoriam/problemofsocialcost

[156] R.D. Cooter, "The Coase Theorem," in (eds.) J. Eatwell, M. Milgate, P. Newman, *Allocation, Information and Markets* (The New Palgrave: Palgrave Macmillan, London: 1989), 64.

[157] Agnieszka A. McPeak, "Regulating Rideshare Platforms Through Tort Law," *University of Hawai'I Law Review* 39, no. 357 (2017), 358; Rhone v. Try Me Cab Company, 65 F. 2d 834, 835 (D.C. Cir. 1993).

[158] Sam Shead, "Uber's Main Argument for Why It Doesn't Need to Give Driver's Worker Benefits is Flawed, Lawyer Claims," *Business Insider*, September 28, 2017, accessed December 24, 2017. http://www.businessinsider.com/lawyer-fighting-for-uber-drivers-uber-cant-call-itself-an-agent-2017-9

The crux of both Try Me Cab Company and Uber's argument lies in the strict legal definition of ***respondeat superior*** ("let the master answer"), which stipulates that the consequences of an employee's actions made under the guise of their employment are made with vicarious liability to their employer. Just as the concept of the Limited Liability Corporation reduces the uncertainty entrepreneurs face in starting businesses that could one day fail, so too does the concept of *respondeat superior* grant employees the freedom to enter employment without the risk of being made culpable for the actions to which they are assigned. So, in the case of Rhone v. Try Me Cab Company, the disagreement lay not in whether Miss Rhone was injured, but rather the assignment of *liability* to that injury. A review of the Try Me Cab Company summarizes well the court's interpretation of Try Me Cab Company business practices:

> In essence, Try Me Cab Company went to great lengths to design its business to avoid being liable, but the court looked beyond the company's own characterization of its role. It noted how the public relied on the company's advertising, and that the company itself created a perception of responsibility through the use of its name and logo in advertising transportation services. The court looked at the reality of the company's business and held that the facts supported the use of vicarious lability.[159]

Because the United States legal system is shaped by legal precedent (*stare decisis*), it is imperative even today to appreciate the nuanced reasoning behind the assignment of vicarious liability to Try Me Cab Company. Though Try Me Cab may have believed itself to be something of a precursor TNC, the manner in which it advertised itself to the public and the public's perception of the company itself gave the court cause to assign it as *respondeat superior*. The findings of the court also serve to explain why it is imperative to companies like Uber that they drive home to the public the notion of their driver's independence: if they did not do so, they could be found *respondeat superior*.

Beyond the specific details of Rhone v. Try Me Cab Company, the case also serves to illustrate Coase's interpretation of legal battles. At a macroscopic level, the legal battle Miss Rhone waged with the Try Me Cab Company, and indeed many of the current legal battles against TNCs, are attempts *to properly define who owns the property rights of their labor*. Contrary to what one might expect, many drivers argue that, because they are managed by TNCs, *they do not own their labor outright and therefore should not hold fiscal pure responsibility for their employment.* Many TNCs argue just the opposite. To Coase, these legal battles are simply a means to establish rights, and once these assigned, both employers and laborers can negotiate an exchange of these rights more efficiently. But, Coase is also no idealist, he understands that because in the real-world transaction costs are often high, the allocation of these rights may not resolve with most efficiency. For instance, it may result in places like London that workers end up with more rights than is economical for TNCs to operate. Such a result, indeed even such a possibility, may cause TNCs to look for alternate means of operating their businesses, such as the use of autonomous vehicles. Consequently, if one were to take one thing away from the Coase Theorem, it should be this: most often rights and entitlements *are not* exchanged freely. Whether inefficiencies exist through a lack of technology and organization, or because

[159] McPeak (2017), 358; Rhone v. Try Me Cab Company, 65 F. 2d 834, 835 (D.C. Cir. 1993).

intermediary institutions hold a monopoly on producer-to-consumer transactions, costs will often be higher than they otherwise would.

Shared mobility platforms may work to dismantle and decentralize these institutional inefficiencies. A 2015 report on the shared economy compiled by information systems experts describes the effects of shared economy marketplaces in Coaseian terminology. According to these analysts, shared economy platforms are "…just a few shining stars in a galaxy of internet-based platforms that enable a new economy, one that is based on the exchange of goods and services between individuals that *disintermediate* traditional commercial channels and increase the impact of excess resources."[160] In other words, the emergence of shared mobility platforms have helped to reduce the transaction costs and inefficiencies associated with the transportation through market through technological internalization. Using Coaseian terminology, in the absence of technological internalization many market transactions would be costlier, thus resulting in so-called ***market failures***—the suboptimal consequence of market inefficiencies.

Until the emergence of mobile telematics and data analytics, the socio-political means of mitigating market failures were more limited. At one end of the spectrum was ***laissez-faire*** economics. Stemming from the French Physiocratic movement, which asserted that all production value stems from land and agriculture, the laissez-faire doctrine advocates for market non-interference. Given enough time, advocates might say, the market will fix itself. At the other end of the spectrum is the interventionist philosophy of ***regulatory economics***. At its extreme, proponents of this philosophy assume the market to be endlessly imperfect and that, unless institutions are formed to monitor and regulate exchanges, market failures will continually occur.

Over time, each philosophy has had attached to it dogmas that have obscured the shared objective by both approaches: to overcome ***use-based market failures*** and ***exchange-based market failures***. Use-based market failures, or externalities, occur when individuals and firms have not taken into account the costs of their activities on third parties. A classic example of a use-based market failure is the pollution emitted from cars. Drivers need not worry about the effect of this pollution on, say, respiratory health because they are not held directly responsible. At the risk of over-simplification, most economists would claim that use-based market failures could be solved simply by pricing activities appropriately. For instance, if the price of gas included the cost of pollution to society, theoretically drivers would drive less.

Far more complicated are exchange-based market failures, which generally occur due to the misallocation of information between parties. Perhaps not coincidentally, the most well-known example of exchange-based failure also happens to be a useful medium for understanding the economics of regulation. Known among economists as "The Market for Lemons" Problem, for some time this problem had eluded simple explanation by theorists. "Just what economic theory best explains why the price of a car falls the moment it is driven off the lot," spectators asked. Was it the utility of vehicles that changed? Perhaps the loss of value had something to do with margins… The answer, eventually provided by economist George Ackerlof, also happened to illustrate the role telematics and analytics companies can play to improve both economic efficiency and the lives of everyday people.

Ackerlof's answer to the Lemon's Problem, it turned out, relied on the economist's distinction between ***risk*** and ***uncertainty***. Since the early 1900s, the layperson's definition of risk and uncertainty seemed too imprecise to economists seeking to use these concepts. What was

[160] Italics added. Michel Avital, et. al., "The Sharing Economy: Friend or Foe?" *Thirty Sixth International Conference on Information Systems*, Fort Worth, Texas (2015), 2; B. Solomon, "The Numbers Behind Uber's Exploding Driver Force," *Forbes*, May 1, 2015, 2.

needed was a universally accepted understanding of what risk and uncertainty were. In 1921 economist Frank H. Knight delivered a solution to this problem in his influential book *Risk, Uncertainty, and Profit*. To Knight, it was clear that true risk only occurs "…when future events occur with measurable probability." Any incalculable risk, that is any future outcome that could not be mathematically defined, was to Knight no risk at all: it was uncertainty.[161]

It may seem to some as though Knight's contribution was insubstantial. After all, a definition cannot stimulate new economic activities. Indeed, many institutions concerned with future outcomes already depended on the quantifiability of risk for some time, such as insurance companies with their concern for claims loss or provides of credit with their concern for consumer default. Still, as hopefully evidenced by reports such as this, sometimes the long-term benefits of market understanding are more useful than the short-term benefits of strict market production. Like a physicist's equation or a botanist's classification, Knight's contribution gave the clarity of comprehension to economists seeking to identify market dynamics.

Knight's timing could not have been better. With the onset of the Great Depression eight years after his book's publication, his definitions would prove to be both prescient and useful. Recall, if you will, that starting in 1929 the exuberant consumption habits of a public newly acquainted to on-demand credit schemes that started with the automobile quickly soured with the collapse of the stock market and lowering labor productivity rates. The public's mass retreat from their consumptive lifestyle combined in a perfect storm with the insecurity of future income. As income insecurity rose for the individual, so too did the looming visage of credit default. The creeping image of the repossession of their property was too great for many. In the face of this uncertainty, of not knowing just how much one would have in the next month, consumers attempted to reduce the likelihood of default, of risk, by saving more and spending less. The result was mass economic contraction.

The cumulative effects of the Great Depression demonstrated to the world two things: first, under the right circumstances uncertainty can be as or more significant than risk. Not being aware of what the future holds may affect behavior as much or more than if future events could be expected. Second, and by that same token, risk and uncertainty are two sides of the same coin; as uncertainty rises consumers might react by attempting to reduce risk in unexpected and even economically unfavorable ways. As a consequence of this realization, a new regulatory paradigm emerged from the ashes of the Great Depression. Many legislators began to believe that the costs of laissez-faire economics were too high a price to pay for the intricacies of the modern world and a modern economy. To legislators radical New Deal reforms were needed to reduce uncertainty, to make known to the public that which is unknown, and to shift the scales of market action toward quantifiable risk rather than unquantifiable uncertainty. Legislative acts were passed in quick succession. This new regulatory paradigm manifested in 1933 with the passage of the Banking Act (Glass-Steagall) and the Securities Act. The express intention of each act was informational; the former sought to improve the transparency of securities offered and traded to the public, the latter sought to reduce asset sale bias between banks.[162]

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[161] Morgan Rose, "Risk versus Uncertainty, or Mr. Slate versus Great-Aunt Matilda," *Library of Economics and Liberty*, November 5, 2001, accessed December 26, 2017. http://www.econlib.org/library/Columns/Teachers/riskuncertainty.html; *Merriam Webster's Collegiate Dictionary*, Tenth Edition (1996), 1011, 1285.

[162] Youssef Cassis, "Regulatory Responses to the Financial Crises of the Great Depression: Britain, France, and the United States," *Duke University* (2017), 10.

Regardless of their effectiveness, this legislation endeavored to reduce exchange-based market failures by decreasing ***asymmetries of information***—situations where either producers or consumers withhold or are denied relevant and potentially vital information during market exchanges. Laissez-faire philosophy argues that informational asymmetries, and for that matter all inefficiencies, tend to work themselves out naturally through either reputation (*i.e.* consumers cease to shop at used car lots) or through increased competition (*i.e.* prices will decrease to such a point as to represent the real value of used cars.) For the most part, laissez-faire theory is correct; in the long-run, the free market does tend to correct itself through pricing mechanisms. But not always do these corrections occur. Already there have been offered at least three situations in which pricing alone does not naturally cure the market of its ills. Traffic congestion, pollution, and market irrationality are all examples of market failures that have occurred in some manner for hundreds of years. Consequently, the regulatory philosophy such as that adopted during Depression-era America, believed that by leveling the informational playing field, uncertainty would be reduced and consumers would be able to make efficient choices. Unfortunately, so many factors played into the macroeconomic conditions of the Great Depression that the effects of information uncertainty remained unappreciated until around the 1970s when economists like Joseph Stiglitz and George Ackerlof began to explicitly demonstrate the importance of informational asymmetries through microeconomic analysis.[163]

For his part, Ackerlof would demonstrate his ingenuity by exploring the effects of uncertainty in the purchasing of used cars. Ackerlof approached the Lemons Problem by first making a realistic assumption: when faced with two seemingly similar cars, the average consumer will not be able to distinguish between the high-quality and low-quality car. Under this assumption, Ackerlof determined that uncertain consumers will average the value of these two cars. High-quality cars will therefore be priced less than their true value, while low-quality cars will be priced higher than their true value. According to these conditions then, where only sellers are aware of the value of their car, those selling "lemons"—low-quality defunct cars—would be the only suppliers willing to sell at the prices consumers offer. Perceiving these prices as insufficient, sellers of high quality cars would then choose to leave the used car market altogether. With fewer high-quality options available to them, consumers would only become more uncertain of car quality, and would therein reduce their average valuation of cars further until such a point that *only* lemons exist.[164] Finally, the almost instantaneous reduction in price of new cars leaving the lot becomes clear. Even if these cars are returned within enough time to minimize capital depreciation, producers will be compelled to reduce the resale price of high-quality used cars due to the uncertainty of their condition from the perspective of consumers.

As can be seen from Ackerlof's Lemons example, transactional costs can manifest in the needless *reduction* of price just as easily as a rise. Ackerlof's explanation also nicely demonstrates how market inefficiencies can arise from informational uncertainty. In such cases as the Great Depression, when the costs of informational failures were higher than society could stand, regulators would step in and establish rules that theoretically would enlighten consumers and reduce uncertainty.

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[163] Cassis (2017), 2, 7; Michael Rothschild and Joseph Stiglitz, "Equilibrium in Competitive Insurance Markets: An Essay on the Economics of Imperfect Information," *The Quarterly Journal of Economics* 90, no. 4 (1976), 629.

[164] George A. Ackerlof, "The Market for 'Lemons'" Quality, Uncertainty, and Market Mechanism," *The Quarterly Journal of Economics*, 84, no. 3, (1970).

Theoretically, informational transparency sounds like it would be a net benefit to all, but such rules often elicit negative responses from businesses and laissez-faire oriented individuals. While it is possible some of these grievances may come from a disingenuous place, most of these complaints do not.[165] Often firms that take issue with informational regulation do so because of the ***increasing marginal cost of information***. In a word, the gathering of useful information is costly; with every additional unit of information collected, analyzed, and distributed, comes a concomitant marginal increase in transaction costs for businesses.[166] Consequently, firms seek only to provide enough information as to cover the costs of processing and delivering it. Theoretically then, the information firms provide would be sufficient. If it were not, consumers facing asymmetrical information would not engage with the market. In the case of used car markets, rational consumers would simply not buy a car they were unsure about, leaving only uncaring or risk-seeking individuals to purchase cars from these markets.[167] In reality, to average consumers purchasing potentially dangerous goods and services such as automobiles, asymmetric purchasing information is intolerable. In large part, society has agreed, and has compelled the sellers of potentially dangerous goods to be regulated.

When it comes to regulation, most economists fall somewhere between the extremes of laissez-faire ideology and regulatory fervor. At the end of the day, the usefulness of regulation versus non-intervention comes down to competition and price. Western economists are, in general, loath to recommend price controls (*e.g.* set maximum airline ticket prices) in markets of three or more competitors. As far as they are concerned, unless cartels exist to artificially maintain high prices, competition should act to lower prices to natural representative levels. At the same time, economists are equally averse to market entry-controls (*e.g.* hair-dresser licensing laws), and only tend to endorse barriers-to-entry in circumstances where low-quality goods and services are deemed inadmissible such as in cases of defective brake pads.[168]

So, what would most economists have to say about these measures when it comes to the problems afflicting the TNC operations? It is a fair bet that many economists would point out that, by their nature, TNCs hold low barriers-to-entry. Theoretically, all someone would need to establish shared mobility company is a business license and the ability to code a smartphone application. Indeed, for emergent phenomena, there are a variety of TNCs from which consumer

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[165] In regards to business and regulation, Adam Smith is often quoted as having said that, "People of the same trade seldom meet together, even for merriment and diversion, but the conversation ends in a conspiracy against the public, or in some contrivance to raise prices." Smith continues to say, however, that, "It is impossible indeed to prevent such meetings, by any law which either could be executed, or would be consistent with liberty and justice. But though the law cannot hinder people of the same trade from sometimes assembling together, it ought to do nothing to facilitate such assemblies; much less to render them necessary." In other words, though Smith was quite careful of the incentives businesses had to avoid regulation or to artificially maintain high prices, he was also cognizant of the role the government could play to hinder business practices.

Adam Smith, *On the Wealth and Poverty of Nations*, 1776, edited by Edwin Cannan (5th ed.) (London: Methuen & Co., Ltd., 1904), I.10.82

[166] For more on the cost of information and choices, see: Randall L. Calvert "The Value of Biased Information: A Rational Choice Model of Political Advice," *The Journal of Politics* 47, no. 2 (1985).

[167] John C. Moorhouse, "Consumer Protection, Regulation, and Information on the Internet," in *The Half-Life of Policy Rationales* (eds.) Fred E. Foldvary and Daniel B. Klein (New York University Press: New York and London, 2003).

[168] Robert Litan, "Regulation," *The Concise Encyclopedia of Economics*, 2008, accessed December 25, 2017. http://www.econlib.org/library/Enc/Regulation.html.

can choose; from carshare companies (*e.g.* ZipCar, Car2Go, Turo, Maven, and more) to rideshare companies (*e.g.* Uber, Lyft, Sidecar, Flywheel, and more) there is little evidence to support the notion of monopolistic or oligopolistic behavior in the shared mobility market.

Then again, an unbiased economist would also be quick to point out the unmistakable truth that ridesharing prices are artificially depressed. According to investor-released financial data, by the end of fiscal year 2015 Uber had lost over $2 billion in driver bonuses and fare subsidies.[169] For its part, Lyft has also been spending hundreds of millions of dollars in similar efforts.[170] The implications of price depression are complicated. For one, high subsidies raise questions of the sustainability of the rideshare market. Many drivers report that, without driver bonuses and incentives, they would not be able to continue driving solely for one company.[171] This would be fine enough, but historical precedent already indicates that rideshare's reduced prices come at the cost of existing transportation infrastructure, namely taxis.

The perception that there exists a two-tiered system between taxi companies and TNCs is prevalent in both the academic literature and within the taxi industry.[172] Indeed, academics and taxi services have consistently taken issue with what they perceive to be unfair regulatory advantages since personal taxiing services began between 1914-1917. In 1915, Nebraskan taxi drivers began to protest the unfair competition independent drivers brought to the market, complaining that jitney prices were too low.[173] Though initially successful in lobbying to regulate jitney services out of existence, taxi drivers could not themselves avoid the watchful eye of the government. The taxi industry of the early 20th Century experienced myriad regulatory prescriptions including measures to limit barriers to entry, transit prices, vehicle types, and service quality. By the time of the Great Depression, when jitney-like services again began to creep into existence, commercial and private taxi services caused so much congestion that cities responded by requiring drivers to hold operational licenses or "medallions." By limiting the number of medallions available to drivers, not only could cities theoretically reduce congestion, they could also form a market out of a newly scarce resource from which they could earn revenue.[174]

As time passed and society advanced, so too did regulations only increase for taxi companies. Soon taxicabs were also required to carry taximeters, radio equipment, and roof-mounted service signs. Regulations eventually stretched to stipulate the maximum age of vehicles in operation, their colors for easy identification, the cleanliness and composition of their

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[169] Yves Smith, "Can Uber Ever Deliver? Part One – Understanding Uber's Bleak Operating Economics," *Naked Economics*, November 30, 2016, accessed December 23, 2017. www.nakedcapitalism.com/2016/11/can-uber-ever-deliver-part-one-understanding-ubers-bleak-operating-economics/

[170] Johana Bhuiyan, "Lyft Is on Track to Turn a Profit, But Will Need to Spend More to Add Riders and Drivers as It Expands," *Recode*, January 13, 2017, accessed December 23, 2017. www.recode.net/2017/1/13/14267926/lyft-growth-revenue-losses-profitability-discounts-incentives

[171] Jacob Bogage, "Uber's Controversial Strategy to Finally Defeat Lyft," *Washington Post*, August 23, 2016, accessed December 23, 2017.

[172] For examples, see: Tamer Cetin and Elizabeth Deakin, "Regulation of taxis and the rise of ridesharing," *Transport Policy* (2017); Deanna Dupuy, "The Regulation of Transportation Network Companies," *Agora* (2017); Michel Avital, et. al., "The Sharing Economy: Friend or Foe?" *Thirty Sixth International Conference on Information Systems*, Fort Worth, Texas (2015).

[173] Adam Hodges, "'Roping the Wild Jitney': The Jitney Bus Craze and the Rise of Urban Autobus Systems," *Planning Perspectives* 21 (2006), 262.

[174] Cetin and Deakin (2017), 2.

interiors, the identifiability of their drivers, and even required the installation of barriers for driver and passenger safety. Many cities went even further, banning shared taxi pickups, guaranteeing that passengers were provided exclusive transport to their destinations. Finally, companies were also required to maintain records of all transportation activity and to permit audits of their records at a city's behest.[175]

Fast-forward to today, and with the onset of the rideshare revolution, one cannot help but draw parallels between the protestation of early 20th Century taxi drivers and those made today in cities the world over such as Paris, Bogota, Mexico City, and more.[176] So commonplace have protests and lawsuits become against Uber alone, that there is now a Wikipedia page to track them globally: http://www.wikipedia.org/wiki/Uber_protests_and_legal_actions. Today, as a century earlier, the taxi driver's refrain remains essentially the same: Why are taxi drivers regulated more than personal-line taxiing services?

To the economist, this question seems more than fair. Perhaps for just as long, economists have seen logical fault-lines in the differentiation between personal and commercial taxi-services. In 1915 economist F. W. Doolittle, in a review of the economics of jitney operations, pointed out that the legal distinction of transportation has been key to their regulatory treatment. Doolittle pointed to the 1914 findings of the Bureau of Fare Research of the American Electric Railway Association which stated that:

> According to a recent decision of the Oregon courts, a "common carrier" is one who, as a regular business, undertakes to transport persons or commodities for all who will pay his charges, a "jitney" bus is undoubtedly a common carrier. Moreover, since a state legislature has power, subject to constitutional limitations, to prescribe reasonable regulations for the conduct of common carriers . . . and may do so through a commission, a way is open for the various railroad and public utility commissions to assume regulation of the jitney bus industry. … It may be urged that "jitney" buses are taxicabs and are therefore immune from regulation, and yet a taxicab company, in the business of transporting persons for hire from one part of the city to another and holding itself out to carrying one and all, is a common carrier of passengers, and therefore subject to regulation.[177]

For those unfamiliar with transportation law, Doolittle is quite simply reminding his readers of the power of local, state, and federal courts to assign to transportation providers "private carrier" or "common carrier" status. Beyond mere words, the legal classification of transportation firms and services will determine the *respondeat superior* liability of rideshare companies and, correspondingly, the regulations drivers face. Here, yet again, the parallels between modern day transportation debates and those of the past are almost staggering. To this day, TNCs such as Uber appreciate all too well the implications each status assignment holds and attempt to avoid

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[175] Ibid.

[176] Avital, et. al., (2015), 2; Rory Mulholland, "Uber Protests Sweep Europe," *The Telegraph*, June 11, 2014, accessed December 26, 2017; Reuters Staff, "Thousands of Bogota Taxi Drivers Protest Uber, Cabify, and Higher Costs," *Reuters*, October 23, 2017, accessed December 26, 2017; Christopher Woody, "A Protest Against Uber in Mexico 'Paralyzed the Roadways' Before Turning Into a Violent Street Riot," *Business Insider*, March 9, 2016, accessed December 26, 2017.

[177] F. W. Doolittle, "The Economics of Jitney Bus Operation," *Journal of Political Economy 23*, no. 7 (1915), 680-681.

common carrier status as best they can.[178] To TNCs, a shift in carrier status would essentially leave them vulnerable to the costly regulation that taxi cabs face.

For all the good regulators thought they were doing, the success of their regulations may have been unfounded. Evidence indicates that barriers-to-entry and price controls have only stripped consumers of choice, limited transportation innovation, and have even worked to limit areas of operation to locations such as hotels and tourist attractions. Starting in the 1960s, economists began to voice their dissent against the burdensome regulations applied to a variety of transportation institutions. While local, state, and federal governments the world over largely heeded these arguments, reforming airline, rail, and motor carrier industries, most cities opted not to deregulate the taxi industry. Those cities that did reform taxis did not find an appreciable difference in quality or service, consequently for quite some time there has been a lack of political courage to engage in further reforms.[179]

Regulation	Justification	Critique
entry restrictions (limits on number of taxis, medallion requirements)	avoid race to the bottom and loss of participants due to "destructive competition"	opens up risk of regulatory capture; evidence that competition in taxi industry is destructive is mixed at best; limited number of operators may not be able to respond to growth and change in market demand
regulating prices	barriers to entry and economies of scale in the taxi industry (due to dispatching and vehicle fleet factors) risk monopoly	former modest barriers to entry such as radio dispatching and vehicle fleet management are vanishing, rapidly being replaced by cellphone technology and third party vehicle provision and maintenance; price regulation leads to politically set fares that do not necessarily reflect market realities
regulating prices/ price setting	need for clearly established rates due to asymmetric price and route information between driver and customer	data available on smart phones and tablets have made this information readily available to most customers as well as drivers
regulation vehicle age, make, condition, markings, etc.	consumer protection, environmental protection	can be managed through less intrusive, more flexible, more effective information systems, inspections, audits, pricing strategies, etc.
driver training requirements	driver competence, knowledge of area	can be managed through normal licensing; customer rating systems; knowledge of street system partly replaced by GPS systems

Figure Thirty: Justifications and Critiques of Taxi Regulation.[180]

[178] **Better souce.** Robert Hackett, "The Latest Victim of Uber's Disruption May Be Itself," *Time*, March 9, 2017, accessed December 28, 2017.

[179] Cetin and Deakin (2017), 2-3

[180] Ibid, 3.

With the onset of the shared economy revolution, the questions of taxi regulation, fairness, and efficiency have once again emerged, though in an altogether different socio-political landscape. Today, technological innovations in mobile connectivity, telematics, and data analytics have fundamentally shifted the character and functionality of the transportation industry. Consequently, today many of the aforementioned regulations designed to reduce volatility, improve consumer safety, and ensure fairness may no longer be relevant. Transportation staples such as taximeters, radio equipment, roof-mounted signs, and vehicle models and colors have clearly become antiquated due to the capabilities of cellular technology. So, the question remains, why are taxis still regulated as they are and, moreover, why should TNCs care about the regulatory status of taxicabs? Figure Thirty lays out the four major contemporary arguments for and against taxi regulation: entry restrictions, price regulation, vehicle regulation, and public safety regulation. Whereas in the past the latter three issues had been costly enough for municipalities to justify the regulation of taxis, the modern critiques of these justifications demonstrated in Figure Thirty indicate that, overall, mobile technology can act to internalize these inefficiencies. When it comes to practical matters, GPS technology, informational databanks, and supply and demand algorithms are at least as transparent and efficient, if not more so, than the mechanics that previously underlay the taxi industry. As for the regulation of market entry, which is meant to ameliorate one of the oldest inefficiencies both TNCs and taxi companies contribute to, congestion, as yet no efficient technological solution has emerged. This is unfortunate because nowhere is the two-tier system between commercial and private mobility made more obvious to legislators than in the congestion caused by meandering Uber and Lyft drivers in downtown Manhattan.[181] That said, it seems obvious that the creation of a mobile-based pricing system to maintain efficiency is well-within the capabilities of telematics and analytics companies, and that this would serve as a far superior solution to preventative licensing and medallion agreements.

[181] Winnie Hudec, "Your Uber Car Creates Congestion. Should You Pay a Fee to Ride?," *New York Times*, December 26, 2017, accessed December 26, 2017.

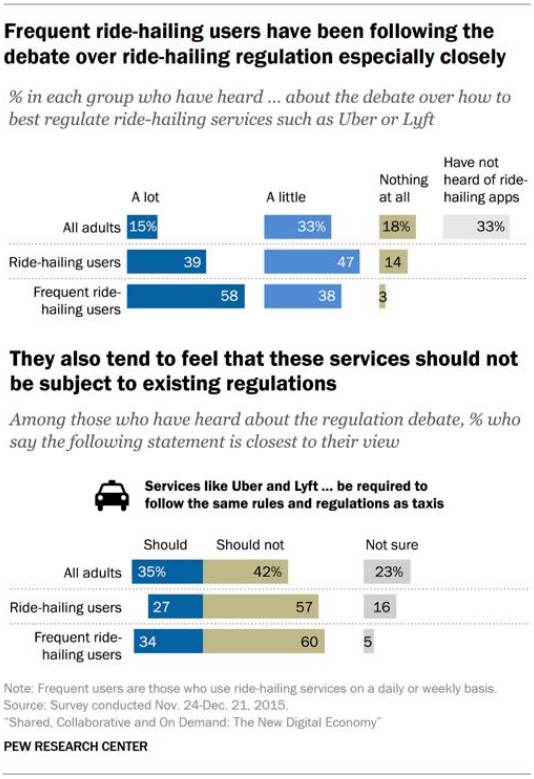

Figure Thirty-One: Opinions on Regulation of TNCs.[182]

As for TNCs, why should they care about regulatory fairness? Using ***game theory***, or the economics analysis of competitive strategy, it seems clear that if TNCs are to operate unencumbered by similar regulatory efforts in the future, they will have to do so in a world where the taxi industry is on equal regulatory-footing. Not only does the technology exist for taxis to operate similarly to ridesharers, but were taxis to remain in regulatory limbo, there is every reason to believe they would continue to lobby for similar regulations to apply to rideshare providers and TNCs.

Thankfully, public sentiment currently seems to favor of deregulation. According to research from the Pew Research Center illustrated in Figure Thirty-One, frequent users of rideshare apps both follow the debates surrounding the industry closely, and do not believe TNCs should be regulated like the taxi industry. In fact, regardless of their use-patterns, most of the adults surveyed seemed to hold this perspective. Consequently, it does seem as though the pendulum will swing towards deregulation. Still, appearances are only part of the equation. If TNCs are to continue to operate and grow on level-footing, they cannot face the burdens of regulation similar industries faced a century earlier. Lobbying and education efforts are required to demonstrate the improved efficiencies technology has brought to the transportation sector. What is more, if regulation is to truly be avoided, systems must be established to reduce traffic congestion caused by taxi companies and TNCs.

And if similar regulations do occur, if TNCs are encumbered by similar regulations the taxi industry has experienced over the last century, what then? Economically speaking, if this does occur, TNCs will work to mitigate costs in other, less cumbersome ways. Indeed, it would

[182] Smith (2016): 22.

seem as though the shared mobility sector is already working towards this end by investing in only more technological breakthroughs.[183] In no uncertain terms, the disruption set to occur in the transportation industry through the adoption of AVs is not simply meant to be innovative, in every respect it is an effort to cut costs. And if regulations are anywhere near as strenuous on TNCs as traditional taxi industries, one might expect the industry to invest only more regularly in AVs. That is, unless AV technology itself is not outlawed, or at least taxed out of existence. Indeed, the technological disruption that has been shown to occur throughout this report may well face growing opposition. Movements by some of the most successful thought leaders including Bill Gates and Nobel laureate Robert Shiller have begun to suggest robots and technology face the same taxes humans do.[184] Despite these proposals, the pace of AV adoption is set certainly to increase technological unemployment, perhaps drastically, in the taxi industry, the rideshare industry, and even the trucking industry. If protests have occurred due to unfair pricing and cumbersome regulation, what will be the effect of the wholesale disruption of the transportation industry? In the next report, just a fraction of these concerns about the future of transportation, and the future to which societies may be headed, will be reviewed.

Conclusion

In this extensive report, great consideration has been made of the present state of the shared mobility market. By building upon the theory and insight gleaned from the previous two reports to this series, a comprehensive analytical foundation has been established of the shared mobility market that, it is likely, will not be found in any other place. Beginning with the establishment of the economic history of rideshare, these reports have identified and analyzed specific socioeconomic patterns that, time and again, have emerged as relevant in the shared mobility sector. These factors include, but are not limited to: the costs and benefits of transportation and car ownership, the cultural and civic perceptions of rideshare risk and safety, and the effects of technological innovation on travel habits.

Having identified the critical socioeconomic inflection points of shared mobility, great effort was then taken in proceeding reports to explain the mechanics which generate them. In part one of the analysis of the present, particular effort was taken to integrate the economic theories of labor, property rights, capital allocation, and incentives with the shared mobility market. The current shared mobility market cannot be properly understood without a basic understanding of these theories. Only those with an appreciation of socioeconomic theory can adequately comprehend the market shifts occurring in the modern transportation industry and then, critically, anticipate future shifts that may occur. To accomplish this task of forecasting, an analyst must possess at minimum an appreciation of economic incentives and disincentives

Where part one of the analysis of the present ended by describing the moral hazards inherent to the carshare sector (the Tragedy of the Commons), part two extrapolated on the theme of incentives in a new way. By completing the review of the automobile revolution that ended in the Economic History of Rideshare, an essential economic truth was established:

[183] Samuel Gibbs, "Uber to Buy 24,000 Autonomous Volvo SUVs in Race for Driverless Future," *The Guardian*, November 20, 2017, accessed December 28, 2017.

[184] Arjun Kharpal, "Bill Gates Wants to Tax Robots, But the EU Says, 'No way, No Way," *CNBC*, June 2, 2017, accessed December 28, 2017; Robert Shiller, "Why Robots Should be Taxed If They Take People's Jobs," *The Guardian*, March 22, 2017, accessed December 28, 2017.

consumers are not just incentivized by what they stand to gain, they are perhaps equally (if not more) incentivized by what they stand to lose.[185] As debt rose in the early 1900s thanks in large part to novel credit schemes designed to market automobiles, the sudden shock of the stock market crash of 1929 created great economic uncertainty among the public. Suddenly a reckoning occurred as businesses and investors realized they had been blind to the realistic state of the economy. Despite the auspicious portents of persuasive public figures like Henry Ford and Frederick Taylor, they now realized that labor productivity was unavoidably down. This would have major consequences on the incomes of the public. In response to this uncertainty, the public largely chose to restrict their spending in order to ensure their loans were paid off; defaulting on their loans and continuing the exorbitant spending habits of the 1920s was not an option. The shift in consumption had a contractionary effect on the economy, changing the face and shape of the nation in the process.

After describing the unavoidable traits of the economic individual, it was then brought to the reader's attention that, according to the most comprehensive surveys of rideshare users, millennials (in the broadest sense of the term) are the largest cohort of rideshare users. millennials also happen to be, far and away, the most indebted generation. Data was presented to show that, since the Great Recession, millennials have been the only generation to *reduce* their spending habits. The claim was then made, not without merit, that debt has largely shaped the consumption habits of millennials, therein explaining in some part why millennial rideshare user are also less likely to own vehicles. In so many words, evidence has amassed to indicate that debt is shaping the modern economy and the modern transportation industry.

In that vein, the analysis of millennial debt was only expanded. The evidence presented had only generated a looming question: Why are millennials so indebted in the first place, and does their debt somehow relate to the rise of the shared mobility sector? After further analysis, it became apparent that, indeed the prominence of shared mobility use and the indebtedness of millennials both largely stem from the technological shock of the I.T. Revolution.

Much of the I.T. Revolution was explained in part one of the analysis of the present. The biggest take away from that section was that the ubiquity of mobile technology has altered the shape and form of the modern economy and allowed for the development of modern shared mobility platforms. In part two of the analysis, it has now been shown that, just as falling (real) smartphone prices have allowed for the increased interconnectivity of the public, so too has there been a concomitant shift in the ecology of jobs in western economies. Using data from the UK and the US, it was shown that non-routine cognitive jobs are experiencing greater growth numbers than routine or non-routine manual jobs, which in many cases have shrunk. The wage and employment-share data presented made clear that cognitive employment, jobs that require greater training usually in the form of a degree, is more prevalent and more lucrative comparable to non-cognitive alternatives. Indeed, in a seeming rebuttal of the economic Law of Supply and Demand, data from the New York Federal Reserve indicated that, despite an 81 percent increase in average tuition costs in all states over the last decade, demand for college was not seen to fall. The inelasticity of demand for education seems to indicate that, whether accurate or otherwise, the possession of a degree is perceived a requirement for modern employment. Educational inelasticity would also explain in large part the rise in consumer debt among Millennials, who are also the most educated generation in US history.

[185] Studies show consumers tend to be afraid more afraid of what they stand to lose, than encouraged by what they stand to gain. This is called the "endowment" effect and can be learnt in any behavioral economic textbook.

At this point an additional economic lens was adopted in order to explain the economic efficiencies the shared mobility market thrives upon. By adopting the lens of spatial economics, the branch of economics concerned with the efficient and optimal allocation of scarce resources over space and location, a perhaps obvious, but altogether important point was made: shared mobility services rely upon the dense population of cities to operate efficiently. Said another way, the typical spatial and temporal restrictions that make transportation costly in sparse regions are made cheaper in areas of high mobility access; areas with relatively efficient means of intro- and intra-urban transportation due to high population density. Four spatial-economic relationships in particular allow the shared mobility market to function efficiently within cities: the relationship of scale and space, the relationship of shared inputs and space, the relationship of transactional costs and space, and the relationship of risk space, which relies on the Law of Large Numbers.

Of these spatial-economic relationships, insights gathered from scale and space presents great promise for the development of predictive transportation analysis. Power laws, the scaling rates cities tend to follow over time irrespective of global location, seem particularly fruitful for the generation of predictive telematics. In-depth analysis has shown that cities tend to grow at a 1:.85 infrastructural scale, and a 1:1.15 socioeconomic scale. Said another way, as a general approximation, doubling the population of Chicago should require the construction of only 85 percent more telephone lines, gas stations, roads, etc., but will likely result in a fifteen percent increase in the number of patents produced per year.

These insights have real-world implications, too. By means of the Inverse Square Law it was demonstrated that for any given urban location, the number of people that travel to it will scale as a power function (of exponent negative two) of both distance and visitation frequency. Theoretically, using spatial economics analysts would be able to predict the frequency of use of specific gas stations from different areas, determine the optimal placement of a carshare car, or perhaps even predict traffic patterns in areas of the city before they occur. Further research and conversations would certainly generate more ideas.

The analysis of urban and spatial economics also helped to describe some fundamental aspects of the distribution of individuals and firms in space. First, Bid-Rent Theory (BRT) explains then that, generally speaking, as distance from city-centers increases, land costs decrease in proportion to transportation costs. BRT provides a helpful description of the economics of location choice, that is where firms and individuals choose to locate. Using Millennials as an example, BRT was used to explain why many have increasingly chosen to live in the suburbs, all but discouraging their use of shared mobility services. Millennials who choose to live in the suburbs do so not only because the price of rent may be cheaper, but also because they value mobility access less than the benefit of saving on home prices. Said another way, as the price of urban living continues to rise, those millennials who are cost-sensitive will suburbanize, and even invest in houses. Depending on the extent of suburbanization, this may fundamentally change the focus of transportation networkers. It may be wise to anticipate transportation innovations to suburban areas, rather than simply cities.

In the final section of the report, the economics of regulation was described. Certain to be a hot-button issue in the future, in this section two closely interrelated features of regulatory economics were focused upon: technological internalization and regulatory fairness. With new innovations in technology, many of the problems surrounding the shared mobility sector including asymmetries of information between consumers and producers can be accounted for. An area of possible improvement might be in the process of car purchases (especially used cars)

where consumers still cannot be sure of the car's internal quality. Business in particular would appreciate a cheap, fixed cost application or hardware to ameliorate the cost of regulations designed to improve transparency. Though the most pressing issue in transportation today, one which regulation has not ever completely fixed, is the process of congestion. Telematics companies may be able to provide a solution to this centuries-old problem.

Many remain skeptical of benefits of shared mobility. Nowhere is this divide more distinct than between the regulation-encumbered taxi industry and the relatively unregulated shared mobility platforms. The difference in oversight of these two industries experience has led some to argue there is a two-tiered system between traditional transportation providers and modern transportation network companies (TNCs). If TNCs are to avoid overregulation, they must first demonstrate that technology can account for all the social costs regulatory measure are designed to account for, and they will have to expect, even promote, the deregulation of the taxi industry in a gambit of fairness.

After all, in the current market there is little reason to believe that the structure of the taxi industry or even that of the shared mobility market will remain as it is today in the near future. With great leaps in data telematics and analytics, AV technology, and great investment into cities of the future, transportation as it is currently known may well be unrecognizable in the next five-to-ten years. At least, such are the auspicious portents of many industry analysts. The truth of these developments may well be altogether different. In the next report on the future of shared mobility, the economics of socio-technological change will be explored. By relying on the theory generated in these three reports on shared mobility a rational analysis will be made of the potential changes to regulation, labor, transportation, data analysis, capital ownership, and more.