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Social Agglomeration Forces and the City

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Abstract

The presence of "agglomeration forces" in production markets is widely accepted and has been recently quantified in the economics literature. Social scientists have done little theoretical work, however, and even less quantitative work, on how the logic of agglomeration might also apply to social groups and the gains that people derive from their social interactions. This paper attempts to bridge this gap by modeling and measuring the benefits in terms of social prestige that arose from the spatial concentration of socialites in Manhattan in the 1920s. I formulate a model of location-based social status determination that illustrates why these benefits might make spatial concentration desirable for members of the social elite. To test the model, I draw on the 1920 and 1924 volumes of the New York Social Register, federal income tax data for New York City residents in the 1920s, and United States Federal Census records to compile a novel dataset containing demographic information, club affiliations, occupations, incomes and addresses of over 700 socially prominent men living in Manhattan in the early 1920s. Treating club memberships as a proxy for social prominence, I exploit an instrumental variable approach, using expected changes in family size as an instrument for neighborhood choice, to measure the relationship between an individual's residence relative to others in the group and his social status. My results suggest that there are strong, statistically significant benefits in terms of social status that come with living in closer proximity to others in one's social group; in the context of my 1924 Manhattan data, a move of just a few blocks from 12 West 44th Street to 421 Park Avenue would, on average and all else equal, result in a 54.3% increase in club memberships for the mean individual in my dataset.

1 Introduction

Economists have long recognized the existence of what are called "agglomeration effects" in labor and production markets. Marshall (1890) wrote of the benefits that arise when people engaged in the same trade work in close proximity to one another, though he did not call what he observed "agglomeration." More recently, Krugman (1991), Greenstone et al. (2008), Delgado et al. (2012) and others have described "agglomeration economies" and their strengths with both theory and empirics (see Puga (2009) for a literature review). Economists seem to agree that agglomeration can drive higher productivity, and that this may be one of the major causes of the spatial concentration in economic activity that we observe in the world around us. There exists also a parallel body of literature on how social interactions play a critical role in determining individual behavior and outcomes for things ranging from fertility (Durlauf and Walker, 2001) to unemployment (Topa, 2001) and crime (Glaeser et al., 1995)(see Brock and Durlauf (2001) for a literature review),[1] Yet there is much less work on the intersection of these two areas of study — on how "agglomeration forces" might apply to social networks and play a role in determining not just production outcomes, but also individual "social outcomes" such as social status and quality of social life. This is despite the fact that the logic of agglomeration appears to apply to the social sphere and not just labor and production markets. Indeed, anecdotal evidence suggests that people concentrate in certain areas not just because it makes them more productive, but because they derive some social utility therefrom.[2].

This paper attempts to determine whether there are in fact benefits, in terms of increased social prestige and more frequent social interactions, that come from living near others in one's social group. "Social agglomeration forces," if they exist, could drive the spatial concentration of social elites that seems evident in the world around us. In the same way that a worker can become more productive if he works near other workers in the same field, a socialite might enjoy heightened social prestige and "social productivity" if he lives near other socially prominent socialites. To characterize and estimate this phenomenon, I formulate a model that seeks to illustrate how "social agglomeration forces" might incentivize spatial concentration among people in the same social group. I then combine this model with various historical data sources and employ a two-stage least squares approach to estimate the model's parameters.

Anecdotal evidence from the history literature indicates that spatial concentration among the members of the same social groups is almost as prevalent as the geographical concentration in production observed by economists. Social elites (those who wield the most social influence or prestige) have concentrated in particular neighborhoods and towns throughout history. During the "Gilded Age" of the late 19th and early 20th centuries, most of New York's social elite lived along 5th Avenue in Manhattan (Homberger, 2004), while in turn-of-the-century Morristown, New Jersey one avenue was known as the "street of 100 millionaires" because of the incredible concentration

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[1]Some prominent theoretical work on social interactions include Bernheim (1994) and Schelling (1971).

[2]I provide evidence for this claim in a couple of paragraphs, but for a broad history of spatial concentration in a social group see Hood (2017).

of wealthy families that lived along it (Rae, 1999). Data collected from the 1924 New York Social Register reveal that most of New York City's social elite lived in a narrow strip of Manhattan between 5th and Park Avenues that year (see Figure 1 below). The aggregation of wealth in Newport, Rhode Island, during the same time period is legendary, and in the 21st century, the clustering of rich and socially prominent families in the suburbs of Greenwich and Darien and on the Upper East Side of Manhattan and in the apartment buildings lining Central Park is notorious. A recent Wall Street Journal article observes that "uber-wealthy home buyers tend to congregate not just in the same cities, but in the same buildings or neighborhoods [...]." (Taylor, 2019) In short, the spatial concentration that economists observe in labor markets also appears to manifest itself in a social sense.
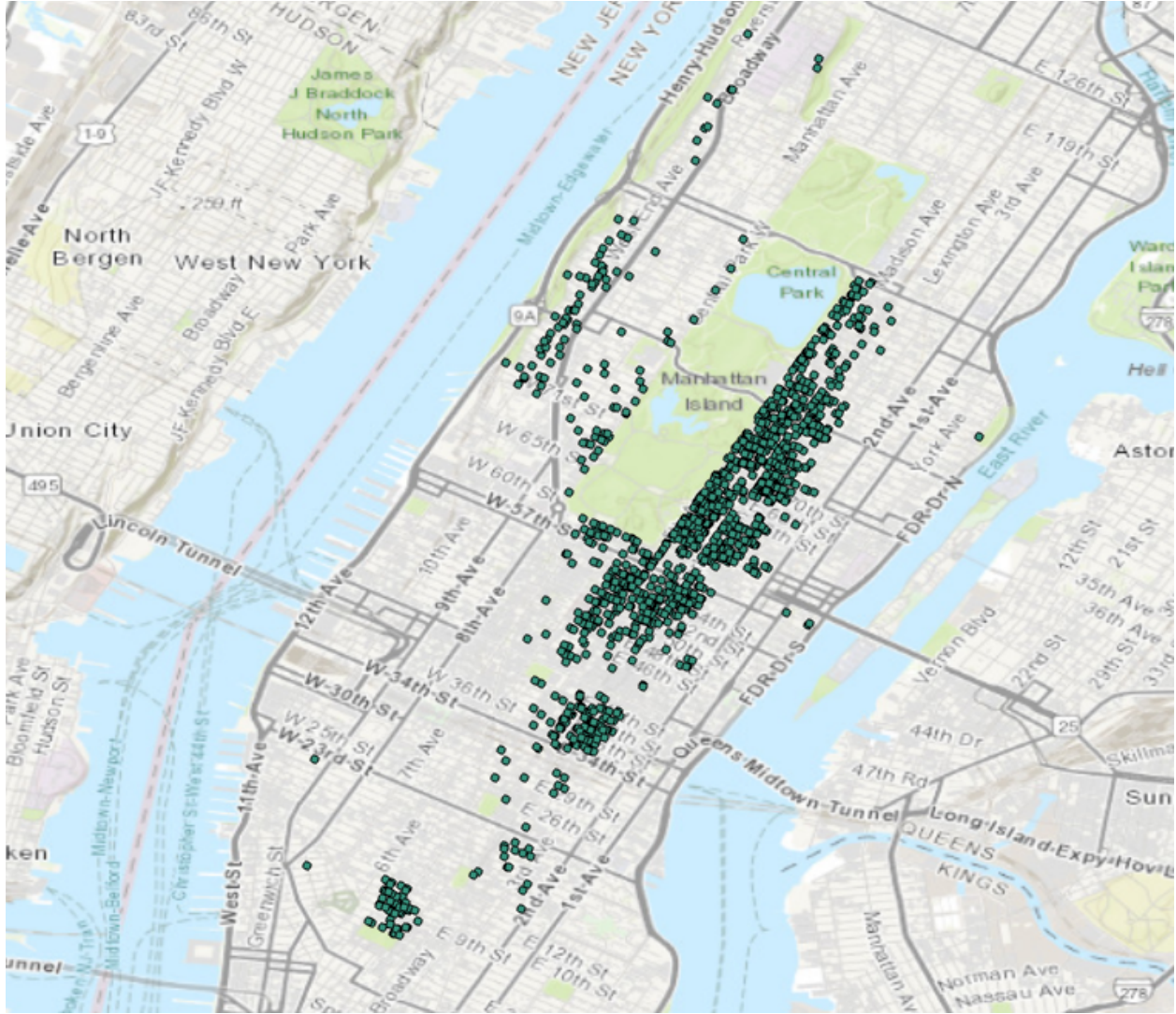
Figure 1: A plot of the Manhattan residences of the 1,882 men in my linked Social Register-Tax dataset (described in Section 4). Most of the people are clustered in the Upper East Side along Central Park, in Murray Hill around the intersection of 5th Avenue and 39th street, and in the blocks north of Washington Square Park.

This spatial concentration is difficult to explain with conventional economic accounts. Productivity spillovers do not seem to be the driving force, given that many of the social elite do not work, or at least do so more as a means of amusement than necessity. The Gilded Age socialites who all built chateau-esque mansions along Fifth Avenue most likely did not do so simply because of the street's proximity to good jobs and schools, or because they might benefit from neighborhood knowledge spillovers. [3] Thus there seem to exist "social agglomeration forces," distinct from

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[3]Amenities such as good weather or favorable geography do not seem to be the explaining factor, either, as most

the traditional productivity agglomeration forces described in the economics literature, that are responsible for this spatial concentration of the social elite.

To characterize these forces, I build a model that illustrates how individuals can attain greater social prestige by living near other socially prominent people. The model presents social status as a function of fixed individual characteristics and interactions between socialites; these interactions are in turn decreasing in distance between socialites. Agents choose their social interactions in order to maximize their social statuses and the resulting system of agent-optimized social status equations is solved with a fixed point approach. I characterize the model's equilibrium with a number of examples that demonstrate the benefits in terms of social status that individuals can derive from living in the "social core" of a city and highlight the influence that phenomena such as infrastructure construction and "white flight" can have on the social geography of a city.

I combine this model with data from various historical sources in order to estimate its parameters. I gather address and club membership information from the New York Social Register,[4], incomes from tax payment data that were made public and published in newspapers in the early 1920s (Marcin, 2014), and demographic information from the United States Federal Census. By using an individual's number of club affiliations as a proxy for his social prominence and measuring the distance between each pair of people in the dataset with geocoding software, I assess whether social prominence really does increase with proximity to other socially active people.

My OLS specification finds that living in a "socially dense" neighborhood (one populated with many socialites) has small, yet positive benefits in terms of social prestige. To account for potential endogeneity bias posed by the unobservable of social ambition, though, I also implement an instrument variable approach, using expected changes in family size as an instrument for moves between neighborhoods with varying concentrations of socially prominent people. My two-stage least-squares results indicate that living near other prominent Social Register members has a positive, statistically significant effect on social status. In the context of my 1924 data, a move from 12 West 44th Street to 421 Park Avenue would, on average and all else equal, increase a socialite's number of club memberships by 2.32 (or 54.3% for the average man in my dataset).

To understand the extent to which "social agglomeration" dynamics can shape the social topography of a city, I consider a counterfactual scenario in which a newly-built trolley system cuts the effective distance between the blocks around Washington Square and the rest of Manhattan by 25 percent. In the post-trolley equilibrium, residents of the Washington Square neighborhood enjoy heightened social statuses, while the socialites outside of Washington Square are less socially prominent than they were in the pre-trolley equilibrium. I also compare the pre- and post-trolley equilibria to identify the biggest "winners" and "losers" in terms of social status from the infrastructure project. The changes in Manhattan's social topography induced by the hypothetical trolley system provide one explanation for the historical shifts in Manhattan's social geography noted in

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of the elite socialite neighborhoods/colonies were not all that remarkable *ex ante* in terms of their natural or built characteristics apart from the fact that lots of prominent people congregated in them.

[4]An annual publication that has printed the names, addresses and club affiliations of the New York metropolitan area's social elite every year since 1887 (and much more, as I explain in 2.2.1).

the history literature Hood (2017).[5]

This paper seeks to bridge the gap between the economic literature on networking, social geography and social interactions (works such as Arzaghi and Henderson (2008), Brock and Durlauf (2001) and Battaglini et al. (2019)) and economists' vast body of work on agglomeration by offering one explanation of how geographical proximity can facilitate a form of social networking. The data I collect can also be a starting point for examining how social clubs facilitate professional networking more broadly. While the "social returns" to living in a particular neighborhood have gone largely unstudied by economists due to the difficulties of tracking social activity in datasets, the Social Register provides unique insight into, and quantifiable information about, the social lives of thousands of prominent people, offering social scientists a rare opportunity to study the composition of a decades-old social network. The presence of social agglomeration effects could also help to explain the clustered residential patterns that we observe in the United States today, beyond just the labor productivity benefits of agglomeration. While social agglomeration is not a purely economic phenomenon, per se, it will hopefully allow economists to incorporate more robust representations of endogenous social amenities into their models and more realistically model the way in which economic agents choose where to live.

The theory presented here is also closely related to the spatial economics literature. This paper's model resembles the spatial model introduced by Allen and Arkolakis (2014) and is solved using theorems presented in the spatial methodological literature (Allen et al., 2015). My model builds on the agglomeration forces reflected in the Allen and Arkolakis production functions, in which there are increasing returns to labor in a given city, by showing that the "amenities" enjoyed by a city's residents might also be an increasing function of population. In this way this paper's model provides a representation of endogenous local amenities similar to Ahlfeldt et al. (2015)'s characterization of endogenous amenities. Allen and Arkolakis suggest that city amenities decrease with population due to "congestion forces," but this paper's findings suggest that population density also provides added social benefits that might offset the costs of greater congestion.

In Section 2 I discuss the historical social network that motivates this paper's model and the sources I will use to estimate it, followed by an explication of the model in Section 3. In Section 4 I describe the processes I used to link my various datasets and geocode my geographical data. In Section 5 I estimate the model using both an OLS and an IV approach, and in Section 6 I consider a counterfactual in which an infrastructure development alters the social topography of Manhattan. Finally, I conclude in Section 7.

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[5]The counterfactual shows how the social prestige benefits of certain neighborhoods can change drastically, and therefore alter the relative social desirability of various neighborhoods in Manhattan. In the long run this would shift the social geography of the city because it would push socialites to move into newly desirable neighborhoods and out of newly undesirable ones.

2 Data Overview and Historical Background

In this section I describe the social network — the New York social elite of the 1920s — that forms the basis of my theoretical model and my empirics. I explain the historical role of men's social clubs in New York City, arguing that club memberships can serve as a reasonable proxy for social status. I show that the social elite of Manhattan in the 1920s constitute a coherent social group for which we can gather quantifiable information on social activity and some of the other individual attributes that might affect social status. I then provide an overview of the data sources I will use to characterize this network.

2.1 Historical Background

In this subsection I describe the historical role of private New York social clubs in Manhattan in the late 19th and early 20th centuries. Through this brief history overview I show why club memberships can serve as a good proxy for social status for the people studied in my empirics.

2.1.1 Social Clubs and the New York City Social Life

Men's social clubs were a crucial component of social life in Manhattan during the 19th and 20th centuries; therefore club memberships are an extremely useful measure of New Yorkers' social activity during that time period. In a city characterized by its "large and unstable" upper class, as historian Clifton Hood has characterized it, New York's social clubs helped to ensure some consistency within the city's social elite, even as the membership of Manhattan's top economic ranks was anything but stable (Hood, 2017). As Hood explains, "upper-class men made the clubs a significant part of their lives." Hood describes the late 19th-century life of Harper S. Mott, a lawyer who had a private income from inherited assets and spent a great deal of time at the New York Athletic Club and the Lawyers' Club, where he would eat lunch, meet friends and engage in business dealings. J.P. Morgan, meanwhile, according to Hood, "was constantly hopping from [one club] to the next." The *New York Times* obituary of one John L. Lawrence noted that the Union Club was "virtually [Lawrence's] home during the daylight hours for most of the year" (*New York Times* quoted in Hood (2017)).

J.P Morgan, John Lawrence and Harper Mott were just three of the thousands of New York City men for whom clubs comprised a key element of their social lives. By the 1880s and 1890s, clubs were so important to the social fabric of New York's upper class that the world surrounding clubs and "clubmen," as they came to be known, were collectively known as "Club World" or "Clubdom" (Hood, 2017). In 1902 there were over 150 social clubs in the New York metropolitan area. Some clubs were affiliated with universities or university graduate status (the university-specific alumni clubs and the University Club), others sought to promote the arts or literature (the Lotos Club and the Century Association, among others), while others were founded with a particular political bent (the Union League Club) (Nevius, 2015). I discuss some of the differences between these clubs in Section 8.4 in the Appendix.

2.1.2 Club admissions

Club admissions procedures for top New York social clubs were rigorous, high stakes processes. The "blackballing," or rejection, of famous people from these clubs often made the news — an indication of how seriously club members and the broader public took the matter of club admissions and the clubs' role as arbiters of social prestige. In 1893, Theodore Seligman was denied admission to the Union League Club primarily because he was Jewish, even though his father had been a member for 25 years. "MR. SELIGMAN BLACKBALLED — UNION LEAGUE CLUB DECLARES ITSELF AGAINST HEBREWS," the front page of the New York Times read after Seligman's rejection (New York Times, 1893). As the Seligman episode illustrates, the exclusivity of social clubs was a means through which New York's elite could defend their social territory from ethnic and geographic newcomers, sometimes with harmful consequences. By the same token, acceptance into multiple clubs was a sign that one had already achieved prominence in Manhattan society. While "social prominence" and prestige is always subjective, and especially difficult to pin down at a distance of 100 years, in the decades around the turn of the 20th century a man's number of club memberships was a good indicator of his social prominence (Hood, 2017) .

In addition to the extensive information provided by Hood on the role of exclusive social clubs as arbiters of prestige and social prominence, a review of the 1924 Social Register provides further evidence of the link between prominence and club memberships. Indeed, the elite New Yorkers of 1924 who remain well-known to 21st century students of New York society appear to have been in far more clubs than any of their contemporaries. Harry Payne Whitney belonged to no fewer than 27 New York-area clubs in 1924, while J.P. Morgan belonged to 22, Robert Walton Goelet to 19, George F. Baker Jr. to 17, Chauncey M. Depew to 16, and Harold Irving Pratt to 15. Other New Yorkers with famous names — John Ross Delafield, J.S. Morgan Jr., Thomas W. Lamont, Edward S. Harkness, Eugene Thayer, Robert W. De Forest, Vincent Astor, Harold Vanderbilt, Walter Jennings, William Iselin — all boasted more than 10 club memberships, compared to 3 memberships for the median man in my Social Register-Tax dataset (described in Section 4). Thus, the history of New York City men's social clubs and a review of the 1924 New York Social Register supports my decision to use club memberships as a measure of social status.

2.2 Data

In this subsection I describe the three primary sources — the New York Social Register, Marcin (2014)'s tax data, and the United States Federal Census — that I use for data on the New York social elite in the 1920s. Together these datasets provide social scientists with a wide range of economic, social, geographic and demographic data about the New York socialites of the 1920s.

2.2.1 New York Social Register

To capture data about social status, which is usually unobservable and difficult to measure, I turn to the Social Register, first published in New York City in 1887. The Social Register is the most

famous and enduring of the "blue books" that began to appear in a number of American cities during the late 19th century. The first Social Register was put together using the "visiting lists" of New York's old, elite families, and was meant to be the authoritative "record of society" in New York (Hood, 2017; Sargent, 1997). For this reason the New York Social Register's membership serves as a fairly complete picture of one prominent social network — the social elite of the New York metropolitan area – for at least the end of the 19th century and the first few decades of the 20th (Hood, 2017). I provide further justification for this claim in Section 8.2 of the Appendix.[6]

Each edition of the Social Register lists the names of the adults and "juniors" (usually teenagers) in each "society" household in the New York metropolitan area. For each household, the Register records club affiliations (denoted by codes for each club), alma maters, and addresses, among other things.[7] A page of the 1924 register is included in Figure 2 below for reference. The letters next to Frederick B. Adams's name, for example, indicate that he was a member of the University (Uv.), Metropolitan (Mt.), Racquet (R.), New York Yacht (Ny.), and Downtown (Dt.) clubs, among other organizations, and a class of 1900 graduate of Yale (Y. '00). Frederick lived at 8 East 69th Street in New York City with his wife Ellen, whose maiden name was Delano, and they had at least one son, Frederick Adams Jr. By transcribing these data, one can compare the club memberships of each man (social clubs at this point were primarily men-only institutions, and thus are only useful proxies of social status for men) to where he lived in relation to other members of the Social Register (i.e., in relation to the other members of New York "society"). Counting up the club letters we can see that Adams belonged to seven New York-area social clubs in 1924 (Chch. represents a club in Chicago and Cly. was a women's club that Adams's wife would have belonged to).

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[6]Over time the Social Register Association, the organization behind the annual publication, released Social Registers for other American cities, but this study will focus on the New York edition because of its notoriety and the consistency of New York addresses over time, which allows for easy geocoding using modern maps. While for this paper I use Social Registers from the 1920s because they coincide with publicly available tax data, the register is in fact still published today and includes much of the same information that it did a century ago. Thank you to my friend AWB for confirming this for me by perusing her copy of the 2020 Social Register. Also, the Social Register today is no longer divided by city — there is instead one national copy.

[7]It also includes some useful reference information, such as a table for looking up the maiden names of married women, a list of the most recent season's marriages, the leadership rosters of dozens of New York metropolitan-area clubs, and the names of the "subscribers" to some famous New York society events like the Patriarchs' Balls. It also lists its members' summer houses (in the "Summer Supplement") and even members' yachts.

Figure 2: Extract from 1924 New York Social Register.

2.2.2   1920s Income Tax Data

The amount of federal income tax paid by most New Yorkers with tax bills above $500 for 1923 and 1924 was published by the New York Times in the autumns of 1924 and 1925, respectively (Marcin, 2014). While tax write-offs and strategies obviously varied by individual, this data (compiled by Marcin (2014)) gives researchers a rough idea of New Yorkers' taxable income in those years. I use the 1924 tax year's federal income tax brackets gathered from that year's Form 1040 (Individual Income Tax Return) to calculate net taxable income for each of the people whose federal income tax payments are recorded in Marcin (2014)'s dataset. The brackets derived from the 1040 form are included in Section 8.3 of the Appendix.

I use this imputed income data in my model to control for the income of Social Register socialites in my analysis of whether residences affect their social prominence. Because I expect income to be correlated with both social productivity (richer people can throw more lavish parties, buy bigger mansions and donate more to cultural institutions, which can all contribute to heightened fame and social prestige) and neighborhood (socially prestigious neighborhoods are often more expensive), it is important to control for income as otherwise the analysis would suffer from an omitted variable bias problem.

Figure 3: Part of the 1924 tax year 1040 form. See Section 8.3 of the Appendix for the tax brackets gathered from this form.

2.2.3 United States Federal Census Data

The United States Census, taken every 10 years, provides additional information on the individuals listed in the Social Register. By matching census data to the dataset produced by merging tax payment and Social Register data, I add key demographic information about these individuals (age, birthplace, race, occupation, household type and members) to my dataset. These demographic traits are important to account for in any analysis of social productivity because many of them are likely to be correlated with social activity. Age, for instance, is likely correlated with both choice of neighborhood (young people might prefer certain neighborhoods more than older people do) and social prominence (middle-age people might have more friends than 20 year-olds who have just graduated from university, while the elderly may retreat from social life and become recluses). Moreover, the 1920 and 1930 censuses record the number of their own children that each adult had living with them at the time of the census enumeration, data that I use in my instrumental variable approach to estimating my model in Section 5.3. While there was no federal census taken in 1924 (the year of my social register and tax data), the 1920 Census will still be relevant as most demographic information is time-invariant.

2.2.4 Summary Statistics

Table 1 summarizes three key variables in the Social Register-Tax dataset: club memberships, taxable income and an age variable imputed from the college graduation years of the 1,284 men in the dataset for whom this information was available in the Social Register. Table 2 shows the club memberships breakdown by three income brackets.

3 Model

In this section I formulate a model of location-based social status determination among the social elite that illustrates how spatial concentration might increase social productivity and therefore drive

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Table 1: 1924 Social Register-Tax Dataset Summary Statistics

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
NY Club Memberships	1,882	3.898	3.115	0	2	5	27
Imputed Age	1,284	49.932	12.385	21.000	42.000	58.000	105.000[8]
Taxable Income	1,882	$89,512	$366,497	$2,600	$22,021	$76,549	$13,712,802

Table 2: Club Memberships by Income

Group	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Less than $25,000	580	2.733	2.262	0	1	4	17
$25,000 to $75,000	818	3.626	2.469	0	2	5	15
$75,000 and above	484	5.754	4.016	0	3	8	27

a form of "social agglomeration" in space. I then provide a number of examples that illustrate how the model works and the insights that it has to offer.

3.1 Environment

We begin with an abstracted socialite i whose only goal is to maximize his or her own social status, s_i. Thus, i's welfare is equal to his social status.

$$W_i = s_i \tag{1}$$

Note that s_i must always be positive. This makes sense intuitively (the least social status one could ever have is zero social status) and will help make the math more sensible later on by ensuring that the equilibrium equation meets the gross substitution condition for uniqueness and existence.

Suppose that person i's social status s_i consists of two components — a base value, $\overline{s_i}$, that reflects i's income, age and some unobservables such as family background, personality, social ambition and other traits that might contribute to his social status, and a modifier h_i that is determined by i's interactions with others in his social group. We have:

$$s_i = \overline{s_i} + h_i, \tag{2}$$

where the modifier h_i, the total benefit in terms of social status that person i derives from his interactions with other people, is the sum of many h_{ij}, the social status benefit i derives from his interactions with a person j in the society S.

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[8]This may seem strange but the Social Register entry for John A. Stewart in the dataset does say that he graduated from Columbia in 1840. A quick Google search reveals that Mr. Stewart was indeed a famously old New Yorker who was over 100 in 1924: `https://www.findagrave.com/memorial/57034979/john-aikman-stewart`.

$$h_i = \sum_{j \in S} h_{ij} \tag{3}$$

This h_{ij}, the increase in social status a person i will derive from his contact with a person j, is defined as

$$h_{ij} = (V_{ij}s_j)^\omega - V_{ij}c(d_{ij}), \tag{4}$$

where V_{ij} is the volume of social interactions which person i has with person j, d_{ij} is the distance between i and j, and s_j is the social status of the person j. Combining equations (3) and (4) we have:

$$h_i = \sum_{j \in S} (V_{ij}s_j)^\omega - V_{ij}c(d_{ij}) \tag{5}$$

There exist strong decreasing returns to social interactions, represented by the following assumption:

Assumption 1. $0 < \omega < 0.5$

The importance of this constraint will become clear later when I show that it helps to guarantee a unique equilibrium. The cost of each interaction, $c(\delta_{ij})$, can be thought of as the social status opportunity cost of traveling to a social engagement — time spent riding across town is time that could be spent meeting other people or hosting parties that could have added to one's social status. Because the benefits of V_{ij} have diminishing returns but costs are linear, there is a point at which further interactions with j no longer increasing person i's h_i, as illustrated in Figure 4 below. This means that the V_{ij}^* chosen by i is finite.

The model also assumes that there exists some minimum distance between two people d_{min} such that $d_{i,j} \geq d_{min} > 0$ because there is always some distance between people, even if they live in the same building. This minimum distance also represents the fact that all social interactions come with some cost and ensures that there are no cases where V_{ij} goes to infinity.

Assumption 2. $d_{i,j} \geq d_{min} > 0$

Note that the V_{ij} in equations (4) and (5) does not necessarily have to equal V_{ji}. This is because social interactions are not always symmetric. Person i, for instance, could attend lots of person j's parties but not vice versa, or j might go out of her way to send gifts and perform favors for i without these gestures being reciprocated. Thus it is perfectly plausible that we might have $V_{ij} > V_{ji}$ or $V_{ij} < V_{ji}$. My approach here bears resemblance to the assumptions sometimes used in the political economy and trade literature. The idea that the volume of interactions V_{ij} between two people i and j decreases with distance, d_{ij}, is consistent with the negative relationship between distance and trade volume demonstrated by the "gravity" literature in international economics (Anderson and van Wincoop, 2003; Bergstrand, 1985). The ability of V_{ij} and V_{ji} to be unequal,

meanwhile, is consistent with the approach adopted by Battaglini et al. (2019) in their model of social connectedness between legislators, which assumes that the connectedness of legislator i to legislator j can be different from that of legislator j to legislator i. One difference is that I do not use a match parameter like the one used by Arzaghi and Henderson (2008) because all of the people j with whom i could personally interact for the purposes of this model are in the same social group or segment of society and therefore i has access to all of them. For the specific social group that I am studying with my empirics, this assertion is justified by my historical and sociological description of the group provided above in Section 2.1.

Combining equations (2) and (5) we thus have the following "production function" by which socialites produce their social statuses:

$$s_i = \overline{s_i} + \sum_{j \in S}((V_{ij}s_j)^\omega - V_{ij}c(d_{ij})) \tag{6}$$

The decreasing relationship between s_i and d_{ij} in the model (the feature driving the "social agglomeration" described earlier) could operate through a number of channels, some of them similar to the means through which Arzaghi and Henderson (2008) claim that geographic concentration facilitates greater networking and higher productivity in the Manhattan advertising industry. The cost of interacting with people increases with distance, therefore individuals who live in closer proximity to others in their social group might be able to participate in more social events with others of their class. People who live in the same neighborhood are also more likely to eat at the same restaurants, shop at the same stores and partake in the same civic gatherings, another way in which living in a certain area can facilitate closer social bonds with the people in that area. Because admission to New York's elite social clubs in the 1920s was based primarily on a referral system (described in Section 8.2), the closer social bonds with the social elite that people gained from living near those elites could increase one's odds of gaining admittance to a selective social club. Thus, relocating to a neighborhood heavily populated by the social elite, or "moving to society," might help one become a member of more prestigious clubs and attain a higher social status.

3.2 Optimization

In the model, n many socialite agents i in society S play a game to determine their social statuses and hence their welfare (as $W_i = s_i$). In this game, the socialites' social statuses $s = (s_1, ..., s_n)$ and the social interaction matrix $V = (V_{ij})_{i,j \in S}$ are endogenous variables, while the distance matrix $d = (d_{ij})_{i,j \in S}$, the base social status values $\overline{s} = (\overline{s_1}, ..., \overline{s_n})$ and the parameters ω, ψ, α and β are exogenous. At $t = 1$ the socialites choose V based on d, $\overline{s}$, and ω, ψ, α and β. These chosen V then determine s in conjunction with the exogenous elements.

As Battaglini et al. (2019) note in their analysis of social networks among legislators, the presence of network externalities in a game like this one make it such that "each action has, in addition to a straightforward direct effect, a set of indirect effects" which render the analysis more complicated. To give the sort of example provided by Battaglini et al. (2019) but for my model,

when i chooses $V_{i,j}$ this will affect s_i directly, but this change in s_i will in turn influence the s_j's of the people j who interact with i and so on.

This problem, as Battaglini et al. (2019) observe, is similar to the problems that come with "studying a general equilibrium in an exchange economy in which a change in an agent's demand has a direct obvious effect on an agent's utility and an indirect effect on equilibrium prices." In that sort of analysis we resolve the problem by assuming that each agent is a "price taker" who takes prices as given, because in many such "exchange economies, each agent has only a marginal impact on equilibrium prices, thus allowing us to ignore the indirect effects." I adopt a similar approach in analyzing my social network, and assume that each socialite takes as given the social statuses s_j of the other people in his social network. This assumption seems valid for large social networks like the Social Register society I am analyzing with my data. Hence I can define the same sort of Network Competitive Equilibrium (NCE) for my model that Battaglini et al. (2019) define for their model.

Definition 1: *Socialities' social statuses $s = s_1, ..., s_n$ and the social interaction matrix $V = (V_{ij})_{i,j \in S}$ constitute a Network Competitive Equilibrium (NCE) if:*

1. *Social interaction volumes $V^i = (V_{i,1}, ... V_{i,n})$ are optimal for i given s;*

2. *The vector of social statuses (s) satisfies the "production function" (6) given V.*

3.2.1 Agent Optimization

For the first condition above, that of agent optimization, to be satisfied, we solve the first order condition of s_i with respect to V_{ij}:

$$\frac{\partial s_i}{\partial V_{ij}} = \omega \times V_{ij}{}^{\omega-1} \times s_j{}^{\omega} - c(d_{ij}) \tag{7}$$

and we see that at $t = 1$ the socialite i will choose:

$$V_{ij}{}^* = \left(\frac{c(d_{ij})}{s_j{}^{\omega} \times \omega}\right)^{\frac{1}{\omega-1}} \tag{8}$$

Figure 4 highlights this optimal choice of V_{ij}, showing how $(V_{ij}s_j)^{\omega}$, the benefits of interactions V_{ij}, increase with diminishing marginal benefits until they eventually become equal to the cost of those interactions, $V_{ij}c(d_{ij})$, at $V_{ij} = V_{ij}{}^* = \left(\frac{c(d_{ij})}{s_j{}^{\omega} \times \omega}\right)^{\frac{1}{\omega-1}}$.[9] Note that, given this optimal choice of $V_{ij}{}^*$ and the observation in Section 3.1 that it is possible to have $V_{ij} > V_{ji}$ or $V_{ij} < V_{ji}$, we will have $V_{ij} > V_{ji}$ when $s_j > s_i$, and vice versa, if interaction costs are symmetric ($c(d_{ij}) = c(d_{ji})$). In other words, less socially prominent people will choose to have more interactions with their more socially prominent peers than those more socially prominent peers will choose to have with them.

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[9]I designed Figure 4 and Figure 5 with the Desmos online graphing tool and Google Slides.

Figure 5, meanwhile, shows the decreasing relationship between $V_{ij}{}^*$ and d_{ij}, where the leftmost value on the d axis is equal to d_{min}.
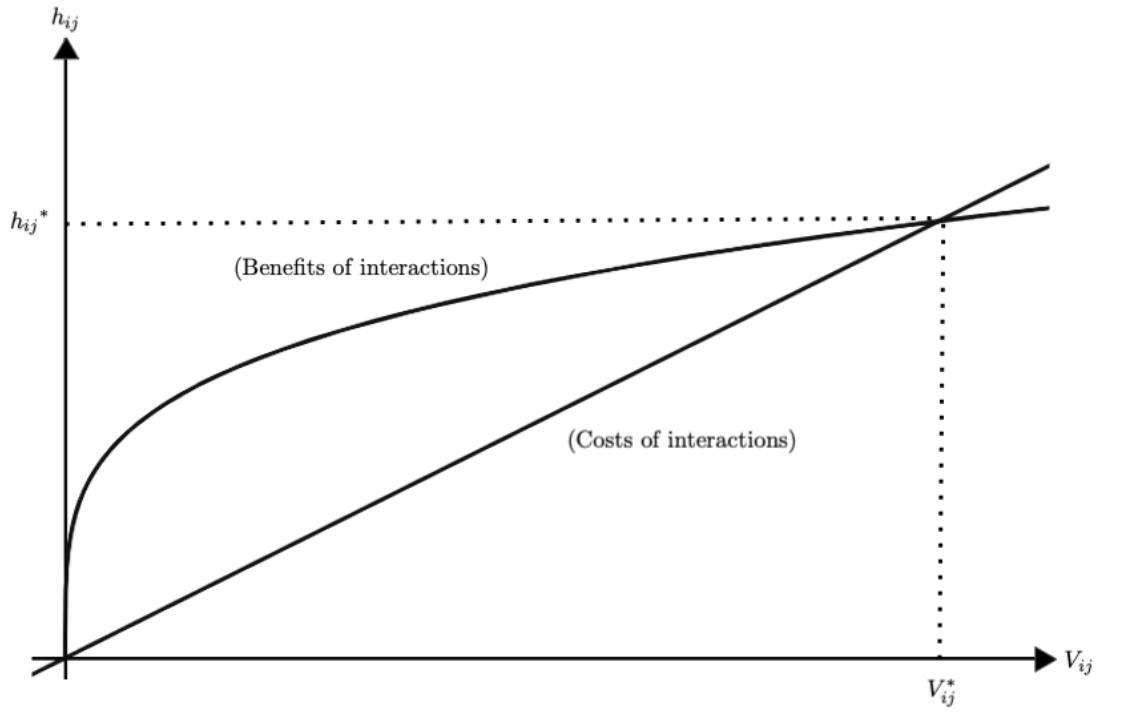
Figure 4: Tradeoff between costs and benefits of social interactions.
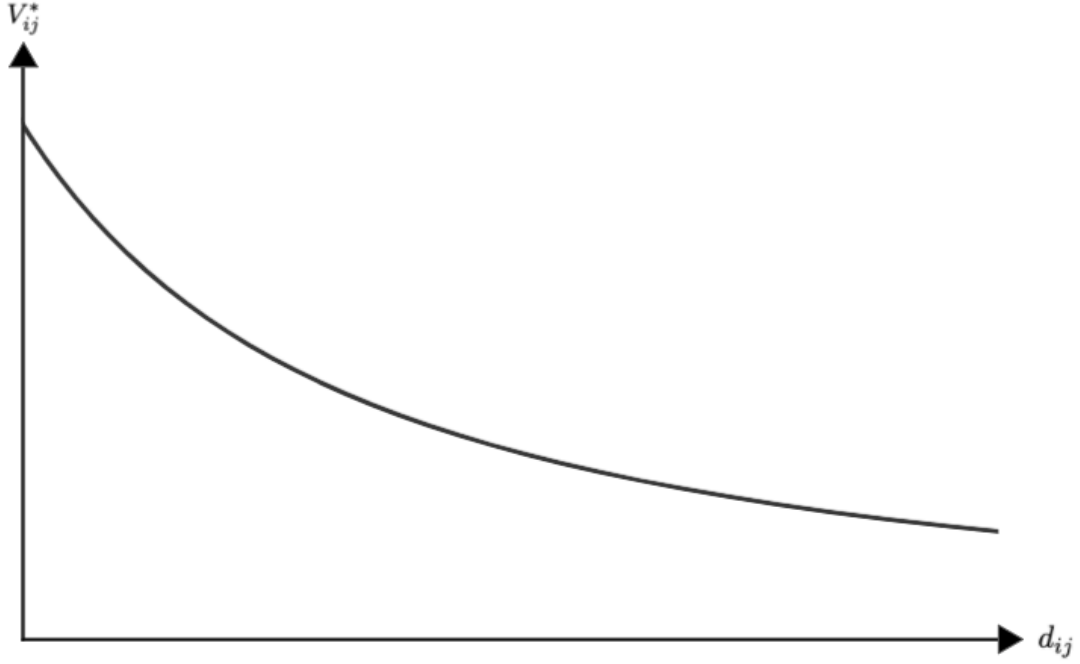
Figure 5: Social interactions and distance.

Plugging equation (8) into equation (5) we see that the sum of the social status derived by person i from his interactions with others, h_i, is represented by:

$$h_i = \sum_{j \in S} \left(\left(\frac{c(d_{ij})}{s_j{}^\omega \times \omega} \right)^{\frac{\omega}{\omega-1}} s_j{}^\omega - \left(\frac{c(d_{ij})}{s_j{}^\omega \times \omega} \right)^{\frac{1}{\omega-1}} c(d_{ij}) \right) \tag{9}$$

where S is the set of all people in society. Assuming that $c(d_{ij})$ is linear, and thus $c(d_{ij}) = \beta \times d_{ij}$, we have:

$$h_i = \sum_{j \in S} \left(\left(\frac{\beta \times d_{ij}}{s_j{}^\omega \times \omega} \right)^{\frac{\omega}{\omega-1}} s_j{}^\omega - \left(\frac{\beta \times d_{ij}}{s_j{}^\omega \times \omega} \right)^{\frac{1}{\omega-1}} \beta \times d_{ij} \right) \tag{10}$$

Simplifying (10), we arrive at:[10]

$$h_i = \sum_{j \in S} s_j{}^{\frac{-\omega}{\omega-1}} \times d_{ij}{}^{\frac{\omega}{\omega-1}} \times \beta^{\frac{\omega}{\omega-1}} \times \left(\omega^{\frac{-\omega}{\omega-1}} - \omega^{\frac{-1}{\omega-1}} \right) \tag{11}$$

Person i's overall social status s_i is a function of h_i and the inherent level of social status $\overline{s}_i$ that reflects i's income, age, family background and other traits that might contribute to his social prominence.

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[10]See 8.5 for the algebra.

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$$s_i = \alpha \times \overline{s_i} + \psi \sum_{j \in S} s_j^{\frac{-\omega}{\omega-1}} \times d_{ij}^{\frac{\omega}{\omega-1}} \times \beta^{\frac{\omega}{\omega-1}} \times (\omega^{\frac{-\omega}{\omega-1}} - \omega^{\frac{-1}{\omega-1}}) \tag{12}$$

Removing some terms from the summation:

$$s_i = \alpha \times \overline{s_i} + \psi \times \beta^{\frac{\omega}{\omega-1}} \times (\omega^{\frac{-\omega}{\omega-1}} - \omega^{\frac{-1}{\omega-1}}) \times \sum_{j \in S} s_j^{\frac{-\omega}{\omega-1}} \times d_{ij}^{\frac{\omega}{\omega-1}} \tag{13}$$

For simplicity in writing this equation many times, I will combine $\psi \times \beta^{\frac{\omega}{\omega-1}} \times (\omega^{\frac{-\omega}{\omega-1}} - \omega^{\frac{-1}{\omega-1}})$ into one term σ, thus we have:

$$s_i = \alpha \times \overline{s_i} + \sigma \times \sum_{j \in S} s_j^{\frac{-\omega}{\omega-1}} \times d_{ij}^{\frac{\omega}{\omega-1}} \tag{14}$$

3.2.2 "Market Clearing" Condition

The second condition of the NCE defined in Section 3.2 is the equivalent of the market clearing condition in the analysis of exchange economies. Returning to 14 , if there are n people in the network then we will have a system of n equations with n variables (the n s_i values for each person in the network). Thus the system is defined by the solution $s^* = (s_1^*, ..., s_n^*)$ to the following system for $i = 1, ..., S$:

$$s_i^* = \alpha \times \overline{s_1} + \sigma \times \sum_{j \in S \setminus 1} s_j^{*\frac{-\omega}{\omega-1}} \times d_{ij}^{\frac{\omega}{\omega-1}}, \tag{15}$$

To find a set of $\{s_i\}$ that satisfy condition 2 of the NCE, we need to solve this system for $s^* = (s_1^*, ..., s_n^*)$.

Proposition 1 *Consider the social network S with n individuals i and assume that Assumptions 1 and 2 are satisfied (i.e. $0 \leq \omega \leq 0.5$ and $d_{i,j} \geq d_{min} > 0$). There exists a unique set of social statuses $s^* = (s_1^*, ..., s_n^*)$ that satisfy the system of n equations in the form of equation (14) when $\overline{s_i} = 0$.*

Proof. See Appendix Section 8.1.

3.3 Equilibrium

To find the unique equilibrium $s^* = (s_1^*, ..., s_n^*)$ to the system when $\overline{s_i} = 0$ as described above I turn to a process described in Arkolakis (2020) lecture slides which operationalize the computational algorithm in Allen and Arkolakis (2014). The n equations of the system are in the form:

$$s_i = \sigma \times \sum_{j \in S} s_j^{\frac{-\omega}{\omega-1}} \times d_{ij}^{\frac{\omega}{\omega-1}} \tag{16}$$

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Following the Arkolakis lecture slides on iterative solutions for equilibria, I rewrite my equilibrium equation:

$$s_i = \sigma \times \sum_{j \in S} s_j^{\frac{-\omega}{\omega-1}} \times d_{ij}^{\frac{\omega}{\omega-1}} \iff s_i = \sigma \sum_{j \in S} K_{ij} \times s_j^{\frac{-\omega}{\omega-1}}, \tag{17}$$

where $d_{ij}^{\frac{\omega}{\omega-1}} \equiv K_{ij}$.

Per the Arkolakis process, define $P_{ij} = \frac{\sum_j K_{ij}}{\sum_i \sum_j K_{ij}}$ by normalizing the K_{ij} matrix. **P** is a transition matrix which represents the relative likelihood of interactions between i and j. As Arkolakis (2020) explains, we can reapply this matrix — $P^2 = PP$, $P^3 = PP^2$, and so on. We have in the limit:

$$s^* = \lim_{n \to \infty} P^n \times s_j^{\frac{-\omega}{\omega-1}(0)}, \tag{18}$$

where $s_j^{\frac{-\omega}{\omega-1}(0)}$ is some guess about the true s^* — for example, that all s are equal. The iteration converges to the true solution as n goes to ∞. Thus we have as the equilibrium solution to the system of n equations in the form of equation (16).

3.4 Examples

I now use some abstracted examples to highlight key features of the model formulated above. These examples show how d_{ij} can shape the social topography of a network.

3.4.1 Two People

We examine a social group with two members with $\overline{s_1} = \overline{s_2} = 0$. Our system is:

$$s_1{}^* = \sigma \times s_2{}^{*\frac{-\omega}{\omega-1}} \times d_{12}^{\frac{\omega}{\omega-1}} \tag{19}$$

$$s_2{}^* = \sigma \times s_1{}^{*\frac{-\omega}{\omega-1}} \times d_{21}^{\frac{\omega}{\omega-1}} \tag{20}$$

To solve, plug $s_1{}^*$ into $s_2{}^*$ and get:[11]

$$s_2{}^* = \sigma^{\frac{1-\omega}{(1-2\omega)}} \times d_{12}^{\frac{-\omega^2}{1-2\omega}} \times d_{21}^{\frac{\omega(\omega-1)}{(1-2\omega)}} \tag{21}$$

By symmetry we know that:

$$s_1{}^* = \sigma^{\frac{1-\omega}{(1-2\omega)}} \times d_{21}^{\frac{-\omega^2}{1-2\omega}} \times d_{12}^{\frac{\omega(\omega-1)}{(1-2\omega)}} \tag{22}$$

If we had $d_{12} = d_{21} = d$ we would have:

$$s_1{}^* = s_2{}^* = s^* = \sigma^{\frac{1-\omega}{(1-2\omega)}} \times d^{\frac{-\omega}{(1-2\omega)}} \tag{23}$$

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[11]See 8.6 for algebra.

But let's pretend that d_{12} and d_{21} are different — perhaps because a subway runs from 1 to 2, but not from 2 to 1, or vice versa, therefore making the effective distance in each direction different. Then things would proceed as follows, calling the two people j and i instead of 1 and 2 and substituting in for σ:

$$s_i{}^* = (\psi \times \beta^{\frac{\omega}{\omega-1}} \times (\omega^{\frac{-\omega}{\omega-1}} - \omega^{\frac{-1}{\omega-1}}))^{\frac{1-\omega}{(1-2\omega)}} \times d_{ji}^{\frac{-\omega^2}{1-2\omega}} \times d_{ij}^{\frac{\omega(\omega-1)}{(1-2\omega)}} \tag{24}$$

$$s_i{}^* = \psi^{\frac{1-\omega}{(1-2\omega)}} \times \beta^{\frac{\omega(1-\omega)}{(\omega-1)(1-2\omega)}} \times (\omega^{\frac{-\omega}{\omega-1}} - \omega^{\frac{-1}{\omega-1}})^{\frac{1-\omega}{(1-2\omega)}} \times d_{ji}^{\frac{-\omega^2}{1-2\omega}} \times d_{ij}^{\frac{\omega(\omega-1)}{(1-2\omega)}} \tag{25}$$

Assumption 1 that $0 < \omega < 0.5$ implies that $\frac{-\omega^2}{(1-2\omega)} < 0$ and $\frac{\omega(\omega-1)}{(1-2\omega)} < 0$. The condition $0 < \omega < 0.5$ also means that $0 \leq (\omega^{\frac{-\omega}{\omega-1}} - \omega^{\frac{-1}{\omega-1}})^{\frac{1-\omega}{(1-2\omega)}} \leq 1$ and that $(\omega^{\frac{-\omega}{\omega-1}} - \omega^{\frac{-1}{\omega-1}})^{\frac{1-\omega}{(1-2\omega)}}$ is decreasing in ω. Hence $\frac{\partial s_i{}^*}{\partial d_{ij}} < 0$ and $\frac{\partial s_i{}^*}{\partial d_{ji}} < 0$ as we would expect according to the theory. The exponent of d is decreasing in absolute value in ω, thus the exponent of the d terms is more negative for bigger ω and hence the deleterious effects of higher d on social status are greater as ω gets bigger. Note that $\frac{-\omega^2}{(1-2\omega)} > \frac{\omega(\omega-1)}{(1-2\omega)}$ when $0 < \omega < 0.5$, so $s_i{}^*$ is more decreasing in d_{ij} than it is in d_{ji} (in other words, $|\frac{\partial s_i{}^*}{\partial d_{ij}}| > |\frac{\partial s_i{}^*}{\partial d_{ji}}|$). Additionally, the exponent of β, $\frac{\omega(1-\omega)}{(\omega-1)(1-2\omega)}$, is less than zero, so s^* is also decreasing in β as we would expect. Lastly, $\frac{1-\omega}{(1-2\omega)} \geq 1$, so $s_i{}^*$ is increasing in ψ, also as we would expect.

Comparing $s_1{}^*$ and $s_2{}^*$:

$$s_1{}^* = \psi^{\frac{1-\omega}{(1-2\omega)}} \times \beta^{\frac{\omega(1-\omega)}{(\omega-1)(1-2\omega)}} \times (\omega^{\frac{-\omega}{\omega-1}} - \omega^{\frac{-1}{\omega-1}})^{\frac{1-\omega}{(1-2\omega)}} \times d_{21}^{\frac{-\omega^2}{1-2\omega}} \times d_{12}^{\frac{\omega(\omega-1)}{(1-2\omega)}} \tag{26}$$

$$s_2{}^* = \psi^{\frac{1-\omega}{(1-2\omega)}} \times \beta^{\frac{\omega(1-\omega)}{(\omega-1)(1-2\omega)}} \times (\omega^{\frac{-\omega}{\omega-1}} - \omega^{\frac{-1}{\omega-1}})^{\frac{1-\omega}{(1-2\omega)}} \times d_{12}^{\frac{-\omega^2}{1-2\omega}} \times d_{21}^{\frac{\omega(\omega-1)}{(1-2\omega)}} \tag{27}$$

Because $|\frac{\partial s_i{}^*}{\partial d_{ij}}| > |\frac{\partial s_i{}^*}{\partial d_{ji}}|$, if $d_{21} > d_{12}$, we will have $s_1{}^* > s_2{}^*$ when $\overline{s_1} = \overline{s_2}$. This demonstrates the social status benefits for i of living in closer proximity to the others in his society — i.e., of having lower d_{ij} values. Importantly, $s_i{}^*$ is a function of one or more d_{ij}'s — the distances from person i to the other people j in his society — and the distances d_{ji} from the other people in i's society j to person i. It is just that the effect of d_{ij} on $s_i{}^*$ is greater than the effect of d_{ji} for any one j when $\overline{s_i} = \overline{s_j}$.

Thinking about what would happen if we expanded this scenario to have n identical people instead of just 2, and all $d_{ij} = d$, we would end up with the following equilibrium:[12]

$$s_i{}^* = \sigma^{\frac{1-\omega}{(1-2\omega)}} \times n^{\frac{1-\omega}{(1-2\omega)}} \times d^{\frac{-\omega}{(1-2\omega)}} \tag{28}$$

We can observe that s^* is increasing in n when Assumption 1 that $0 < \omega < 0.5$ holds — in other words, the more people in society, the higher social status will be. A way of thinking of the benefits of n here is that there are returns to interacting with more people. Because social status is generally

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[12]See Section 8.11 in the Appendix for further explanation of this.

a relative measure, the benefits of n might not be totally clear in this illustration with equal s^* values. If we think of s^* as the social status value for the members of an identical group of n people, though, the social statuses of the people in this group will be higher, *ceterus paribus*, than those of the people in a separate, isolated group (no interactions across groups) with n' people such that $n' < n$. The individuals in the group with more people will enjoy higher social statuses.

3.4.2 The "Line"

Imagine a society with 10 people $\{1, 2, ..., 9, 10\}$ spread out along a line from point $t = -4.5$ to $t = 4.5$, with person 1 at $t = -4.5$, person 2 at $t = -3.5$, and so on until person 10 is at $t = 4.5$. The center of the society is at $t = 0$. I alter my notation such that the distance between person 1 and person 2 is now $d_{1,2}$ instead of d_{12} in order to make things clearer when I have a distance between people labeled with a number with double digits (i.e., distance between 1 and 10 is $d_{1,10}$ instead of d_{110} which would be confusing). Also assume that we have symmetry in distances such that $d_{i,j} = d_{j,i}$. With this arrangement we have $d_{1,10} = 9$, $d_{1,2} = 1$, $d_{9,10} = 1$, $d_{5,10} = 5$, $d_{5,6} = 1$, $d_{5,4} = 1$ and so on, as should be obvious. People 5 and 6 live in the most central locations in this society (they have the lowest average $d_{i,j}$ values), while 1 and 10 live on the fringes (they are on average farther away from their peers than people 2 through 9 are). For ease of solving assume that each person has the same base characteristics $\bar{s} = 0$. Hence our equilibrium condition 14 looks like this:

$$s_i = \sigma \times \sum_{j \in S} d_{ij}^{\frac{\omega}{\omega - 1}} \times s_j^{\frac{-\omega}{\omega - 1}} \tag{29}$$

To determine social statuses in the initial arrangement of the society, I use the process described in 3.3. For the purposes of running this process I need an ω value so I assume $\omega = 0.25$. Applying the process I arrive at an equilibrium,[13] and as expected, the people living in the center have the highest social statuses, and those on the periphery have the lowest. I graph social status by location (t) in Figure 6. We see that social status is highest in the core (with the social center of the city at $t = 0$) and lowest in the periphery.

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[13]See Section 8.8 for the explication of the process
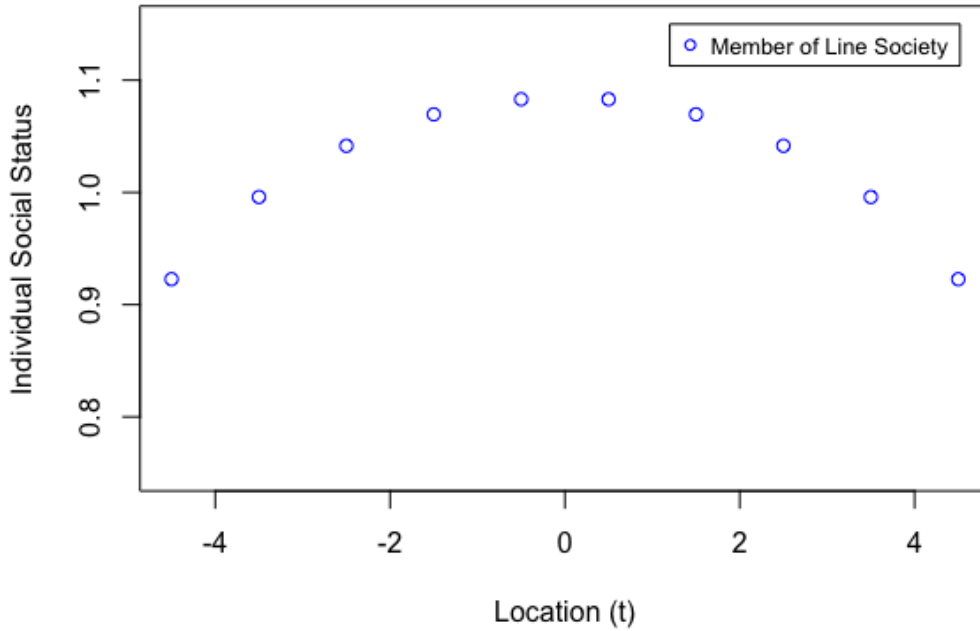
Notes: The x axis shows the location t of each individual from $t = -4.5$ to $t = 4.5$. The geographical center of this "line" city is at $t = 0$. Each dot represents one individual. We can see that the two people closest to the city center, at $t = -0.5$ and $t = 0.5$, enjoy the highest social statuses s_i, while those on the fringes of the line have the lowest s_i.

Figure 6: Social Status by Location

3.4.2.1 Scenario 1 — Subway Suppose that we build a "subway" between $t = -0.5$ and $t = 0.5$ and this makes it such that the effective distance between these two locations is cut in half, so that $d_{t=-0.5,t=0.5} = 0.5$ instead of 1 as it did previously. Applying the same process[14] used previously we get a new distribution of social statuses, plotted in Figure 7 against the old social statuses. We see that the subway increases the social status of the people living in the core ($i = 3$ through $i = 8$) but decreases the social statuses of those on the periphery. The s^* of the people living in the center of the line increase the most, both in absolute and proportional terms.

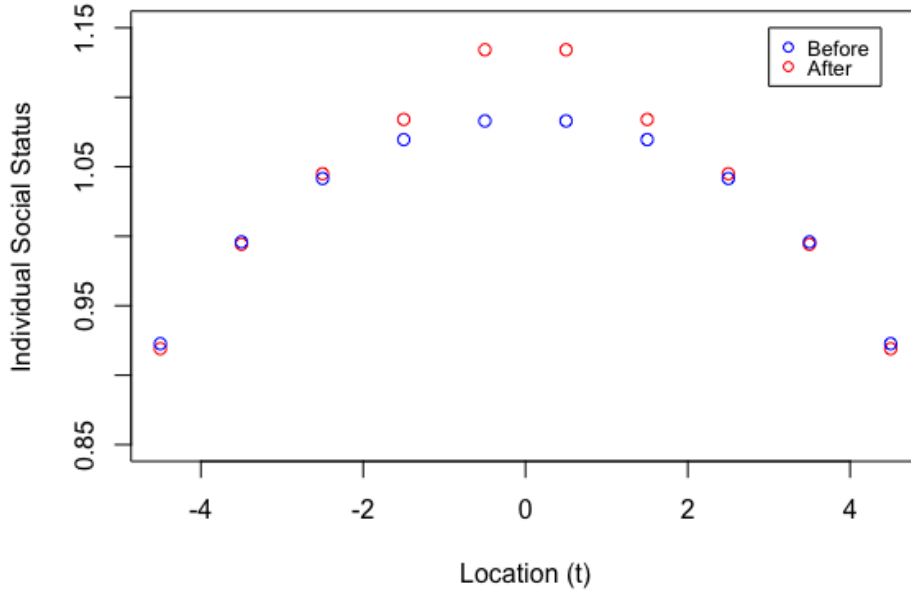
[14]See Section 8.9 for the explication of the process.

Notes: The x axis shows the location t of each individual from $t = -4.5$ to $t = 4.5$. The geographical center of this "line" city is at $t = 0$. For each location t, the blue dot represents the s_i of the person living at that location before the subway; the red dot is that person's s_i after the construction of the subway. Social status increases the most for the people in the center.

Figure 7: Social Status by Location — Pre and Post-Subway

Intuitively the higher social status benefits for the people in the core make sense because the j that have the greatest impact on i's social status are the j that live closest to i. Therefore a reduction in $d_{i,close j}$ will cause a greater increase in s_i than a reduction in $d_{i,far j}$ will — and the people in the core have had more of these $d_{i,close j}$ reduced. One can also think of this in terms of the proportional reduction in $d_{i,j}$'s experienced by the people in the core compared to those in the periphery — a reduction of $d_{t=-0.5,t=0.5}$ from 1 to 0.5 is a reduction of half, while a decrease in $d_{t=-4.5,t=4.5}$ from 9 to 8.5 is a much smaller proportional decrease.

The results of this scenario make for an interesting contrast with papers such as Brueckner et al. (1987), Alonso et al. (1964), Mills (1967), Muth (1969) and Von Thünen (2014) in the urban economics literature, which assume that economic agents face a tradeoff between rents (higher in the core, lower in the periphery) and commuting costs (lower in the core, higher in the periphery) when choosing where to live. This relationship implies that infrastructure improvements make living on the periphery more desirable by reducing commuting costs; the core, by comparison, benefits less from the improvements because commuting costs are relatively less important to the people who live there. In this context infrastructure makes the "rent gradient" — the rate at which rents fall as distance from the core increases — less steep. But in the framework of my social model,

infrastructure improvements made solely in the core of the city do the opposite to this model's "social gradient" — i.e., the rate at which social status increases as distance to the core decreases — as the people in the most central locations experience the highest social status gains from the subway construction.

Compare this to a similar scenario but where the subway is on the left fringe of the city, reducing the effective distance between $t = -4.5$ and $t = -3.5$ from 1 to 0.5. Figure 8 below compares the pre and post fringe subway social statuses at each location (see supporting table in Section 8.9 in the Appendix). This result shows that, in this model, infrastructure improvements benefit those closest to the actual infrastructure. This is because a greater proportion of these people's links d_{ij} are affected by the new infrastructure, and with greater intensity, than are the links of the people who live far away from it.

Notes: The x axis shows the location t of each individual from $t = -4.5$ to $t = 4.5$. The geographical center of this "line" city is at $t = 0$. For each location t, the blue dot represents the s_i of the person living at that location before the subway; the red dot is that person's s_i after the construction of the subway. Social status increases the most for the people on the left side of the city.

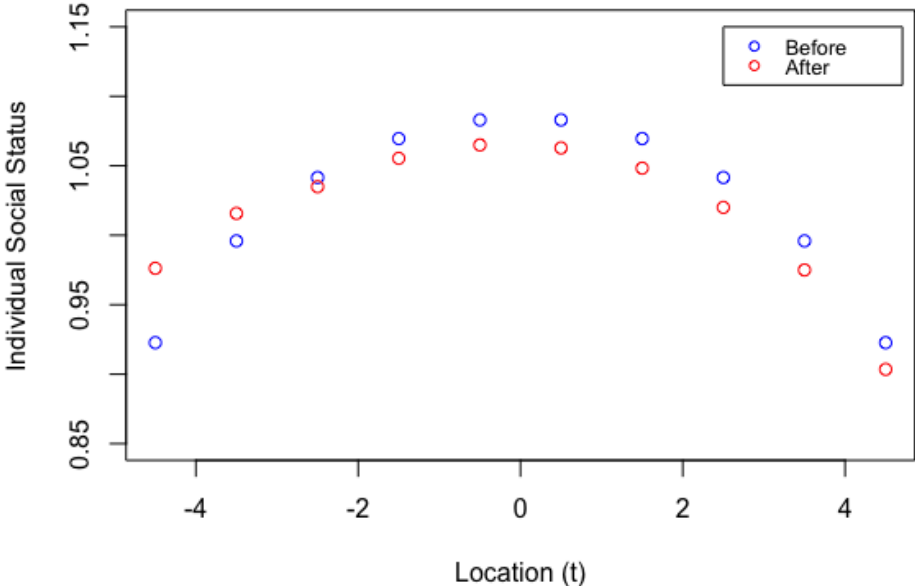Figure 8: Social Status by Location — Pre and Post-Fringe Subway

3.4.2.2 Scenario 2 — "White Flight" From the Center to the Periphery

In this scenario we explore what happens if the line city experiences 'White Flight" — in other words, the members of the society in the core of the society move to its periphery. To model this, let's say that people 4 and 5 move to $t = -4.5$ and people 6 and 7 move to $t = 4.5$, while the others remain

in their original positions (the subway from the previous example is gone). We also add one more person, $i = 11$, in the very center of the city at $t = 0$. We will pretend that this is the one remaining member of society in the core. Applying the same process used in the prior scenarios, we arrive at the following plot of social statuses by location t in Figure 9.[15]
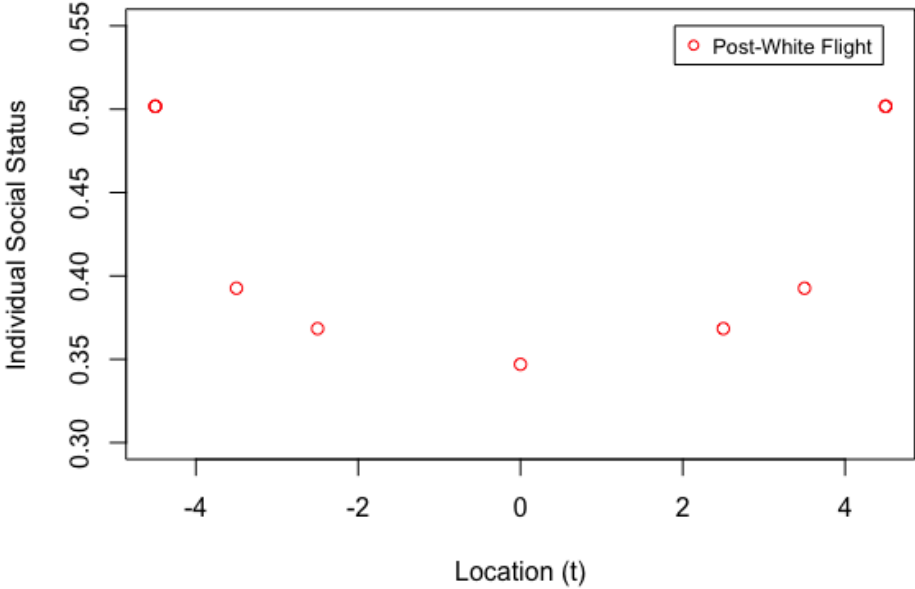
Notes: The x axis shows the location t of each individual from $t = -4.5$ to $t = 4.5$. The geographical center of this "line" city is at $t = 0$. Each dot represents one individual. Social status is now lowest in the core.

Figure 9: Social Status by Location — Post-"White Flight" From the Center

We see here that social status is higher in the peripheral "suburbs" and lowest in the urban core (i.e. where $i = 11$ lives). Note that total population might still be highest in the core ($t = 0$) but it is still least dense in terms of where the members of "society" live. The distribution of social statuses here means that there will be incentives for those remaining in the core to also relocate to the suburbs if they want to regain a high social status. This phenomenon is consistent with a trend that plagued Manhattan in the middle of the 20th century, when the city's social elite moved *en masse* to the suburbs and joined rapidly growing country clubs, making these suburban regions the new "society centers" in the New York metropolitan region. This move in turn made Manhattan less desirable for the social elites and placed some of the social clubs in downtown Manhattan in financial distress due to declining membership (Hood, 2017).

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[15]See Section 8.10 for matrix of social statuses.

4 Data Matching Process and Preparation for Empirics

In this section I describe the process I used to link my various datasets. Figure 14 below provides a summary of the dataset linking process described here.

4.1 Social Register and Tax Data

I first manually matched the approximately 22,000 records in Marcin (2014)'s 1924 tax data with information from the roughly 950 pages of the 1924 New York Social Register. For each individual in the tax data who met certain criteria and belonged to the Social Register I recorded that person's corresponding Social Register information. I restricted my matches to men who lived in Manhattan and were adults (not the teenage "juniors" listed in the Social Register) — to men because social clubs were primarily for men, and therefore only serve as a useful measure of social activity for men (Hood, 2017), and Manhattan because the Social Register provides precise addresses for people who live in Manhattan, while only giving towns or estate names for people living outside of Manhattan island. Because precise locations are necessary for my analysis, families based outside of New York are not useful.[16] For men who did meet these criteria, I recorded the following information — their address (the address given in the Social Register is the person's residence, whereas the tax data

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[16]People for whom New York addresses were listed but whose entries pointed the reader to other Social Registers (Cleveland, Philadelphia, Boston, etc.) were also excluded, because these messages typically indicate that the listed individual's home city was not New York, even though they may have had a *pied de terre* in Manhattan. Lastly, some entries point the reader towards the Social Register's "dilatory domiciles" for the address of the household listed, indicating that that household did not submit its updated address information on time or did not submit it at all. These addresses are only provided in later "dilatory domicile" supplements that are much harder to track down. Individuals with "Dilatory Domiciles" not included in the December 1923 supplement (the first 1924 edition is published in November) are excluded, but I do not expect this to create endogeneity problems because dilatory domiciles should not be correlated with choice of residence or social activity.

Figure 10: Example of a "junior" (a young man between 14 and 20, by the Social Register's definition), Mr. H. Edward Manville Jr, who was excluded from my transcription because he was not an adult. His father, by contrast, as an adult male living in Manhattan, was included.

Figure 11: Example of a "see Boston" entry for Mr. Shepard Krech.

addresses are unreliable because people often used business or accountant addresses when filing their taxes), full name if more extensive than the name information provided in the tax data, other parts of the person's address ("Plaza Hotel," for instance), number of memberships for clubs outside of New York and number of club memberships in the New York area, first alma mater (i.e. only undergraduate if undergraduate and graduate institutions are listed) and graduation year if given, and whether he belonged to seven specific clubs of interest — the Metropolitan Club, the Union Club, the Knickerbocker Club, the Union League Club, the University Club, the Jekyll Island Club and the New York Yacht Club. My dataset after completing this process included observations of 1,882 men. Hereafter I will refer to this dataset of 1,882 men as the Social Register-Tax dataset.

4.2 Appending Census Data

The United States Federal Census includes a range of demographic data (birth year, race, occupation, birthplace, marital status and more) not always included in the Social Register, therefore by appending census data to the merged Social Register-Tax data one can produce a dataset that provides a much more holistic view of the individuals it covers. While there is no census for the exact year of my tax and social register data (1924), I use the closest federal census available, 1920, for my analysis. I do not expect the 4 year disconnect between the Social Register information and the census data to be a problem as the demographic data supplied by the census should be largely time invariant.

I use the full-count 1920 federal census data obtained from NBER for my matching process. As an initial filter, I pare this data down to the male inhabitants of Manhattan island, as my Social Register/Tax dataset includes only men living in Manhattan. The identifying information from the Social Register-Tax dataset that I use to match individuals with their US census equivalents are their first, last and, when available, middle names. I also use imputed birth year, calculated from the college graduation years provided by the Social Register for people who have graduated college, as an identifying trait. To impute birth year from college graduation year, I first calculate the average age at college graduation to be 21.17 for the 41 college graduates in the dataset who had already been matched to the census by Marcin (2014) in his dataset. While Marcin (2014) linked the richest people in his tax data to the 1920 federal census, and therefore my sample of the 41 men skews towards the very wealthy, I do not expect there to be a significant difference between the average graduation date of the man who is ultra-wealthy in 1924 and the man who is merely wealthy. For the 1,284 of the 1,882 men in my data table for whom college graduation date information was supplied by the Social Register, I subtracted 21 from their college graduation

Mᵐᵉ Elizabeth C Chater . . . .|29 Fifth Av
King Mʳ Roland–K.Trb . . . . .24 Kay Newport R I . .see Dⁱˡᵃᵗᵒʳʸ ₘₒₙᵢcᵢₗₑₛ
King MᵃMʳˢ Rufus (Downing–Jane L Skinner)Y'94

Figure 12: Example of a "Dilatory Domiciles" entry for Mr. Roland King.

years to arrive at imputed year of birth.

There is a substantial methodological literature about the merits of different matching algorithms (see Abramitzky et al. (2019); Bailey et al. (2017); Price et al. (2019)) but for the purposes of matching my datasets I use a modified version of the record-linking algorithm used by Arkolakis and Lee (2018) (also described in Lee (2020)) to match census records across years in their study of historical American growth.[17] Due to the difficulty of matching individuals to the 1920 census for Manhattan with only names as identifiers, I had to cut my dataset down to college graduates, for these were the only people for whom I could impute birth dates and thereby narrow the universe of potential matches with the 1920 census.

After applying the Arkolakis and Lee (2018) algorithm to match these 1,284 individuals to the 1920 census, the code still returned many men as having multiple potential matches in the 1920 census. To further cull the universe of potential matches, I applied occupation restraints to the men from the census returned as possible matches, removing people with occupations that made them very unlikely to be Social Register or New York social club members. I removed all laborers and shoe-makers, for instance, because men with these sorts of working-class jobs were simply not included in the Social Register in 1924, and are therefore not possible matches with the Social Register members in my dataset.[18]

I also impose a Jaro-Winkler measure minimum of 0.8 for similarity between the standardized name from the social register and name in the census, and a cap of 5 years on the difference between Social Register imputed age and census age — although I relax these constraints for a handful of individuals whose census entries did not meet these criteria because they went by their initials or middle name, or who had graduated college at an atypical age. I confirmed these sorts of "special" matches manually by comparing the names of family members in their households. For individuals for whom the matching process still returned multiple potential matches after applying these constraints, I use addresses to see if there is a match in street address between the 1924 Social Register entry for a person and the address listed for his potential match in the 1920 federal census. If the correct match is still ambiguous these entries are dropped. This matching process left me with a dataset of 769 men.

For the instrumental variable approach described in Section 5.3, I perform 2 more data linking processes. First, I link the 769 men from the 1924 Social Register-Tax-1920 Census dataset (I will call it the Census Linked dataset) by hand to the 1920 Social Register, in order to collect the addresses (social register addresses are much cleaner than the addresses transcribed by census digitizers) and club memberships of the people in my Census Linked dataset in 1920. This leaves me with 704 men in my dataset for the IV regressions.[19]. I will refer to this dataset of 704 men as the Social Comparison dataset. Finally, to estimate the change in family size of the men in my

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[17]I am grateful to Dr. Sun Kyoung Lee for letting me use this algorithm and for helping me to apply it to my data.

[18]Other removed occupations: machinists, carpenters, waiters, chauffeurs, tailors, motormen, janitors, foremen, bricklayers, cooks, bartenders, horseshoers, stablemen, truck drivers, barbers butchers, tinsmiths, butlers, undertakers, teamsters, drivers, orderlies, tailors, gardeners, brakemen peddlers, water boys, handymen and upholsterers.

[19]Some of the 769 were not in the Social Register in 1920, either due to erroneous omission or because they were not listed yet then.

group between 1920 and 1930, I link as many of the 769 men as possible to the 1930 census and get 179 matches. I describe how I use these later.
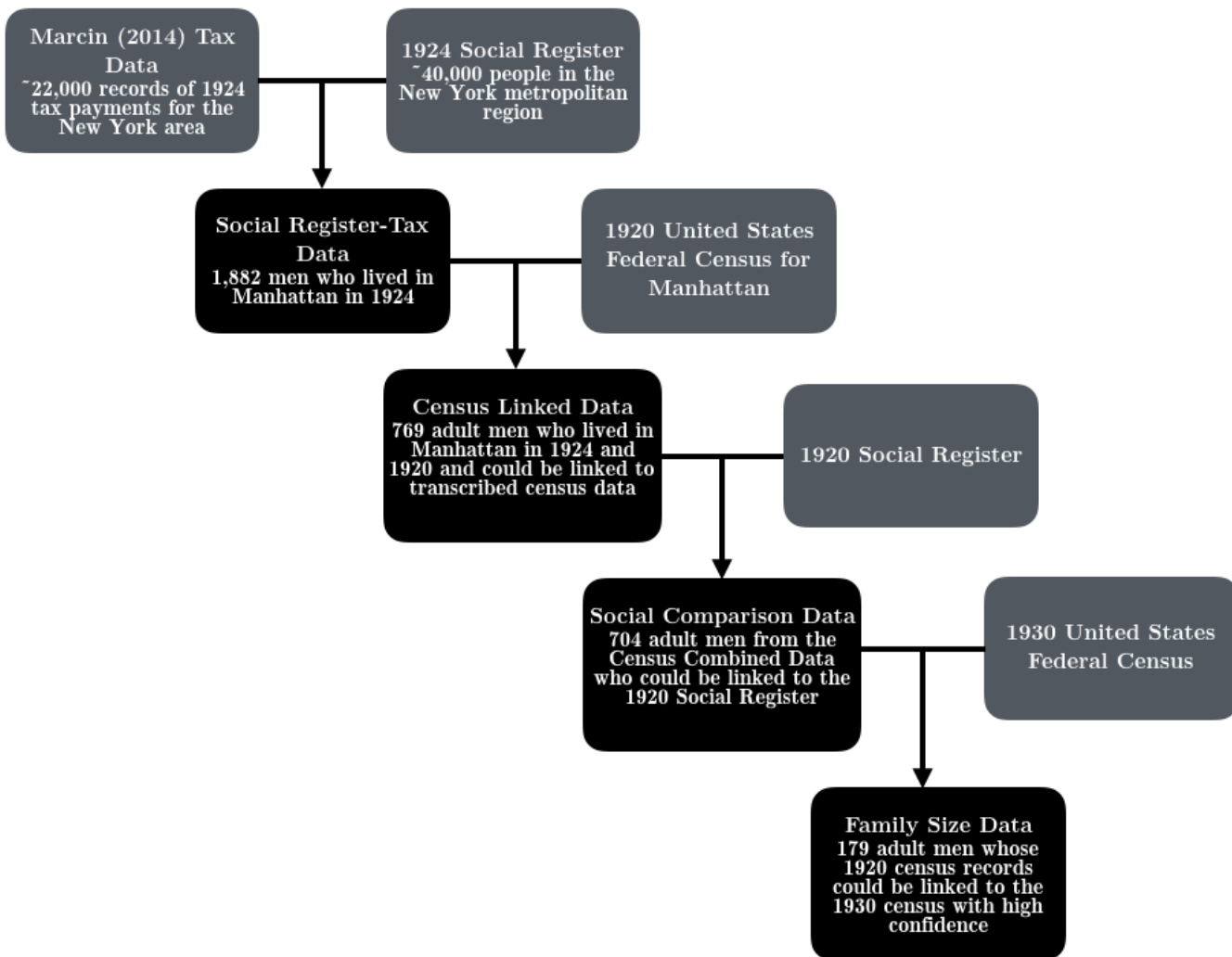
Figure 13: Summary of Data Linking Process. Gray boxes are input datasets; black boxes are linked datasets.

4.3   Sample Linking Procedure — The Story of Philip J. Roosevelt

I now describe the linking procedure for one individual, Mr. Philip J. Roosevelt (a relative of Theodore and Franklin Delano Roosevelt) in order to illustrate the different stages of the record linking process. We begin with a record in the Marcin (2014) tax data for a P.J. Roosevelt who paid $42,503 in federal income tax for the year 1924. The address given, 30 Pine Street, indicates that Roosevelt likely lived in Manhattan, but is not necessarily Roosevelt's actual address because many New Yorkers (and wealthy individuals in particular) used third parties (accountants, lawyers,

etc.) to file their taxes. A quick Google Maps search reveals that 30 Pine Street is in the Financial District in Manhattan, indicating that this is almost certainly Roosevelt's business address or the address of his accountant, as virtually no wealthy, socially prominent people lived in the Financial District in 1924.

Roosevelt, P. J.	30 Pine	42503		Second District

Figure 14: 1924 Tax Record for Philip J. Roosevelt

I now manually match this record to an entry in the 1924 Social Register for Philip J. Roosevelt living at 804 5th Avenue. The unique last name (which also indicates a wealthy and socially prominent family) and the absence of any other plausible matches gives me confidence that this is a correct match. From this entry we can see that in 1924 Roosevelt belonged to a total of 3 New York area clubs — the Metropolitan Club (Mt.), the Seawanhaka Yacht Club (S.) and the Knickerbocker Club (K.) — and had graduated from Harvard in 1913 (H. '13). He was living with a Mr. and Mrs. W. Emlen Roosevelt (likely family members) and the asterisk next to Philip's name indicates that he served in World War One. Using tax brackets gathered from the 1924 income tax return form, I calculate that Philip J. Roosevelt collected $145,867.44 in net taxable income in 1924.

Figure 15: 1924 Social Register Entry for Philip J. Roosevelt

For the next stage of the linking process, appending census information to produce the Census Linked Dataset, I use the IPUMS full count census data and the Arkolakis and Lee (2018) matching algorithm described above to isolate Philip J. Roosevelt's United States federal census entry for 1920. This record tells us that Roosevelt was unmarried and had no children in 1920, was born in New York and worked as an "investor" in 1920. His first name and middle initial have been flipped, but this is a typical census enumerator error, and the presence of the same Mr. and Mrs. W. Emlen Roosevelt (Philip's parents, according to the census) identified in the 1924 Social Register entry gives us high confidence that this is the same Philip J. Roosevelt.

Figure 16: 1920 Census Record for Philip J. Roosevelt

I next manually locate Philip J. Roosevelt in the 1920 Social Register in order to collect information on his address and club memberships for that year (creating the Social Comparison Dataset). We see that in 1920 he lived at the same address as he did in 1924 (804 5th Avenue) and had the same number of club memberships (3), but belonged to the Aero club (Ao.) instead of the Knickerbocker Club.

Figure 17: 1920 Social Register Record for Philip J. Roosevelt

For the last step of my record linking, creating the Family Size Dataset, I find Philip J. Roosevelt in the 1930 United States Federal Census in order to see how his family size changed between 1920 and 1930. We find that Roosevelt still works in the "investment" field but is now married with two children and is the "head" of his household.

Figure 18: 1930 Census Record for Philip J. Roosevelt

4.4 Geocoding

After compiling the linked dataset, I plot the addresses using ArcGIS Pro's geocoding capability. For addresses that returned a "tie" instead of a single match (in other words, two or more potential matching locations on the map), I used Google Maps to plot the address and then pick the correct location from among the tied locations generated by ArcGIS. The upper left panel of Figure 19 below plots the geocoded addresses for the 1,882 men in my Social Register-Tax dataset, while Figure 20 plots taxable income by residence in a three-dimensional format and Figure 21 does the same for club memberships. Next, I calculate the distance between each address and every other address using ArcGIS's "Generate Near Table" function. The resulting distance matrix lists the distance in meters between every i and every $j \in S$.

This distance data, when merged with my other data, produces a dataset which lists a variety of demographic information for each individual, but also variables for his distance in meters from each of the other men in the dataset. Because some addresses are home to multiple people in the dataset (in the case of a few prominent apartment buildings), I add 5 meters to each of these distance values to reflect the distance cost of moving from a building to the street or between residences in the same building. This also helps me to avoid having denominators of zero when I weight club memberships by distance to create density measures. The resulting table of distances is the distance matrix $d = (d_{ij})_{i,j \in S}$ described previously. This matrix can be used in conjunction with club membership data that captures s_j to calculate the social density measure $(\sum_{j \in S} (\frac{s_j}{d_{ij}})^{\frac{-\omega}{\omega-1}})$, from equation (14) in the model, for each socialite's residence in 1924. These "social density scores" (calculated in Section 5) are plotted for the residences of the 704 individuals in the Social Comparison dataset in Figure 22 below.[20] For more details on geocoding and some initial takeaways from the distance matrix see Section 8.12 in the Appendix.

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[20]The ω value for this measure is also estimated in Section 5.
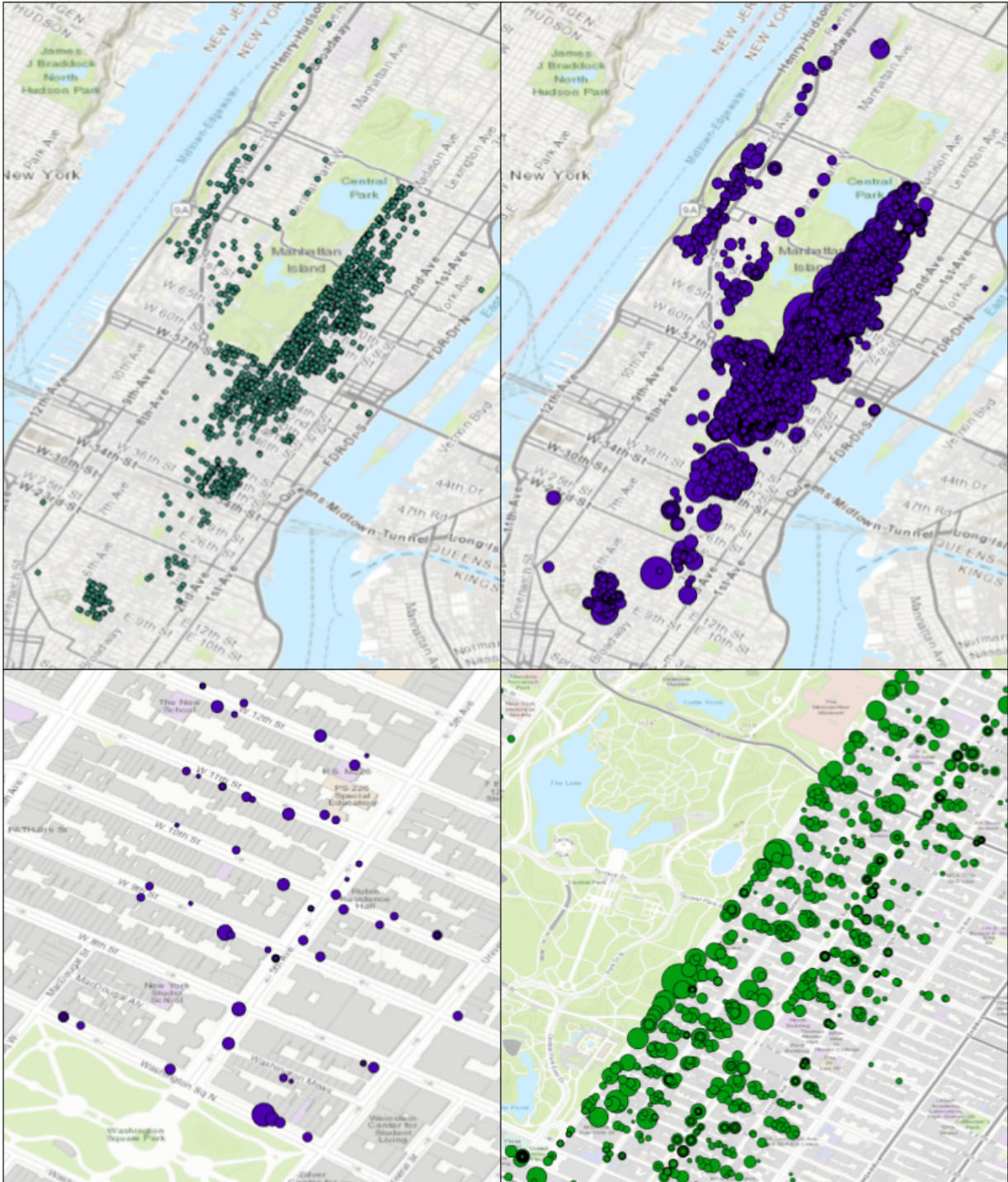
Figure 19: Some maps that illustrate some of the key residential patterns present in my combined dataset. Upper left: A plot of the Manhattan residences of the 1,882 men from the merged Social Register-Tax data. Upper right: The same map as above, but where the size of the circle representing each person corresponds to the number of New York-area social clubs to which he belonged. Lower left: A close-up of the club-weighted map but for the area around Washington Square Park. Lower right: Another close-up but for the Upper East Side.
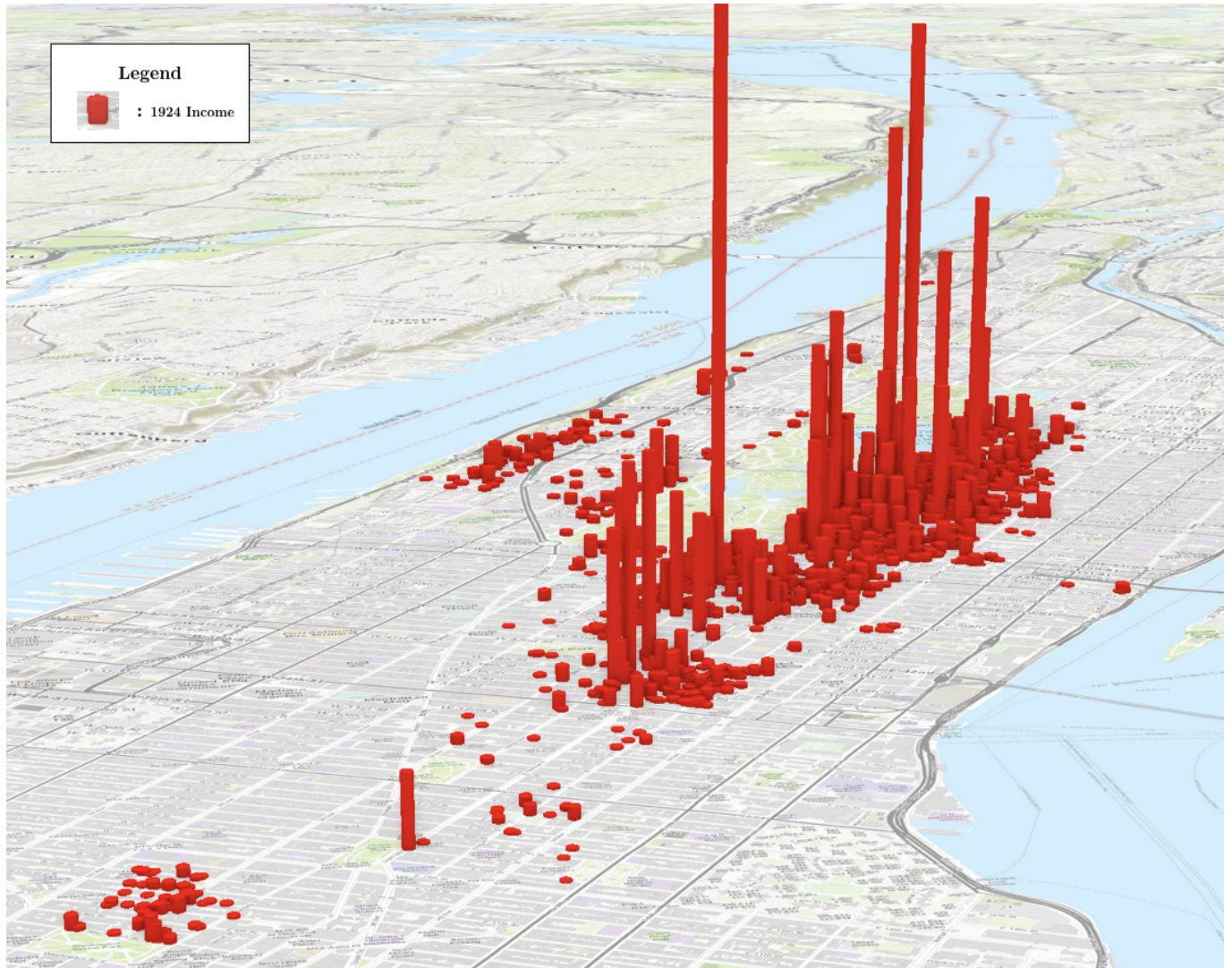
Notes: Size of bar at each location represents the 1924 net taxable income of the socialite who lived at that location in 1924, as reported by the New York Social Register, for the 1,882 men in my Social Register-Tax dataset. Observe that most of the dataset's highest earners lived along Central Park and in Midtown. The bar that extends beyond the scope of the image is John D. Rockefeller Jr.'s at 10 West 54th Street. Rockefeller earned $13,806,420 in taxable income in 1924.

Figure 20: Incomes by Residence
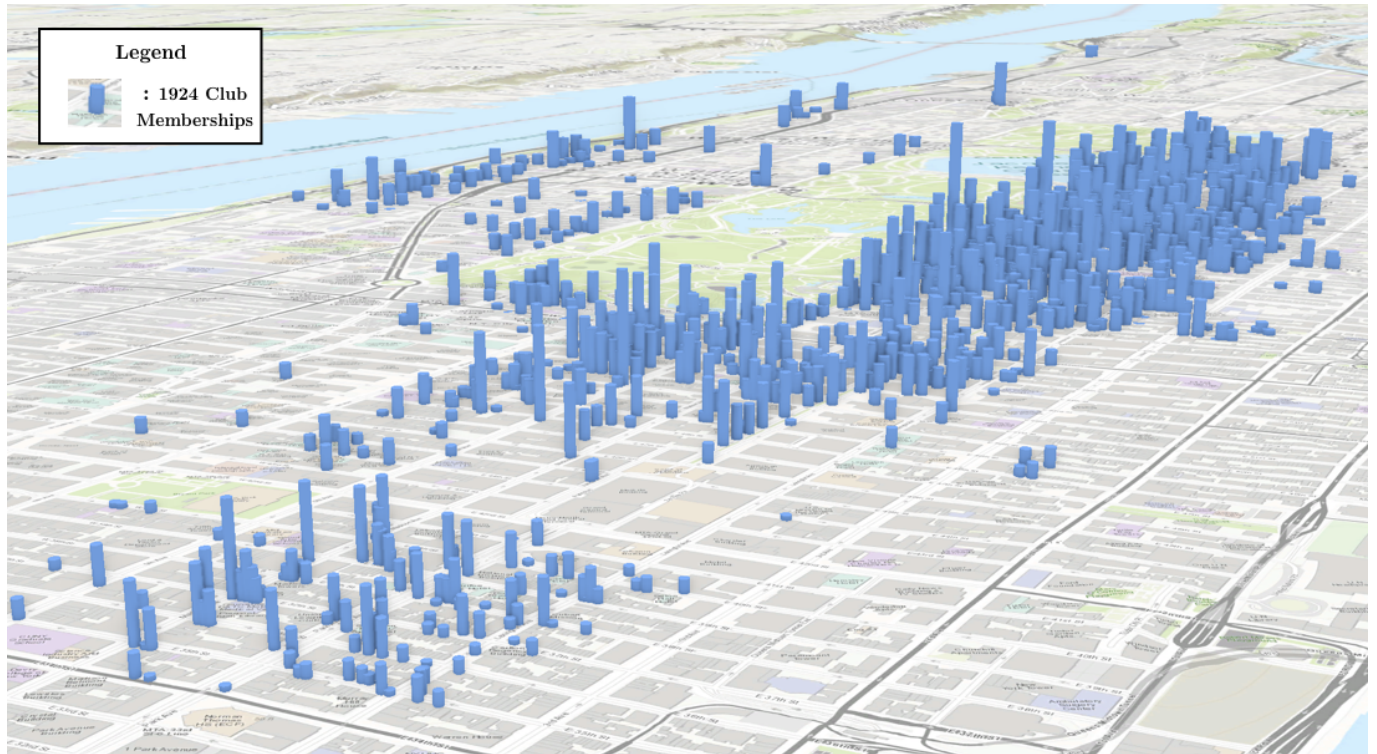
Notes: Size of bar at each location represents the 1924 New York-area club memberships of the socialite who lived at that location in 1924, as reported by the New York Social Register, for the men in my Social Register-Tax dataset. Note that this map cuts off some of the individuals in the dataset (including those around Washington Square) in order to provide a better perspective on the club memberships of individuals who lived in the core of the network.

Figure 21: Club Memberships by Residence
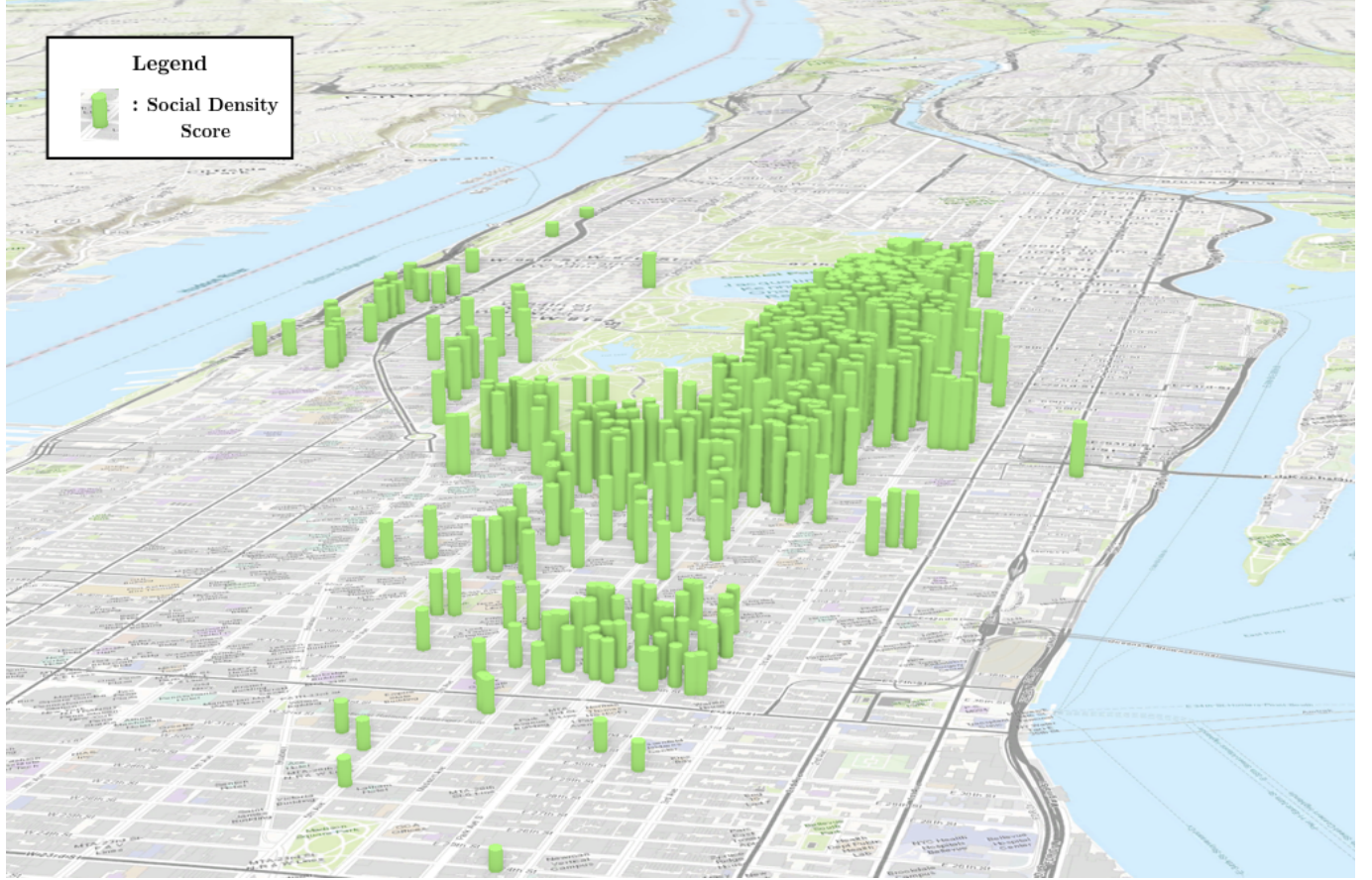
Notes: Size of bar at each location represents that location's social density measure $(\sum_{j \in S}(\frac{s_j}{d_{ij}})^{\frac{-\omega}{\omega-1}})$ (from equation (14) in the model) as calculated in Section 5 using the estimated $\omega = 0.23874$. Each bar marks the 1924 residence of one of the 704 individuals in the Social Comparison dataset (described in Section 4.2), rather than the Social Register-Tax dataset, hence there are fewer bars in this map than in the prior two. The most socially-dense locales are on the East side of Central Park; the least socially-dense are along the Hudson River. Note that this map cuts off some of the individuals in the dataset (including those around Washington Square) in order to provide a better perspective on social densities in the core of the network.

Figure 22: Social Density by Residence

5 Estimation

In this section I attempt to estimate the parameters of the model expostulated in Section 3, first using an OLS approach and then with an instrumental variable identification strategy. To estimate α and σ I will use a simple linear regression. To estimate the elasticity ω I employ an iterative approach, running a grid search to find the best ω.

5.1   OLS Results — Social Density and Social Status

To start, I run the regression 31 below, which reflects equation (14) from the model explicated earlier, on my Census Linked Dataset. I do not have a good *a priori* sense of ω's value so I start with an estimate of $\omega = 0.25$.[21] The regression also makes some assumptions about the makeup of $\overline{s_i}$ — namely, because I have income, birthplace, college and age data, I will define $\alpha \times \overline{s_i} = \alpha \times (age_i) + \delta \times (age_i)^2 + \beta \times log(y_i) + \nu \times (local_i) + \rho \times ivy_i$ where y_i is the taxable income of person i, $local_i$ indicates whether i was born in the New York area (Connecticut, New Jersey or New York), and ivy_i indicates whether i graduated from an Ivy League college.[22] I include these last two regressors because coming from the New York area or having attended a prestigious college could provide socialites with existing social networks in New York City that might influence their social statuses independent of the other variables in my model. I also include a dummy variable indicating whether a socialite was born outside of the United States in one iteration of the regression presented in Table 3. In terms of control variables, I try to include as many of these demographic traits that I can quantify, even if their coefficients may not be statistically significant in the regression results, in order to avoid omitted variable bias.

Note that the definition of the members of society (S) in the term $(\sum_{j \in S}(\frac{s_j}{d_{ij}})^{\frac{-\omega}{\omega-1}})$ here is the 1,882 men in the Social-Register Tax dataset.[23] This could present some problems if the 769 men in my Census Linked dataset are not representative of the 1,882 men in the Social Register-Tax dataset, but I do not expect this to be the case because the ability to link those 769 records of out the 1,882 initial records to census data was largely the product of random factors such as quality of census transcription, and not individual traits.

$$s_i = \gamma + \alpha \times (age_i) + \delta \times (age_i)^2 + \beta \times log(y_i) + \nu \times (local_i) + \rho \times ivy_i + \sigma \times \left(\sum_{j \in S}(\frac{s_j}{d_{ij}})^{\frac{-\omega}{\omega-1}}\right) + \epsilon \quad (30)$$

$$s_i = \gamma + \alpha \times (age_i) + \delta \times (age_i)^2 + \beta \times log(y_i) + \nu \times (local_i) + \rho \times ivy_i + \sigma \times \left(\sum_{j \in S}(\frac{s_j}{d_{ij}})^{\frac{1}{3}}\right) + \epsilon \quad (31)$$

I continue iterating by doing a grid search over ω until I arrive at a specification with $\omega = 0.23874$.[24] The regression represented by equation (32) reflects this updated ω.

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[21]This approach of guessing an initial value for a parameter is the same used by Arkolakis (2016) for α in their model.

[22]Only undergraduate studies considered here. Graduate school information from the Social Register is not as reliable and I did not transcribe it.

[23]The $j \in S$ in $(\sum_{j \in S}(\frac{s_j}{d_{ij}})^{\frac{-\omega}{\omega-1}})$ excludes i, of course

[24]With the lowest sum of the residuals squared of 5475.477020659494 (the sum of squares were largely very similar even for very different ω).

$$s_i = \gamma + \alpha \times (age_i) + \delta \times (age_i)^2 + \beta \times log(y_i) + \nu \times (local_i) + \rho \times ivy_i + \sigma \times \left(\sum_{j \in S} \left(\frac{s_j}{d_{ij}}\right)^{\frac{-0.23874}{0.23874-1}}\right) + \epsilon \quad (32)$$

Table 3: OLS Results

| | *Dependent variable:* |
| | New York Social Clubs |
	(1)	(2)	(3)	(4)
$(\sum_{j \in S}(\frac{s_j}{d_{ij}})^{\frac{-0.23874}{0.23874-1}})$	0.005*	0.005*	0.005*	0.005*
	(0.003)	(0.003)	(0.003)	(0.003)
Age	0.105**	0.114**	0.125**	0.125**
	(0.050)	(0.050)	(0.050)	(0.050)
Age squared	−0.001	−0.001	−0.001	−0.001
	(0.0005)	(0.0005)	(0.0005)	(0.0005)
Log Income	1.710***	1.709***	1.721***	1.725***
	(0.111)	(0.110)	(0.110)	(0.110)
Ivy League graduate		0.420*	0.363	0.370
		(0.249)	(0.249)	(0.249)
Born in NY, CT or NJ			0.519**	0.461**
			(0.207)	(0.216)
Foreign born				−0.495
				(0.522)
Constant	−19.439***	−20.042***	−20.789***	−20.761***
	(1.832)	(1.864)	(1.882)	(1.882)
Observations	769	769	769	769
R^2	0.285	0.288	0.293	0.294
Adjusted R^2	0.281	0.283	0.288	0.288
Residual Std. Error	2.693 (df = 764)	2.690 (df = 763)	2.681 (df = 762)	2.681 (df = 761)
F Statistic	76.101*** (df = 4; 764)	61.598*** (df = 5; 763)	52.733*** (df = 6; 762)	45.322*** (df = 7; 761)

Note: *p<0.1; **p<0.05; ***p<0.01

The regression output for equation (32) is in column 3 of Table 3; the results of alternate specifications are in columns 1, 2 and 4. In the preferred specification given in column 3, age, income and the NY/NJ/CT birth indicator variable all have statistically significant positive effects on social status. These results make sense: older people have had time to establish more social ties and thus gain admittance to more clubs; wealthier people are able to increase their prestige by throwing more parties and having outsized influence in society more broadly; and New York/New Jersey/Connecticut-born men can likely take advantage of their existing networks in the New York City area to gain entry to more social clubs.

To contextualize the coefficient on $(\sum_{j\in S}(\frac{s_j}{d_{ij}})^{\frac{-0.23874}{0.23874-1}})$, I will compare $(\sum_{j\in S}(\frac{s_j}{d_{ij}})^{\frac{-0.23874}{0.23874-1}})$ values across locations. Severyn B. Sharpe, who lived at 32 East 64th Street (on the prestigious Upper East Side) in 1924, enjoyed $(\sum_{j\in S}(\frac{s_j}{d_{ij}})^{\frac{-0.23874}{0.23874-1}}) = 327.052$, while George F. Kunz, who lived at 601 Cathedral Parkway in Morningside Heights had only $(\sum_{j\in S}(\frac{s_j}{d_{ij}})^{\frac{-0.23874}{0.23874-1}}) = 193.0419$. The difference between these two values is 134.01. Based on the results of my regression, we would expect the social density difference between the two men's residences to account for Sharpe belonging to 0.71 more New York clubs than Kunz, on average. This is significant because the median man of the 769 men in my Census Linked dataset belonged to only 3 New York social clubs, suggesting that social geography can account for a notable portion of club memberships and hence social status.

5.2 Possible Endogeneity Issues

One potential endogeneity concern with the regression specification above is that it may be subject to selection bias. In other words, the unobserved social ambition of the men in the dataset may influence both their choices of neighborhood and their club memberships. For example, a very socially ambitious 30 year old man, who aspires to join a number of prestigious Manhattan social clubs, might move to an apartment on a desirable stretch of Park Avenue because he believes that living at this prestigious address will help him to make more social connections. Because he is socially ambitious, he will also try harder to gain entry into multiple clubs, and thus likely become a member of more clubs than the average New Yorker. Someone who is not socially ambitious, meanwhile, may choose to live in a quieter neighborhood and will not work as hard to gain admittance to clubs, and thus will have few if any club memberships. In this way, the unobservable of social ambition is correlated with both residence and social status in a way that biases the coefficient on residence. We know from the history literature that this sort of heterogeneity of social ambition across individuals did exist during the Gilded Age. Homberger (2004) writes that some members of the New York elite simply chose not to participate in its social life, and as a result did not belong to many clubs. John Wendel and Edward Schermerhorn, for instance, both came from old, important Manhattan families but lived primarily as recluses rather than socialites (Homberger, 2004).

Another concern is that my income measure is imperfect. As Marcin (2014) notes in his explanation of the tax data, tax payments only reflect taxable income, not income that someone might receive from tax-free municipal bonds and other such non-taxable assets. Thus, it is likely that the true net income of the individuals in my dataset is higher than the Net Taxable Income measure I

am using. That said, I do not expect proportion of true income that is non-taxable to be correlated with the ϵ in my model, so it should not pose an endogeneity problem. In other words, propensity to invest in tax-free bonds should not be correlated with social status, choice of neighborhood or social ambition. On top of this, Marcin notes that the share of total income that was tax free in 1924 was relatively small — only 1/16, according to one contemporary estimate that he cites. Therefore at worst the imperfect relationship between tax payments and income should only be a source of measurement error, and thus attenuation bias, in my model — it will not increase the odds of making a type 1 error.

Lastly, there is also a possibility that the traits of the spouses of the men in the dataset could introduce bias into my estimation. If man i has a wife who is very wealthy and/or comes from a socially prominent family, this could affect i's social status in a way that is not captured in my current dataset. Person i could reap the benefits of a high-income lifestyle if his wife is a high-earner, even if i's own income was not very high. Similarly, i could be more socially prominent by virtue of having married into a socially prominent family such as the Vanderbilt, Rhinelander, Goelet or Kip families. This is a source of added social prestige that is not reflected in my current dataset, although the maiden names of some men's wives could be gleaned from the Social Register.

I do not expect these spousal effects on social prestige to compromise my estimation, however. In the case of income, hardly any women worked in the 1920s, and if they did have independent incomes these may have been counted with their husbands' income for tax purposes (and are thus already captured in my income measure) anyways, therefore I do not expect the effect of this omitted variable to be sizable. With regards to spillover effects from spousal social status, I do not expect this unobserved variable to be correlated with the other regressors in my model, therefore it should not create omitted variable bias.

5.3   Instrumental Variable and Diff-in-Diff Approach

A way to circumvent the endogeneity created by unobserved social ambition is by using a research design that exploits a natural experiment in location choice. If individuals moved to neighborhoods with different prestige levels, for instance, for reasons uncorrelated with their social statuses and the ϵ error term in the OLS regressions, this would provide us with a potential instrumental variable for measuring the effect of social density on social status.

One source of exogenous location changes are neighborhood moves induced by changes in family size. We expect the number of children in a family to contribute significantly to that family's decision about what neighborhood it will inhabit. If a family has more children, the parents might on average choose to live in neighborhoods with housing stock more suited to families with lots of children — for example, neighborhoods with houses with larger backyards and proximity to schools, or floor plans that have more bedrooms. Adults with fewer children in their households, meanwhile, might move to areas that offer more housing well-suited to "empty nesters" or only one or two children.

We also expect adults' moves to reflect expectations of future family size. A newlywed couple

planning to have four children might move to a house with space for a large family, even though they do not have any children yet, while two 50 year-olds with one 17 year-old son left at home might move to an empty-nester neighborhood, despite the fact that they still have one child at home, in anticipation of becoming empty-nesters in the near future. These family size-induced moves or location choices may shift individuals to neighborhoods with higher or lower social density for reasons unrelated to the social ambition component of ϵ. It could be, for instance, that neighborhoods with more housing stock for large families happen to also be less socially prestigious, while neighborhoods with more empty-nester housing are more prestigious.

I apply this to my dataset by linking my Social Comparison dataset to one additional data source — the 1930 census. By observing the families of the men in my dataset in 1930, I can see how the number of children in their households changed between 1920 and 1930. I then assume that the difference in the number of children in i's household between 1920 and 1930 is a rough proxy of i's expected change in family size over the next decade in 1920, which would then influence where i chose to live between 1920 and 1924. I then apply this instrument to a difference-in-differences regression that is slightly different from my OLS regression above, but which still tests for the same phenomenon. Instead of regressing i's club memberships in 1924 on the social density of i's residence in 1924, I regress the *change* is i's club memberships between 1920 and 1924 (determined by linking my 1924 observations to the 1920 social register to get club counts for 1920) on the *change* in the social density of i's residence between 1920 and 1924, or $(\sum_{j \in S}(\frac{s_j}{d_{ij}})^{\frac{\omega}{\omega-1}})_{i,1924} - (\sum_{j \in S}(\frac{s_j}{d_{ij}})^{\frac{-\omega}{\omega-1}})_{i,1920}$.

In the first stage of the two-stage least squares, I see whether change in family size between 1920 and 1930 (my instrument z) predicts the x in my regression, or the change in the social density of i's residence between 1920 and 1924: $x = (\sum_{j \in S}(\frac{s_j}{d_{ij}})^{\frac{-\omega}{\omega-1}})_{i,1924} - (\sum_{j \in S}(\frac{s_j}{d_{ij}})^{\frac{-\omega}{\omega-1}})_{i,1920}$. In the second stage, I regress my y, or the change in i's club memberships between 1920 and 1924, $y = s_{i,1924} - s_{i,1920}$, on the predicted x calculated in the first stage.

To run the first stage, I first link the individuals from my 1924 dataset to the 1920 social register in order to determine s_i in 1920 for the 704 people I was able to match for my Social Comparison dataset, and then linked these people's 1920 census entries to the 1930 census to compare their number of children at home in 1920 to the same metric in 1930 (see Section 4 for a description of this process). While this procedure only had a 25% match rate (typical for this sort of inter-year census linking), I use the change in number of children at home information for the 179 individuals I was able to link to estimate the z for all of the individuals in the dataset based on their age and marital status in 1920.[25]. For consistency I use the predicted z for all of the men in the dataset, including the 179 linked individuals.[26] The results from the regression I used to predict z are in Table 4.

In the first stage (equation (34) below) the left-hand side is the change in the social density

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[25]I regressed change in number of children between 1920 and 1930 for my 179 linked records on their age in 1920, age in 1920 squared, and marital status in 1920, and then used this regression to predict z for all of the observations.

[26]I do not want to introduce a new bias by treating the 179 linked men and the unlinked men differently, in case the ability to link men to the 1930 census is correlated with some other relevant variable in a way that I am unaware of.

Table 4: Predicting Change in Family Size Based on Age and Marital Status

	Dependent variable:
	Change in Children at Home, 1920 to 1930
Married in 1920	−0.555**
	(0.230)
Age in 1920	−0.155***
	(0.046)
Age in 1920 Squared	0.001**
	(0.0005)
Constant	4.830***
	(1.015)
Observations	179
R^2	0.235
Adjusted R^2	0.222
Residual Std. Error	1.087 (df = 175)
F Statistic	17.940*** (df = 3; 175)
Note:	*p<0.1; **p<0.05; ***p<0.01

$(\sum_{j \in S}(\frac{s_j}{d_{ij}})^{\frac{-\omega}{\omega-1}})$ of i's neighborhood between 1920 and 1924 (due to i moving, or 0 if i did not move). On the right-hand side are the instrument z and the same demographic control variables that I used in the OLS and which will appear again in the second stage regression, and I use the $\omega = 0.23874$ calculated earlier. I can include these control variables in this regression because they should also be exogenous.

I also add a new control variable called "1920 Neighborhood Socioeconomic Characteristic," represented by "$nbrhdchar_i$" in the regression equations, which reflects the socioeconomic characteristics of the neighborhood in which i lived in 1920. For each neighborhood this variable is equal to the mean "occupational score" (a rough measure of income imputed from occupation) of everyone living there in 1920 as calculated by Lee (2020).[27] 1920 neighborhood socioeconomic traits are important to control for in my analysis of changes in club memberships between 1920 and 1924 because the characteristics of the neighborhood where i lived in 1920 may have affected his social advancement opportunities over the next four years. The mean "1920 Neighborhood Socioeconomic Characteristic" scores by neighborhood are plotted in 23 below (adapted from Lee (2020)). Like the demographic control variables, I can include this variable in the regression because I also expect it to be exogenous.
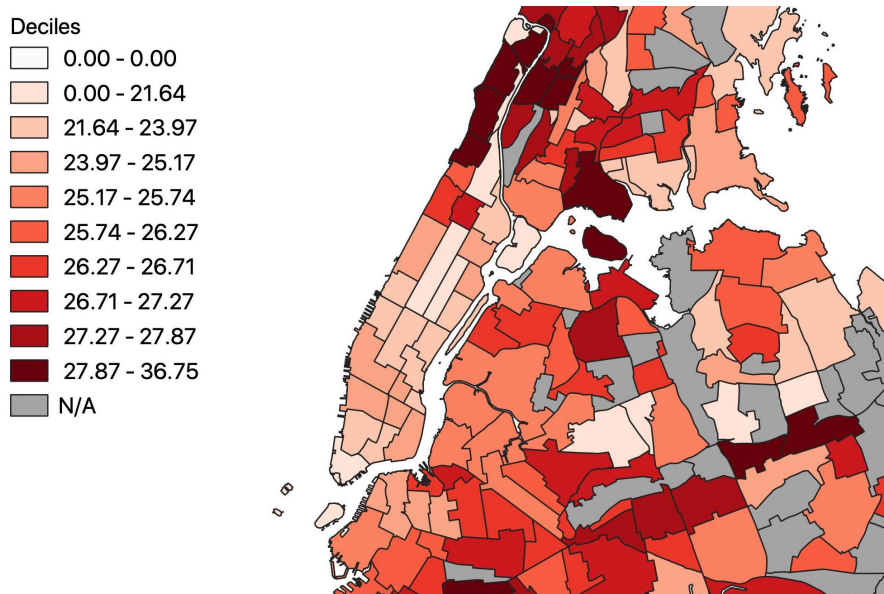
Notes: Neighborhoods are demarcated by black lines. Higher scores represent higher average income levels (as imputed from resident occupations). Adapted from Lee (2020).

Figure 23: 1920 Socioeconomic Characteristic score by Neighborhood

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[27]Detailed description of the "Occscore" variable from `https://usa.ipums.org/usa-action/variables/OCCSCORE#description_section`: "OCCSCORE assigns each occupation in all years a value representing the median total income (in hundreds of 1950 dollars) of all persons with that particular occupation in 1950. OCCSCORE thus provides a continuous measure of occupations, according to the economic rewards enjoyed by people working at them in 1950."

$$\left(\sum_{j \in S} \left(\frac{s_j}{d_{ij}}\right)^{\frac{-\omega}{\omega-1}}\right)_{i,1924} - \left(\sum_{j \in S} \left(\frac{s_j}{d_{ij}}\right)^{\frac{-\omega}{\omega-1}}\right)_{i,1920} \iff x_i \tag{33}$$

$$x_i = \psi + \mu \times z_i + \xi \times (age_{i,1924}) + \phi \times (age_{i,1924})^2 + \chi \times log(income_i) + \kappa \times nbrhdchar_i + \zeta \times ivy_i + \lambda \times (local_i) + \epsilon \tag{34}$$

The first stage results in Table 5 show that the instrument is in fact relevant — its coefficient is significant at the 95% confidence level.

Table 5: First Stage Results

	Dependent variable:
	Change in Social Density 1920-1924 (x)
Change in Children at Home, 1920 to 1930	−11.400***
	(4.060)
Age in 1924	−2.350**
	(0.919)
Age in 1924 squared	0.018**
	(0.007)
Log Income	1.100
	(0.998)
1920 Neighborhood Socioeconomic Characteristic	5.210***
	(0.837)
Ivy League graduate	−1.340
	(2.340)
Born in NY, NJ or CT	2.060
	(1.910)
Constant	−54.900
	(34.100)
Observations	704
R^2	0.062
Adjusted R^2	0.053
Residual Std. Error	23.400 (df = 696)
F Statistic	6.620*** (df = 7; 696)
Note:	*p<0.1; **p<0.05; ***p<0.01

For the second stage (equation (35) below), I use the results of the stage 1 regression to construct predicted x, which I will call x', for each of the 704 people in my Social Comparison dataset. I then regress $y = s_{i,1924} - s_{i,1920}$ on x' and the other control variables that I included in the first stage. The concern, of course, is that the instrument may not be valid — in other words, that z_i may be correlated with the error term τ in equation (35) and thus influence y_i through some channel other than x_i. Could it be that family size or expected family size influence social status through some mechanism other than its effect on neighborhood choice? Might families that have more children become less involved in social life due to childcare demands, or more involved, for some other reason? Is the number of children someone has correlated with social ambition?

Based on my research on the historical role of clubs in the social fabric of the 1920s, the answer to these questions appears to be no. Belonging to private social clubs and having children were such deeply ingrained social norms in the world of the Manhattan social elite in the early 20th century that I do not expect them to have any causal effect on each other except through the channel of neighborhood choice. Social clubs were "essential to how upper- and upper-middle-class New York men organized their lives," according to Hood (2017), while having children was almost a fact of life for New York's social elite, more so than a decision that was tied up in individual preferences that might also affect social status (Hood, 2017).[28] The modern-day trope of adults choosing not to have children in order to focus on their professional lives (or social ambitions, if they are socialites) simply does not appear to have applied, or at least not to the same extent. In my Social Comparison dataset the correlation between i's club memberships and his number of children in 1920 is only 0.011, meanwhile, lending further credence to my argument. Family size changes are correlated with age, which does affect s_i, but I control for age separately in my second stage regression, so $|corr(z, age)| > 0$ does not mean that $|corr(z, \tau)| > 0$. Moves across neighborhoods with different social densities induced by expected changes in family size were probably fairly random with respect to other things that might affect social status. Thus the instrument seems valid and I am able to proceed with the second stage of the regression. The results for the specification given by equation (35) are in column 3 of Table 6. Alternate specifications are in the other columns.

$$y_i = s_{i,1924} - s_{i,1920} = \gamma + \sigma \times x_i' + \alpha \times (age_{i,1924}) + \delta \times (age_{i,1924})^2 + \beta \times log(income_i) + \kappa \times nbrhdchar_i + \rho \times ivy_i + \nu \times (local_i) + \tau \tag{35}$$

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[28]Hood explains in Chapter 7 how having children who went to preparatory school was a key part of upper class culture for New Yorkers in this time period. In Chapter 5 he also notes that raising children was viewed as a key duty for women.

Table 6: Second Stage Results

	Dependent variable:			
	Change in Club Memberships 1920-1924 ($s_{i,1924} - s_{i,1920}$)			
	(1)	(2)	(3)	(4)
Predicted Δ in Social Density 1920-1924 (x')	0.034*	0.027	0.052**	0.051**
	(0.020)	(0.020)	(0.022)	(0.022)
Age in 1924	−0.049*	−0.054*	−0.058**	−0.058**
	(0.028)	(0.028)	(0.028)	(0.028)
Age in 1924 squared	0.0003	0.0003	0.0003	0.0003
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Log Income	0.128*	0.134**	0.098	0.101
	(0.066)	(0.066)	(0.067)	(0.067)
1920 Neighborhood Socioeconomic Characteristic	−0.197*	−0.166	−0.279**	−0.271**
	(0.112)	(0.114)	(0.118)	(0.119)
Ivy League graduate		−0.230	−0.152	−0.152
		(0.144)	(0.146)	(0.146)
Born in NY, NJ or CT			−0.386***	−0.405***
			(0.124)	(0.127)
Foreign born				−0.191
				(0.308)
Constant	5.080*	4.700*	7.810***	7.640**
	(2.830)	(2.830)	(2.990)	(3.000)
Observations	704	704	704	704
R^2	0.049	0.052	0.065	0.066
Adjusted R^2	0.042	0.044	0.056	0.055
Residual Std. Error	1.430 (df = 698)	1.430 (df = 697)	1.420 (df = 696)	1.420 (df = 695)
F Statistic	7.190*** (df = 5; 698)	6.430*** (df = 6; 697)	6.970*** (df = 7; 696)	6.140*** (df = 8; 695)

Note: *p<0.1; **p<0.05; ***p<0.01

The coefficient on x' in column 3 of Table 6 tells us is that, if my instrument is both relevant and valid, on average and all else equal, moving from a residence with social density measure $m = \sum_{j \in S}(\frac{s_j}{d_{ij}})^{\frac{-\omega}{\omega-1}}$ to one with social density $m' = m + 1$ increases i's club memberships by 0.052. This coefficient is significant at the 95% confidence level with a p score of 0.0164. I will now illustrate the meaning of this coefficient with the same concrete example comparing George Kunz and Severyn Sharpe that I used in explaining the OLS results, given that the actual value of the social density regressor is not very informative here. In 1924, Severyn B. Sharpe living at 32 East 64th Street enjoyed $(\sum_{j \in S}(\frac{s_j}{d_{ij}})^{\frac{-0.23874}{0.23874-1}}) = 327.052$, while George F. Kunz at 601 Cathedral Parkway in Morningside Heights had only $(\sum_{j \in S}(\frac{s_j}{d_{ij}})^{\frac{-0.23874}{0.23874-1}}) = 193.042$. Based on the results of my regression and the "social density premium" of 134.01 enjoyed by Sharpe at 32 East 64th Street, we would expect the social density difference between the two men to account for Sharpe belonging to 6.95 more New York clubs than Kunz, on average.

Note that while this number is very large, the social density gap between the residences of these two men is the most extreme in the dataset. The 75th percentile of the social density measure $(\sum_{j \in S}(\frac{s_j}{d_{ij}})^{\frac{-0.23874}{0.23874-1}}) = 315.444$ (421 Park Avenue) and the 25th percentile of $(\sum_{j \in S}(\frac{s_j}{d_{ij}})^{\frac{-0.23874}{0.23874-1}}) = 270.697$ (12 West 44th Street). Thus the social density difference between a man at the 25th percentile in terms of social density and a man at the 75th percentile would account for the 75th percentile man belonging to 2.32 more clubs, on average, than the 25th percentile man. Given that the average man in my Social Comparison Dataset belonged to 4.27 clubs in 1924, and assuming linear returns to social density, this result implies that a move from 12 West 44th Street to 421 Park Avenue would, on average and all else equal, result in a 54.3% increase in club memberships for the mean individual in my dataset.

6   Counterfactual

I now consider a counterfactual in which a trolley system is built that reduces the effective distance d_{ij} between socialites in the Washington Square neighborhood in Manhattan (highlighted in red in Figure 24 below) and socialites in the rest of the city by 25 percent. Distances between socialites who both live in Washington Square are also reduced by 25 percent and I set $\omega = 0.23874$, the value estimated for that parameter in my regressions above. For simplicity's sake, given the difficulties that come with solving for the equilibrium when $\overline{s_i} \neq 0$, I will pretend that the 1,882 people in my Social Register-Tax dataset have $\overline{s_i} = 0$ and see what their social statuses would have been in 1924 had this trolley system been in operation relative to the world without the trolley system. Using the equilibrium solving process described in Section 3.3 I can solve the system to make this comparison.
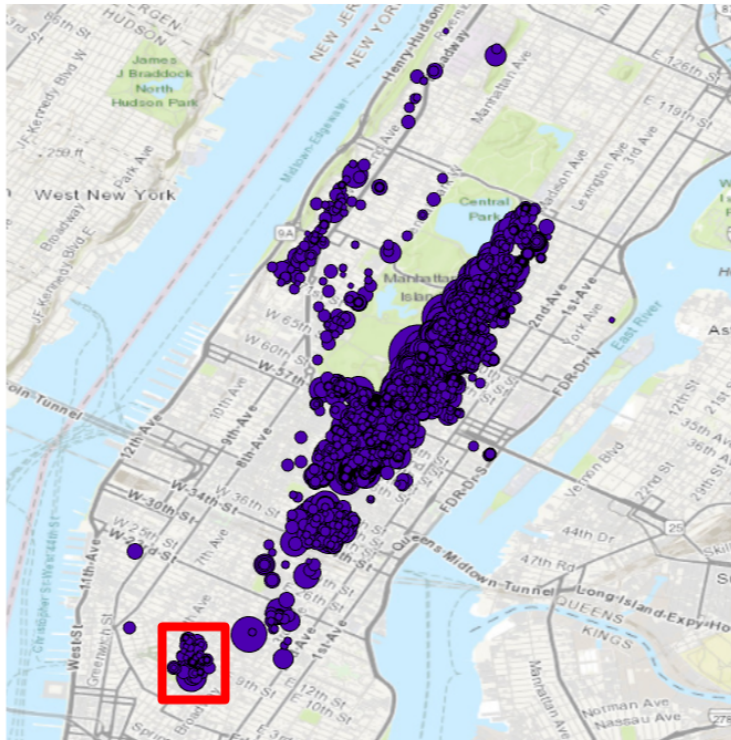
Figure 24: Washington Square neighborhood highlighted.

My results show that social status actually on average decreases, but that the residents of the Washington Square neighborhood experience significant increases in social status. Intuitively this makes sense because the Washington Square residents' d_{ij} with all other j have gotten smaller, while for those not in Washington Square only some of their d_{ij} have decreased, and thus their neighborhoods have fallen in relative social density. The average Washington Square resident sees an 8.4% boost in social status after the construction of the trolley system, while the average person living outside of the Washington Square area experiences a decrease in social status of 1.2%. The biggest "losers" from the trolley construction in terms of social status lived at 570 Park Avenue (though they are the most socially prominent out of the 1,882 men both before and after the trolley), while the greatest winners in the Washington Square area lived at 37 5th Avenue. Converting the social status scores into social status "ranks" (1st, 2nd, etc., through 1,882nd), we see that the biggest relative loser is Frederick W. Jackson living at 884 West End Avenue, who fell 58 spots from 73rd least socially prominent to 15th least socially prominent. The biggest relative winner is Henry Bedinger Mitchell living at 37 5th Avenue, who rose 35 ranks from 65th least socially prominent to 100th least socially prominent. These changes in social status "ranks" are plotted for each individual by residence in Figure 25 below. This map shows that the relative social status effects of the trolley system vary significantly by neighborhood.
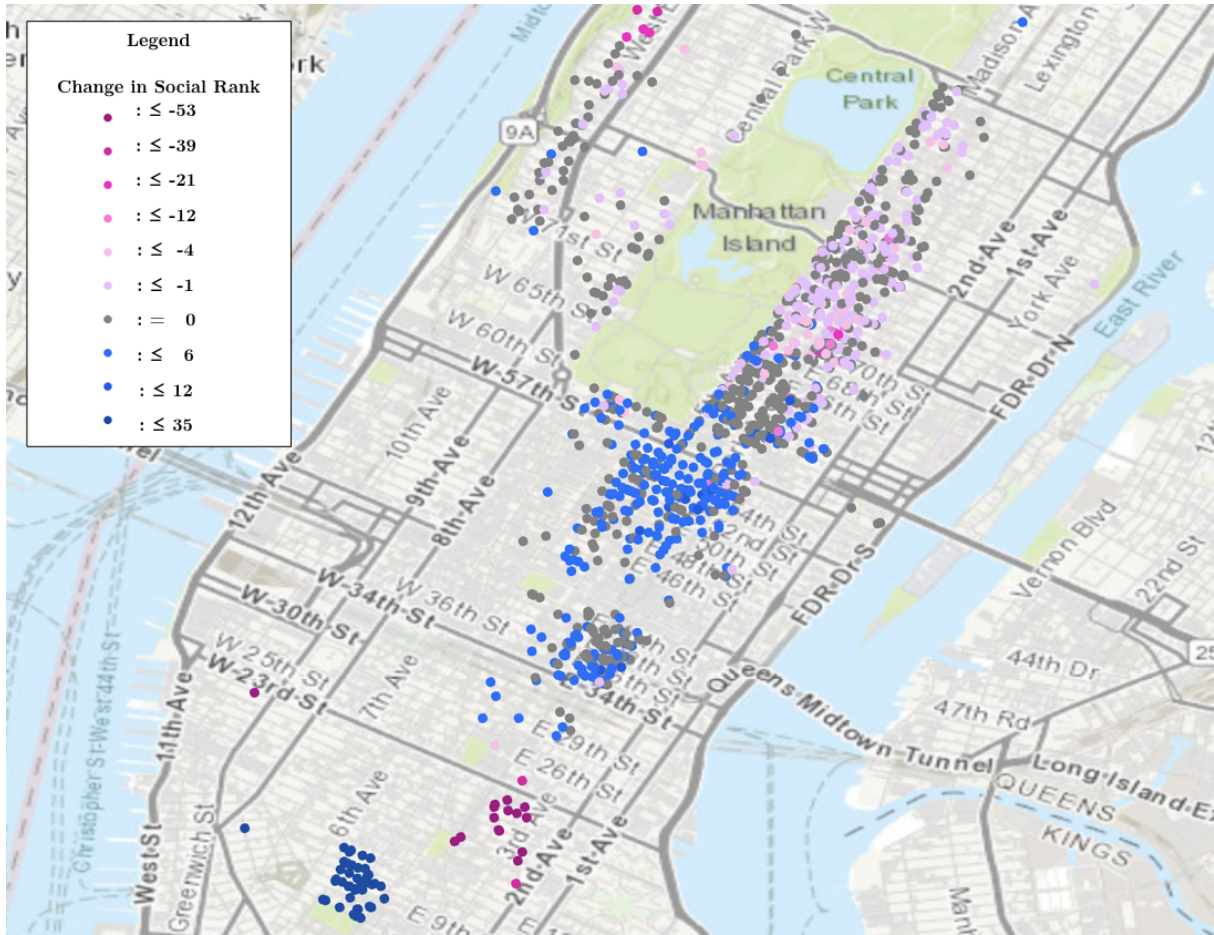
Notes: Color of circle corresponds to change in social status rank of the person who lived at that location after the construction of the trolley system. Blue dots indicate an individual who became more socially prominent relative to their peers post-trolley, grey dots represent those whose social status ranks were unchanged, and purple to red dots denote people who became less socially prominent relative to their peers post-trolley. The legend should be read as follows: the bottom-most dot in the legend (the darkest shade of blue) marks individuals who climbed between 13 and 35 places in the social status ranking after the construction of the trolley system. Observe that some of the biggest relative "losers" from the trolley system (the dark purple dots) lived on the fringes of the social network plotted here. This is because, pre-trolley, these people were competing with the similarly-remote Washington Square residents for the last places in the social status hierarchy; by elevating the Washington Square denizens, the trolley pushes these other fringe individuals to the bottom of the social status ranking. Note also that Upper East Side inhabitants are on average made worse-off by the trolley system than their Midtown counterparts are; this is because Washington Square connections are relatively less important to Upper East Side residents than they are to Midtown residents, therefore Upper East Side inhabitants benefit less from more efficient interactions with people in Washington Square than Midtown inhabitants do.

Figure 25: Change in Social Status Rank Post-Trolley

These results show that infrastructure changes can drastically reshape the social topography of a city like Manhattan. These changes in topography could, in turn, incentivize agents to move to newly more socially dense neighborhoods in pursuit of higher social status — moves that could transform the social geography of the city. This result is encouraging because it provides an explanation for the many drastic changes in

Manhattan's social geography that have occurred over the decades (Hood, 2017).[29]

7 Conclusion

This paper makes first steps towards illustrating the ways in which forces of "social agglomeration," in addition to more traditional economic notions of labor agglomeration, can drive concentration in space, especially among members of the same social group. The model formulated here provides a framework for understanding how these social agglomeration forces work and seeks to explain the very clear spatial concentration in social terms that we observe in the world around us. This paper's empirics, meanwhile, suggest that social agglomeration forces are in fact sizable and indicate that real-world truths underlie the model's assumptions.

An interesting next step for this model of social agglomeration would be to account for locational mobility by allowing for endogenous location choice. While the current iteration of this model takes residences and the distance matrix as exogenous variables due to the absence of granular property value data, with information on rents or property values one could hypothetically design and estimate a similar model in which socialites are faced with a tradeoff between social status and other goods. Socialites would have to "buy" greater social status by paying higher rents in neighborhoods with higher social density. One could then combine this model with historical data to estimate the "price" of social density, or in other words the rent premium commanded by housing in higher social density locales. These results could in turn predict the movements of socialites across neighborhoods in response to changes in social topography. Without detailed data on living costs by neighborhoods, however, a clean link between the theory and the empirics of such a model would not be possible.

In sum, this paper's findings are a first step towards uniting the social interactions and agglomeration branches of the economics literature, and will hopefully allow economists to construct more accurate models of locational choice among economic agents. Agents are not motivated by solely economic factors when choosing to reside near their peers; rather, utility derived from greater opportunities for social interaction and status can be motivating factors as well. To attribute all of the spatial concentration that we observe in residential patterns to production agglomeration forces is probably to overestimate the economic productivity benefits of concentration and to underestimate the social benefits.

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[29]One historical example of this was the Upper East Side replacing Murray Hill as the premier Manhattan neighborhood in the 1910s and 1920s, discussed by Hood in Chapter 7 of his book. This marked a major realignment of the social geography of Manhattan. A century earlier, meanwhile, Washington Square and Gramercy Park were among the most popular neighborhoods for members of the city's social elites.

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8 Appendix

8.1 Proof of Existence and Uniqueness

Allen et al. (2015) show in Lemma 1, reproduced below, that there exists an equilibrium vector x^* for a system like that described in 3.2.2 if three conditions are met.

Lemma 1: *Suppose there exists a once continuously differentiable* ***"scaffold"*** *function $F: \mathbb{R}^{n+1}_{++} \to \mathbb{R}^n$ where for all $i \in \{1, ..., n\}$, $f_i(x) = F_i(x, x_i)$ and the following conditions are satisfied:*

1. *For all $x' \in \mathbb{R}^n_{++}$, there exists x_i such that $F_i(x', x_i) = 0$.*

2. *$\frac{\partial F_i(x', x_i)}{\partial x_i} - \frac{\partial F_i(x', x_i)}{\partial x'_j} < 0$ for all j.*

3. *There exists x' such that for x_i defined in $F_i(sx', x_i) = 0$, $x_i = o(s)$ (i.e. when $s \to \infty$, $\frac{s}{x_i} \to \infty$; when $s \to \infty$, $\frac{s}{x_i} \to 0$).*

I will show that these conditions hold for 14, reproduced below, when Assumptions 1 and 2 are met and $\overline{s_i} = 0$.

$$s_i = \alpha \times \overline{s_i} + \sigma \times \sum_{j \in S} s_j^{\frac{-\omega}{\omega-1}} \times d_{ij}^{\frac{\omega}{\omega-1}} \tag{36}$$

When $\overline{s_i} = 0$ we have:

$$s_i = \sigma \times \sum_{j \in S} s_j^{\frac{-\omega}{\omega-1}} \times d_{ij}^{\frac{\omega}{\omega-1}} \tag{37}$$

We defined the scaffold function as described by Allen et al. (2015):

$$F_i(s', s) = (\sigma \times \sum_{j \in S} s_j'^{\frac{-\omega}{\omega-1}} \times d_{ij}^{\frac{\omega}{\omega-1}}) - s_i \tag{38}$$

Condition (i) holds as setting $s_i = \sigma \times \sum_{j \in S} s_j'^{\frac{-\omega}{\omega-1}} \times d_{ij}^{\frac{\omega}{\omega-1}})$ means that $F_i(s', s) = 0$; condition (ii) is satisfied because $\frac{\partial F_i(s', s)}{\partial s_i} = -1$ and $\frac{\partial F_i(s', s)}{\partial s'_j} > 0$; condition (iii) holds as well because $F_i(ts', s)$ implies that $s_i \propto t^{\frac{-\omega}{\omega-1}}$ and $\frac{-\omega}{\omega-1} < 1$, in other words, $s_i = o(t)$. So we know that there exists a set of $\{s_i\}$ that satisfy 14.

With regards to uniqueness, Allen et al. (2015) lay out two conditions: gross substitution and partial homogeneity as they describe it. We know that 14 satisfies gross substitution because for any $j \neq i$, $\frac{\partial s_i(s', s)}{\partial s_j} > 0$. To fulfill the next condition of partial homogeneity, we need to denote $f_i(s) = g_i(s) - h_i(s)$, where $g_i(s) = (\sigma \times \sum_{j \in S} s_j'^{\frac{-\omega}{\omega-1}} \times d_{ij}^{\frac{\omega}{\omega-1}})$ and $h_i(s) = s_i$. $g_i(s)$ and $h_i(s)$ are homogenous of degree $\frac{-\omega}{\omega-1}$ and 1, respectively, and $\frac{-\omega}{\omega-1} < 1$ when we impose the condition of Assumption 1 that $\omega < 0.5$. Together with my demonstration of existence above, I have shown the existence and uniqueness of a set of $\{s_i\}$ that satisfy 14.

8.2 Social Register Membership

While pinning down an exact heuristic for Social Register membership is impossible, the New York Social Register of the early 20th century can be thought of as a record of the members of New York's social elite that tended to reproduce the ethnic makeup of its original WASP members. Given the secretive nature of the Social Register Association it is difficult to obtain precise information on the criteria for membership,

but secondary sources provide some clues. In the 1990s, prospective members had to be nominated for membership by a current member and supported with letters of recommendation from other current members. A 25-member advisory board then voted on whether to admit the nominee. The advisory board's spokesman told the New York Times in 1997 that the board "simply asks themselves this question when evaluating a candidate: Would one want to have dinner with this person on a regular basis?" (Sargent, 1997). The process described for the 1990s appears to be almost identical to that followed in the 1890s, according to Hood (2017)'s description of historical club admissions practices. Importantly, the Social Register was meant to be more than just a record of the economic elite. Hood (2017) explains that, in the 1930s and 1940s, the New York metropolitan area was home to a sizable "intermediate zone of corporate elites" who "had good jobs as corporate presidents, vice presidents, bankers, and the like," but "were not part of the Social Register crowd" and "did not want to be." These individuals were not in the Social Register even though many of them likely earned much more money than most Social Register members. James A. Farrell, the President of the United States Steel corporation and a resident of Manhattan, earned around $240,000 in taxable income in 1924 (over $3.5 million in today's dollars), but was not a member of the Social Register that year despite his substantial wealth. Farrell, who started his career as a laborer at the age of 15 and was a practicing Roman Catholic, did not fit in with the primarily old-money, Protestant social elite documented by the Social Register (Bureau of Labor Statistics, 2019; Marcin, 2014; New York Times, 1943). Walter C. Teagle, President of the Standard Oil Company and a New York area resident, paid a whopping $72,381 in federal income tax in 1924, but like Farrell did not make the cut for the New York Social Register. Teagle was instead included in the Social Register of his home city, Cleveland (Marcin, 2014; New York Times, 1962). All in all, while pinning down an exact heuristic for membership is impossible, the New York Social Register of the early 20th century can be thought of as a record of the members of New York's social elite that tended to reproduce the ethnic makeup of its original WASP members (Hood, 2017).

8.3   1924 Tax Brackets

These are the tax brackets taken from the 1924 1040 tax return form, used to calculate taxable income from tax payments.

Tax Rate	Over	But Not Over	Tax Paid	Total Paid
0.02	$0	$4,000	$80	$80
0.04	4,000	8,000	160	240
0.06	8,000	10,000	120	360
0.07	10,000	14,000	280	640
0.08	14,000	16,000	160	800
0.09	16,000	18,000	180	980
0.10	18,000	20,000	200	1,180
0.11	20,000	22,000	220	1,400
0.12	22,000	24,000	240	1,640
0.13	24,000	26,000	260	1,900
0.14	26,000	28,000	280	2,180
0.15	28,000	30,000	300	2,480
0.16	30,000	34,000	640	3,120
0.17	34,000	36,000	340	3,460
0.18	36,000	38,000	360	3,820
0.19	38,000	42,000	760	4,580
0.20	42,000	44,000	400	4,980
0.21	44,000	46,000	420	5,400
0.22	46,000	48,000	440	5,840
0.23	48,000	50,000	460	6,300
0.24	50,000	52,000	480	6,780
0.25	52,000	56,000	1,000	7,780
0.26	56,000	58,000	520	8,300
0.27	58,000	62,000	1,080	9,380
0.28	62,000	64,000	560	9,940
0.29	64,000	66,000	580	10,520
0.30	66,000	68,000	600	11,120
0.31	68,000	70,000	620	11,740
0.32	70,000	74,000	1,280	13,020
0.33	74,000	76,000	660	13,680
0.34	76,000	80,000	1,360	15,040
0.35	80,000	82,000	700	15,740
0.36	82,000	84,000	720	16,460
0.37	84,000	88,000	1,480	17,940
0.38	88,000	90,000	760	18,700
0.39	90,000	92,000	780	19,480
0.40	92,000	94,000	800	20,280
0.41	94,000	96,000	820	21,100
0.42	96,000	100,000	1,680	22,780
0.43	100,000	200,000	43,000	65,780
0.44	200,000	300,000	44,000	109,780
0.45	300,000	500,000	90,000	199,780
0.46	500,000			

Figure 26:   Part of the 1924 tax brackets table I generated from the 1924 1040 form.

8.4 Types of Social Clubs

By 1902 there were over 150 social clubs in the New York metropolitan area. These clubs differed in prestige and the types of men they attracted as members, however – something that is important to take into account when using club memberships as a measure of social status or activity. Some clubs were affiliated with universities or university graduate status (the university-specific alumni clubs and the University Club), others sought to promote the arts or literature (the Lotos Club and the Century Association, among others), while others were founded with a particular political bent (the Union League Club) (Nevius, 2015). Among these dozens of clubs, a few always stood out for being the most exclusive and prestigious. The Union Club, as the oldest of New York's men's social clubs (having been founded in 1836), carried its top status into the 20th century. The Union League Club was founded in 1863 by elite Republican New Yorkers seeking to support the Republican Party and provide moral leadership for the city's upper classes. (Hood, 2017) writes that, like the Union Club, the Union League Club "adopted a rigid admissions policy intended to ensure its social exclusivity," and within five years the club had "almost as much social cachet as the Union [...]" (Hood, 2017). The financier J.P. Morgan, angered by his friend's rejection from the Union Club as a result of its stringent membership requirements, founded the Metropolitan Club in 1891, and it soon joined the ranks of New York's prestigious social institutions. According to Hood, Morgan's club "became known as the "millionaires' club" for its openness to new money and its sumptuous clubhouse on upper Fifth Avenue." The Knickerbocker Club was another prestigious New York general-purpose social club, while the New York Yacht Club had a nautical focus (Hood, 2017). Although constructing a ranking of New York's social clubs is difficult, based on Hood's study the Metropolitan, Union, Union League (which, by the 1890s, had dropped its political affiliation), Knickerbocker and New York Yacht clubs appear to have been the most prestigious around 1924 (Hood, 2017). For this reason I construct dummy variables for individuals' membership in each of these clubs in my "prestigious" club memberships may need to be weighted differently from the typical club in my analysis. In the end I do not incorporate this into the regressions printed in Section 5 because there is not enough data to have significant variation in "prestigious" club memberships, but it could be useful for future research. I also track membership in the Jekyll Island Club, located in Georgia but comprised almost entirely of Northerners, as a dummy variable because of the club's fame as a "Southern Haven for America's Millionaires," as the title of one book about the club puts it (McCash and McCash, 1989).

8.5 Simplifying equation (10)

$$h_i = \sum_{j \in S} ((\frac{\beta \times d_{ij}}{s_j{}^\omega \times \omega})^{\frac{-\omega}{\omega-1}} s_j{}^\omega - (\frac{\beta \times d_{ij}}{s_j{}^\omega \times \omega})^{\frac{1}{\omega-1}} \beta \times d_{ij}) \tag{39}$$

$$h_i = \sum_{j \in S} ((s_j{}^\omega \times \omega)^{\frac{-\omega}{\omega-1}} s_j{}^\omega (\beta \times d_{ij})^{\frac{\omega}{\omega-1}} - (s_j{}^\omega \times \omega)^{\frac{-1}{\omega-1}} (\beta \times d_{ij})^{\frac{\omega}{\omega-1}}) \tag{40}$$

$$h_i = \sum_{j \in S} ((s_j)^{\frac{-\omega}{\omega-1}} (\omega)^{\frac{-\omega}{\omega-1}} (\beta \times d_{ij})^{\frac{\omega}{\omega-1}} - (s_j)^{\frac{-\omega}{\omega-1}} (\omega)^{\frac{-1}{\omega-1}} (\beta \times d_{ij})^{\frac{\omega}{\omega-1}}) \tag{41}$$

$$h_i = \sum_{j \in S} ((s_j)^{\frac{-\omega}{\omega-1}} (\beta \times d_{ij})^{\frac{\omega}{\omega-1}}) (\omega^{\frac{-\omega}{\omega-1}} - \omega^{\frac{-1}{\omega-1}}) \tag{42}$$

$$h_i = \sum_{j \in S} s_j{}^{\frac{-\omega}{\omega-1}} \times d_{ij}{}^{\frac{\omega}{\omega-1}} \times \beta^{\frac{\omega}{\omega-1}} \times (\omega^{\frac{-\omega}{\omega-1}} - \omega^{\frac{-1}{\omega-1}}) \tag{43}$$

8.6 Section 3.4.1 Algebra

To solve, plug $s_1{}^*$ into $s_2{}^*$ and get:

$$s_2{}^* = \sigma \times \left(\sigma \times s_2{}^{*\frac{-\omega}{\omega-1}} \times d_{12}{}^{\frac{\omega}{\omega-1}}\right)^{\frac{-\omega}{\omega-1}} \times d_{21}{}^{\frac{\omega}{\omega-1}} \tag{44}$$

$$s_2{}^* = \sigma \times \sigma^{\frac{-\omega}{\omega-1}} \times s_2{}^{*\frac{\omega^2}{(\omega-1)^2}} \times d_{12}{}^{\frac{-\omega^2}{(\omega-1)^2}} \times d_{21}{}^{\frac{\omega}{\omega-1}} \tag{45}$$

$$s_2{}^* = \sigma^{\frac{-1}{\omega-1}} \times s_2{}^{*\frac{\omega^2}{(\omega-1)^2}} \times d_{12}{}^{\frac{-\omega^2}{(\omega-1)^2}} \times d_{21}{}^{\frac{-\omega}{\omega-1}} \tag{46}$$

$$\frac{s_2{}^*}{s_2{}^{*\frac{\omega^2}{(\omega-1)^2}}} = \sigma^{\frac{-1}{\omega-1}} \times d_{12}{}^{\frac{-\omega^2}{(\omega-1)^2}} \times d_{21}{}^{\frac{\omega}{\omega-1}} \tag{47}$$

$$s_2{}^{*\frac{1-2\omega}{(\omega-1)^2}} = \sigma^{\frac{-1}{\omega-1}} \times d_{12}{}^{\frac{-\omega^2}{(\omega-1)^2}} \times d_{21}{}^{\frac{\omega}{\omega-1}} \tag{48}$$

$$s_2{}^* = \sigma^{\frac{-(\omega-1)^2}{(\omega-1)(1-2\omega)}} \times d_{12}{}^{\frac{-\omega^2}{1-2\omega}} \times d_{21}{}^{\frac{\omega(\omega-1)^2}{(\omega-1)(1-2\omega)}} \tag{49}$$

$$s_2{}^* = \sigma^{\frac{-(\omega-1)}{(1-2\omega)}} \times d_{12}{}^{\frac{-\omega^2}{1-2\omega}} \times d_{21}{}^{\frac{\omega(\omega-1)}{(1-2\omega)}} \tag{50}$$

$$s_2{}^* = \sigma^{\frac{1-\omega}{(1-2\omega)}} \times d_{12}{}^{\frac{-\omega^2}{1-2\omega}} \times d_{21}{}^{\frac{\omega(\omega-1)}{(1-2\omega)}} \tag{51}$$

8.7 Different distances algebra

For illustrative purposes, if $\omega = 0.25$, $d_{21} = 2$ and $d_{12} = 1$ we have:

$$s_2{}^* = \left(\psi \times \beta^{\frac{\omega}{\omega-1}} \times \left(\omega^{\frac{-\omega}{\omega-1}} - \omega^{\frac{-1}{\omega-1}}\right)\right)^{1.5} \times 1^{\frac{-\omega^2}{1-2\omega}} \times 2^{\frac{\omega(\omega-1)}{(1-2\omega)}} \tag{52}$$

$$s_2{}^* = \left(\psi \times \beta^{\frac{0.25}{0.25-1}} \times \left(0.25^{\frac{-0.25}{0.25-1}} - 0.25^{\frac{-1}{0.25-1}}\right)\right)^{1.5} \times 1 \times 2^{\frac{0.25(0.25-1)}{(1-2\times0.25)}} \tag{53}$$

$$s_2{}^* = \psi^{1.5} \times \beta^{-0.5} \times 0.325 \times 2^{-0.375} \tag{54}$$

Meanwhile:

$$s_1{}^* = \left(\psi \times \beta^{\frac{\omega}{\omega-1}} \times \left(\omega^{\frac{-\omega}{\omega-1}} - \omega^{\frac{-1}{\omega-1}}\right)\right)^{1.5} \times 2^{\frac{-\omega^2}{1-2\omega}} \times 1^{\frac{\omega(\omega-1)}{(1-2\omega)}} \tag{55}$$

$$s_1{}^* = \left(\psi \times \beta^{\frac{0.25}{0.25-1}} \times \left(0.25^{\frac{-0.25}{0.25-1}} - 0.25^{\frac{-1}{0.25-1}}\right)\right)^{1.5} \times 2^{\frac{-0.25^2}{1-2*0.25}} \times 1 \tag{56}$$

$$s_1{}^* = \psi^{1.5} \times \beta^{-0.5} \times 0.325 \times 2^{-0.125} \tag{57}$$

8.8 Solving the Line equilibrium

$$s_i = \sigma \sum_{j \in S} d_{ij}^{\frac{-1}{3}} \times s_j^{\frac{1}{3}} \tag{58}$$

I rewrite my equilibrium equation as:

$$s_i = \sigma \sum_{j \in S} d_{ij}^{\frac{-1}{3}} \times s_j^{\frac{1}{3}} \iff s_i = \sigma \sum_{j \in S} K_{ij} \times s_j^{\frac{1}{3}} \tag{59}$$

where $d_{ij}^{\frac{-1}{3}} \equiv K_{ij}$.

Per the Arkolakis process, I define $P_{ij} = \frac{K_{ij}}{\sum_i \sum_j K_{ij}}$, normalizing the K_{ij} matrix. To make this work I need to define a $d_{i,i} = d_{min} = 0.1$ in my distance matrix, otherwise the process and model do not work. I can reapply this matrix — $P^2 = PP$, $P^3 = PP^2$, and so on. We have in the limit, per the Arkolakis algorithm:

$$s^* = \lim_{n \to \infty} P^n \times s_j^{1/3}{}^{(0)} \tag{60}$$

where $s_j^{\frac{1}{3}(0)}$ is some initial guess about the true $s^{*\frac{1}{3}}$ — for example, that all s are equal. The iteration converges to the true solution as n goes to ∞. I apply this process, multiplying P to my initial guess of all $s_j = 1$ 10 times and I arrive at the final s^*. I scale up these numbers by 10000000000 because they are very small, and this will make them easier to deal with. The process returns the following matrix for $s_i{}^*$, where the first entry is s_1, the second is s_2, and so on:

$$\begin{bmatrix} s_1 & 0.9227 \\ s_2 & 0.9959 \\ s_3 & 1.0416 \\ s_4 & 1.0696 \\ s_5 & 1.0830 \\ s_6 & 1.0830 \\ s_7 & 1.0696 \\ s_8 & 1.0416 \\ s_9 & 0.9959 \\ s_{10} & 0.9227 \end{bmatrix}$$

8.9 The Subway Scenario Equilibrium

The distance matrix now looks like this, where element i, j gives $d_{i,j}$:

$$\begin{bmatrix} 0.1 & 1.0 & 2.0 & 3.0 & 4.0 & 4.5 & 5.5 & 6.5 & 7.5 & 8.5 \\ 1.0 & 0.1 & 1.0 & 2.0 & 3.0 & 3.5 & 4.5 & 5.5 & 6.5 & 7.5 \\ 2.0 & 1.0 & 0.1 & 1.0 & 2.0 & 2.5 & 3.5 & 4.5 & 5.5 & 6.5 \\ 3.0 & 2.0 & 1.0 & 0.1 & 1.0 & 1.5 & 2.5 & 3.5 & 4.5 & 5.5 \\ 4.0 & 3.0 & 2.0 & 1.0 & 0.1 & 0.5 & 1.5 & 2.5 & 3.5 & 4.5 \\ 4.5 & 3.5 & 2.5 & 1.5 & 0.5 & 0.1 & 1.0 & 2.0 & 3.0 & 4.0 \\ 5.5 & 4.5 & 3.5 & 2.5 & 1.5 & 1.0 & 0.1 & 1.0 & 2.0 & 3.0 \\ 6.5 & 5.5 & 4.5 & 3.5 & 2.5 & 2.0 & 1.0 & 0.1 & 1.0 & 2.0 \\ 7.5 & 6.5 & 5.5 & 4.5 & 3.5 & 3.0 & 2.0 & 1.0 & 0.1 & 1.0 \\ 8.5 & 7.5 & 6.5 & 5.5 & 4.5 & 4.0 & 3.0 & 2.0 & 1.0 & 0.1 \end{bmatrix}$$

Applying the same process used previously we get a new distribution of social statuses. Putting these values alongside the initial social status matrix from the beginning of section for comparison, In the middle column are the original s_i values; on the far right we have the post-subway construction s_i values.

$$\begin{bmatrix} s_1 & 0.9227 & 0.9190 \\ s_2 & 0.9959 & 0.9942 \\ s_3 & 1.0416 & 1.0450 \\ s_4 & 1.0696 & 1.0841 \\ s_5 & 1.0830 & 1.1342 \\ s_6 & 1.0830 & 1.1342 \\ s_7 & 1.0696 & 1.0841 \\ s_8 & 1.0416 & 1.0450 \\ s_9 & 0.9959 & 0.9942 \\ s_{10} & 0.9227 & 0.9190 \end{bmatrix}$$

The resulting matrix for the second subway scenario:

$$\begin{bmatrix} s_1 & 0.9762 \\ s_2 & 1.0157 \\ s_3 & 1.0349 \\ s_4 & 1.0554 \\ s_5 & 1.0650 \\ s_6 & 1.0628 \\ s_7 & 1.0483 \\ s_8 & 1.0200 \\ s_9 & 0.9750 \\ s_1 0 & 0.9035 \end{bmatrix}$$

8.10 White Flight Matrix

Applying the process, we arrive at the following matrix for s_i :

$$\begin{bmatrix} s\_1 & 0.5017 \\ s\_2 & 0.3926 \\ s\_3 & 0.3684 \\ s\_4 & 0.5017 \\ s\_5 & 0.5017 \\ s\_6 & 0.5017 \\ s\_7 & 0.5017 \\ s\_8 & 0.3684 \\ s\_9 & 0.3926 \\ s\_10 & 0.5017 \\ s\_11 & 0.3470 \end{bmatrix}$$

8.11 Many identical people example explication

Now try with n people i all with $\overline{s_i} = 0$ and an equal distance away from one another such that all $d_{ij} = d$. This is spatially impossible for more than three people in a 2D spatial plane but I will continue with the example anyways for illustrative purposes. We know there will be symmetry so we have, for the equilibrium equation (14):

$$s_i{}^* = \sigma \times n \times s_i{}^{*\frac{-\omega}{\omega-1}} \times d^{\frac{\omega}{\omega-1}} \tag{61}$$

$$s_i{}^{*\frac{2\omega-1}{\omega-1}} = \sigma \times n \times d^{\frac{\omega}{\omega-1}} \tag{62}$$

$$s_i{}^* = \sigma^{\frac{1-\omega}{(1-2\omega)}} \times n^{\frac{1-\omega}{(1-2\omega)}} \times d^{\frac{-\omega}{(1-2\omega)}} \tag{63}$$

Substitute in for σ and say $s_i{}^* = s$:

$$s^* = \psi^{\frac{1-\omega}{(1-2\omega)}} \times \beta^{\frac{\omega(1-\omega)}{(\omega-1)(1-2\omega)}} \times \left(\omega^{\frac{-\omega}{\omega-1}} - \omega^{\frac{-1}{\omega-1}}\right)^{\frac{1-\omega}{(1-2\omega)}} \times n^{\frac{1-\omega}{(1-2\omega)}} \times d^{\frac{-\omega}{(1-2\omega)}} \tag{64}$$

To rehash some of the logic explicated in the two person example, assumption 1 that $0 < \omega < 0.5$ implies that $\frac{-\omega}{(1-2\omega)} < 0$. The condition $0 < \omega < 0.5$ also means that $0 \leq \left(\omega^{\frac{-\omega}{\omega-1}} - \omega^{\frac{-1}{\omega-1}}\right)^{\frac{1-\omega}{(1-2\omega)}} \leq 1$ and that $\left(\omega^{\frac{-\omega}{\omega-1}} - \omega^{\frac{-1}{\omega-1}}\right)^{\frac{1-\omega}{(1-2\omega)}}$ is decreasing in ω. Hence $\frac{\partial s^*}{\partial d} < 0$ as we would expect according to the theory. The exponent of d is decreasing in absolute value in ω, thus the exponent of the d terms is more negative for bigger ω and hence the deleterious effects of higher d on social status are greater as ω gets bigger. Additionally, as noted in the two person example, the exponent of β, $\frac{\omega(1-\omega)}{(\omega-1)(1-2\omega)}$, is less than zero, so s^* is also decreasing in β as we would expect. Lastly, $\frac{1-\omega}{(1-2\omega)} \geq 1$, so s^* is increasing in ψ, also as we would expect.

In this new example, though, we can also observe that the exponent of the number of people in society is greater than zero, so s^* is also increasing in n — in other words, the more people in society, the higher social status will be. If $\omega = 0.25$ we have:

$$s^* = \frac{\psi^{1.5} \times n^{1.5} \times 0.325}{\beta^{0.5} \times d^{0.5}} \tag{65}$$

Assuming perfect mobility, the two people will try to choose $d = d_{min}$ as this will maximize s^*.

Another way of thinking of the benefits of n shown in this identical person example is that there are returns to interacting with more people. Because social status is generally a relative measure, the benefits of n might not be totally clear in the above illustration with equal s^* values. If we think of s^* as the social status value for the members of an identical group of n people, though, the social statuses of the people in this group will be higher, ceterus paribus, than those of the people in a separate, isolated group (no interactions across groups) with n' people such that $n' < n$. The individuals in the group with more people will enjoy higher social statuses.

8.12   Geocoding and Density Details

I use my distance data to construct a shorthand measure of the "social density" in each location inhabited by one or more men in the dataset. Returning to the model earlier, 14 is the equilibrium equation:

$$s_i = \alpha \times \overline{s_i} + \sigma \times \sum_{j \in S} s_j^{\frac{-\omega}{\omega-1}} \times d_{ij}^{\frac{\omega}{\omega-1}} \tag{66}$$

Here we know that the term with the summation, $h_i = \sigma \times \sum_{j \in S} s_j^{\frac{-\omega}{\omega-1}} \times d_{ij}^{\frac{\omega}{\omega-1}}$, conveys the social status benefit that i derives from his interactions with others. The summation can in a way be thought of the "social density" of the location where i lives, because it measures the social status-weighted distance of i to the others in his social group. If we do not know what ω is, but simply want to get a sense of social density, we can create the following measure of "social density," m_i for person i:

$$m_i = \sum_{j \in S} \frac{s_j}{d_{ij}} \tag{67}$$

The resulting number m_i conveys how close person i lives to other socially prominent people in Manhattan. For instance, the m_i for Henry H. Abbott living at 863 Park Avenue in 1924 was 12.6, whereas the m_i for Andrew A. Adams, who lived at 2 West 55th Street, was 16.5, indicating that Adams lived closer to the other members of New York society, weighted by their importance, than did Abbott. The seven men in the dataset who lived in the Plaza Hotel at 768 5th Avenue have the top-ranked m_i scores, indicating that the Plaza Hotel was approximately the geographical center of the Manhattan social world in 1924 relative to the other residences of the 1,882 men in my Social Register-Tax Dataset. The addresses with the lowest m_i scores are generally on the outskirts of Manhattan because fewer socialites lived in those areas — men living in Morningside Heights have the first and third lowest m_i scores, for example. It is important to note that people living at the same address can have different social density scores because an individual's m_i does not take into account his own social status, therefore the person with the lowest s_j in a building y will have a higher m_i than the person with the highest s_j living in that same building.