Social status competition and the impact of income inequality in evolving social networks: An agent-based model[1]

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Abstract

In this paper, we consider conspicuous consumption in a model where individuals compare themselves to their social network neighbors in terms of the amount of a status good purchased. Individuals are heterogeneous with respect to income and can change their network links based on utility considerations. We study the impact of income inequality and income redistribution on status competition and individual welfare. We find that individuals with similar income levels tend to be connected to each other in the social network emerging in the long-run. Under these circumstances, the income (re-)distribution does not significantly affect the income share spent on the status good and the relative status of individuals. In a relatively more equal society, only individuals with the lowest income levels are better off in terms of welfare, everybody else are worse off, the aggregate effect of income redistribution on welfare is negative.

Keywords: Social Status, Conspicuous Consumption, Social Networks, Inequality, Income Redistribution

JEL codes: D85, D31, Z13

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1. Introduction

The mainstream economic theory postulates that absolute consumption or income is what matters for individuals: the higher the consumption, the higher the utility of an individual (Luttmer, 2005). Nonetheless, a big stream of theoretical literature (e.g., Akerlof, 1997; Boskin and Sheshinski, 1978; Corneo and Jeanne, 1997; Duesenberry, 1949; Frank, 1985; Knell, 1999; Layard, 1980; Ljungqvist and Uhlig, 2000; Pollak, 1976) and empirical (e.g., Alpizar et al., 2005; Carlsson et al., 2007; Pingle and Mitchell, 2002; Solnick and Hemenway, 2005) illustrates that individuals are concerned with their relative position in the society and tend to compare themselves with relevant others. Such comparisons are dubbed as "comparison effect" (e.g., Senik, 2004) or "keeping up with the Joneses" effect (e.g., Aronsson and Johansson-Stenman, 2008) and may have detrimental impact on the overall welfare of the society. Indeed, the comparison with relevant others can trigger conspicuous consumption (e.g., Corneo and Jeanne, 1997; Duesenberry, 1949; Frank, 1985, 1999) and increase the share of the budget spent on positional or status-related visible goods (e.g., vehicle, the amount spent for anniversary dinners, houses, luxury accessories, outfit), depleting savings and public good provision (Frank, 2005).

Nonetheless, who the relevant others for an individual are, is still an open question in the literature. Some authors assume that individuals' reference group consists of all other citizens of the same country (e.g., Easterlin, 1995; Fischer and Torgler, 2013). According to another set of scholars, individuals' reference group is the cohort with a similar education level, inside the same age bracket, and living in the same region (e.g., Clark and Oswald, 1996; Ferrer-i-Carbonell, 2005; Senik, 2004, 2008). The third group of researchers focuses on the geographical location, defining the reference group as all individuals (or households) living in the same neighborhood (e.g., Antinyan, 2016; Luttmer, 2005; Quinn, 2006). These studies share an implicit assumption that individuals compare themselves with everyone else in the community or in the country (Ghiglino and Goyal, 2010). In contrast, a large literature on social networks illustrates that individuals mostly interact with a smaller set of social contacts (e.g., Goyal, 2011; Jackson, 2010; Jackson et al., 2016) and the structure of these connections determines both the individual and the aggregate outcomes of social interactions. In this regard, we are aware of only two recent studies (Ghiglino and Goyal, 2010; Immorlica et al., 2017) that investigate individuals' relative concerns and

conspicuous consumption in social networks, where the reference groups of individuals are composed of small sets of neighbors, rather than the entire society (or community).

Ghiglino and Goyal (2010) show that an individual's status good consumption primarily depends on her network position, in particular, her centrality in the social network. The more central a person in the social network is, measured by the Katz-Bonacich centrality measure (Ballester et al., 2006), the more exposed she is to spillover effects from others and needs to spend more on status goods. Immorlica et al. (2017) demonstrate that a new measure of interconnectedness, called network cohesion, determines the intensity of competition for social status and the resulting welfare loss. Both of these studies assume that the social network is fixed and remains unchanged over time. However, as correctly noted by Ghiglino and Goyal (2010) (p.114): *"...a defining characteristic of modern societies is that individuals have the freedom to choose their neighbors."* A similar point is touched by Immorlica et al. (2017) (p. 21): *"...while the network of status concerns is fixed in our model, people can, at least partially, choose their social connections and reference groups."*

In this paper, we consider a simulation model of conspicuous consumption and status competition in an evolving social network. First, we study the structure of the social network that emerges in the long run. Second, we investigate the impact of income inequality and income redistribution on status competition and (individual) welfare. In our model, individuals are assumed to be heterogeneous with respect to income and allocate their budget between a private and a status good. Each individual assesses her status with respect to that of her social network neighbors by comparing her status good consumption to the average status good consumption of the neighbors. Connections change over time: the status concerns may induce individuals to delete existing links or add new connections in order to maximize utility. Individuals may increase their status by severing links to those with whom they cannot catch up in terms of conspicuous consumption or by forming ties to others with lower level of conspicuous consumption. Links are formed on mutual consent by two individuals, while deleting links does not require mutual consent. We compare the results of an evolving social network to those of a fixed network where neighbors are randomly drawn from the entire population. This benchmark is comparable to the case, often studied in the literature, whereby individuals make comparisons relative to the entire society in the sense that the income distribution of their network neighbors is representative to the income distribution of the society.

To analyze the model introduced above, we utilize an agent-based model (ABM) (Namatame and Chen, 2016; Testafsion and Judd, 2006; Colander, 2005). ABM is suitable for studying the behavior of interacting agents who are heterogeneous according to various dimensions. It allows to explore complex systems that often emerge when interactions are mediated by a social network. Given that in our model agents are heterogeneous with respect to income and network position, as well as consumption choices co-evolve with the structure of the social network, the model is hard to be analyzed by other methods without introducing overly restrictive assumptions (see e.g., Jackson and Watts, 2002; Vega-Redondo, 2006).

Regarding the structure of the social network that emerges in the long-run, we find that the social network exhibits large degree of homophily with respect to income: individuals tend to be connected to others with similar income levels. The Pearson correlation coefficient between the income levels of two connected individuals is above 0.65 in all of our simulations. In contrast, in the random network this correlation is not significantly different from zero. Homophily emerges because link formation is based on mutual consent and individuals do not want to connect to significantly richer others, who can afford high status good consumption and decrease their relative status.

Income homophily established in an endogenous network in the long-run suggests that the deleterious impact of the comparison effect on the welfare of low- and middle-income individuals identified in the literature can be mitigated. Indeed, low- and middle-income individuals face a lower degree of status competition, as they compare themselves to others with similar income levels instead of comparing to typically richer individuals as in a random network. This implies that the former need to spend a lower share of their income on status goods which leads to higher utility and lower welfare loss from status competition.

Regarding, the impact of increased income inequality on status competition and individual welfare, our results suggest that in a fixed, random network a larger degree of inequality increases the income share spent on status goods by poor individuals, meanwhile decreases their relative status and welfare. This is mostly because of the fact that on average the poor individuals have to compare themselves to richer neighbors relative to a more equal society. We obtain opposite results for rich individuals, who increase their welfare in a more unequal society. In contrast, in the endogenous network, where homophily emerges, poor agents compare themselves to each other, and do not raise the income share spent on status goods under a more unequal income distribution.

Under these circumstances, poor individuals do not lose relative position and their utility decreases to a smaller extent. As for the impact of inequality on the welfare of the whole society, we obtain that the total welfare increases when the level of inequality becomes larger.

We further verify these results in an exercise of income redistribution where we decrease the income of individuals richer than the median and distribute the income collected equally among individuals poorer than the median. The results show that in endogenous networks, the income share spent on status goods is not affected by the income redistribution. Only individuals in the first income decile benefit from the income being redistributed, meanwhile, others are worse off in terms of welfare. Under the fixed, random network much more individuals at the bottom of the distribution (the first three income deciles) benefit from income redistribution.

Recent debates surrounding the rising inequality in developed countries often propose progressive taxation and income redistribution to curb down inequality. Our paper shows that redistribution and a more equal distribution of income do not imply higher welfare if individuals care about their relative status in the society. In a more equal society, competition for social status intensifies and reduces welfare. We show that this effect is more significant if individuals choose their social connections and form a social network that exhibits strong income homophily. In this case it may be advisable to raise consumption taxes on status goods in parallel to the implementation of redistributive policies or to help the poor through non-monetary transfers, such as education vouchers.

The rest of the paper is structured as follows. Section 2 reviews the relevant literature and highlights our contribution to it. Section 3 introduces our simulation model. Section 4 illustrates the results of the simulations. We first discuss the properties of the social network that emerges in the long-run. Then we study the impact of inequality and income redistribution on social status competition and welfare. Section 5 concludes the paper.

2. Literature Review

Our work touches upon several strands of literature.

First, our paper relates to the studies that investigate individuals' relative concerns and conspicuous consumption in social networks (e.g., Ghiglino and Goyal, 2010; Immorlica et al., 2017). The main difference is that we consider an endogenous network formation process, while the extant literature is focused on fixed networks, as well as that we analyze the impact of increased

inequality in a (continuously evolving) networked society. For instance, Ghiglino and Goyal (2010) study the status good consumption and welfare in exogenously fixed networks, where poor and rich economic agents are either integrated with or segregated from each other. In contrast, we study the dynamic process of integration (or segregation) in an endogenously evolving network. We are interested not only in conspicuous consumption and welfare, but also in the network structure, i.e., whether integration or segregation emerges in the long run. In addition, Ghiglino and Goyal (2010) do not consider the impact of increased income inequality on conspicuous consumption. The authors study income redistribution between more and less central agents in the network, rather than between the rich and poor, as we do it here.

Second, our paper contributes to the literature that considers the impact of inequality on status-signaling consumption and welfare (e.g., Bilancini and Boncinelli, 2012; Hopkins and Kornienko, 2009; Merzyn, 2006). Whether equality deters or encourages the consumption of status goods hinges on the assumption about relative concerns (see the excellent discussion in Bilancini and Boncinelli, 2012). On the one hand, if the relative concerns are assumed to be ordinal— i.e., when people care only about their rank in the distribution of the status bearing good or asset — decreased inequality is deemed as harmful because it fosters social competition and the wasteful conspicuous consumption (e.g., Hopkins and Kornienko, 2009). On the other hand, in case of cardinal relative concerns—i.e., people also care about how far other people are in the relevant distribution— increased inequality may be deleterious for the society (see e.g., Merzyn, 2006). In contrast to the extant literature, we consider cardinal comparisons with network neighbors and illustrate that in a networked society even in case of relative cardinal concerns inequality can increase total welfare, especially when income homophily emerges in case of an endogenous network.

Third, our work adds to the literature that studies the impact of redistributive income taxation on conspicuous consumption and welfare in the society. For instance, Ireland (1998) illustrates that in the presence of relative concerns, tax redistribution can result in Pareto improvement, as the poor gain a cross subsidy from the rich, while the latter have to make smaller expenditures to signal their status. Dodds (2012) extends the framework of previous studies by considering a society with heterogeneous rather than homogenous preferences: part of the population exhibits relative concerns while the other part does not. According to the author, even if the population with relative concerns is low enough, the optimal degree of progressive taxes is significantly higher than in the absence of relative concerns. Other studies end up with similar findings based on the

analysis of homogenous societies (e.g., Boskin and Sheshinski, 1978; Oswald, 1983). Unlike the previous work, in our model the strength of relative concerns is individual-specific and can accept a continuum of values. The second fundamental difference is that social comparisons take place either in fixed or evolving networks. We find that the impact of income redistribution on the overall welfare is negative in both cases.

As a forth contribution, we provide a novel explanation for homophily, which (to the best of our knowledge) has not been discussed in the literature yet. Homophily in income, occupation and social status has been empirically documented in many datasets (see McPherson et al., 2001, for a review). One reason for the prevalence of homophily is biased meeting opportunities: individuals are more likely to meet with others who are similar to them (Blau, 1977; Currarini et al., 2009). This may arise due to geographical proximity, joint organizational membership or assortative marriage (McPherson et al., 2001). Another cause for homophily can be that connecting to similar others is either less costly due to easier communication or brings more benefits. For example, Horvath (2014) shows that connection to others in the same occupation increases the wages earned. Our model explains homophily with respect to income as an unintended consequence of status-seeking and utility maximization, without assuming biased meeting opportunities, or direct economic benefits from connecting to others with similar incomes.

3. Model

Individuals allocate their income between two consumption goods. Good *x* is a private good which is consumed only for its own characteristics and its consumption is unobservable to others in the society. For instance, saving is often used as an example of a private good. In contrast, good *y* is consumed not only for its own characteristics but also for the intention to increase individual's social status. We assume that the individuals are connected by an undirected social network that we denote by *g*. An individual assesses her social status by comparing the status good consumption level between herself and her neighbors in the social network. Individual's social status increases if she consumes more of the status good relative to the average status good consumption among her network neighbors. We follow Ghiglino and Goyal (2010) in this respect. If y_i is the status good consumption of individual *i*, social status is given by the following function:

$$\Phi_i(y_i, y_{-i}) = \left[y_i - \frac{1}{n_i} \sum_{k \in N_i(g)} y_k \right], \qquad (1)$$

where $N_i(g)$ is the set of neighbors of individual i in social network g and n_i is the number of neighbors.

Based on the consumption levels of goods x_i and y_i, the social network g and the individual's social status Φ_i, we define the individual's utility according to the function:

$$U_i\big(x_i, y_i, \Phi_i(y_i, y_{-i})\big) = x_i^{\xi}[y_i + \gamma\Phi_i(y_i, y_{-i})]^{1-\xi} + \alpha_i max_{k\in N_i(g)} y_k. \qquad (2)$$

Utility increases with the consumption of the two goods and the individual's social status. γ measures the strength of status seeking among individuals. The larger γ is, the more individuals care about their social status.

Note that according to the status definition in (1) an individual's utility always decreases if she is connected to someone of higher status good consumption. While this assumption is common in the literature, some papers notice that this formulation of utility is very restrictive. For example, Immorlica et al. (2017) (p.22) writes: "In our simple model, there are only losses from being linked to others. But of course people also benefit emotionally and economically from friendships and social interactions. A richer model of social status would involve network formation with benefits from friendships as well as status concerns." We generalize the model in this direction and assume that individuals also benefit from being connected to others of high social status. High-status individuals provide financial and informational benefits. Indeed, compared with low-status individuals, high-status individuals may have better sources of information, such as access to excellent job opportunities, to elite educational institutions, and connections to other high-status people with similar resources (Binning and Huo, 2012; Lin 1999a,1999b; Ostroff and Kozlowski, 1992).[5] This idea is captured by the last term of the utility function which states that the network resources accessed by individual i depend on her highest-status neighbor.[6] Individuals are heterogeneous with respect to how much they rely on network resources. This is captured by the parameter α_i, which is randomly drawn from the uniform distribution between 0 and 1.

[5] For example, Campbell et al. (1986) find that socioeconomic status positively correlates with the social resources an individual has access to. According to Lin (1999a) the individual's social capital depends on the resources her network neighbors have access to and we assume that neighbors with higher status good consumption have access to more valuable resources. In addition, Lin (1999a) (p. 7) writes "in social resource theory, valued resources in most societies are represented by wealth, power and status... Thus, social capital is analyzed by the amount or variety of such characteristics of others with whom an individual has direct or indirect ties."

[6] The highest status neighbor of individual *i* is the one, who has the highest status good consumption among the neighbors of individual *i*.

Individuals differ in income as well, with z_i denoting the income level of agent *i*. In the low-inequality case, $z_i = \theta + w_i$, where θ >0 and w_i follows a Beta distribution with parameters β_1 and β_2. The support of the income distribution is $(\theta, \theta + 1)$. We compare this case to other societies where the income inequality is larger by considering the mean-preserving spread of this income distribution. We add a shock ε_i to z_i, where ε_i follows a normal distribution with zero mean and σ^2 variance. Changing σ^2 allows us to study the impact of inequality, namely, a larger σ^2 represents higher inequality.

The price of private good *x* is normalized to 1, the price of the status good is denoted by *p* with *p*>1. Indeed, it is natural to assume that the status good is more expensive than the private good. Agent *i*'s budget constraint is given by

$$x_i + py_i = z_i. \qquad (3)$$

We consider a dynamic process where the consumption choices and the social network evolve together over time. In a given period, all individuals make utility maximizing decisions about the allocation of their income between the two goods. Agents maximize the utility function (2) with respect to x_i and y_i subject to the budget constraint. The decisions are myopic in the sense that they take the status good consumption of their neighbors as given, and do not form expectations of prospective consumption changes. The decision rule is given by the following best-response function which is derived from the first-order condition of the utility maximization problem:

$$y_i = \frac{Az_i + \gamma \frac{1}{n_i} \sum_{k \in N_i(g)} y_k}{1 + \gamma + A_p}, \qquad (4)$$

where $A = \frac{(1-\xi)(1+\gamma)}{\xi p}$.

In a given period, an individual is allowed to update her social network with probability $\lambda < 1$. The assumption that λ is smaller than 1 captures the idea that consumption choices are more frequent than the updating of the network. If given the possibility, individuals may add or delete links based on utility maximization. If the current network is *g*, denote the network that is obtained by deleting the link *ij* by $g - ij$, and the network that is obtained by adding the link *ij* by $g + ij$. The links are deleted or formed as follows. Consider agent *i* in a given period. With probability λ we randomly draw another agent *j* from the entire population. If agent *j* is a current neighbor of agent *i*, the two consider deleting the link by comparing their utility levels with and without the

link ij. The link is deleted if at least one of the agents can improve utility by deleting the link. More formally, if either $U_i(x_i, y_i, y_{-i}, g) < U_i(x_i, y_i, y_{-i}, g - ij)$ or $U_j(x_j, y_j, y_{-j}, g) < U_j(x_j, y_j, y_{-j}, g - ij)$. In the alternative case, when agent *j* is not a neighbor of agent *i* in the given period, the two consider adding the link. We assume that links are formed on mutual consent, which means that both agents' utility has to increase when the link is added. Formally, individuals i and j become connected if and only if both $U_i(x_i, y_i, y_{-i}, g) < U_i(x_i, y_i, y_{-i}, g + ij)$ and $U_j(x_j, y_j, y_{-j}, g) < U_j(x_j, y_j, y_{-j}, g + ij)$. Utilities are computed given the current consumption choices of individuals: agents do not take into account the future changes in the consumption bundles that are generated by the formation/deletion of links.

The initial conditions and the simulation process can be described as follows:

1. In period t=1, create initial conditions:
    a) Draw the income level z_i for all agents $i \in [1, N]$, where N is the population size.
    b) Create an initial random network where each link is present in the network with probability p_k.
    c) Initialize consumption levels: assign a random status good consumption level to each agent. Draw y_i randomly from the uniform distribution between 0 and z_i. Given y_i, compute x_i using the budget constraint.
2. In each period t<T and for all agents $i \in [1, N]$:
    a) Update consumption choices (x_i, y_i) by myopic best response using equation (4).
    b) A chance to update the social network arrives with probability λ<1: draw another agent *j* uniformly at random from the entire population. If agent *j* is a neighbor of *i*, consider deleting the link. If agent *j* is not a neighbor of *i*, consider adding the link.

We compare two network configurations. First, we set $\lambda = 0$ which is equivalent to considering a fixed Erdos-Renyi network. In this network, the average degree of agents is $p_k n$. Most importantly, links are randomly formed irrespective of the agents' income and status good consumption. The neighbors of any agent i are a representative sample of the entire population. Therefore, the fixed network is comparable to the case, often studied in the literature, where agents compare themselves to the entire population in terms of status good consumption.[7] Second, we

[7] In the random network, it is also true that, on expectations, the average status good consumption of the neighbors of any agent *i* is the same for all *i*.

consider the evolving network where $0 < \lambda < 1$ and links are changed based on utility considerations. While the assumption of a fixed network is plausible in the short-run, in the long-run individuals certainly change their set of friends which may also be based on status considerations.

We simulate the model with *N*=1000 agents for *T*=150000 periods. The baseline parameter values are shown in Table 1. For a given parameter setting we take a sample of 30 runs and we compute averages for all statistics over the sample. We record the status good consumption, utility level, relative status, number of neighbors, average income and status good consumption of neighbors. Since agents are heterogeneous with respect to income and network position, all these statistics vary from agent to agent. We summarize the distribution of statistics by deciles of the income distribution and compute the average value of each statistics for those agents who belong to the same income decile. Then we analyze how these statistics change for a given income decile if the level of inequality changes or some policy measures are introduced. That is, we compare the outcomes for individuals who occupy the same rank in two different income distributions, even if their actual income level might be different (similar to Hopkins and Kornienko, 2009). This allows us to make comparisons between distributions even if their supports do not overlap completely.

[Table 1 about here]

Figure 1 shows the time evolution of various outcomes from a typical simulation run. We depict the status good consumption and the income distribution of neighboring nodes for various income deciles. We can see that the outcomes stabilize roughly after about 100000 periods and do not change significantly afterwards. Our choice of running the simulation for *T*=150000 periods seems to be plausible.

[Figure 1 about here]

We study the following research questions in this model:

RQ1: What is the structure of the social network in the long run when individuals form and delete connections based on utility and social status?

RQ2: What is the impact of income inequality on status competition and individual welfare when agents compare themselves to their neighbors in endogenous and fixed, random social networks?
RQ3: What is the impact of income redistribution on status competition and individual welfare when agents compare themselves to their neighbors in endogenous and fixed, random social networks?

4. Results

4.1. Network Structure in the Long Run

We begin our analysis by describing the long-run network structure that emerges in case of status competition. This will have important implications for the rest of the analysis. Our main result is that

Result 1. *The social network emerging in the long-run exhibits large degree of assortativity by income. While the majority of neighbors of any agent are from the same income decile as herself, she also connects to someone significantly richer to secure benefits from high-status neighbors. The degree of assortativity decreases along the income distribution.*

The large degree of assortativity can be seen from the average Pearson correlation coefficient between the income levels of the two agents connected by a link which rises from 0.001 for the random network generated at the beginning of the simulation to 0.676 after T periods of simulations. Figure 2 provides more evidence for Result 1. The first panel shows the average income of neighbors relative to the individual's own income, both for the initial random and long-run endogenous networks.[8] For the random network, this measure linearly decreases with income, since a richer person has poorer neighbors on average when neighbors are randomly drawn. In contrast, for the long-run endogenous network, this measure is very close to 1 for almost all income deciles. The only exception is the top of the distribution: top earners tend to connect to others with lower incomes.

[8] We compute this measure for each income decile, by taking averages over the individuals who belong to the same income decile.

[Figure 2 about here]

A similar picture emerges in the low panels in Figure 2, that depict the percentage of neighbors from the same income decile and the percentage of neighbors representing income deciles lower than the current decile. In the fixed random network, about 10% of the neighbors of any individual are from the same income decile, while the share of poorer neighbors linearly increases with the individual's own income. In the endogenous network, about 60-80% of neighbors are from the same income decile as the individual, while the share of poorer neighbors is less than 10%. For the endogenous network, assortative linking decreases along the income distribution: especially the top income decile tends to connect to lower income groups.

While strong assortativity is a general tendency, agents also tend to connect to at least one high-income individual, in order to secure benefits from high-status neighbors. The upper right panel in Figure 2 shows the income decile of the richest neighbor. Below median income, individuals connect to someone from the top income decile, agents from the 6^{th}-9^{th} income decile can connect to someone who is richer than themselves but cannot link to top earners.[9]

The intuition of these results is as follows. A link between a low income earner and a high income earner (not from the top income decile) is not that trivial to establish, as the relative status concerns may decrease the utility of the low-income earners. Indeed, to improve the relative standing in the reference group, any high income earner would like to establish links with low income earners who have lower status good consumption. However, the latter will reject link proposals from the former, since the presence of a link would decrease their relative standing. Consequently, an individual can successfully establish links only to others with similar income, since she does not prefer richer contacts and she is not preferred by poorer contacts. The only exception happens to individuals in the top income decile, as they are able to successfully connect to poorer individuals. This is due to the fact that top income earners provide benefits for others that can outweigh the concerns for relative position. In other words, individuals in lower income groups tend to connect to at least one top earner to secure benefits from high-status friends.

[9] Top earners do not benefit from connections to agents above the median income because their relative status does not improve much, so they refuse these connections. This is especially the case if a top-earner has poor neighbors, who secure high social status to her. Then connecting to someone from higher income deciles decreases social status and utility.

The average number of neighbors in each income decile is also investigated in Figure 3. In the fixed network, all agents have 10 neighbors on average. In the long-run endogenous network, there are more connections and the average degree decreases in income. Individuals at the bottom of the income distribution form one link to a top-earner to secure benefit from high-status individuals. This decreases their social status and gives them incentives to form many links to others from their own income decile to improve relative status. Moving up along the income distribution, individuals cannot connect to top earners, nevertheless they connect to at least one richer individual than themselves. This connection decreases their relative status, but they do not need to form so many links to compensate for the status loss.

[Figure 3 about here]

4.2.The Impact of Inequality

For the ease of exposition of the results we adopt the following structure. We analyze the impact of increased inequality under fixed and endogenous networks, respectively. Most of our discussion is structured around four variables of interest: the status good consumption (y), the income share spent on status goods (py/z), the relative status (Φ), and the utility levels (U). To capture the increased income inequality, we add a shock with zero mean and variance $\sigma^2 = 1.1$ to the income levels, leaving the mean of the income distribution intact and then compute the difference of the abovementioned four variables across high (shock with $\sigma^2 = 1.1$) and low (no shock) inequality regimes for a given network structure. Figure 4 depicts the results of the simulations. The dashed line indicates no change, while a positive (negative) value on the graph implies an increase (decrease) in a variable (e.g., status good consumption) when the society becomes more unequal.

4.2.1. Fixed, Random Network

Result 2. *When inequality rises*

a) The status good consumption of poor (rich) individuals decreases (increases).

b) Poor (rich) individuals spend a larger (smaller) share of their income on status goods.

c) Poor (rich) individuals receive lower (higher) relative status.

d) Poor (rich) individuals obtain lower (higher) welfare.

The first panel in Figure 4 shows the income distribution with low and high levels of inequality. When inequality rises, income deciles below the median represent lower incomes, while those above the median, higher incomes. Due to the income effect individuals below median spend less on the status good in absolute terms, while those above the median spend more. This pattern is immediately evident from the middle left panel in Figure 4, which represents the difference in the status good consumption.

[Figure 4 about here]

However, the income share spent on status goods (py/z) (the middle right panel in Figure 4) changes in the opposite direction: in relative terms, poor individuals spend more on the status good. Recall that in the fixed network, neighbors are randomly drawn from the entire population. Poor individuals are thus connected and compare themselves to richer individuals on average. Since the reference group of poor individuals can afford to spend more on the status good than themselves, the poor also need to spend more on the status good relative to their income to keep up with the competition. This results in lower status and utility for them (see the upper right and lower left panels in Figure 4). For rich individuals, we have the opposite picture: they compare themselves to poorer individuals on average when the level of inequality increases. Under these circumstances, the rich spend less on the status good relative to their income and their utility rises. Inequality in income thus enlarges the inequality in welfare: a more equal society is beneficial for the poor.

4.2.2. Endogenous Network

The impact of inequality on status good consumption is substantially different in an endogenous network.

Result 3. *When inequality rises:*

a) The status good consumption of poor (rich) individuals decreases (increases) as in a fixed network.

b) The share of income spent on status goods varies much less along the income distribution than in a fixed network. Therefore, inequality has almost no impact on the share of income spent on status goods.

c) The status of individuals is not reactive to increased inequality in an endogenous network.

d) Inequality has less detrimental effect on the welfare of the poor in an endogenous than in a fixed network.

Regarding Result 3b, for the endogenous network the poorest individuals spend about 67% percent of their income on the status good, while the richest individuals about 62% when $\sigma^2 = 1.1$. These numbers are 76% and 62% for the fixed network, respectively. The poor spend a lower share of their income on status goods in the endogenous network. The middle right panel in Figure 4 also shows that the degree of inequality has a small impact on the income share spent on status goods.

These results follow from the strong assortativity in income that emerges in the long-run network. The correlation coefficient of income levels of neighboring agents is 0.676 for the more equal income distribution and goes up to 0.756 when inequality rises. Inequality has a negligible impact on the share of income dedicated to status goods because individuals compare themselves to others with similar incomes, independent of the general level of inequality in the society. Thus, the reference group of an individual consumes almost the same amount of the status good as the individual herself, implying that there is no incentive to invest more (the poor) or less (the rich) on the status good relative to the income. In particular, poor individuals do not compare themselves to richer agents on average as in the fixed network, which implies that they spend a much smaller share of their income on status goods in the endogenous network. For the same reason, the individual's relative status is little affected by inequality. This is especially true for poor individuals who have a more assortative social network (see the upper right panel in Figure 4).

Considering the impact of inequality on welfare, the lower left panel in Figure 4 shows the utility levels by income. Individuals above the 20^{th} percentile will have higher utility when the level of inequality increases, only the bottom decile suffers from inequality. This is in sharp contrast with the fixed network, where the bottom 40% suffered from inequality. Under the endogenous network, the utility of the poor does not decrease as much as in the fixed network, because the relative status of the poor does not change much with the level of inequality. As a

result, the total welfare increases with inequality but more so in the endogenous network. Considering the fixed network, the total welfare increases from 2643.4 to 2830.3 (by 7.07 percent) when the level of inequality rises. For the endogenous network the total welfare is 2730.1 for the low inequality regime which goes up to 3029.6 (by 11 percent) when inequality becomes larger. Note also that in the endogenous network total welfare is always larger than that in the fixed network. This stems from the fact that agents can avoid status competition and suffer less from conspicuous consumption by changing the network neighbors.

In sum, when individuals can modify their social network based on utility considerations, everybody, except the poorest individuals, are worse off (better off) when the income distribution becomes more equal (unequal). This finding is in line with the results of Hopkins and Kornienko (2009), who obtain that greater equality is beneficial for the poorest but detrimental for the middle-class who face higher status competition. In their model, however, individuals compare themselves to the entire population and their utility depends on their rank in the distribution of status good consumption. We show that the same result holds when individuals compare themselves to their neighbors in the social network that evolves over time based on utility maximizing decisions. Bilancini and Bonicelli (2012) find that the form how status is modeled is crucial regarding the conclusions on the impact of income inequality. When status depends on the rank of the individual in the distribution, greater equality intensifies status competition and decreases welfare. In contrast, when individuals also care about how far they are from others in terms of status good consumption, equality may reduce the level of competition and welfare waste under some circumstances. Our results illustrate that greater inequality can be welfare improving even if social status concerns are cardinal, in contrast to Bilancini and Bonicelli (2012).

4.3. Income Redistribution

In this section, we turn our attention to the impact of income redistribution from the rich to the poor, given substantial inequality in the society. We consider a very simple redistribution policy: individuals earning more than the median income level pay 20% of their income to the government who redistributes the total tax revenue equally among those earning less than the median income. We set the variance of income shock to $\sigma^2 = 1.1$. The results are displayed in Figure 5, where the first panel shows the impact of the policy measure on individual income and the other panels show its impact on the four variables of interest under fixed and endogenous networks. To understand

the impact of income redistribution, we compute the value of each variable under scrutiny with and without the redistribution of income and take the difference between the two cases to evaluate the impact of the policy measure. We do this for fixed and endogenous networks separately.

4.3.1. Fixed, Random Network

Result 4. *Under fixed, random network, income redistribution*

a) *increases (decreases) the amount spent on status good by the poor (rich).*
b) *decreases (increases) the income share spent on status good by the poor (rich).*
c) *increases (decreases) the relative status of the poor (rich).*
d) *increases (decreases) the welfare of the poor (rich).*
e) *decreases the total welfare of the society.*

Overall, income redistribution raises the income of individuals below the median income who can thus afford a higher level of status good consumption, the contrary holds for agents above the median (see the middle left panel in Figure 5). Under the fixed, random network, the share of income spent on status goods, however, moves in the opposite direction: poor individuals spend a lower share of their income on the status good, while rich individual a higher share (see the middle right panel in Figure 5).

[Figure 5 about here]

Recall that under the fixed network, each individual's social network is a random sample of the population. Poor individuals compare themselves to richer ones on average, though the redistribution decreases the income and status good consumption of their reference group. As a consequence, they need to spend a lower share of their income on the status good to keep up with their reference group's consumption and gain relative status (see the upper right panel in Figure 5). Their utility increases both because they can afford to consume more status goods and as they enjoy higher relative status, since their typically richer reference group spends less (see the bottom right panel in Figure 5). For agents above the median income, we obtain the opposite: their reference group mainly consists of poorer individuals whose income increases, and who spend

more on the status good. Therefore, rich individuals need to spend a higher share of their income on the status good. Individuals above the 7th decile still lose relative status while agents between the median and 7th decile are able to raise their status due to their higher relative spending on the status good. Despite this, the utility level decreases for everybody above the 3rd decile income, which partially includes the people who receive higher income with income redistribution. Consequently, the total welfare of the society becomes smaller. Indeed, without redistribution, the total welfare in the fixed network is 2830.3 which reduces to 2736.2 after the income is redistributed.

4.3.2. Endogenous Network

Result 5. *Under the endogenous network income redistribution,*

a) *has a limited impact on the share of income spent on status goods.*
b) *increases (decreases) the relative status of the poor (rich), but to a lesser extent than under fixed, random network.*
c) *increases (decreases) the welfare of the poor (rich), but for most individuals welfare is lower than under fixed, random network.*
d) *decreases the total welfare of the society.*

As already discussed earlier in the text, when the network is endogenous, individuals connect to others with similar income levels. Hence, compared to the fixed network, the income of an individual's reference group is less exposed to the redistribution policy. This reflects on the income share spent on status goods which is little affected by the redistribution policy. Homophily is especially relevant for poor individuals. Under fixed network, they spend a significantly lower share of their income on the status good after the income is redistributed: this reduction is much smaller under the endogenous network. In absolute terms, however, poor individuals purchase more status goods due to their higher income. Nevertheless, the relative status of the poor increases to a lesser extent in an endogenous network compared to that in a fixed network, since their reference group consists of individuals with similar income levels.

In an evolving network, only the bottom 10 percent benefits from the redistribution despite that everybody below median receives higher income (see the bottom left panel in Figure 6).

Redistribution increases the consumption of status good, the relative status and the welfare of the poorest individuals. For rich individuals the relative status and utility decrease. Since most individuals obtain lower levels of utility after the income redistribution, we expect that the total welfare of the society goes down. Without redistribution, the total welfare in the endogenous network is 3029.6, after redistribution it reduces to 2920.7.

In sum, our results about the impact of income redistribution confirm the findings of the previous section: a more equal income distribution benefits the poorest individuals only. This is especially the case for the endogenous network where only the bottom 10 percent benefits from income redistribution, as opposed to the bottom 30 percent for the fixed, random network.

5. Conclusion

We have studied an agent-based model of social status competition and conspicuous consumption where individuals with heterogeneous income levels compare their relative status to that of their neighbors in a social network. We have compared two network configurations, a fixed random network and an evolving network where links are formed and deleted based on utility considerations. We find that in the evolving social network strong assortativity with respect to income emerges in the long-run. Status competition can thus explain why individuals with similar income levels are connected to each other in real social networks.

We analyze the impact of income inequality and obtain that most individuals, except those at the bottom of the income distribution, benefit from a larger degree of income inequality. While in the fixed network the bottom 30 percent of individuals are worse off when the income distribution becomes more unequal, in the evolving network only the bottom 10 percent are. The impact of inequality on the individual consumption choices is also very different under the two network configurations. Under fixed network, individuals below (above) median spend a higher (lower) share of their income on status good when inequality rises, and lose (gain) relative status. In contrast, when agents can modify their social connections, they connect to others with similar incomes and their consumption choices are less dependent on the overall income distribution. Thus, the income distribution does not influence the income share spent on status goods and the social status of individuals.

The aforementioned results have important consequences for the effects of income redistribution. Although the redistribution policy studied here increases the income level of

everybody below the median income, only the welfare of the bottom 10 percent increases when the social network evolves over time. Income redistribution intensifies the social status competition below the median which reduces the welfare-enhancing effects of higher income. This effect is much reduced in a fixed, random network. These findings suggest that income redistribution should be accompanied by a consumption tax on status goods, in order to have a larger positive impact on the welfare of the poor. Alternatively, cash transfers may not be an effective form of helping the poor, instead the provision of non-monetary benefits in the form of food stamps, education vouchers or better public services should be more welfare-enhancing.

Our research has important limitations. We assumed that individuals compare themselves to their network neighbors by comparing their own social status good consumption to the average status good consumption of their neighbors. While this seems to be a plausible assumption, it remains to be seen whether our findings extend to the choice of other functional forms, for example, if individuals consider their rank among network neighbors. Our paper is also limited in the sense that it remains silent on broader aspects of status competition, in particular, on why individuals seek a higher relative position. It would be possible to embed our model into a larger agent-based model where relative status allows individuals to gain better job opportunities or determines who marries to whom. We leave these aspects of status competition for future research.

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6. Appendix: Tables

Parameter	Value
Population size N	1000
Price of status good p	2
Parameter of utility function ξ	0.5
Sensitivity of utility to relative status γ	1
Lower bound of income distribution for baseline case θ	5
Variance of income shock (baseline) σ^2	0
Parameters if income distribution β_1	2.0
Parameters if income distribution β_2	7.0
Link updating rate λ	0.1
Benefit from social status α	α_i drawn from $U(0,1)$
Linking probability for initial network p_k	0.01
Period T	150,000

Table 1. Parameter values for the simulation.

7. Appendix: Figures

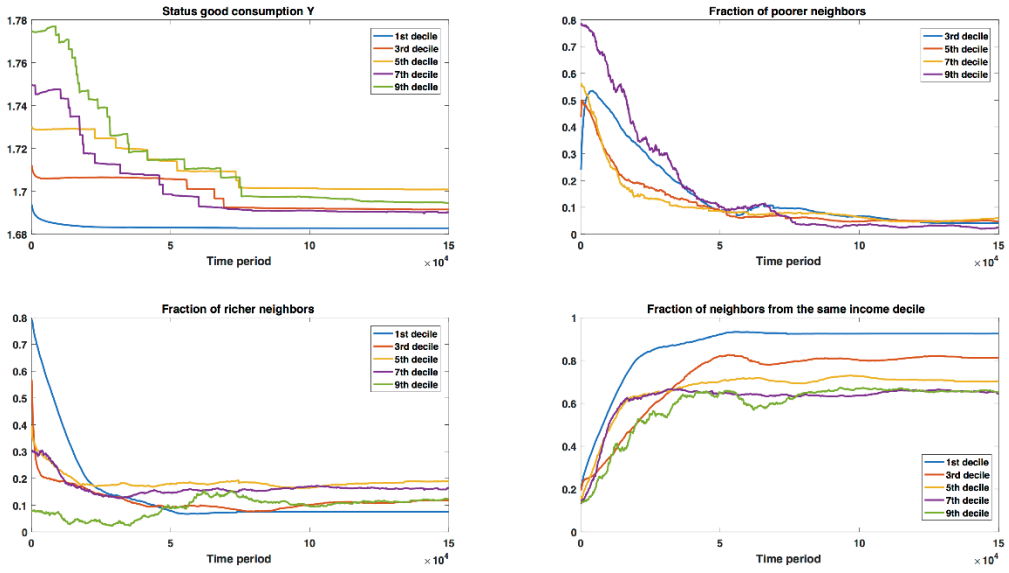

Figure 1. The evolution of various statistics over time in a typical simulation run. Upper left panel: status good consumption, upper right panel: fraction of neighbors from poorer income deciles, lower left panel: fraction of neighbors from richer income deciles, lower right panel: fraction of neighbors from the same income decile.

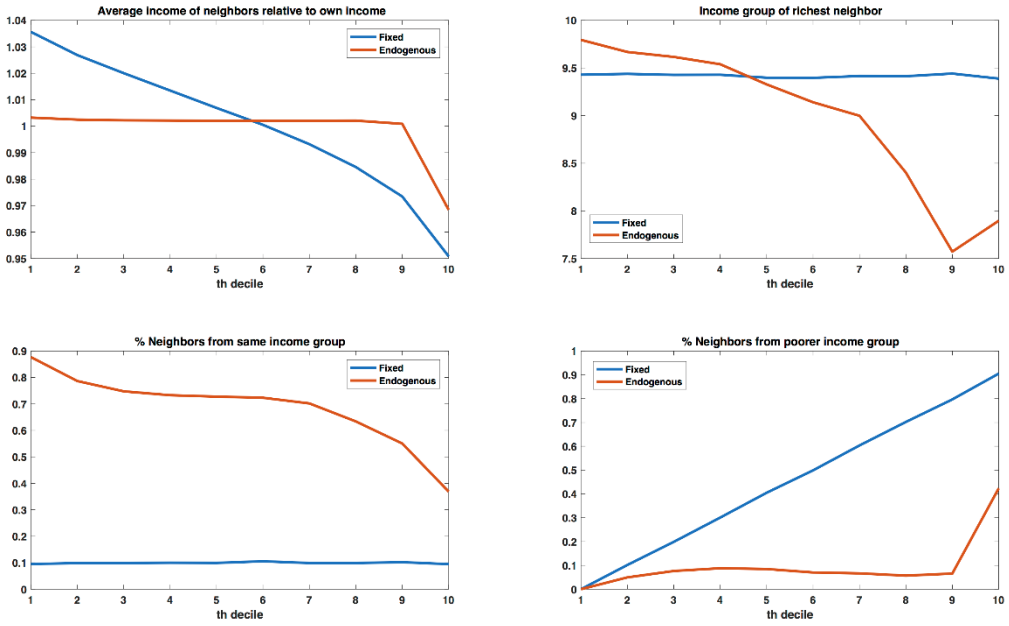

Figure 2. Statistics on the income level of neighboring nodes by income deciles, for fixed and endogenous networks. Upper left panel: average income of neighbors divided by own income, upper right panel: income decile of the richest neighbor, lower left panel: fraction of neighbors from the same income decile, lower right panel: fraction of neighbors from poorer income deciles.

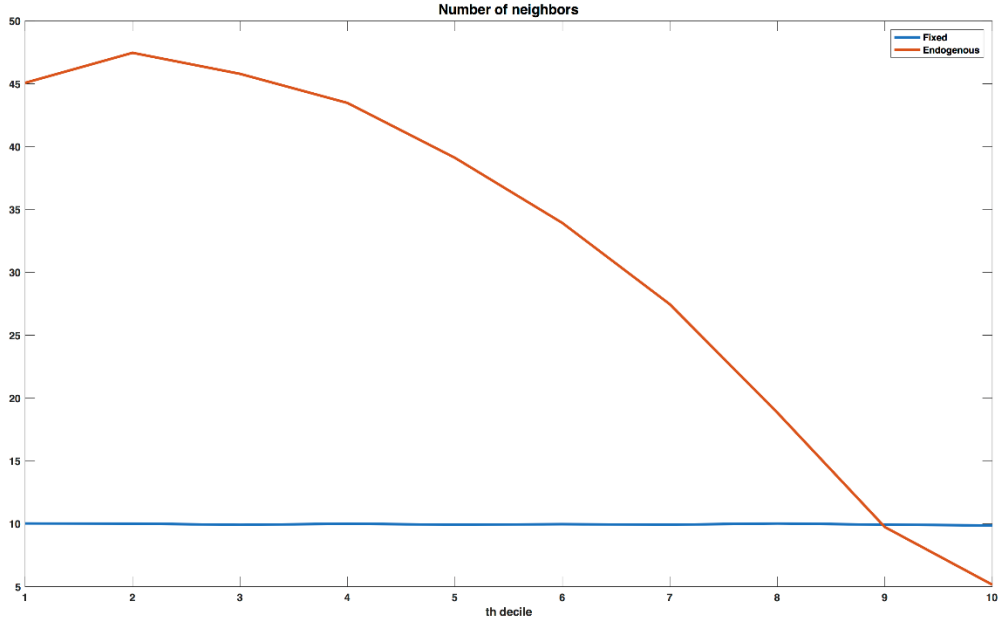

Figure 3. Average number of neighbors by income deciles, for fixed and endogenous networks.

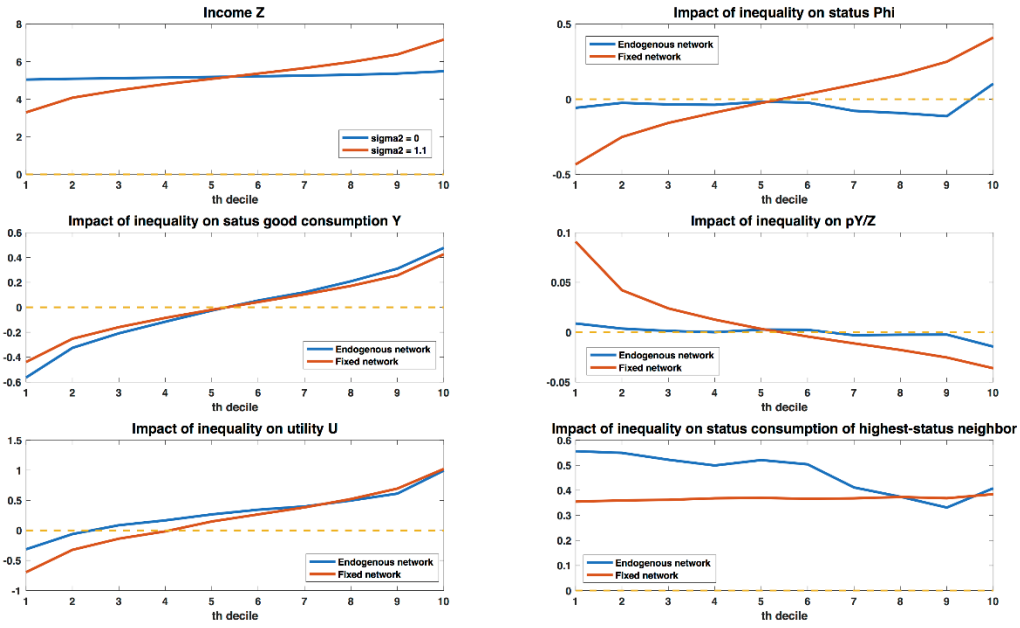

Figure 4. Impact of inequality on the long-run outcomes by income deciles, for fixed and endogenous networks. Upper left panel: Income, Upper right panel: Relative status, Middle left panel: Status good consumption, Middle right panel: Income share spent on status good, Lower left panel: Utility, lower right panel: Maximum status good consumption among neighbors.

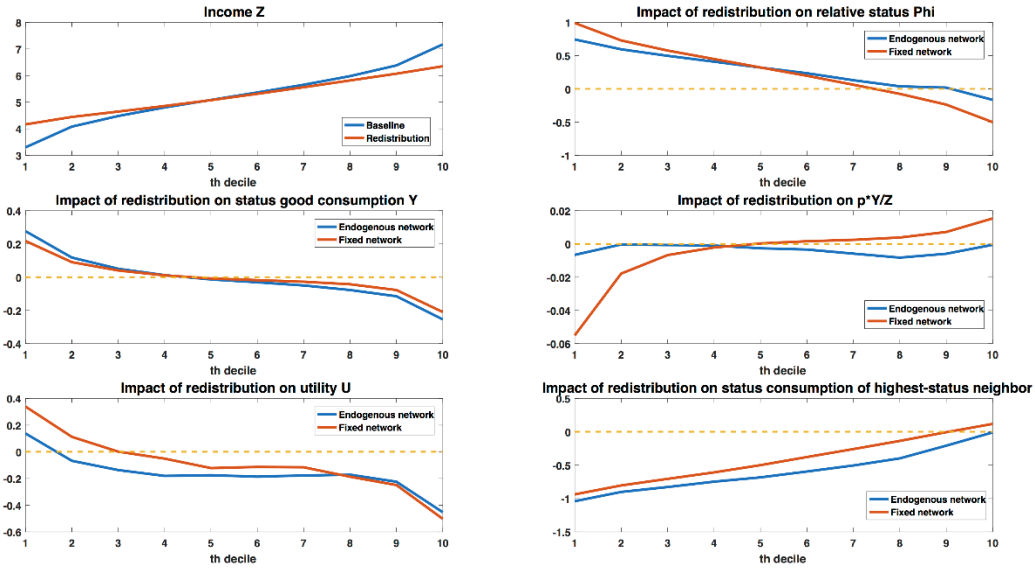

Figure 5. Impact of income redistribution on the long-run outcomes by income deciles, for fixed and endogenous networks. Upper left panel: Income, Upper right panel: Relative status, Middle left panel: Status good consumption, Middle right panel: Income share spent on status good, Lower left panel: Utility, lower right panel: Maximum status good consumption among neighbors.