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An agent based model of fads

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An agent based model of fads

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Abstract

We examine the dependence of the cyclical fluctuations of demand on specific behavioral attitudes of heterogeneous agents. Extending the model of Tassier (2004), we use simulations to investigate consumption dynamics when agents are inclined both to conformism and distinction, and they use goods as elements of a communication system. Our results challenge the view stating that conspicuous consumption is typical only of a wealthy class and of some positional goods, since in our model there are no assumptions about features of the goods or income distribution.

Keywords— *goods cycles, agent based model, sociology of consumption.*

JEL Classification Codes: D91

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1 Introduction

Many social theories distinguish between consumption of luxury and ordinary goods, or primary and secondary needs, implicitly relegating the mechanisms of fashion to the wealthy class. These theories start from the intrinsic and objective characteristics of the goods. As a matter of fact, the same good can be used as element of personal identity by one subject and for its use value by another one. In our model, introducing two simple (and belonging to an old sociology) behavioral elements in the utility function of consumers is enough to observe cyclical fluctuations, which we interpret as a marker of fashion. This effect occurs without subdividing the goods between luxury and non luxury.

The importance of exploring these aspects of consumption comes from the belief that economic theory still tends to consider fashion, but more generally the link between consumption and identity in contemporary society, as a phenomenon relegated only to an affluent minority, and that, therefore, has a minimal impact on the economy. With our model we want to bring economic theory more in line with the empirical evidence that even among poor and middle social strata a cyclical dynamic of consumption may emerge. And, more precisely, that also poor and middle classes give a connotation to goods and services.

In order to build the model we start from the ideas of Simmel (1957) about conformism and distinction as necessary conditions for fashion. In particular, we embed these behavioral element in the utility of consumers. Our result may apparently contradict Simmel's thesis, since he theorized fashion cycles as consequence of a tension between conformism and distinction. On the contrary, in our paper fashion cycles are stronger when agents care more about distinction. We will deepen this aspect of the model in the conclusions.

The issues of conspicuous consumption and fashion cycles have been extensively treated in the literature. There are several papers showing that the quest for social distinction through consumption practices is not only characteristic of a wealthy class and of a restricted set of luxury goods. This economic literature is both theoretical (Moav and and Neeman, 2012; Moav and Neeman, 2010) and empirical/experimental. A subset of the latter belongs strictly to economics (Charles et al., 2009; Fafchamps and Shilpi, 2008; Murphy, 2018; Guillen-Royo, 2011; Kaus, 2013; Ordabayeva and Chandon, 2011; Chen and Nelson, 2020; Wisman, 2009; Sundie et al., 2011), while another one stems from business, management and marketing studies.(Bellet and Colson-Sihra, 2018; Jaikumar and Sarin, 2015; Mazzocco et al., 2012; Podoshen et al., 2014).There are also papers from development studies addressing this issue (Van Kempen, 2003, 2007), and books explaining that the life-style and purchase choices of the poor are often determined by factors closer to the social logic of conformism/distinction than to the economic logic of prices. For instance, very poor people spend an higher fraction of their income in conspicuous goods than the middle-income ones ((Harriger, 2010; Duflo and Banerjee, 2011)).

Some of these authors call this kind of consumption *aspirational* to stress the fact that, differently from the classic concept of conspicuous consumption, in this case there is nothing to signal in terms of wealth, since only the poorest people are taken into consideration.
The essay of Simmel (1957), and the sociology of consumption as a whole, offer a much relevant motivation for this paper. In the sociological perspective, consumption is viewed as one of the biggest mass-communication systems in the Western culture. Sociologists were the first to write about a *consumer society*, suggesting that consumption became a way of expressing one's identity and position in a stratified society (Codeluppi, 2005). In this perspective, conspicuous consumption is widespread in society as a form of individual expression, defining who you are (Fremling and Posner, 1999; Stewart and Hoell, 2016). According to these theories, not only luxury goods, but many other more accessible categories of goods convey the most disparate social meanings, and not just prestige or status.
Following these arguments, the research question of the paper can be summarized as follows: are fashion cycles a minor phenomenon in the economy, involving luxury or positional goods and only a wealthy class? According to our results, the answer to this question is negative. Fashion cycles can be extended to a wider range of goods and agents than the traditional luxury goods-leisure class combination. In order to explore this consumption dynamic we insert two behavioral parameters of consumption in a heterogeneous agent framework(Caiani et al., 2016). Indeed, we will see that the heterogeneity of consumers is critical to achieve the main results of this paper. Since heterogeneity comes at the cost of higher complexity, firstly we provide some analytical results for a simplified setup of the model, and then we study the full setup numerically. Specifically, we modify the mathematical structure of Tassier (2004). While in Tassier's model agents have an exogenous social network, so that they can interact only with a subset of the population, here instead each agent interacts with whoever has the same good as her. We assume that heterogeneous agents have a personal tendency to distinguish themselves and to conform at the same time, using goods as elements of a communication system. In this way they cause fashion cycles (if distinction prevails) or they get clustered into stable groups (if conformism prevails). The first step of our analysis is to provide the sufficient conditions for fashion cycles. While the literature assumes that all the agents give the same weight to distinction and conformism, in this model we assume that these weights are heterogeneous across agents. In this way, we are basically generalizing the sufficient conditions of Tassier (2004).
The paper is organized as follows. The next section presents a brief literature review about fashion cycles. Section 3 explains the theoretical model and presents some analytical results which hold for its simplified setup. Section 4 presents the results obtained from simulations on the full model, including the particular case with one influencer and her followers. Section 5 concludes and discusses some possible further developments of the paper.

2 Related literature

The fact that some goods are conspicuously consumed does not necessarily imply that they are luxury goods. It may instead concern psychological and cognitive attitudes of the agents (Banuri and Nguyen, 2020), or/and of their reference group (Barrington-Leigh, 2008). More precisely, conspicuous consumption does not mean only to consume to show that one is rich. It refers to all those practices that connect consumption and identity, or any connotation conferred to the good/service that contributes to designate the individual or the group that owns/uses it, because it communicates a social meaning (or a sign value), beyond its use value.

Furthermore, the same good can be a luxury good for one agent and a standard good for another one.

A sociological argument against the division between luxuries and non-luxuries according to objective features of the good, is that some goods are luxuries for those at the bottom of wealth (or cultural/social capital) distribution, but they are absolutely non distinctive for those at the top of that distribution. Similarly, people who have a low level of education can consider an object to be elegant or attractive, while the highly educated consider it vulgar or unpalatable, even if the income is the same for both groups of consumers.

In our model preferences are endogenous. The first economic contribution on this topic comes from the well known relative income hypothesis of Duesenberry et al. (1949). Many subsequent papers have proposed to study the effects of sociological behavioral variables on consumption. Leibenstein (1950) analyzes the impact of the Veblen effect, of the bandwagon effect (conformism) and of the snob one (distinction) on demand for certain goods. By Veblen effect he means the phenomenon of conspicuous consumption, whereby the demand for a good increases with price instead of decreasing. The bandwagon effect refers to the case where demand for a commodity increases if others are increasing the consumption for the same commodity. The distinction effect refers to the opposite situation, when demand for a given good decreases if the others are increasing consumption of that commodity. We should emphasize the difference between the distinction and conformism effects on the one side and the Veblen effect on the other. While the former are a function of the consumption of others, the latter is a function of price. Without the Veblen effect, the demand curve is always negatively inclined regardless of which of the two other effects prevails. In our model we focus on conformism and distinction, while demand is negatively related to price. The Veblen effect is thus excluded.

Other papers come close in inspiration to the approach we follow. Johnstone and Katz (1957) find that preferences in popular music among teen-age girls vary according to the neighborhood in which a girl lives and her relative popu-

larity among her peers. They suggest that personal relations play an important role in musical fads and fashions. One of the most important models about this issue is provided by Matsuyama (1991). It is a random matching model where the socially stable pattern of behavior depends on the relative share of conformists to non-conformists. Tassier (2004) assumes different types of agents and different levels of attraction attached to each of them. He measures the average type that buys a certain good and the influence of price on the magnitude of cycles. Finally, he shows that increasing the number of goods increases the time agents need to reach a type-based clustered equilibrium and decreases the probability of reaching such equilibrium. Frank (2005) argues that consumption theory must reconcile three basic patterns that seems to be contradictory: the rich save at higher rates than the poor; national savings rates remain roughly constant as income grows; national consumption is more stable than national income over short periods. He makes some examples suggesting that the relative income hypothesis was abandoned prematurely by economics and that it's possible to solve the contradiction stated above by saying that poverty is relative. Duesenberry et al. (1949) indeed explained that the poor save at a lower rates because the higher spending of others kindles aspirations that they find difficult to meet. Acerbi et al. (2012) show that the social transmission of preferences for cultural traits is a sufficient condition to achieve fashion cycles. They identify a success index that predicts how much a fashion (or a trait) will spread in the population. The numerator of this index is the ease with which a trait is transmitted. On the other hand, since individuals have many occasions to learn new traits and replace the existing ones, the denominator of this index measures the resistance of traits in being relinquished. On the same line, following Simmel (1957), Di Giovinazzo and Naimzada (2015) endogenize preferences that evolve from the interaction of 2 types of agents (snobs and bandwagon). Their main contribution is to show that the endogenous nature of preferences and social interaction is a precondition for setting off the cycles of fashion. By means of simulations, we are able to extend this result to a richer setting, where there are numerous types of agents.
If preferences are endogenous, there are some interesting implications in terms of welfare and policy. For instance, Bilancini et al. (2009) find that, if status depends in an ordinal way on the individual relative standing in terms of economic resources, then redistributing resources from the rich to the poor decreases social waste (defined as any expenditure in conspicuous consumption), if pre-taxes inequality is low enough. If, instead, status depends in a cardinal way on individual relative standing, then the relationship between pre-taxes inequality and change in social waste is non monotonic.

We will try to elaborate some general policy implications of our results in the conclusions.

3 The model

Our simple economy is populated by N agents. Each agent i has two features:

- $T_i \in [0, 1]$ is the type of agent i, where it's possible that two or more agents are of the same type. Conformism is represented by the following mechanism: the higher is the distance between the type of the agent i and the prevailing type among those agents that consume same good as i, the lower is the utility of i. We consider two decimals for T_i, so in our simulation there are 100 different types. Thus, if T is the vector containing the types of all agents, we have that $|T| = 100$.

- $D_i \in [0, 1]$ indicates the level of distinction of agent i. If $D_i > D_j$, then i is more attractive than j for every agent in the population N. The higher is the average distinction of a group, the higher is the utility of buying a good placing the consumer in that group. D is the vector containing the values of distinction for all agents.

Every agent is initially endowed with a randomly chosen good and at each period one agent is randomly drawn to receive the opportunity to buy a new good. There are G goods that are functionally equivalents. Q_g is the number if agents owning good g and the marginal cost of that good is $C(Q_g)$. For simplicity, the cost function is assumed to be the same for all goods. We suppose that the market is perfectly competitive, so that $P_g = C(Q_g)$. Price is determined simultaneously with the choice of agents. The price function in the simulations is $P_g = ln(1 + Q_g)$.
Each agent i receives a fixed amount of money m_i at each period. This amount is randomly drawn for each agent in a closed interval: $m_i \in [\underline{m}, \overline{m}]$. Once drawn at the beginning of the simulations, m_i remains the same in the following periods, so it can be considered as a kind of permanent income assigned to agents. In our simulations we set $\underline{m} = 6$ and $\overline{m} = 50$. This interval is chosen considering that the maximum price of a good is $\ln(1001) = 6.908$. So there are some agents who cannot buy a good bought by more than 403 agents (since $\ln(403) = 5.99$ and there is no negative utility). The upper bound of the interval instead is fixed at a level that allows the existence of very rich people. It is noteworthy that income does not affect the possibility of agents to buy one unit of given good at any price, as long as their income is above $\ln(1001) = 6,9087$.
Each agent buys at most one of the G goods in each period. The good bought by i is denoted as g_i. The group of agents owning g is denoted by N_g and the number of agents buying g is $|N_g|$. When one agent buys one good g, she enters in N_g, so groups are defined endogenously in the model and the number of groups can be strictly lower than G if nobody buys some good g.
The utility each agent maximizes is given by the following Cobb-Douglas preferences:

$$\begin{aligned} \max_{g \in G} U(g) = & \quad (m_i - P_g)^{\beta} V_{i,g}^{(1-\beta)} \\ \text{s.t.} & \quad m_i - P_g \geq 0 \end{aligned} \tag{1}$$

Where $V_{i,g}$ is the network or social value for agent i of owning good g and is given by

$$V_{i,g} = \frac{(1-\alpha_{i,t})\sum_{j\neq i\in N_g}(1-|T_i-T_j|)+\alpha_{i,d}(D_i+\sum_{j\neq i\in N_g}D_j)}{|N_g|} \quad (2)$$

$\beta \in [0,1]$ is a parameter weighting the two components of U. The first component is the monetary part of the utility $(m_i - P_g)$, which we can conceive as the utility related to standard microeconomic theory. The second one $(V_{i,g})$ expresses the importance of society for agents. In $V_{i,g}$, $(1-\alpha_{i,t})$ with $\alpha_{i,t} \in [0,1]$ measures the attitude of agent i for buying the same goods as her type (conformism), while $\alpha_{i,d} \in [0,1]$ measures the attitude for buying the same goods as agents with a high level of distinction. The reason why we chose $1-\alpha_{i,t}$ instead of $\alpha_{i,t}$ is mainly technical. The interpretation is straightforward: $(1-|T_i-T_j|)$ is a measure of similarity between i and j, $1-\alpha_{i,t}$ is the importance of similarity for agent i, whilst $\alpha_{i,t}$ is a measure of the aversion to conformism. The distinction of agent i enters her own utility. This is a way of formalizing the idea that agent i actually knows which is her own contribution in terms of distinction to the group she is going to join when she buys a specific good. It is also a way of allowing agents to buy goods not owned by anyone, otherwise there would be a problem in the determination of the utility when agents are alone, and *proposition 2* below would not hold anymore. In practice, this assumption avoids that the completely isolated agent earns a zero utility, allowing the model to capture the social dynamics of distinction.

4 Some analytical results

Under some restrictions over parameters, the model provides analytical results that may be useful to understand its basic properties. These results are valid both in the Tassier (2004) model and in the one we present here. It is important to introduce them because they give an idea of how the model works and what are the driving effects in agents' interaction.

When agents receive the same amount of money, the following propositions hold:

Proposition 1

When the N agents receive the same amount of money and do not care about distinction ($\alpha_{i,d} = 0\ \forall i \in N$) , there is at least one clustered equilibrium where agents sort themselves into G stable groups of equal size.

Proof. Suppose there are only two goods, a and b, with the same cost function. The utility of agent i from buying a (or b) decreases monotonically in the distance of her own type T_i from the average value of T among the agents buying a (or b), while the price of a (and b) increases in the number of agents buying a (or b). Then, there exist a value T^* such that every agent with $T_i \leq T^*$ chooses good a if every other agent with $T_j \leq T^*$ chooses good a and every agent with $T_i > T^*$ chooses good b if every other agent with $T_j > T^*$ chooses good b. In particular, $T^* = 0.50$ if the agents are uniformly distributed in term of types (T_i) between 0 and 1. Let's suppose that the agents are split in two equally sized groups. Then consider the agent k with $T_k = T^*$, supposedly belonging to the first group, who deviates and buys good b. If this agent is closer to members of group a, in doing so she increases her distance from the average value of T in her group (that now is the group of agents buying b), and increases the price of the good she buys, since she increases the number of agents buying that good. So the deviating agent k gets a strictly lower utility both in the network part (social value) and in the monetary part (exchange value). If instead the agent is equally close to the two groups, let's suppose without loss of generality that $N_a = N_b + 1$ (N is odd). The agent with $T_k = T^*$, which we suppose is among the buyers of a, is indifferent between the two groups. Since all other agents will obtain a strictly lower utility if they switch membership, then this is an equilibrium. This argument can be extended to the case with $G \geq 2$, showing that the situation in which each agent in every partition of types (where G is the number of partitions) buys the same good, and no agents in two different partitions buy the same good, is an equilibrium.

Proposition 2

If agents do not care about types ($\alpha_{i,t} = 1$ $\forall i \in N$) there may not exist an equilibrium.

Proof. Suppose there are two different goods and two agents receiving the same amount of money m. Agent 1 has $D_1 = 0.9$ and agent 2 has $D_2 = 0.1$. If the agents own the same good, agent 1 will deviate since the average distinction passes from 0.5 to 0.9; note that the average distinction is now given by her own level of D_1 alone. Furthermore, in doing so she gets also a lower price ($P(1) < P(2)$). Hence owning the same good as the other agent is not an equilibrium in this setting. Let's suppose now that the two agents buy different goods, for instance agent 1 buys good a and agent 2 buys good b. The utility of agent 2 is $(m-P(1))^\beta(0.1)^{(1-\beta)}$ if she keeps good b and $(m-P(2))^\beta(0.5)^{(1-\beta)}$if she switches to a. So, for any price function that increases sufficiently slowly, we have that

$$(m - P(1))^\beta(0.1)^{(1-\beta)} < (m - P(2))^\beta(0.5)^{(1-\beta)} \quad (3)$$

or more generally:

$$(m - P(1))^\beta(D_2)^{(1-\beta)} < (m - P(2))^\beta((D_1 + D_2)/2)^{(1-\beta)} \quad (4)$$

Then agent 2 is better off choosing the same good as agent 1, but this is not an equilibrium as we know from the first step. Basically, the two agents enter a cycle where the highly distinctive agent precedes the low one in choosing the good not bought by anyone and the low distinctive agent follows the former when called to choose. At this point, the high distinctive agent changes the good again since her own level of distinction is less diluted.

Finally, for $\beta = 1$, utility is decreasing in $P_g = 1 + Q_g$, so the higher is the consumption of good g, the lower is U. Since agents are in a finite number, let's suppose that they are sorted into G groups of equal size. In this situation, no agent has incentive to deviate because, if she switches to a different good, she will increase its demand and thereby decrease her own utility. This shows that a clustered equilibrium occurs for $\beta = 1$.

The main insight of this short analysis is that, for the system to exhibit cycles, it is necessary that $\alpha_{i,d} \neq 0$. Cycles happen because low distinctive agents want to buy goods held by highly distinctive agents, but when too many low distinctive agents buy a given good, highly distinctive agents move to a different good. In other words, there are three main effects in this model: the *distinction effect*, that induces agents with low distinction to buy the same good as agents with high distinction and agents with high distinction to buy different goods from low distinction agents; the *conformism effect* that induces stability of the system with agents clustered in groups based on types; the *price effect* that pushes agents to sort themselves into G groups of equal size. Clustered equilibria occur because the fraction of population buying a given good is limited by the price effect and because agents tend to conform to their own type.

5 Simulations

The reason why we rely on simulations is that the analytical results above apply to simplified setups. Moreover, the existence of equilibrium alone does not tell us whether the agents will actually converge to it and, if so, how long it takes for them to reach it. In this section we will proceed as follows. The first set of simulations with extreme parameter values provides a benchmark for understanding the model's behavior, while the second set of simulation explore the numerical solutions for internal parameter values. The vertical axis of graphs represents the number of agents buying good g, the horizontal axis represents time.

For extreme behavioral parameter values, the simulations confirm the analytical results. In the first set of simulations, we make the agents indifferent to distinction by setting $\alpha_{i,d} = 0$. From Fig. 1 we see that in this case we obtain a clustered equilibrium with no cycles. The different size of the groups reflects the distribution of the random values for the parameters $\alpha_{i,t}$ and T_i across the agents. For all simulations, we set $N = 1,000$, $G = 3$ and we assign a a value (a type) to each agent taken from the interval $T_i \in [0, 1]$. These values are randomly assigned, thus for each simulation there could be two different agents with the same type.

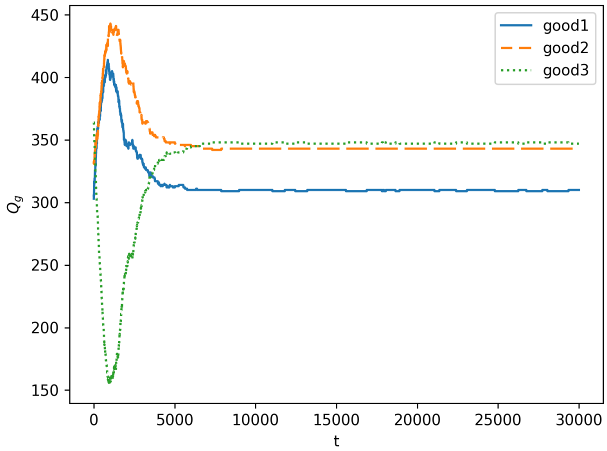


Figure 1: *With $\alpha_{i,d} = 0$, $\alpha_{i,t} \in [0, 1]$ and $\beta = 0.1$ agents are clustered.*

A question arising from the equilibrium represented in Fig. 1 is whether the group of consumers buying a given good overlap in terms of types. The computation of the average type of agents buying each good leads to the results depicted in Fig. 2. The small squares represent the average type buying each good, and the black error bar quantifies the standard deviation of the types that form each group. Agents sort themselves into 3 non-overlapping groups of similar size and similar standard deviations within them. In particular, the average type buying good $g = 1, 2, 3$ is respectively $\overline{T}_1 = 0.16$, $\overline{T}_2 = 0.83$ and $\overline{T}_3 = 0.49$, and their standard deviations are respectively 0.105, 0.096 and 0.093. Agents buying goods 1, 2 an 3 fall respectively in the following non overlapping ranges: $[0, 0.33]$, $[0.67, 1]$ and $[0.34, 0.66]$. Since the distinction effect does not matter here ($\alpha_{i,d} = 0$), the three non overlapping groups can be interpreted as three different consumer "styles" (or life-styles).

The higher value of the first group's standard deviation is due to the presence of one agent who do not care about types. In fact, since the type's weight $\alpha_{i,t}$ is randomly assigned to agents, this one happens to have a very low $\alpha_{i,t}$. Then, even if she has a type far away from those in her group, she does not care about that, and her choice is driven by the price effect. Indeed, from Fig. 3 we see that good 1 has the lowest price since it is bought by the lowest fraction of the population).

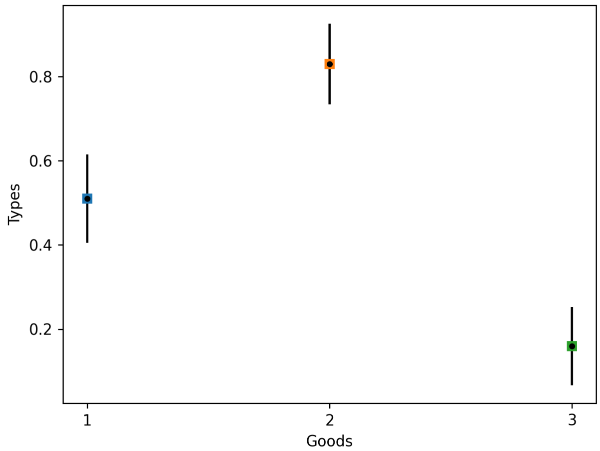
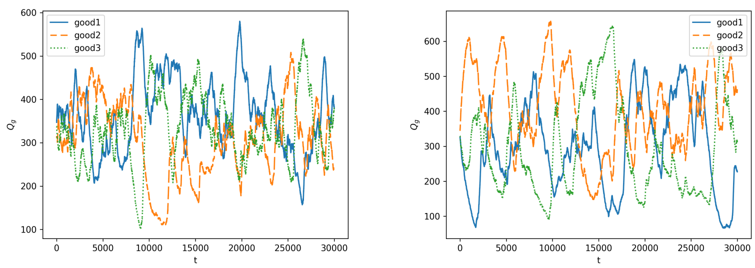


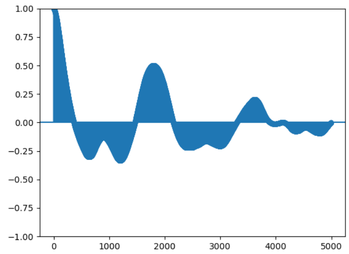
Figure 2: *Types' analysis in the clustered equilibrium case of Fig. 1*

If agents do not care about types but care about distinction, cycles arise, as represented in Fig. 3, panel (a). In even more extreme situation of panel (b), where all the agents maximally care about distinction and do not care about types, cycles become more frequent. The graph 3(b) may look like a white noise, but the autocorrelation function (ACF) of the time variations of the market shares shows that this is not the case (Fig . 4, panel (a)). Specifically, Fig. 4 refers to good 3, but the other market shares behave in the same way. The difference between the ACF in the cyclical and clustered equilibrium cases is apparent. In the latter, a small random noise is added to the market share in order to compute the ACF.

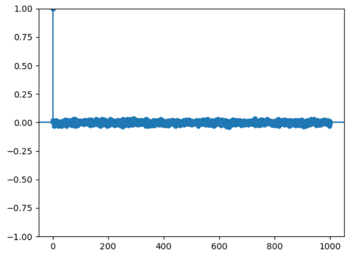


(a) **(b)**

Figure 3: *(a) When $\alpha_{i,t} = 1$, $\alpha_{i,d} \in [0, 1]$ and $\beta = 0.1$ cycles emerge (types and attraction level are randomly assigned to agents). (b) When $\alpha_{i,t} = 1$, $\alpha_{i,d} = 1$ and $\beta = 0.1$ cycles become more frequent.*



(a)



(b)

Figure 4: *Autocorrelation function of good 3 referred to the cyclical case (panel (a)) and to the equilibrium one (panel (b))*

The following table lists the parameter values of this first set of simulations. We recall that the values in D are not relevant for the results of Fig. 1, while the values in T are not relevant for the results of Figs. 2 and 3.

Table 1: *Parameter values for simulations in Figs. 1-3*

Parameter	**Figure 1** (Conformism effect)	**Figure 2** (Distinction effect 1)	**Figure 3** (Distinction effect 2)
N	1,000	1,000	1,000
G	3	3	3
β	0.1	0.1	0.1
$\alpha_{i,t}$	$\alpha_{i,t} \in [0,1]$	$\alpha_{i,t} = 1$	$\alpha_{i,t} = 1$
T	$T_i \in [0,1]$	$T_i \in [0,1]$	$T_i \in [0,1]$
$\alpha_{i,d}$	$\alpha_{i,d} = 0$	$\alpha_{i,d} \in [0,1]$	$\alpha_{i,d} = 1$
D	$D_i \in [0,1]$	$D_i \in [0,1]$	$D_i \in [0,1]$

In the next set of simulations we systematically explore the parameter space in order to quantify the effect of different combinations of parameter values on the standard deviations of the goods' market shares. In particular, the relationship we want to explore is the one between $\alpha_{i,d}$ and $\alpha_{i,t}$ on the one hand, and the volatility of market shares over time $\sigma_g \equiv \sigma(|N|_g(t)/N)$ on the other. This is a signal for the existence of cycles since, as we have seen above, if there are no cycles the market shares converge to a fixed value and then we expect σ_g to be zero. In Fig. 5 we plot, for a set of ordered pair of exogenous parameter values $(\alpha_{i,d}, \alpha_{i,t}) \in [0,1] \times [0,1]$, the average SD of market shares computed across 10 simulations, thereby yielding a matrix of standard deviations corresponding to the different combinations of $\alpha_{i,d}$ and $\alpha_{i,t}$. In this set of simulations we added some additional constraints in order to contain the stochasticity of simulations and obtain a neater relationship in the graph. Firstly, agents are equally distributed in terms of types (we stress that these restrictions hold only for this set of simulations). This means that with $|T| = 100$ and $N = 500$, the first 5 agents belong to T_1 (are of type 0.01) and so on, up to the last 5 agents belonging to T_{100}. Secondly, they have equally distributed attractions with $|D| = 10$: the first group of 50 agents has $D_1 = 0.1$, and so on, up to $D_{10} = 1$. Furthermore, $\alpha_{i,t}$ and $\alpha_{i,d}$ are equal across all the agents. In other words, in each point of the graph all the agents give the same weights to conformism and distinction . However, they are still heterogeneous with respect to money (m_i), types (T_i) and the level of distinction (D_i). These parameters all still assigned with a uniform probability as in the previous set of simulations.

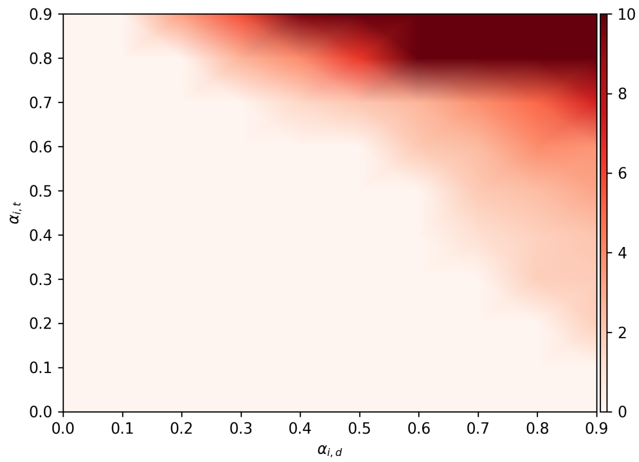


Figure 5: *The more $\alpha_{i,t}$ and $\alpha_{i,d}$ increase, the higher is the value of σ_g (the average standard deviations of the three goods), which corresponds to darker areas.*

The results show that σ_g is increasing in $\alpha_{i,t}$ and $\alpha_{i,d}$, which is consistent with our previous results. We need to remember that a value $\alpha_{i,t}$ closer to one means a lower weight to conformism. We can already observe cycles (i. e. a positive σ_g) when $\alpha_{i,d}$ is close to 0.3 and agents care very little about types ($\alpha_{i,t}$ close to $0.8 - 0.9$). The fact that the shaded area is negatively inclined is easily explained, since for a higher value of $\alpha_{i,d}$ there is less need for $\alpha_{i,t}$ to be high to observe cycles. Conversely, for a lower value of $\alpha_{i,d}$, $\alpha_{i,t}$ must exceed a certain threshold for cycles to arise.

From the point of view of conformism instead, it can be said that, for the agents to be clustered, it is sufficient either that they give a high value to conformism and a low value to distinction (bottom left corner of the graph), or also that they give low value to both (top left corner of the graph) or high to both (bottom right corner of the graph). One might therefore conclude that the conformism effect prevails over distinction one as the size of the lighter area of the graph suggests. In other words 5 tells that the clustered equilibrium

is more likely to happen than cycles when considering the entire parameter space. This could be also due to the price effect. For instance, in the top left corner, where both the behavioral weights are very small (agents do not care about the network component of their utility), it is likely that price matters even when $\beta = 0.1$. Therefore, the fact that the conformism effect prevails over the distinction effect is not the only explanation of the dynamics in Fig 5. This leads us to wonder whether it is the price effect that pushes the system towards clustered equilibria more than the conformist attitude. Another reason why the price effect would matter is that, even in cases where all the agents have enough money to buy every good (with $N = 1000$, there is no rationing when the number of agents buying a given good is below 403), the money spent enters directly the utility, thus agents prefer to spend less.
In order to clarify this question, we now explore the case $\beta = 0$, with all the other parameters exactly equal to the case in Fig. 5. We do not replicate the figure of this set of simulations, since the results are indistinguishable from those of Fig. 5. An higher β reduces the absolute magnitude of cycles but the relative differences are preserved. So the price effect is not the reason why the white area in Fig. 5 is wider than the red one. The conclusion we can draw is that in this model there is an higher probability of observing a clustered equilibrium than cyclical dynamic, independently of the price effect. This is true up to a certain threshold value of β, above which the price effect starts to prevail over the other effects and we converge again to a clustered equilibrium.
To complete this analysis, we finally consider the role of each parameter in a multivariate context. In order to do so, we perform a set of 20 simulations for each item from a sample of 17 combinations of parameter values. The latter are obtained by an optimal sampling scheme (Sanchez, 2005). The dependent variables in Tab. 4 are again the standard deviations of the market shares of goods 1, 2 and 3 respectively. These regressions show that the values of the two parameters $\alpha_{i,t}$ and $\alpha_{i,d}$ contribute positively to the volatility of the product shares (remind that the higher is $\alpha_{i,t}$, the lower is the importance of conformism for agent i). On the other hand, the higher is β the lower is volatility, as anticipated in the analytical results, although the effect of this parameter is not significant, which is consistent with the arguments above.
Finally, in order to gauge in a more precise way the intensity of the cyclic behavior in the data, we also employ as dependent variables the log of the sums of the values in the periodogram of the market shares, i.e. $\log \sum_f P_g(f)$. The periodogram provides an estimate of spectral density of the market share, i. e. of the Fourier transform of its ACF . In practice, the higher $P_g(f)$ for each frequency f, the stronger the cyclic behavior of the data at that frequency. The results of Tab. 5 show that cycles in the market shares occur when $\alpha_{i,t}$ and $\alpha_{i,d}$ are higher, i.e. when agents are less conformists but instead care more for the distinction of buyers of their own good (including their own). Again, the impact of β is non significant.

Table 2: *The contribution of parameters to the model output*

	Dependent variable:		
	σ_1	σ_2	σ_3
$\alpha_{i,t}$	2.148***	1.831***	2.184***
	(0.170)	(0.170)	(0.180)
$\alpha_{i,d}$	0.890***	0.910***	1.085***
	(0.164)	(0.161)	(0.177)
β	−0.195	−0.264	−0.705
	(0.772)	(0.746)	(0.841)
Observations	340	340	340
R^2	0.368	0.319	0.366
Adjusted R^2	0.363	0.313	0.360
Residual Std. Error (df = 336)	1.168	1.191	1.167
F Statistic (df = 3; 336)	65.304***	52.460***	64.689***
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 3: *The relation between the cyclic behavior of the data and the parameter values*

	Dependent variable:		
	$\log \sum_f P_1(f)$	$\log \sum_f P_2(f)$	$\log \sum_f P_3(f)$
	(1)	(2)	(3)
$\alpha_{i,t}$	14.503***	14.915***	15.151***
	(0.862)	(0.833)	(0.835)
$\alpha_{i,d}$	5.953***	5.885***	4.806***
	(0.862)	(0.833)	(0.834)
β	−1.337	−3.742	−1.248
	(4.291)	(4.146)	(4.156)
Observations	340	340	340
R^2	0.496	0.524	0.519
Adjusted R^2	0.491	0.520	0.514
Residual Std. Error (df = 336)	4.869	4.704	4.715
F Statistic (df = 3; 336)	110.080***	123.506***	120.724***
Note:			*p<0.1; **p<0.05; ***p<0.01

6 The impact of an influencer

In this section we describe a situation where a single agent has a higher distinction than the others, who have the same, lower, value of distinction. This setting is conceived to reflect the dynamics of a single influencer and her followers. The population size is fixed at $N = 1000$. From Fig. 6 we see that, in the case of a stark asymmetry between the influencer and the other agents, long lasting cycles emerge. The duration of cycles depends crucially on whether the influencer is selected to choose a good or not (the selection mechanism is random as in previous section). The black dashed vertical lines signal the moment in time when the influencer receives the opportunity to buy a good. The lines represent the fractions of the population owning a given good. The transition of the influencer from, say, good a to good b, when it occurs, triggers a swap in popularity from a to b.

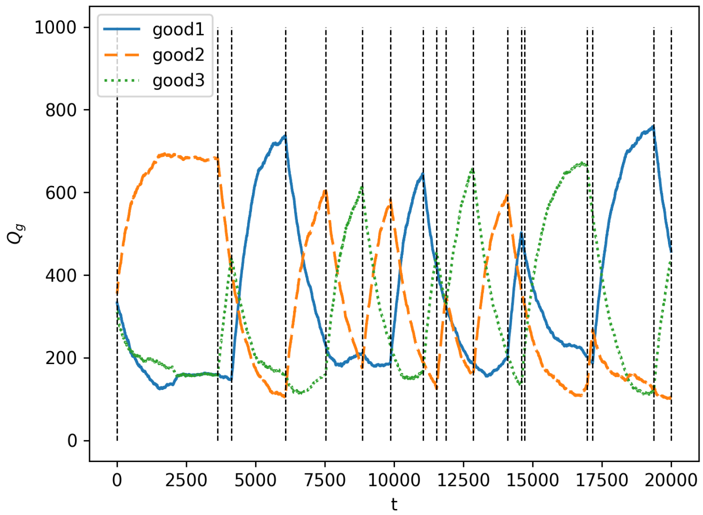


Figure 6: *$\beta = 0.1$, influencer-followers case, the influencer has $D_i = 0.99$ and the followers $D_j = 0.01$, $\alpha_{i,t} = 0.99$, $\alpha_{i,d} \in [0, 1]$. The influencer also gives minimal attention to the type and distinction of other agents ($\alpha_{influencer,t} = 0.99$ $\alpha_{influencer,d} = 0.01$). The vertical lines denote the times when the influencer gets the opportunity to switch between goods.*

The good selected by the influencer each time she is called to choose is the one prevailing in the population in a given time spam (between two successive choices of the influencer). For instance when the influencer is choosing good 2, good 2 start to be owned by an increasing number of consumers. The influencer is basically acting as a trendsetter.
The reasons why the influencer is leaving a group are twofold: firstly, when too many agents with low distinction enter her group, the utility coming from

her own distinction is more "diluted" by the presence of many agents with low distinction, so that the influencer may find convenient to change good in order to better exploit her own distinction and obtain an higher utility. The second reason is that, when many agents enter the influencer's group (and when she is called to choose again), she might be willing to choose a cheaper good.
It should also be added that the rise of the fraction of the population buying a given good tends to stabilize (after a certain threshold) if the influencer is not selected for the choice, as in the first 3500 periods in Fig. 6. The reason is that, from a certain threshold onward (with $N = 1000$, about 700 agents), the price of the good becomes too high and some agent cannot buy the good owned by the majority. Another reason, linked to the first one, is that the marginal utility from buying the same good as the influencer (in terms of additional distinction) decreases with the number of agents owning it.
Now we wish to measure how the magnitude of cycles changes for different values of the difference in distinction among agents, up to the point where agents are all equal in this respect. As in the previous section, we take the standard deviation of market shares as a measure of the magnitude of cycles. Firstly, we observe model's behavior for different distinction gaps between the influencer and her followers. After that, we check whether these results survive when prices are fixed at the level where each good is owned by one-third of the population. Simulations have been repeated 10 times for each parameter setting as in the previous cases. All the results of in this section are obtained by cutting the first 5000 periods, in order to allow the system to reach an eventual equilibrium condition. The standard deviations of each good are averages over 10 simulations for each combination of parameter values.

From Tab. 4, we see that cycles disappear as soon as the difference in distinction disappears. Therefore, we might suspect that the price component only contributes to the stabilization of the market share, at least for the value of $\beta = 0.1$.

Table 4: *The standard deviation of market shares declines as the asymmetry in distinction declines*

$\lvert D_{influencer} - D_{followers}\rvert$	0.98	0.6	0.4	0.2	0.02	0
$averageSD$	115.632	91.306	61.753	48.753	3.388	0.716

We already checked in the previous section the effect of $\beta = 1$, so there is no need to include this parameter value in the simulations. We now set the other parameters in the same way as in 1, third column, but with D_i being the same for all the agents other than the influencer. From Tab. 5, we see that cycles decrease in magnitude, without disappearing, when β increases. Since agents are more price sensitive, they abandon the "cool" good earlier and its market share stabilizes on a lower level, which reduces the magnitude of cycles.

Table 5: *The standard deviation of market shares declines as the value of* β *increases*

β	0.1	0.4	0.6	0.8
$averageSD$	115.632	91.306	61.753	48.753

7 Conclusions

The model presented in this paper aims at providing a partial explanation to some empirical observations about consumption. In the model, the absence of assumptions about secondary needs/goods, wealth distribution, or a leisure class, undermines the hypothesis that fashion is only typical of a wealthy class and of luxury goods. The consumption level can fall quite below the minimum vital if this is required for profit creation (just see the low income countries). At the same time, it can be settle well beyond the minimum vital, still as a function of the creation of profit (our consumerist society). In this sense, "necessary" are not only the basic needs, but also the self-reproduction and survival of a social order, which, in the acceptation of structuralism and post-structuralism, "surpasses" the agents' choices. And this "necessary" can both deny the basic subsistence goods for somebody and push somebody else to sacrifice money in the spiral of consumerism.

A concrete situation that the model could explain is, for instance, the fact that Gucci's "gg" hat is the best-selling product of that brand in France, and people people with a low education and income buy/desire it. With this model we want to show that, even among the poor, a mechanisms of consumerism can ensue, and it relies on a logic closer to that one of the *Potlach*[1] than to a rational use of the object.

Our results show that fashion cycles can potentially concern many more goods or services and social strata than those to which they are usually attributed. The idea is that people use goods as elements of a communication system, that is, that they give them a connotation (that in our model is just affiliation or detachment from a group) in addition to their denotation (their objective function). Our theoretical underpinning can be useful for exploring consumption patterns once we eliminate the prejudice that the connotation of goods is a practice only proper of rich people.

The model can be extended in many directions, such as introducing different cost functions for each good, introducing new goods in the market or allowing agents to buy more than one good. Furthermore, we might endogenize money, especially in the influencer case. The influencer might receive an amount of

[1]The *Potlach* has been analyzed by many scholars. For more details see Malinowski (1921) and Mauss (2002). Here we use this word as synonymous to conversion of goods in social values, as Native Americans do with their "prestige" goods. Another example of symbolic exchange is the *kula* analyzed by Malinowski.

money every time a new agent enter her group. In that case, the influencer should be able to change good whenever she wants (and not when she is randomly drawn), in order to maximize profits. Therefore, we expect the influencer to switch more frequently to a different good than in the simulations settings we examined above.

A possible policy implication is related to the wide issue of preferences' interdependence, of which this model is a particular case. Duesenberry et al. (1949) theorized the consumption behavior of an household according not only to the absolute level of its current income, but also to its relative income with respect to that part of the population it identifies with (*demonstration effect*). The other effect that together with the previous one forms the *relative income hypothesis* is the *ratchet effect*: if the household's income is reduced, the level of consumption already achieved will be possibly maintained, even if income decreases permanently. The fiscal implications are relevant because under the relative income hypothesis a progressive redistributive taxation is fully consistent with Pareto optimality criteria (Kapteyn and Van Herwaarden, 1980; Postlewaite, 1998; Corneo and Grüner, 2002; Truyts, 2010).

Lastly, a peculiarity of fashion models is often that fads arise when there is a balancing between conformist and non-conformist agents. Here instead we have the greater magnitude of cycles when agents do not care about types. However, even in this model we may find, inside the definition of distinction, the idea of balancing. The larger magnitude of cycles is observed when agents maximally care about distinction ($\alpha_{i,d}$), but they are still heterogeneous with respect to the absolute level of distinction (D_i), which is randomly assigned. Agents with a below-average absolute distinction actually act as conformists, since they are buying the same good as highly distinctive agents, while those with high distinction are instead acting as trendsetters. Basically, the cycles arise from a balancing between the two groups in this model too. In other words, it is possible to interpret the model in a way that is coherent with the idea of cycles arising from a balancing between conformists and non-conformists.

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