




Conformism, distinction and heterogeneity in an agent-based model of fads

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Received: 30 December 2022 / Accepted: 15 June 2024 / Published online: 29 June 2024
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Abstract

We examine the dependence of the cyclical fluctuations of demand on specific behavioral attitudes of heterogeneous agents. Starting from a modified version of the model of Tassier (Complexity 9(5):51-61, 2004), we use simulations to explore consumption dynamics and market shares when agents are inclined both to conformism and distinction, two necessary conditions for fashion in Simmel (Am j Sociol 62(6): 541–558, 1957). Our results challenge the view stating that conspicuous consumption is typical only of a wealthy class and of some positional goods, since we make no assumptions about features of the goods or income distribution.

Keywords Goods cycles · Agent-based model · Sociology of consumption

JEL Classification D91

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 a wealthy class or an affluent minority. These theories start from the intrinsic and objective characteristics of the goods while, as a matter of fact, the same good can be used as an element of personal identity by one subject and for its use value by another one.

Even economic theory tends to consider fashion (and more generally the link between consumption and identity), as a phenomenon concerning only a minority,

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thus having a negligible impact on the economy as a whole. Modifying the model of Tassier (2004), we believe it is possible to bring economic theory more in line with the empirical evidence that a cyclical dynamic of consumption may emerge even among poor and middle social strata. In the interpretation of our results, we rely on the ideas of Simmel (1957) about conformism and distinction as necessary conditions for fashion. In particular, these behavioral elements are embedded 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 remind for those readers not familiar with the sociology of consumption that the logic of social differentiation is what gives distinction to agents. They have tendency to distinguish themselves or their group from the other agents or group due to the logic of social differentiation, a topic discussed for more than a century in sociology. We will deepen this aspect of the model in the conclusions.

The issues of conspicuous consumption,¹ 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 Neeman 2012, 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 a social logic of wealth's sacrifice than to the economic logic of prices. 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 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. In this perspective, conspicuous consumption is widespread in society as a form of individual expression (Fremling and Posner 1999; Stewart and Hoell 2016). According to these theories, not only luxury goods, but

¹ According to the *Longman American Dictionary* conspicuous consumption denotes the act of owning something, especially something expensive, that is not necessary to one's life, in a noticeable way.

many other more accessible categories of goods convey the most disparate social meanings, and not just prestige or status. Recently, Tassier (2004) proved that introducing attraction in the utility function of consumers is decisive for observing cyclical fluctuations similar to fashion cycles.

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 dynamics, we cast the model of Tassier (2004) in a heterogeneous agent framework (Caiani et al. 2016). Our behavioral parameters have different sociological meanings and are specified so as to leave much more heterogeneity between agents as well as more room for simulations. 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.

More in detail, we modify the mathematical structure of Tassier (2004) in the following way. 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. This modification is essential to incorporate the assumption that goods represent themselves communication devices in the model. The difference between the two models is made particularly clear by Sect. 6, where we consider the case of one influencer, which can only materialize in our setting and not in the one of Tassier. Indeed, we assume that heterogeneous agents have a tendency to conform and to distinguish themselves 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). We think that our setting better reflects consumption phenomena on a large scale, where fashion properly develops and the phenomenon of conspicuous consumption naturally arises, than the one of Tassier, which is more suited for the study of peer effects on a small scale, where conspicuous consumption is less likely to be relevant. Moreover, while Tassier assumes that all the agents give the same weight to distinction and to conformism, we maintain these weights heterogeneous across agents in most of our numerical simulations (as illustrated in Table 2), thus exploring a more general framework. His work also lacks proper measures of cyclicity in the data, which we introduce by looking at the ACF and the periodogram of the product market shares, and a consistent approach to model sensitivity analysis, which we perform by means of multivariate metamodeling. We also perform some robustness checks, which show that the main results of the model are robust to some changes in the price/cost function.

The paper is organized as follows: The next section presents a brief literature review about fashion cycles. Section 3 explains the theoretical model and Sect. 4 presents some analytical results which hold for its simplified setup. Section 5 presents the results obtained from simulations on the full model, while Sect. 6 focuses

on the particular case with one influencer and her followers. Finally, Sect. 7 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. Today it refers to all those practices linking consumption and identity, or any connotation of the good/service related to the *self-design*, beyond the functionality of the object.

The same good can be a luxury good for one agent and a standard good for another one. Indeed, some goods are distinctive for those at the bottom of wealth (or cultural/social capital) distribution, but they are not so distinctive for those at the top of that distribution.

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 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.

An example of positive sloped demand curve unrelated to conspicuous consumption are the Giffen goods, whose demand has a positive sloped due to the prevalence of the income effect over the substitution one. 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 popularity 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 owning a specific 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 is 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, thereby delivering a similar result to Tassier (2004) in implicitly rejecting the idea that fashion is only linked to luxuries. 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. Agent-based methods are widely used to model financial markets dynamics [see for instance Shibano and Mogi (2022), Fratrič et al. (2022) and Son et al. (2022)]. Our work relates to them because it shows how adding behavioral components to the utility function changes the output of the model, being it the price of some financial asset or the risk attached to certain portfolios or the market shares of a certain good or service as in our case.

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 and pre-taxes inequality is low enough, then redistributing resources from the rich to the poor decreases social waste (defined as any expenditure in conspicuous consumption). 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 Q agents. Each agent i has two behavioral features. $T_i \in [0, 1]$ is the type of agent i , where it is possible that two or more agents are of the same type. Conformism is represented by the following mechanism: the higher is

the distance of i from those types consuming the same good as i , the lower is the utility of i . We consider two decimals for T_i and for all the other parameters involved in the model. T is the vector containing the values of distinction for all agents. The second feature is $D_i \in [0, 1]$ and it 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 Q . The higher is the average distinction of a group, the higher is the utility of owning a good placing the consumer in that group. D is the vector containing the values of distinction for all agents. There are G goods that are functionally equivalents and each agent $i \in Q$ owns one and only one good (g_i is the good owned by agent i). N_g denotes the group of agent owning g , while Q_g is the number of agents owning good g (i.e., $Q_g = |N_g|$). The marginal cost of goods, assumed to be the same for all, is $C(Q_g) = \log(1 + Q_g)$. We suppose that the supply is perfectly competitive, so that the price of the good $P_g = \log(1 + Q_g)$.

Each agent i receives a fixed amount of money m_i at the beginning of each simulation (together with her own type T_i and her own level of distinction D_i). These amounts remain the same for all the subsequent time periods (even if an agent spends her money in a given period, and then is randomly selected to choose again in a successive period, she has the same amount of money m_i restored). This mass of money is randomly drawn for each agent in a closed interval: $m_i \in [\underline{m}, \bar{m}]$. Once drawn at the beginning of each simulation, m_i remains the same in the following periods, but without saving. So it can be considered as a kind of permanent income assigned to agents. m_i can be interpreted as one of the characteristics of the agent, in the same way as T_i, D_i and $\alpha_{i,d}, \alpha_{i,t}$ defined below.

Every agent is initially endowed with a randomly chosen good and at each period a single agent (one and only one) is randomly drawn to receive the opportunity to buy a new good. If she buys a different good from the old one, the latter is discarded and the individual switches from one group of owners to another.

The time subscript we introduce below will only be used to clearly explain the sequence of events in the model. Since each agent owns at most one of the G goods in each period, the good owned by i at time s is $g_{i,s}$. At period s one agent is selected to choose one, and only one, good. If she buys a new good, she drops the old one, leaving the group associated with that good and entering a new group. The agent's incentive not to spend all the money, which would be optimal since there is no saving in this model, comes from the fact that the money mass enters her utility, and the more she spends, the less utility she gets. Moreover her choice is driven also from the behavioral part of the utility. The number of agents owning g at s is $Q_{g,s}$. When one agent buys one good $g_{i,s}$ (at time s) she enters in the group of those owning g , so groups are endogenously defined in the model and the number of groups can be strictly lower than G if nobody owns some good g . In dynamic terms the price is $P_{g,s} = \log(1 + Q_{g,s})$. We suppress this time or period subscripts for the remainder of the paper unless needed.

The average similarity of an agent i to a group owning g can be defined as

$$C_{i,g} = \frac{\sum_{j \neq i \in N_g} (1 - |T_i - T_j|)}{Q_g} \tag{1}$$

The average distinction instead is defined as follows:

$$D_{i,g} \equiv \frac{D_i + \sum_{j \neq i \in N_g} D_j}{Q_g}. \tag{2}$$

The consumption rule for agent i is $g_i = \arg \max_{g \in G} U(g)$, where $U(g)$ is a utility function defined as follows:

$$U(g) = \begin{cases} (m_i - P_g)^\beta V_{i,g}^{(1-\beta)} & \text{if } m_i - P_g > 0 \\ 0 & \text{otherwise} \end{cases} \tag{3}$$

where $\beta \in [0, 1]$ is a parameter weighting the two components of U and $V_{i,g}$ is the network or social value for agent i of owning good g and is given by

$$V_{i,g} = (1 - \alpha_{i,t})C_{i,g} + \alpha_{i,d}D_{i,g}. \tag{4}$$

The first component of (3, first case) 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 owning the same goods as her type (conformism), while $\alpha_{i,d} \in [0, 1]$ measures the attitude for owning 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 , while $\alpha_{i,t}$ is a measure of her aversion to conformism. Q_g is the quantity of agents owning good g . 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. When agents receive the same amount of money, the following propositions hold:

Proposition 1 *When the Q agents receive the same amount of money and do not care about distinction ($\alpha_{i,d} = 0 \forall i \in \{1, \dots, Q\}$), 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 owning a (or b) decreases monotonically in the distance of her

own type T_i from the average value of T among the agents owning a (or b), while the price of a (and b) increases in the number of agents owning 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 evenly 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 owning b), and increases the price of the good she buys (price is instantly updated as demand rises), since she increases the number of agents owning 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 $Q_a = Q_b + 1$ (Q is odd). The agent with $T_k = T^*$, which we suppose is among the owners 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. \square

This argument can be extended to the case with $G \geq 2$ by showing that the situation where each agent within each partition of types (where G is the number of partitions) owns the same good and no agents in two different partitions own the same good is an equilibrium.

Proposition 2 *If agents do not care about types ($\alpha_{i,t} = 1 \forall i \in \{1, \dots, Q\}$) 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 own different goods, for instance agent 1 owns good a and agent 2 owns 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

$$(m - P(1))^\beta (0.1)^{(1-\beta)} < (m - P(2))^\beta (0.5)^{(1-\beta)}, \tag{5}$$

or more generally:

$$(m - P(1))^\beta (D_2)^{(1-\beta)} < (m - P(2))^\beta ((D_1 + D_2)/2)^{(1-\beta)}. \tag{6}$$

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. \square

Finally observe that for $\beta = 1$ utility is decreasing in P_g . 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 with equal sized groups 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 own goods held by highly distinctive agents, but when too many low distinctive agents own a given good, highly distinctive agents move to a different good. In other words, there are three main effects in this model. The first one is the *distinction effect* that induces agents with low distinction to own the same good as agents with high distinction and agents with high distinction to switch to different goods when too many low distinctive agents entered their group. The second one is the *conformism effect* that pushes agents to own the same good owned by similar (close) types. The third one is the *price effect* that pushes agents to sort themselves into G groups of equal size among them. Clustered equilibria arise because the fraction of population owning a given good is limited by the price effect and because agents tend to conform to their own type.

5 Simulations

We now turn to simulations since the analytical results above only apply to a simplified setup. 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. 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.

Table 1 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.

The vertical axis of graphs represents the number of agents owning 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 $Q = 1,000$, $G = 3$ and we assign a value (a type) to each agent taken from the interval $T_i \in [0, 1]$. These values are randomly assigned, thus there could be two or more agents with the same type in the same simulation. We set $\underline{m} = 6$ and $\overline{m} = 50$. The lower bound of the interval is chosen considering that the maximum price of a good is $\ln(1001) \approx 6.9$. So by choosing

Table 1 Parameter values for simulations in Figs. 1, 2 and 3

Parameter	Figures 1 and 2 (Conformism effect)	Figure 3, panel (a) (Distinction effect 1)	Figure 3, panel (b) (Distinction effect 2)
Q	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	$D_i \in [0, 1]$	$D_i \in [0, 1]$	$D_i \in [0, 1]$
m_i	$m_i \in [6, 50]$	$m_i \in [6, 50]$	$m_i \in [6, 50]$

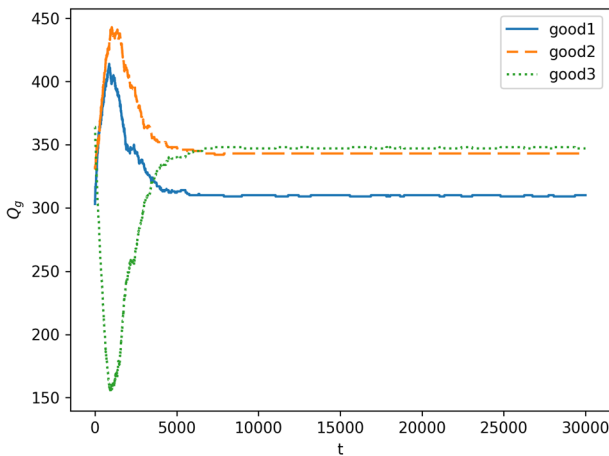


Fig. 1 With $\alpha_{i,d} = 0$, $\alpha_{i,t} \in [0, 1]$ and $\beta = 0.1$ agents are clustered

$\bar{m} = 6$ we allow for the possibility that there is a fraction of agents endowed with $m_i \in [6, 6.9]$, who cannot buy a good if it is owned by an agent specific threshold which exceeds the minimal threshold of $\exp(6) - 1 \approx 402$ other consumers. The upper bound of the interval instead is fixed at a level that allows the existence of very rich people. Indeed, as long as income is greater or equal to 6.9, the level of \bar{m} does not affect the possibility of agents to buy one unit of a given good at any price. But it still affects the level their utility starts from, so it is a way of representing the inequality of agents in terms of initial endowments.

Proposition 1 states that, for any value of $0 \leq \beta \leq 1$, if agents are evenly distributed in term of types and they hold the same amount of money, there exists an equilibrium where they cluster into as many groups of equal size as the number of goods. The results displayed in Fig. 1 are different from this prediction because of the random assignment of money and types to agents. Figure 1 represents a stable groups equilibrium but with different sized groups. Equally sized groups equilibria

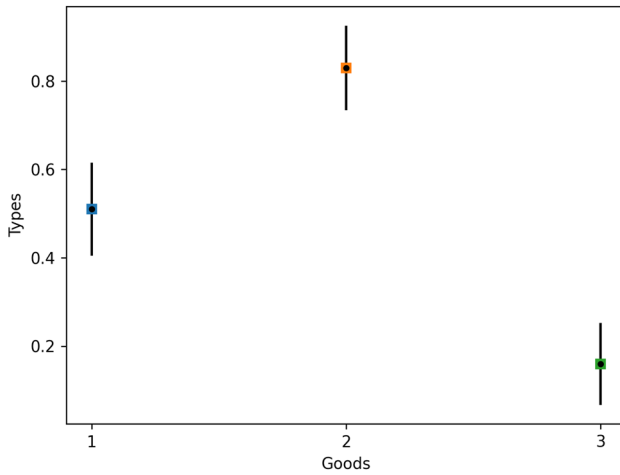


Fig. 2 Types' analysis in the clustered equilibrium case of Fig. 1

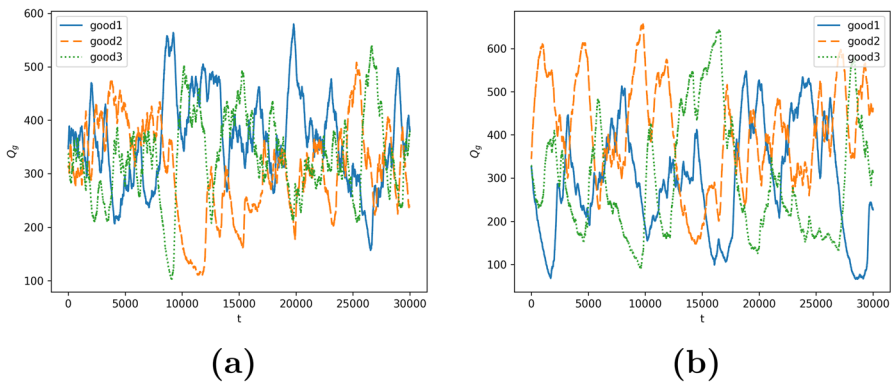


Fig. 3 **a** When $\alpha_{i,t} = 1$, $\alpha_{i,d} \in [0, 1]$ and $\beta = 0.1$ cycles emerge (types and attraction level are randomly assigned to agents). **b** When $\alpha_{i,t} = 1$, $\alpha_{i,d} = 1$ and $\beta = 0.1$ cycles become more frequent

are a subset of stable groups equilibria in this model. In fact, there are two ways to achieve equilibria with stable groups of equal size: when the monetary part of utility prevails over the social one (when $\beta = 1$ this equilibrium is reached for sure) or when the types of agents (T_i) are evenly distributed (this is not the case in Fig. 1) and agents coordinate well with each other. One question arising from the equilibrium represented in Fig. 1 is whether the group of consumers owning a given good overlap in terms of types. The computation of the average type of agents owning each good leads to the results depicted in Fig. 2. The small squares represent the average type owning 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 between them. In particular, the average type owning good $g = 1, 2, 3$ is, respectively, $\bar{T}_1 = 0.16$, $\bar{T}_2 = 0.83$ and

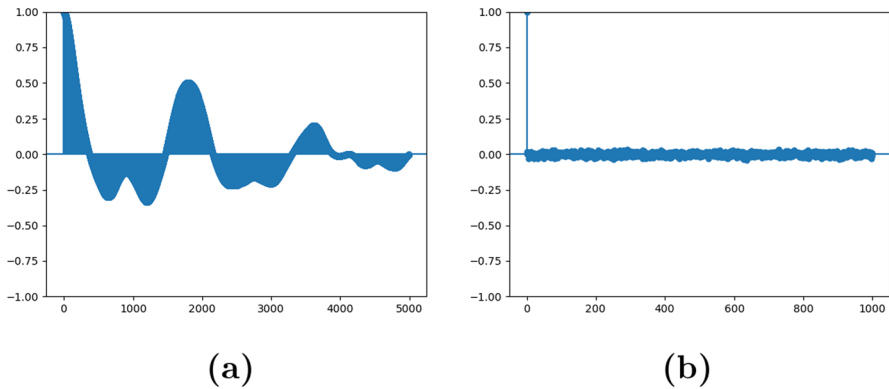


Fig. 4 **a** Autocorrelation function (ACF) of good 3 in the cyclical case of Fig. 3; **b** ACF of good 3 in the clustered equilibrium case of Fig. 1. On the horizontal axis there the lag (k) of the autocorrelation function and on the vertical its value

$\bar{T}_3 = 0.49$, and their standard deviations are, respectively, 0.105, 0.096 and 0.093. Agents owning goods 1, 2 and 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 does 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. 1 we see that good 1 has the lowest price since it is bought by the lowest fraction of the population.

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.

The autocorrelation of the market share of good 3 [Fig. 4, panel (a)] tends to zero when the lag (k , the horizontal axis of the graph) becomes large, which was what we expected because the shares in the long run can only be stationary.

In the next set of simulations, we set the behavioral parameters $\alpha_{i,d}$ and $\alpha_{i,t}$ to be equal across agents and 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 $\sigma_g \equiv \sigma(Q_{g,s}/Q)$ on the other. This is a necessary condition for the

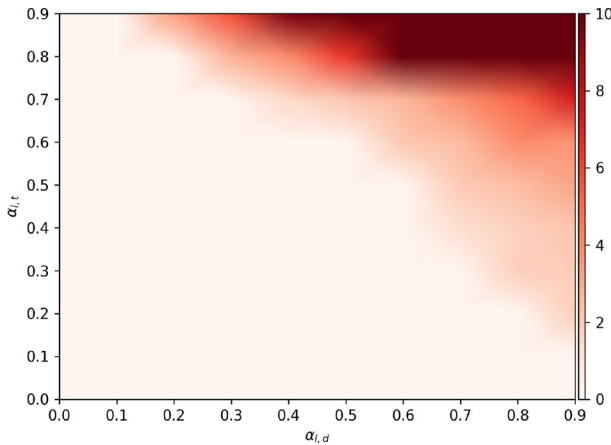


Fig. 5 The more $\alpha_{i,t}$ and $\alpha_{i,d}$ increase, the higher is the value of the average standard deviations σ_g of the three goods, which corresponds to darker areas

existence of cycles since, as we have seen in Fig. 1, if there are no cycles the market shares converge to a fixed value and 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 evenly distributed in terms of types (we stress that these restrictions hold only for this set of simulations presented in Fig. 5). This means that with $|T| = 100$ and $Q = 500$, 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} with $T_i = 1$. Secondly, they have evenly 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, as explained above, $\alpha_{i,t}$ 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 are still drawn from an uniform probability distribution as in the previous set of simulations.

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, 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, Fig. 5 tells us 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 toward 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 $Q = 1000$, there is no rationing when the number of agents owning 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 reproduce the results for this set of simulations, since they are indistinguishable from those of Fig. 5. In particular, a higher β only reduces the absolute magnitude of cycles, but the relative differences are preserved. This shows that 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 dynamics, 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.

Let us now briefly discuss the assumptions on the marginal cost/price function, to show that the results of our model do not depend strictly on the fact that this function is concave, but more generally on the influence that the first part of the utility (the monetary part) has in the final choice. For this purpose, we test different cost/price functions. In the baseline specification of the model, there is a slope threshold for the marginal cost function beyond which agents with low average distinction cannot improve their utility by joining groups with high average distinction, because the price increases too much when they join large groups of consumers (indeed, with a price function that grows too fast, Proposition 2 does not hold anymore). We checked through simulations a number of alternatives to the logarithm function, while keeping $\beta = 0.1$ fixed. For instance, the arc-tangent function provides very similar results to the original model. The same holds for a power function with exponent ranging from 0.1 to 0.4. But, when the exponent becomes 0.5, cycles disappear, because we hit the boundary mentioned above.

In order to resume cycles, we can compensate a higher price effect by means of a lower β . For instance, when the cost function is quadratic, we may allow β to vary between 0 and 0.1. For the lower values in this interval (e.g., $\beta = 0.05$), we can observe again cycles (see Fig. 6). Recall that, for increasing values of β , the price effect becomes prevailing, gradually reducing the magnitude of cycles, up to the point ($\beta = 1$) where agents only care about price and form three groups of equal size. So, if for a given β the cost function must increase sufficiently slow to

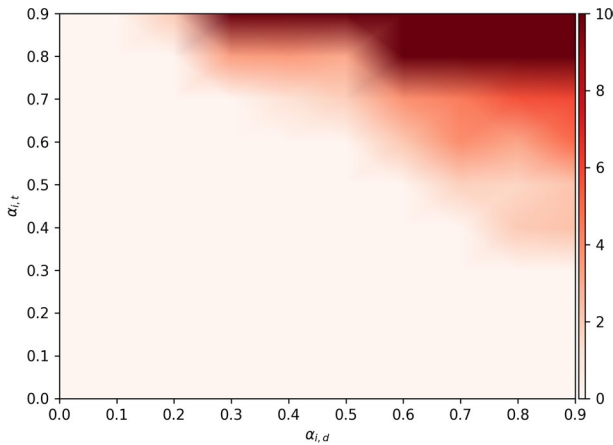


Fig. 6 The matrix of standard deviations with a quadratic cost/price function and $\beta = 0.05$

observe cycles, conversely, for a given cost function, there exist an upper threshold for β below which the monetary component of utility is unimportant enough to make cycles emerge.

As last step of the analysis, we consider the role of each parameter in a multivariate context. In doing so, we build a so-called "metamodel" of our ABM, which is nothing else but a mathematical relationship between the outputs and the parameters of the ABM itself. Metamodels have become popular tools to analyze simulation models in the last years (Salle and Yildizoglu 2014; Lamperti et al. 2018; Bargigli et al. 2020). They necessarily rely on statistical tools whenever the ABM (like in our case) involves a stochastic component (Chen and Desiderio 2022), and they can be used for a variety of purposes, like sensitivity analysis or estimation. In our case, the focus is on sensitivity, since we want to assess which parameters of the model matter most for the cyclical behavior of its simulated market.

In order to obtain the metamodel, we perform a set of 20 simulations for each of a sample of 17 combinations of parameter values. The latter are obtained from an optimal sampling scheme (Sanchez 2005). The dependent variables in Table 2 are the log standard deviations of the market shares of goods 1, 2 and 3, respectively, since we obtain the best fitness with a log-linear specification. By regressing the dependent variables on the values of the two parameters, we see that $\alpha_{i,t}$ 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. We also find a significant interaction effect between $\alpha_{i,d}$ and $\alpha_{i,t}$, which suggests that nonlinear effects are relevant in the model.

In order to gauge in a more precise way the intensity of the cyclic behavior in the data, we also employ, as dependent variables of the metamodel regressions, the log of the sums of the values in the periodogram of the market shares, denoted as $\log \sum_f P_g(f)$ for each product $g = 1, 2, 3$. The periodogram is a vector that provides

Table 2 Metamodel regression for the relationship between the volatility of market shares and the parameter values

	Dependent variable		
	$\log \sigma_1$	$\log \sigma_2$	$\log \sigma_3$
	(1)	(2)	(3)
$\alpha_{i,t}$	5.113*** (0.304)	5.295*** (0.298)	5.166*** (0.313)
$\alpha_{i,d}$	2.771*** (0.304)	2.822*** (0.298)	2.446*** (0.313)
β	-2.393 (1.512)	-2.413 (1.485)	-2.049 (1.560)
$\alpha_{i,t} \times \alpha_{i,d}$	2.698** (1.261)	2.294* (1.238)	2.255* (1.301)
Observations	340	340	340
R^2	0.526	0.550	0.501
Adjusted R^2	0.521	0.544	0.495
Residual Std. Error (df = 335)	1.715	1.685	1.770
F Statistic (df = 4; 335)	93.014***	102.208***	84.019***

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

an estimate of the spectral density of the market share, which is the Fourier transform of its ACF. In practice, the higher are the values $P_g(f)$ at each frequency f , the stronger the cyclic behavior of the data at that frequency. Therefore, their sum gets larger when the cycles exist in the time series. The results of Table 3 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 owners of their own good, with a significant, reinforcing, interaction effect. Again, the impact of β is non-significant. Concluding, the two metamodel regressions confirm that the values of both $\alpha_{i,t}$ and $\alpha_{i,d}$ matter for the existence of cycles, with $\alpha_{i,t}$ having the largest effect (as we see from the magnitudes of coefficients in Tables 2 and 3), while β plays no significant role in this respect.

6 The impact of an influencer

In this section, we describe a situation where a single agent, which we label as influencer, has a higher distinction than the others, who share an equal, but lower, value of distinction. There are several empirical studies exploring the impact of an influencer on consumer behaviors and attitudes, most of which come from the business or marketing areas (Lim et al. 2017; Sudha and Sheena 2017; Belanche et al. 2021; Liu et al. 2021; Lim et al. 2017; Leung et al. 2022; Weismueller et al. 2020). These contributions provide a good reason to analyze what happens to the behavioral dynamic of the consumer when we introduce an influencer. Their main focus is the identification of the conditions and channels through which an influencer is more or less successful in targeting the market. By channels, they mean for instance

Table 3 Metamodel regression for the relationship between the cyclic behavior of market shares and the parameter values

	Dependent variable		
	$\log \sum_f P_1(f)$ (1)	$\log \sum_f P_2(f)$ (2)	$\log \sum_f P_3(f)$ (3)
$\alpha_{i,t}$	14.510*** (0.856)	14.923*** (0.824)	15.158*** (0.827)
$\alpha_{i,d}$	5.959*** (0.856)	5.892*** (0.824)	4.813*** (0.827)
β	-1.344 (4.263)	-3.750 (4.102)	-1.255 (4.118)
$\alpha_{i,t} \times \alpha_{i,d}$	8.285** (3.556)	9.798*** (3.421)	9.139*** (3.435)
Observations	340	340	340
R^2	0.504	0.536	0.529
Adjusted R^2	0.498	0.530	0.523
Residual Std. Error ($df = 335$)	4.837	4.655	4.673
F Statistic ($df = 4; 335$)	85.005***	96.665***	93.951***

In the dependent variables, $P_1(f), P_2(f), P_3(f)$ are the values of the components in the periodogram vectors of the time series of the products' market shares at frequency f . The largest is their sum, the stronger the cyclical behavior in the data

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

originality, follower size, sponsor salience, post positivity and the like.² One key result concerns the increased marketing effectiveness when the influencer, the brand and the consumer are mutually consistent (Leung et al. 2022).

Our setting is conceived to reflect the dynamics of a single influencer and her followers. The population size is fixed at $Q = 1000$. From Table 4, 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 .

The good selected by the influencer at 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

² Post positivity is the level of 'positivity of sentiments' in a social media posts (Berger and Milkman 2012). Sponsor salience is the degree of visibility and recognizability of a sponsor in a given context, such as events or communications, which would influence the perception and association between the sponsor's brand and the sponsored event/activity.

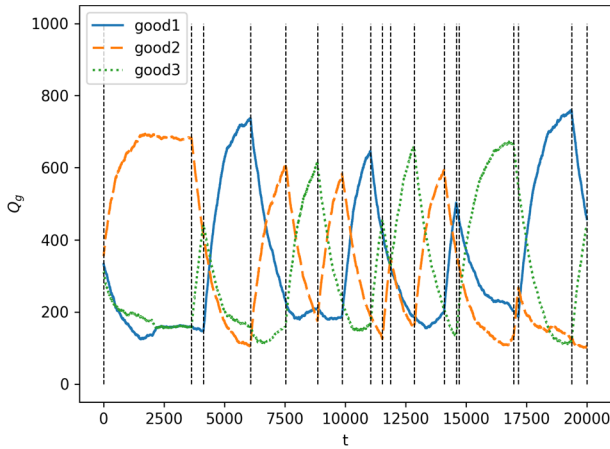


Fig. 7 $\beta = 0.1$, influencer-followers case, the influencer has $D_i = 0.99$ and the followers $D_j = 0.01$, $\alpha_{i,t} = 0.99$, $\alpha_{i,d} \in [0, 1]$. The influencer also gives minimal attention to the type and distinction of other agents ($\alpha_{\text{influencer},t} = 0.99$ $\alpha_{\text{influencer},d} = 0.01$). The vertical lines denote the times when the influencer gets the opportunity to switch between goods

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 a 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 owning 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. 7. The reason is that, from a certain threshold onward (with $Q = 1000$, about 700 agents), the price of the good becomes too high and some agent cannot own the good owned by the majority. Another reason, linked to the first one, is that the marginal utility from owning 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 this section are obtained by cutting the first 5000 periods, in order to allow the

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

$ D_{\text{influencer}} - D_{\text{followers}} $	0.98	0.6	0.4	0.2	0.02	0
average SD	115.632	91.306	61.753	48.753	3.388	0.716

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

β	0.1	0.4	0.6	0.8
average SD	115.632	91.306	61.753	48.753

system to reach an eventual equilibrium condition. The standard deviations of each good are averaged over 10 simulations for each combination of parameter values.

From Table 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 $\beta = 0.1$.

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 Table 1, third column, but with D_i being the same for all the agents other than the influencer. From Table 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, thus generating cycles of a lower magnitude.

7 Conclusions

The model presented in this paper aims at providing an 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 vital minimum if this is required for profit creation, like in low income countries. At the same time, it can settle well beyond the vital minimum, still as a function of profit, like in our consumerist society. In this sense, not only the basic needs are “necessary”, but also the self-reproduction of a social order which, following structuralism and post-structuralism, determines the agents’ choices. This “necessity” can deny the basic subsistence goods for somebody and at the same time push somebody else to sacrifice money in the spiral of consumerism.

A situation in the real world 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 these kind of goods (luxury branded but affordable product in terms of price) are highly demanded by poors, as empirical studies quoted above show. With this model we

want to stress that, even among the poor, a mechanisms of consumerism can ensue, which relies on a logic closer to the one of the *Potlach*³ 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; and this is a limitation of our setting) 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 restricted to rich people.

The model can be extended in many directions, such as introducing different cost functions for each good, modifying the utility function, introducing new goods in the market or allowing agents to own more than one good. The constraint on the number of goods that can be bought is a simplifying assumption, adopted mainly for computational limits. Allowing agents to own more than one good would probably imply a longer time taken by the agents to reach a clustered equilibrium. Another possibility is to endogenize money, especially in the influencer case. The influencer might receive an amount of 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 of the model is related to the wide issue of preferences' interdependence, of which this model is a particular case. Duesenberry et al. (1949) explained the consumption behavior of households not only in terms of the absolute level of current income, but also of 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; Truys 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 largest magnitude of cycles is observed when agents maximally care about distinction ($\alpha_{i,d} = 1$), but they are still heterogeneous with respect to the (randomly

³ The *Potlach* is a ceremony practiced by native populations in North America, which has been analyzed by many scholars, see e.g. Malinowski (1921) and Mauss (2002). Here, we use the term 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.

assigned) level of distinction (D_i). Agents with a below-average distinction actually act as conformists, since they are owning 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.

In Sect. 5, we have seen that this result is robust to a change of the cost function from being concave to convex, provided that the weight of money in the utility function is low enough. Cycles are thus a robust feature of a number of variations of the baseline setup of our model. On the other hand, this result underlines that the assumptions regarding the utility function are critical for the working of the model, inasmuch as they fix the role of the monetary versus non-monetary (network) components of utility. Actually, the two components are encapsulated in a standard Cobb–Douglas framework. A generalization to a CES framework is left for future research.

Funding Open access funding provided by Università di Pisa within the CRUI-CARE Agreement.

Declarations

Conflict of interest Authors have no Conflict of interest.

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References

- Acerbi A, Ghirlanda S, Enquist M (2012) The logic of fashion cycles. *PLoS One* 7(3):e32541
- Banuri S, Nguyen H (2020) Borrowing to keep up (with the joneses): Inequality, debt, and conspicuous consumption. *Debt Conspic Consump* 206:222–242
- Bargigli L, Riccetti L, Russo A, Gallegati M (2020) Network calibration and metamodeling of a financial accelerator agent based model. *J Econ Interact Coord* 15(2):413–440
- Barrington-Leigh CP (2008) Veblen goods and neighbourhoods: endogenising consumption reference groups
- Belanche D, Casalo LV, Flavián M, Ibáñez-Sánchez S (2021) Understanding influencer marketing: the role of congruence between influencers, products and consumers. *J Bus Res* 132:186–195
- Bellet C, Colson-Sihra E (2018) The conspicuous consumption of the poor: forgoing calories for aspirational goods. Technical report, Working paper
- Berger J, Milkman KL (2012) What makes online content viral? *J Market Res* 49(2):192–205
- Bilancini E, Boncinelli L et al (2009) Signalling, social status and labor income taxes. Technical report, Citeseer
- Caiani A, Russo A, Palestrini A, Gallegati M (2016) Economics with heterogeneous interacting agents. *New Econ Windows Spring Ser* 10:973–978

- Charles KK, Hurst E, Roussanov N (2009) Conspicuous consumption and race. *Quart J Econ* 124(2):425–467
- Chen S, Desiderio S (2022) A regression-based calibration method for agent-based models. *Comput Econ* 59(2):687–700
- Chen W-F, Nelson MR (2020) Champagne taste, beer budget: the new poor's incongruent capital and consumption. *J Consum Cult* 20(1):23–42
- Corneo G, Grüner HP (2002) Individual preferences for political redistribution. *J Publ Econ* 83(1):83–107
- Di Giovinazzo V, Naimzada A (2015) A model of fashion: endogenous preferences in social interaction. *Econ Modell* 47:12–17
- Duesenberry JS et al (1949) Income, saving, and the theory of consumer behavior
- Duflo E, Banerjee A (2011) *Poor economics*, volume 619. PublicAffairs
- Fafchamps M, Shilpi F (2008) Subjective welfare, isolation, and relative consumption. *J Dev Econ* 86(1):43–60
- Frank RH (2005) The mysterious disappearance of James Duesenberry. *New York Times*, 9
- Fratric P, Sileno G, Klous S, van Engers T (2022) Manipulation of the bitcoin market: an agent-based study. *Fin Innov* 8(1):60
- Fremling GM, Posner RA (1999) Market signaling of personal characteristics. University of Chicago Law School, John M. Olin Law & Economics Working Paper 87
- Guillen-Royo M (2011) Reference group consumption and the subjective wellbeing of the poor in peru. *J Econ Psychol* 32(2):259–272
- Harriger JL (2010) *Conspicuous consumption and inequality: Theory and evidence*. State University of New York at Binghamton
- Jaikumar S, Sarin A (2015) Conspicuous consumption and income inequality in an emerging economy: evidence from India. *Market Lett* 26(3):279–292
- Johnstone J, Katz E (1957) Youth and popular music: a study in the sociology of taste. *Am J Sociol* 62(6):563–568
- Kapteyn A, Van Herwaarden FG (1980) Interdependent welfare functions and optimal income distribution. *J Publ Econ* 14(3):375–397
- Kaus W (2013) Conspicuous consumption and “race”: evidence from South Africa. *J Dev Econ* 100(1):63–73
- Lamperti F, Roventini A, Sani A (2018) Agent-based model calibration using machine learning surrogates. *J Econ Dyn Control* 90:366–389
- Leibenstein H (1950) Bandwagon, snob, and veblen effects in the theory of consumers' demand. *Q J Econ* 64(2):183–207
- Leung FF, Gu FF, Li Y, Zhang JZ, Palmatier RW (2022) Influencer marketing effectiveness. *J Market* 86(6):93–115
- Lim XJ, Radzol A, Cheah J, Wong MW (2017) The impact of social media influencers on purchase intention and the mediation effect of customer attitude. *Asian J Bus Res* 7(2):19–36
- Liu X, Shin H, Burns AC (2021) Examining the impact of luxury brand's social media marketing on customer engagement: using big data analytics and natural language processing. *J Bus Res* 125:815–826
- Malinowski B (1921) The primitive economics of the trobriand islandees. *Econ J* 31:1–16
- Matsuyama K (1991) Custom versus fashion: path-dependence and limit cycles in a random matching game. Technical report, Discussion paper
- Mauss M (2002) *The gift: the form and reason for exchange in archaic societies*. Routledge, New York
- Mazzocco PJ, Rucker DD, Galinsky AD, Anderson ET (2012) Direct and vicarious conspicuous consumption: Identification with low-status groups increases the desire for high-status goods. *J Consum Psychol* 22(4):520–528
- Moav O, Neeman Z (2010) Status and poverty. *J Eur Econ Assoc* 8(2–3):413–420
- Moav O, Neeman Z (2012) Saving rates and poverty: the role of conspicuous consumption and human capital. *Econ J* 122(563):933–956
- Murphy JL (2018) Measuring conspicuous consumption. Available at SSRN 3309304
- Ordabayeva N, Chandon P (2011) Getting ahead of the joneses: When equality increases conspicuous consumption among bottom-tier consumers. *J Consum Res* 38(1):27–41
- Podoshen JS, Andrzejewski SA, Hunt JM (2014) Materialism, conspicuous consumption, and American hip-hop subculture. *J Int Consum Market* 26(4):271–283
- Postlewaite A (1998) The social basis of interdependent preferences. *Eur Econ Rev* 42(3–5):779–800
- Salle I, Yildizoglu M (2014) Efficient sampling and meta-modeling for computational economic models. *Comput Econ* 44(4):507–536

- Sanchez SM (2005) Nohdesigns spreadsheet. Available online on <http://diana.cs.nps.navy.mil/SeedLab/>
- Shibano K, Mogi G (2022) An analysis of the acquisition of a monetary function by cryptocurrency using a multi-agent simulation model. *Fin Innov* 8(1):87
- Simmel G (1957) Fashion. *Am J Sociol* 62(6):541–558
- Son J, Bilgin MH, Ryu D (2022) Consumer choices under new payment methods. *Fin Innov* 8(1):1–22
- Stewart SA, Hoell RC (2016) Hire someone like me, or hire someone i need: Entrepreneur identity and early-stage hiring in small firms. *J Small Bus Entrepreneurship* 28(3):187–201
- Sudha M, Sheena K (2017) Impact of influencers in consumer decision process: the fashion industry. *SCMS J Indian Manag* 14(3):14–30
- Sundie JM, Kenrick DT, Griskevicius V, Tybur JM, Vohs KD, Beal DJ (2011) Peacocks, porsches, and thorstein veblen: Conspicuous consumption as a sexual signaling system. *J Personal Soc Psychol* 100(4):664
- Tassier T (2004) A model of fads, fashions, and group formation. *Complexity* 9(5):51–61
- Truys T (2010) Social status in economic theory. *J Econ Surv* 24(1):137–169
- Van Kempen L (2003) Fooling the eye of the beholder: deceptive status signalling among the poor in developing countries. *J Int Dev J Dev Stud Assoc* 15(2):157–177
- Van Kempen L (2007) Status consumption and ethnicity in Bolivia: evidence from durables ownership. *Int J Consum Stud* 31(1):76–89
- Weismueller J, Harrigan P, Wang S, Soutar GN (2020) Influencer endorsements: How advertising disclosure and source credibility affect consumer purchase intention on social media. *Austral Mark J* 28(4):160–170
- Wisman JD (2009) Household saving, class identity, and conspicuous consumption. *J Econ Issues* 43(1):89–114