MODELING LUXURY CONSUMPTION: AN INTER-INCOME CLASSES STUDY OF DEMAND DYNAMICS AND SOCIAL BEHAVIORS

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Modeling Luxury Consumption: an Inter-income Classes Study of Demand Dynamics and Social Behaviors

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Summary: In this paper we develop an agent-based model of conspicuous consumption built on well-established social behaviors. The process of preference formation, based on imitation and differentiation under cognitive limitations, endogenously generates class-specific consumption profiles. Considering consumption as competition among households to obtain social recognition, we find that low levels of 'social competition' increases individual well-being. Especially, the desire to imitate 'social models' of consumption appears as the main determinant of individual well-being dynamics. According to the model, public policies, when aiming to reduce income inequality, are efficient for increasing 'subjective well-being' in the economy, however, well-being improvements are low when demonstration effects and consumption standards are high.

Keywords: Preference formation; Conspicuous consumption; Agent-based model; Income inequality; Social behaviours


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1 Introduction

Changes in the distribution of wealth among individuals have an impact on both consumption and individual well-being, not only through the obvious and direct effect of budget constraints but also through the more subtle effect of social norms. There are several ways in which the social environment influences households’ purchasing decisions, one of which is inter-individual comparison of consumption, which is highly influenced by the distribution of wealth and gives rise to Veblen’s concept of conspicuous consumption; the act of consuming as a way of displaying one’s personal wealth to the rest of society. The present paper analyzes the impact of income inequality on individual well-being when social interactions and group identity matter. In particular, it investigates the dynamics of demand on housing market as the result of a social process that determines both individual preferences and agents’ subjective well-being.

Subjective well-being was first explored by Duesenberry (1949), who contends that agents are concerned with their relative living standard positions. This view is shared by Easterlin (1974), Frank (1989), Hirsch (1976) and Layard (1980), among others. Studies related to conspicuous consumption and individual subjective well-being are not legion in economics since most work focuses on objective welfare analyses, derived from utility functions, for example, Basman et al. (1998), Corneo and Jeanne (1997), Frank (1985), Ireland (1994) model status ranking utility as an absolute rather than a relative level. In Hopkins and Kornienko (2004) agents derive utility from their relative positions in some social ranking. However, only individual relative position is taken into account with class and group belongingness ignored. In Bernardino and Araujo (2013), agents are concerned about their position within a restricted group. Cooper et al. (2001), who include peer group concerns in an endogenous growth model with positional and non-positional goods, find that status concerns tend to foster design, marketing and advertising innovations at the expense of quality improvements. In this context, Bagwell and Bernheim (1996) and Pesendorfer (1995) investigate the relation between product quality and conspicuous consumption within a signaling framework. While the former work shows how conspicuous consumption can induce design innovation, the latter investigates the conditions of occurrence of Veblen effects.
The present paper proposes an agent-based model of conspicuous consumption founded on well-established social behaviours. It is based primarily on Cowan et al. (1997)’s findings, from a standard analytical model that investigates the impact of peer groups and rivals on the dynamics of demand for a single good. An agent-based methodology allows the analysis to be extended to a context where heterogeneous agents have cognitive limitations and face different qualities of goods. The price of each good evolves endogenously thereby modifying individual purchasing decisions. Rather than assuming the existence of a pure Veblen good and - as most models do - analyzing substitutability between a positional and a non-positional good, we consider that each positional good is primarily a standard consumption good, with a functional utility in the sense of Leibenstein (1950), and that this good deviates from its basic function to achieve social distinction. We offer an explanation for this deviation: in an economy composed of different income classes, and of agents having status seeking, competition for social distinction pushes consumers to considers most goods as positional goods. These specificities of the model allow analysis of the interaction among income distribution, Veblen effects and inter-individual comparison. Second, we use the concept of social competition, inspired by Hopkins (2008), and consider consumption as competition among households to obtain social recognition, influenced by both degree of income inequality and inter-individual interactions. Using this concept, we explore the implications of conspicuous consumption on housing market demand and individual well-being. The model highlights the preponderant role of imitation in the dynamics of individual well-being.

The model shows that high levels of social competition yield ambiguous results for individual well-being. In fact, the desire for social distinction creates a distortion in individual demand for product quality. When wealthy people seek to distinguish themselves from poor people through consumption, their demand for prestige materializes in both demand for higher quality goods and higher willingness to pay for equivalent quality in order to display wealth, i.e. Veblen effects. Our model shows to what extent desire for prestige leads to the exclusion of the poorest from consumption. According to the model, public policies, when aiming to reduce income inequality, are efficient for increasing 'subjective well-being' in the economy, however, well-being improvements are low when demonstration effects and consumption standards are high.
The rest of the paper is organized as follows. In section 2 we set the general properties of our base line model of preference formation: the imitation and differentiation model (ID model). In section 3, we employ a two class analysis to investigate whether specialized consumption by social class emerges from these simple social behaviours. Section 5 analyzes the impact of inter-individual comparison on consumers’ willingness to pay for housing, consumers’ location choice and individual well-being. Policy implications are derived from the results. Section 6 offers some concluding remarks.

2 Social process of choice: The ID Model

2.1 General setting

The issue of consumption behaviour in a social context is not a recent preoccupation, especially in relation to conspicuous consumption. Economists and social psychologists have for long been interested in this issue. Engel’s 1857s work together with Maslow (1943)’s theory of human motivation gave birth to the concept of hierarchic preferences. However, Trigg (2004) highlights that Maslow’s hierarchy of needs fails to take account of learning in an evolutionary context, ‘since Maslow considers that the individual develops his psyche mainly from within, and not on the basis of learning from cultural environment” (Trigg, 2004, p.399). Trigg (2004) shows how Veblen’s theory of the leisure class (1899) and Bourdieu’s studies about distinction, appear to be alternatives to Maslow to build an evolutionary approach of consumer behaviour. Veblen mainly focuses on the determinants of luxury goods consumption, analyzing consumption as a class-phenomenon. According to him, individuals’ tastes and preferences are shaped by the tastes and preferences of other individuals in the economy, in the sense that upper class consumption behaviour trickles down to the rest of the society, such that “rich people seek to emulate the behaviour of other rich people; poor people seek to emulate the behaviour of rich people” (Trigg, 2002, p.6).

The imitation and differentiation model (ID model) studies conspicuous consumption under social behaviours and cognitive limits. We assume two main factors are involved in the process of demand formation in a social context: imitation and differentiation. Tarde claimed that “society is imitation” (Tarde, 1903, p.74) in the sense that ‘society may […] be defined as a group of beings who are apt to imitate one another, or who, without actual
imitation, are alike in their possession of common traits which are ancient copies of the same model” (ibid., p.68). Here, we are interested not in the behaviour of society as a whole, but rather in the behaviour of sub-groups: that is, social classes. According to Veblen and Bourdieu, the phenomenon of imitation exists both between and within classes. Veblen (1922) stresses that the richest people seek further differentiation from the lower wealth categories, by consuming commodities whose price level prevents less wealthy people from consuming them. Bourdieu states also that ‘social identity is defined and asserted through difference” (Bourdieu, 1979, p.172). Social distinction through consumption, therefore, seems to result from two main behaviours: imitation and differentiation. In the model, individuals have cognitive limits, in the sense that although information is available, agents may not be able to find or perfectly exploit it.

The first stage of the model is part of a non-monetary framework. At each period of time, individuals display a consumption profile that evolves according to the social criteria of imitation and differentiation. Imitation consists of adopting the purchasing behaviour of certain individuals, while differentiation refers to moving away from the consumption profiles of other individuals.

In the model $n$ agents are distributed among different social classes. These latter are denoted by $c_i \in \{1, \cdots, m\}$, from lower to upper classes. At time $t$, each individual chooses from a continuum of alternatives on $[0, 1]$, $\theta_i \in [0, 1]$ is the consumption profile of individual $i$ at time $t$. Alternatives can be interpreted as combinations of goods. Whether an individual chooses an alternative rather than another is described by the ID process below.

### 2.2 Consumer preferences

Our analysis concentrates on individual well-being. As highlighted in the introduction, we focus on subjective well-being, to the extend that it is related to inter-individual comparisons. We think of subjective well-being in terms of satisfaction, in Angner (2010)’s words “we believe that people want to be satisfied” (p. 366). According to Easterlin (1974) and other ”happiness economists” ¹ individuals derive satisfaction (or dissatisfaction) from their relative positions with respect to the prevailing consumption norm. In our

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¹Duesenberry (1949), Layard (1980) and Frank (1989), among others
model, we formalize the consumption standard of each individual as her reference group mean consumption, such that agents’ satisfaction comes from their position relative to their reference group. The agent’s reference group is modeled as the social class from which she belongs to, her peer group, plus the social classes she is attracted to, her aspiration group. Within the model, the latter are all classes above the agent’s class, therefore excluding all social classes below. We call all classes lower than the agent’s class the distinction group, the group from which the agent seeks to differentiate. In this context, the agent’s utility comes from her consumption profile relative to both her reference group and her distinction group. Utility is decreasing with the distance to the reference group and increasing with the distance to the distinction group. The utility of agent \( i \) at time \( t \) is described by the following function:

\[
U_i^t = f(|r_t|) + |\Delta_t|
\]

\( f(|r_t|) \) is a continuous, concave function decreasing in \(|r_t|\) and such that \( \max f(|r_t|) = f(0) \), and \( \lim_{|r_t| \to \infty} f(x) > 0 \). \( r_t \) is the distance from the agent consumption profile to her reference group, and equal to: \( \theta_i^t - \theta_{\text{ref}}^t \). \( \Delta_t \) is the distance between the agent’s consumption profile and her distinction group: \( \theta_i^t - \theta_{\text{diff}}^t \).

Agents maximize their utility following the ID process.

### 2.3 Imitation process

In this first process, individuals maximize their utility coming from the proximity to the reference group. Individuals aim at imitating their peers and those people they regard as models. In the context of income classes, each individual tries to imitate the members of her own income class and also members of the upper classes but not members of lower classes. The imitation process follows a Bayesian-updating rule. Denoting \( \hat{\theta}_i^\text{own} \) the mean of the consumption profile of all the individuals belonging to agent \( i \)’s social class at time \( t \), and \( \hat{\theta}_i^\text{sup} \) the mean of the consumption profile of all the individuals belonging to strictly upper classes at time \( t \) then:

\[
\hat{\theta}_i^\text{own} = E[\theta_i^t : c_j = c_i]
\]

\[
\hat{\theta}_i^\text{sup} = E[\theta_i^t : c_j > c_i]
\]
Under imitation, the consumption profile of agent $i$ tends toward the value to imitate. Formally, the profile of individual $i$ after imitation is defined as:

$$f_{imit}(\theta_i^t) = (1 - \alpha) \cdot \hat{\theta}_{own}^i + \alpha \cdot \hat{\theta}_{sup}^i$$  \hspace{1cm} (1)$$

where $\alpha \in [0, 1]$ is the imitation intensity parameter. In other words, individual $i$ imitates her own class, which embodies the desire of group belongingness, for $1 - \alpha$ and imitates her social models, or aspirational group, for $\alpha$. When $\alpha = 0$, the agent has no aspiration to upper classes, and individual $i$ only refers to her current class, while when $\alpha = 1$, the individual only seek to emulate the behaviour of upper classes. High values of $\alpha$ may arise in societies where demonstration effects are high, and lead to increase in the consumption standard of individuals. Therefore, agent $i$’s consumption standard is increasing in $\alpha$.

This model specification contrasts with previous work on status preference theory\footnote{Bagwell and Bernheim (1996), Corneo and Jeanne (1997), Yamada (2008)} in the sense that people not only care about signaling their wealth - the richer I appear, the better I am - but they also care about their "group belongingness". Based on this specification, our model can easily be extended to different social networks (the reference group could be the income class, as in section 5 of this paper, but could also embody more subtle elements such as culture). People are also usually assumed to imitate only their aspiration group(s), formalized as higher classes. Based on Bourdieu and Veblen, the imitation phenomenon acts both between and within classes in our model, taking into account both peer and aspiration groups. Attachment to the agent’s peer group avoids the emergence of too extravagant or too unrealistic, consumption desires.

### 2.4 Differentiation process

In the second stage, individuals maximize their utility coming from the distance to the distinction group. As stated above, people also want to differentiate themselves from each other. We set that, during the process of differentiation, individuals seek to distinguish their consumption profiles from those of individuals belonging to strictly lower classes. We consider the differentiation process and the imitation process to be symmetric, such that when agent $i$ differentiates himself from individual $j$, he is imitating the agent who is symmetrically opposed to agent $j$ with respect to $i$. The mean repulsive profile, denoted by $\hat{\theta}_t^{diff}$, represents the average consumption profile of all the individuals from whom
individual $i$ wants to differentiate, at time $t$, then:

$$\hat{\theta}_{i}^{diff} = E[\theta_{i}^{j} : c_{j} < c_{i}]$$

The differentiation process tends to drive consumption profiles apart once they have become too close to one another. The threshold parameter $\delta$ defines the maximal proximity tolerated by each individual with respect to individuals belonging to lower classes. If the difference is above this threshold, the individual does not change her profile. However, if the difference is below this threshold, the agent changes his profile by imitating the opposite profile which is at a distance $\delta$ from the repulsive profile. $\beta \in [0,1]$ is the differentiation intensity parameter. The evolution of the consumption profile of an individual under differentiation is defined by the $f_{diff}$ function such that:

$$f_{diff}(\theta_{i}) = \left\{ \begin{array}{ll}
(1 - \beta)\theta_{i} + \beta \cdot \min(1, \hat{\theta}_{i}^{diff} + \delta) & \text{if } 0 \leq \theta_{i} - \hat{\theta}_{i}^{diff} \leq \delta \\
(1 - \beta)\theta_{i} + \beta \cdot \max(0, \hat{\theta}_{i}^{diff} - \delta) & \text{if } -\delta \leq \theta_{i} - \hat{\theta}_{i}^{diff} < 0 \\
\theta_{i} & \text{else}
\end{array} \right.$$ (2)

where $\hat{\theta}_{i}^{diff}$ is the profile that is taken into account is the most extreme possible within the boundaries. When the threshold $\delta$ is null, individuals do not seek to differentiate themselves. However, when the threshold is sufficiently large, people constantly seek to differentiate themselves from those belonging to lower classes. $\beta \cdot \delta$ represents the maximal differentiation intensity possible when the agent’s profile equals the average repulsive profile.

### 2.5 Consumer cognitive limitations

Consumer cognitive limitations capture the fact that human processing information capacity is bounded. In other words, even though information of the class to which each individual belongs is available, obtaining the very right information is difficult and time consuming. Therefore, agents form conjectures about others’ class belongingness. We model cognitive limitations as a stochastic process. Cognitive limitations have the effect of randomly modifying each agent’s profile towards the consumption of combination 0 or 1. This process is described by the following function $f_{lim}$:

$$f_{lim}(\theta_{i}) = z \text{ where } z \sim N_{[0,1]}(\theta_{i}^{t}, \sigma)$$ (3)
Table 1: Parameters of the IDI model.

<table>
<thead>
<tr>
<th>Notation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\alpha)</td>
<td>Imitation intensity</td>
</tr>
<tr>
<td>(\beta)</td>
<td>Differentiation intensity</td>
</tr>
<tr>
<td>(\delta)</td>
<td>Differentiation threshold</td>
</tr>
<tr>
<td>(\sigma)</td>
<td>Cognitive bias intensity</td>
</tr>
<tr>
<td>((c_i)_{i \in {1..m}})</td>
<td>Class of individuals</td>
</tr>
<tr>
<td>(n = \sum_i n_i)</td>
<td>Population size</td>
</tr>
</tbody>
</table>

where \(\mathcal{N}_{[0,1]}\) is a truncated normal law between 0 and 1.

The parameter \(\sigma > 0\) represents the cognitive bias intensity. When \(\sigma\) is null the agent is perfectly rational, and has perfect computational abilities, the cognitive limits of agents are growing with \(\sigma\).

### 2.6 The IDI Model Time Sequence

All individuals evolve simultaneously. The processes occur successively according to the following sequence: first agents compute their imitation profile, second, they adapt their profile through differentiation. The function of cognitive limits captures the deviations of agents from their rational choices in both steps. This first model takes place in a non-monetary framework. Formally:

\[
\forall t \geq 0, \forall i = 1 \cdots n \theta_{t+1}^i = f_{lim}(f_{diff}(f_{imit}(\theta_t^i)))
\]

Table 1 sums up the parameters of the model.

### 3 Non-monetary Model

We analyze each process separately, and then simultaneously. The cognitive limitation is a random walk; its implications are discussed in section 4.

#### 3.1 Imitation

We focus first on only the imitation process. Assume that individuals belonging to the same income class display the same initial consumption profile. In this case, there is no
heterogeneity among individuals, and people in the same class share the same profile all along the dynamics:

\[ \forall t \geq 0 \ \forall i \ \forall j \ c_i = c_j \ \Rightarrow \ \theta_i^t = \theta_j^t \]

Income class 2, which is the upper class, imitates only itself so that its profile remains unchanged:

\[ \forall t \ \theta_2^t = \theta_2^0 \]

Income class 1, which is the lower class, imitates itself and class 2. The dynamics of the system is described by:

\[ \forall t \ \theta_1^{t+1} = (1 - \alpha)\theta_1^t + \alpha \frac{n_1\theta_1^t + n_2\theta_2^0}{n_1 + n_2} \]

Denoting the ratio of the population size as \( k \), such that \( n_1 = k.n_2 \), we obtain:

\[ \forall t \ \theta_1^t = \theta_2^0 + (1 - (\alpha/(1 + k)))^t (\theta_1^0 - \theta_2^0) \] (5)

**Proposition 1.** When only imitation holds, the consumption profile of the lower class converges exponentially toward the upper class profile. The lower the population size ratio, the faster the convergence.

For \( \alpha = 0 \) there is no imitation and \( \theta_1^t \) is constant. When \( \alpha > 0 \), then \( 0 \leq 1 - (\alpha/(1 + k)) < 1 \) and \( \theta_1^t \) converges exponentially toward \( \theta_2^t \). The speed of convergence of the consumption profile of class 1 toward class 2 is a function of the population size ratio, the greater \( k \), the slower the convergence. For example, for an imitation intensity \( \alpha \) = 0.4 and a population size ratio of \( k = 10 \), taking \( \theta_1^0 = 0 \) and \( \theta_2^0 = 1 \) as the initial condition of the system, then \( \theta_1^t \) reaches the value 0.99 in 125 time units.

### 3.2 Differentiation

When the model is restricted only to the dynamics of differentiation, the consumption profile of class 1 remains constant. If the gap between the class 1 and class 2 profiles is bigger than the threshold parameter \( \delta \), then the profile of class 2 also remains constant. We now focus on the cases where the difference between both profiles is less than \( \delta \). We can assume, without loss of generality, that the difference is positive, such that \( 0 \leq \theta_2^0 - \theta_1^0 \leq \delta \). Assume also that the boundaries are never reached, i.e. \( \theta_1^0 + \delta \leq 1 \). In this case, the
dynamics equation becomes:

$$\forall t \quad \theta_{t+1}^2 = (1 - \beta)\theta_t^2 + \beta(\theta_0^1 + \delta)$$

Then, for all $t$, $0 \leq \theta_t^2 - \theta_t^1 \leq \delta$ so that the value of the consumption profile of class 2 is given by:

$$\forall t \quad \theta_t^2 = (\theta_0^1 + \delta) + (1 - \beta)^t(\theta_0^2 - (\theta_0^1 + \delta))$$

(6)

For $\beta = 0$, there is no differentiation and $\theta_t^2$ is constant. For $\beta > 0$ and $\beta \leq 1$, $\theta_t^2$ converges toward $\theta_0^1 + \delta$ exponentially. In the same way, it is possible to show that, when $\theta_0^1 + \delta > 1$, then:

$$\forall t \quad \theta_t^2 = 1 + (1 - \beta)^t(\theta_0^2 - 1)$$

In this case, convergence is toward the upper bound 1.

**Proposition 2.** *When only differentiation holds, the consumption profile of the upper class converges exponentially toward $\theta_0^1 + \delta$."

In the ID model, the imitation and differentiation processes have a similar effect on the evolution of the consumption profiles. In fact, the role of both imitation intensity controlling for the population size of each class $\alpha/(1 + k)$, and differentiation intensity $\beta$, are symmetric. Processes both act together on the strength and on the speed of evolution of each profile. While imitation tends to bring consumption profiles exponentially closer, differentiation tends to drive them exponentially apart from each other. Thus, we are in the presence of two antagonistic dynamics, so that a fixed point can only result from an equilibrium state between the two forces.

### 3.3 Imitation and differentiation

In this section, we study the joint effect of the imitation and differentiation processes.

#### 3.3.1 Dynamics

As long as the difference between class 1 and class 2 consumption profiles is greater than the threshold $\delta$, only the imitation process holds, in particular, class 1 is imitating class 2. The dynamics is therefore given by equation 5 in section 2.1. Let us assume that the gap is less than $\delta$ and, without loss of generality, that the class 2 profile is greater than the
class 1 profile. We assume also that the upper and lower bounds of the profile domains are not reached; this last case is discussed at the end of the section.

\[ \forall t \quad 0 \leq \theta_1^t \leq \theta_2^t \leq 1 \]

Class 1 imitates its own class and class 2. Class 2 imitates only itself, action that has no effect on its profile, and differentiates it from class 1. The dynamics equations are then given by:

\[
\begin{align*}
\theta_1^{t+1} &= (1 - \alpha)\theta_1^t + \alpha_k\frac{\theta_1^{t+1}\theta_2^t}{1 + \kappa} \\
\theta_2^{t+1} &= (1 - \beta)\theta_2^t + \beta(\theta_1^t + \delta)
\end{align*}
\]

which can be written as:

\[
\begin{align*}
\theta_1^{t+1} &= (1 - \alpha_k)\theta_1^t + \alpha_k\theta_2^t \\
\theta_2^{t+1} &= \beta\theta_1^t + (1 - \beta)\theta_2^t + \beta\delta
\end{align*}
\]  \( (7) \)

where \( \alpha_k = \frac{\alpha}{1 + \kappa} \) is the reduced imitation intensity, controlled for the population size ratio.

3.3.2 Pursuit racing

Let us first study the evolution of the distance \( d_t \) separating both profiles. Setting that \( d_t = \theta_2^t - \theta_1^t \), so that the distance dynamics is given by:

\[ d_{t+1} = \lambda d_t + \beta \delta, \text{ with } \lambda = 1 - (\alpha_k + \beta) \]

In the extreme case in which \( \lambda = 1 \), i.e. with neither imitation nor differentiation \( \alpha = \beta = 0 \), the distance is constant, equal to its initial value. In the other extreme case in which \( \lambda = -1 \), that is, both imitation and differentiation intensities are maximal: \( \alpha_k = \beta = 1 \), the distance interchanges between the values 0 and \( \delta \).

Out of these extreme cases, the distance \( d_t \) is stable within the interval \([0, \delta]\). More precisely, for \( \lambda \) positive, a distance \( 0 \leq d_t \leq \delta \) implies that \( \beta \delta \leq d_{t+1} \leq (1 - \alpha_k)\delta \). For \( \lambda \) negative, a distance \( 0 \leq d_t \leq \delta \) implies that \( (1 - \alpha_k)\delta \leq d_{t+1} + 1 \leq \beta \delta \). Equation 7 can be used to study the evolution of the profiles for \( d_0 = \theta_2^0 - \theta_1^0 \in [0, \delta] \). Then the difference is given by:

\[ \forall t \quad d_t = d_\infty + \lambda^t (d_0 - d_\infty) \text{ with } d_\infty = \frac{\beta \delta}{\alpha_k + \beta} \]  \( (8) \)

**Proposition 3.** For \( \lambda \in (-1, 1) \), that is, outside of the extreme cases, the distance \( d_t \)
converges exponentially toward $d_\infty$. This limit is proportional to the threshold $\delta$: the greater $\delta$, the greater the limit distance. The limit distance decreases with the growth of imitation intensity, and increases proportionally as differentiation intensity rises.

Well-being of class 2 is increasing in $d_t$, while well-being of class 1 is decreasing in $d_t$, therefore, due to these antagonist preferences, and outside of the extreme cases, the consumption profiles evolve according to a pursuit-racing pattern. Indeed, by differentiating, class 2 maintains its profile ahead of the class 1 profile and despite the imitation dynamics of class 1. Class-specific consumption profiles, therefore, emerge from this model. Both the asymptotic distance among classes, and the speed of convergence toward this asymptote, depend upon the imitation and differentiation intensities. Pursuit racing among classes modifies when it approaches the domain boundaries.

### 3.3.3 Boundary behaviour

The time to convergence toward a boundary can be calculated by determining the class 2 profile. We can rewrite the system dynamics in matrix form (see (13)), such that $\Theta_t = (\theta^1_t \theta^2_t)$:

$$\Theta_{t+1} = A\Theta_t + B$$

with $A = \begin{bmatrix} 1 - \alpha_k & \alpha_k \\ \beta & 1 - \beta \end{bmatrix}$ et $B = \begin{bmatrix} 0 \\ \beta \delta \end{bmatrix}$

Profiles are given by the relation $\Theta_t = A^i\Theta_0 + \sum_{i=0}^{t-1} A^iB$. Starting from the initial state with $\theta^1_0 = \theta^2_0 = 0$, we obtain that (cf. section 6, appendix):

$$\begin{cases} 
\theta^1_t = \frac{1}{1 + \frac{\alpha_k}{1 - \delta}} \cdot \alpha_k \cdot \delta \cdot \left(1 - \frac{1 - \frac{\alpha_k}{1 - \delta}}{1 - \frac{\alpha_k}{1 - \delta}}\right) \\
\theta^2_t = \frac{1}{1 + \frac{\beta}{1 - \delta}} \cdot \beta \cdot \delta \cdot \left(\frac{\alpha_k}{\beta} + \frac{1 - \frac{\beta}{1 - \delta}}{1 - \frac{\beta}{1 - \delta}}\right)
\end{cases}$$

(9)

The number of time units needed to come close to the upper bound 1 is obtained for $\theta^1_t + \delta \geq 1$, i.e. for:

$$t_{\text{limit}} \geq \log(1 - (\alpha_k + \beta)(1 - (\delta^{-1} - 1)(\alpha^{-1} + \beta^{-1}))) / \log(1 - (\alpha_k + \beta))$$

(10)

The imitation and differentiation intensities play symmetric roles with regard to time to convergence toward a boundary. The time to convergence is a decreasing function of one of these intensities, and of $\delta$. 

13
Let us now explore the boundary dynamics. The neighborhood of the upper bound 1 is described by: \( \theta^1_t > 1 - \delta \). In this case, the dynamics equations are:

\[
\begin{align*}
\theta^1_{t+1} &= (1 - \alpha_k) \theta^1_t + \alpha_k \theta^2_t \\
\theta^2_{t+1} &= (1 - \beta) \theta^2_t + \beta
\end{align*}
\]  

(11)

The class 2 consumption profile converges geometrically toward the upper bound 1 with a coefficient \( 1 - \beta \), similarly, the class 1 consumption profile converges toward 1 with a coefficient \( 1 - \alpha_k \). The greater the differentiation, or imitation, the faster the convergence.

4 Simulation model: the ID model

Next we study the implications of consumer cognitive limitations. If agents have infinite computational abilities (\( \sigma = 0 \)), meaning that they are perfectly able to discover the types of all other agents in the society and to link them to their respective consumption choices, then the consumption profiles of individuals belonging to the same social class are identical. The dynamics is fully deterministic and consumption profiles evolve as described in section 3.3 above. As \( \sigma \) increases, the frontiers of class specific consumption profiles blur as a consequence of individuals’ misinterpretations of their environment. These errors in individuals’ computations lower the speed of convergence toward the model boundaries compared with the deterministic case (see 3.3.3). Finally, as \( \sigma \) becomes larger (\( \sigma > 0.3 \)) the process becomes fully stochastic; class-specific profiles no longer emerge since individuals are unable to correctly identify each other.

In what follows, we respectively denote the consumption profiles of classes 1 and 2 at time \( t \) by \( \theta^1_t \) and \( \theta^2_t \), and respective class size by \( n_1 \) and \( n_2 \). The simulation model investigates the dynamics of evolution under cognitive limitations for different values of imitation and differentiation intensities. We use the following parameters: for imitation intensity \( \alpha \in \{0, 0.2, 0.4, 0.6, 0.8, 1\} \), for differentiation intensity \( \beta \in \{0, 0.2, 0.4, 0.6, 0.8, 1\} \), for differentiation threshold \( \delta = 0.25 \), for cognitive intensity \( \sigma = 0.01 \).

For this set of simulations we consider only two classes \( c \in \{1, 2\} \), and the global population size \( n \) is set equal to 2000. Population is alternately equally divided between both classes and distributed following the rule: 10% into the upper class and 90% into the lower class. For each class, the initial consumption profile is \( \theta_t = 0 \). We ran \( t = 2000 \) iterations and, for each couple of parameters, we performed 30 simulations.
4.1 Consumption patterns

Note first that starting from uniform initial conditions ($\theta_t = 0$), the model endogenously generates class-specific consumption patterns. Simple decision rules, based on the sociological factors of imitation and differentiation, lead to three main results: specialization in consumption by social class, specialization in consumption by social classes with scission of the upper class into two sub-classes, fads or bandwagon phenomena driven by the upper class’s search for distinction.

Figure 1 shows the number of simulations where the dynamics converges toward stable consumption profiles. Stability is computed as follows. From the last 400 iterations, we extracted the average consumption profile of the lower class (class 1): $\theta_{1,t} = E[\theta^j_t : c_j = 1]$. When the standard deviation of $\theta_{1,t}$ for $t \in [1600, 2000]$ is under 0.05, the dynamics is said to be stable. When the 30 simulations show stable consumption profiles, the color is yellow; otherwise, when none simulation shows stable dynamics, the color is black. Four area of parameters can be distinguished.

Within the stable dynamics (yellow area), a general feature of the simulation model is that the average consumption profiles of each classes, even though clearly distinct, remain relatively close. When there is no differentiation ($\beta = 0$), the profiles of both classes are identical and fluctuate randomly around zero. An interesting feature is the emergence of two distinct consumption profiles within the upper class, as shown on the left side of figure 2. To detect these two profiles under cognitive limitations (which follow a normal law), we use a distribution-based clustering method. In these cases, the dynamics of both classes become stable after a period of transition. It appears that in absence of imitation a split does not occur, but for low levels of imitation combined with significant levels of differentiation, it does. The splitting process is fast, completed in a few iterations. The split occurs when the upper class reaches a high value of $\theta_2$. Under the effect of cognitive limitations, the proximity of the mean profiles implies that some members of the upper class are likely to misinterpret their environment and find themselves with consumption profiles lower\(^3\) than the average consumption profile of the lower class. Then, the differentiation process, characterized in the splitting cases by high intensity, leads dissident members to leave the lower class by diminishing\(^3\) their consumption profiles. Since the upper class imitates its mean profile, the imitation effect is not strong enough to reunify the upper

\(^3\)Note that this terminology refers strictly to the numerical hierarchy and not to any qualitative ranking among consumption profiles.
class around a unique profile. The splitting phenomenon is a self-reinforcing mechanism.

The dark area in figure 1 corresponds to non-stable states, representative of cyclical
dynamics. In these cases the upper class leads the way. To differentiate itself, the upper
class modifies its consumption profile toward the upper bound, a movement followed after
some time, by the lower class, which creates a pursuit racing dynamics (see section 2). When the consumption profile of the upper class cannot increase further it splits into two
sub-profiles. As soon as enough members of the upper class display a profile lower than
the lower class mean profile, then the imitation process tends to reunify the upper class
around a unique profile. The pursuit racing goes on, but this time toward the lowest
consumption profiles (see right side of figure 2). This pursuit racing phenomenon can be
interpreted as representing a fad or bandwagon effect. The bandwagon effect occurs when
"the demand for a commodity is increased due to the fact that others are also consuming
the same commodity" (Leibenstein, 1950, p.189). In this context, Simmel (1957, p. 543)
states that "the fashions of the upper stratum of the society are never identical with those
of the lower; in fact, they are abandoned by the former as soon as the latter prepares to
appropriate them".

4.2 Diffusion patterns

Figure 3 depicts the diffusion patterns of a specific consumption profile for the three
different levels of imitation and differentiation studied previously. More precisely, figure 3
shows the number of individuals with consumption profiles higher than 0.9 as a function
of time. It is interesting to note that the model generates the S-shape usually found in the
research on behaviour diffusion initiated by Tarde.
The S-curve appears successively for each class, with a time lag. The first S-curve corresponds to adoption of the profile by 10% of the population belonging to the upper class, the second represents adoption by the rest of the population. The speed of diffusion of the profile across the whole population - rate of adoption - is positively correlated with imitation intensity. Comparing the top half of figure 3 shows that the curve generated with an imitation level equal to 0.8 in the top right of the figure, is steeper, that is, adoption is faster, than the curve in the top left corresponding to an imitation level of 0.2.

The bottom half of figure 3 depicts the cyclical dynamics and shows that abandoning a consumption profile has a similar-shaped curve, although it is a reversed-S shape. Note that abandonment of a profile corresponds to adoption of a new one. This symmetry between phenomena is reassuring that cyclical dynamics correspond to fads. Note that the rate of rejection of the profile is systematically higher than its rate of adoption, due mainly to the behaviour of the upper class whose members abandon profiles faster than they adopt a new one, and is explained by their continuing desire for differentiation.

So far, this out-of-prices analysis shows that people’s natural desire for social distinction can be modeled, in a simple way, based on the principles of imitation and differentiation with cognitive limitations. At this stage, the model clearly can be applied to the consumption choices of rich and poor agents, but it can also be generalized to include any types of differentiation behaviours such as Bourdieu’s ”intellectual class” - which distinguishes itself through purchase of cultural goods, or teenager behaviours. We have proposed a general framework for analyzing consumption in a social context, that can be extended to different

Figure 2: Example of profiles evolution. Average consumption profile for both classes with \( n_1/n = 0.9 \). For the upper, when two consumption profiles can be detected, the average of both clusters are computed.
forms of networks.

There are two main results from the model. First, even starting with the same initial consumption profiles, class specific consumption patterns emerge as soon as we include a desire of distinction. The model shows also that, even in presence of differentiation and cognitive limitations, people tend to stabilize around relatively similar consumption profiles. This outcome can be interpreted as homogenization of desires within a social environment, in our case society as a whole. This result corresponds to the definition of society proposed by Tarde (1903, p. 68) as "a group of beings who are apt to imitate one another". According to Tarde, society is imitation and in this sense generates a global homogeneity over the heterogeneity of individuals. He claims that "without the initial and fundamental heterogeneity, the homogeneity which screens and disguises it never would or could have occurred. In fact, all homogeneity is a likeness of parts and all likeness is the outcome of an assimilation which has been produced by the voluntary or non-voluntary repetition of what was in the beginning an individual innovation" (Ibid., p. 71-72).

Figure 3: Frequency of population with preferences $\theta$ higher than 0.9 as a function of time steps with $n_1/n = 0.9$. 

\[
\begin{align*}
\alpha &= 0.2 \quad &\beta &= 0.8 \\
\alpha &= 0.8 \quad &\beta &= 0.8 \\
\alpha &= 0.5 \quad &\beta &= 0.5 \\
\alpha &= 0.5 \quad &\beta &= 0.5
\end{align*}
\]
5 Monetary model with five income classes

In this section we extend the analysis to five classes and apply the model to the housing market. We then compare our results to empirical studies on consumer behaviour.

5.1 The ID model applied to the housing market

There has been a large body of work on signaling theory Bagwell and Bernheim (1996), Basmann et al. (1998), Corneo and Jeanne (1997), Ireland (1994), which study the relevance and impact of demonstration effects - or Veblen effects -, that is, that consumers exhibit a higher willingness to pay for a functionally equivalent good. For example, Bagwell and Bernheim in their remarkable 1996 paper show that “Veblen effects are naturally rationalized within a signaling context” (Bagwell and Bernheim, 1996, p.351). In other words, paying a higher price grants these individuals higher social recognition. Based on this result, we assume that to achieve social distinction, individuals are willing to pay more for a functionally equivalent good.

In this last version of the model, we apply the ID choice process to the housing market. We choose the housing market for two main reasons. First houses are an obvious means of status demonstration. Second, it simplifies the analysis by allowing us to treat offers as a stock and to avoid production issues. We consider horizontally differentiated houses, homogeneously distributed on a segment \([0, 1]\). For simplicity of interpretation, we assume a discrete homogeneous distribution of houses on the segment, such that each location comprises an equal number of available houses. We set the number of available houses equivalent to the number of agents. We include prices and wealth. Agents are distributed among \(c\) wealth classes. Individuals live for only one period. At each period, each individual \(i\) buys one unit of a single good \(j\), according to her consumption profile \(\theta_i\) and constrained by her wealth, assumed to be identical within each class \(c\) and denoted \(R_c\). \(R_c\) also represents the reservation price of each consumer.

The price of each good evolves according to the type and willingness to pay of its consumers. Whenever a consumer cannot afford to buy at least one unit of the good corresponding to her consumption profile \((\theta_i)\), she transfers her consumption to the nearest affordable good, supporting a loss of well-being. We investigate the impact of this dynamics on consumption profiles and agents’ well-being.

We make a distinction between the maximum price each agent can afford \((\overline{R}_c)\), and her conditional willingness to pay \((R^j)\). Each house has a functional and a non-functional
utility. The functional utility \( (w) \) is linked to the ‘qualities inherent in the commodity itself’ (Leibenstein, 1950, p.188), for example the air quality. The non-functional utility represents the social value of the house, that is the well-being individuals get when consuming the good (defined in section 2.2). The utility for agent \( i \) to consume a good of quality \( q \in \{1, \cdots, \infty\} \), at time \( t \), is now defined as:

\[
V_{t}^{i,q} = w(q)(f(|r_{t}|) + |\Delta_{t}|)
\]

\( w(q) \) is continuous, increasing in \( q \), such that the utility of each good of quality \( q \) is a function of both its intrinsic and social utility. Note that low levels of social utility \((f(|r_{t}|) + |\Delta_{t}| < 1)\) cancel out part of the functional utility of a good. The price of each good comprises a functional part and a non-functional part \((P_{j} = P_{j}^{f} + P_{j}^{s})\) such that goods are non-pure Veblen goods. While the functional price is linked to the functional utility and constant all along the dynamics, the non-functional price is linked to the social value of the good and is increasing with the conditional willingness to pay of consumers. If enough people choose the good, the reward from purchasing this good in terms of social status increases and so do both the conditional willingness to pay for it and the non-functional price. In this case, the social mechanism of distinction is reinforced by the evolution of price.

At time zero, prices are such that each agent is able to buy a house. The intuition behind this model is that at time \( t \) each individual chooses a house, defined by its location, according to her consumption profile (determined by the ID processes) and with respect to her budget constraint. Then, everyone takes stock: if enough people from one class have chosen the same good, its social value increases and the willingness to pay for it rises proportionally with the type of consumers, that is according to the social class. Whenever a location is not chosen by any one, its social value decreases and the willingness to pay for it converges toward its functional price. At time \( t + 1 \), a new generation of households appear, and the ID process takes over. The dynamics of the conditional willingness to pay

\footnote{This structure was inspired by Leibenstein (1950)’s decomposition of the motivations for consumer demand.}
is in line with Pesendorfer (1995)'s findings on fashion cycles.

\[ R_{t+1}^j = \begin{cases} 
  P_F^j & \text{if } Q_{i,t}^j < \bar{Q}_{max} \cdot n_c \text{ with } c \geq c_j \\
  P_F^j - \mu(P_F^j - P_F^j) & \text{if } Q = 0 \\
  \bar{R}_c - \mu(\bar{R}_c - P_F^j) & \text{if } Q_{i,t}^j \geq \bar{Q}_{max} \cdot n_c \text{ with } c \geq c_j 
\end{cases} \tag{12} \]

where \( P_F^j \) is the price of good \( j \) at time \( t \), \( P_F^j \) is the functional price of good \( j \) and \( \bar{R}_c \) is the reservation price of class \( c \). \( \bar{Q}_{i,t}^j \) is the quantity of good \( j \) purchased by the class of individual \( i \) at time \( t \). \( \bar{Q}_{max} \cdot n_c \) is the threshold-quantity (equal for all goods) of goods purchased by the class of individual \( i \), which induces an increase in price (\( \bar{Q}_{max} \in ]0; 1[ \)). That is, when at least \( \bar{Q}_{max} \cdot n_c \) people belonging to classes greater to or equal to agent \( i \)'s class purchase good \( j \), the conditional willingness to pay of agent \( i \) increases toward her total wealth \( R_{c,i} \). Note that \( \bar{Q}_{max} \) can be interpreted as a measure of the Veblen effects, the lower \( \bar{Q}_{max} \), the sooner the price increases with \( Q_{i,t}^j \), and thus the higher the Veblen effects. Finally, \( \mu \) is a factor of willingness to pay evolution, fixed at 0.95.

The simulation model investigates, alternatively for two and five wealth classes, the dynamics of individual well-being under cognitive limitations for different states of imitation intensity, differentiation intensity and wealth inequality (low, intermediate and high differences in wealth). In the five-classes model, population is normally distributed among classes: the lower-class, the lower-middle-class, the middle-class, the upper-middle-class and the upper-class. Higher wealth inequality is modeled as a decrease in the median wealth (i.e. an increase in wealth of the top classes: upper-middle-class and upper-class). We also compare a model with homogeneous goods to a model with differentiated goods. In the differentiated case, we assume that houses are ordered from low to high quality on \([0, 1]\). We find that, everything equal, agents are better off in the homogeneous case. In this setting, agents allocate only according to their social utility and cluster by income classes, each income class displays more than one cluster, such that social diversity exists in space, we may call it soft segregation. At the opposite in the differentiated case, when quality increases, as we approach 1, segregation becomes hard, clusters are orders by income levels on the axis \([0, 1]\). Lower classes purchase low quality goods, and only upper classes access the higher qualities. For the rest of the analysis, we focus on the differentiated case.

Let us introduce the concept of social competition. Hopkins (2008, p. 352) proposed that ‘if life is a tournament where prizes are awarded to a society’s winners, it would be
rational to seek high social position”. Consider our framework from the perspective of competition: people compete for social distinction by adjusting their choices with respect to their social environment. Note first that competition for social distinction is deeper for higher level of inter-classes comparisons, that is for high level of \( \alpha \). In the non-monetary model, this competition ends up with small differences between the consumption profiles of the two social groups considered whatever \( \alpha \). However, as soon as we include prices and wealth inequality, the structure of competition changes, giving the rich a competitive advantage and increasing the gap between upper and lower class’ consumption profiles. The implications of wealth inequality on well-being are analyzed in this section.

We have already highlighted that in the non-monetary framework, the bandwagon phenomenon is led by the upper class. In the monetary model with two classes, the upper class is also leaders, in the sense that its satisfaction determines the model equilibrium, that is, on which location and at what price level each group will stabilize its demand.

In the model with five classes, whatever the level of wealth inequality, the lower-class is excluded from the market. As wealth inequality increases, the lower-middle class also finds its members enable to purchase a house. This result is in accordance with empirical data which show that the bottom 50% of the wealth distribution does not reach the immovable property (Piketty, 2014). In total, variations in social welfare are driven by the middle-class dynamics of well-being. This result comes from the dominant relative weight of the middle class in the total population. The interesting point is that the middle class appears as the one which supports the largest dissatisfaction, with exception made for the excluded class(es), whatever the characteristics of the model. Indeed, being stuck between its desire to emulate upper classes and its willingness to differentiate from the lower ones, effective consumption is never in accordance with primary choice for the middle class.

The study of the dynamics of middle-class well-being shows that reducing wealth inequality does not have a significant impact on its satisfaction, especially for high level of imitation (Figure 4). Middle-class dissatisfaction significantly decreases only when its budget reaches a level equivalent to the upper-middle class. For low levels of imitation, the well-being of the middle-class is lower when inequalities are low. Indeed, differentiation dynamics takes the lead on imitation, since wealth inequality is too low to exclude the lower-middle-class from the market, differentiation pushes middle-class to aspire to houses which it cannot afford buying. For high values of imitation, differences in well-being due to wealth inequality vanish, the only factor determining satisfaction being how far one is from its aspiration group.
The main determinant of middle-class well-being appears to be the imitation intensity, that is, the desire to emulate the consumption behaviour of social models (Figure 5). As a general result, as long as the desire to emulate upper classes is present, any level of wealth inequality among classes creates a disutility for lower classes. This disutility is stronger for the middle class for which the upper class consumption profile has a higher relative weight. The gap between middle class effective consumption and its consumption standard is thus the highest in the society. This gap is increasing in $\alpha$, that is, in societies where demonstration effects are high. Indeed, for low levels of $\alpha$ the middle class satisfaction increases significantly, whatever the state of wealth inequality and differentiation intensity (figure 5).

5.2 Evidence on imitation intensity and reference groups

The predominant role of imitation intensity and of the composition of reference groups in the dynamics of individual well-being is in accordance with empirical studies on consumers’ behaviour. Schor (1998) finds a positive correlation between the time allocated to watching

\[ \beta = 0.5 , \alpha = 0.2 \quad \text{and} \quad \beta = 0.5 , \alpha = 0.8 \]

Figure 4: Middle class loss of well-being for different states of wealth inequality: low inequality (lightgray), intermediate inequality (gray), high inequality (black)).
Figure 5: Middle class loss of well-being for different states of imitation and differentiation intensities ($\alpha = 0.2$ (lightgray), $\alpha = 0.5$ (gray), $\alpha = 0.8$ (black)) and intermediate state of wealth inequality.
television and spending. She states that “the more TV a person watches, the more he or she spends. The likely explanation for the link between television and spending is that what we see on TV inflates our sense of what is normal. The lifestyles depicted on television are far from the average American’s: with a few exception, TV characters are upper-middle-class, or even rich” (p.80). She adds that “it is partly because of television that the top 20 percent of the income distribution, and even the top 5 percent within it, has become so important in setting and escalating consumption standards for more than just the people immediately below them” (p.81). Her findings are in accordance with previous studies on the subject conducted by O’Guinn and Shrum (1997) who find that “heavy exposure to the consumption-rich portrayals of television programming is significantly associated with beliefs about what other consumers have and do” (p.289). In our model, the escalating consumption standards are formalized by the parameter $\alpha$, the higher it is, the more influential is the aspiration group. Our results that high values of $\alpha$ generate bigger dissatisfaction match O’Guinn and Shrum (1997) and Schor (1998) findings. High values of $\alpha$, that is high influence of the agent’s aspiration group, can be seen as the diffusion of upper-middle-class and upper-class models by the mass media.

It is worth highlighting that, nowadays, reference groups tend to embody not only “real” people but also models providing by advertising and TV shows. However, as highlighted by Schor (1998), when compared with the real reference groups, the virtual ones are less likely to comprise people who all earn approximately the same amount of money. She states that “our real-life friends [...] have been joined by our media ‘friends’. We watch the way television families live, we read about the lifestyles of celebrities and other public figures we admire, and we consciously and unconsciously assimilate this information” (Schor, 1998, p.5). The problem with these new reference groups lies in the fact that “while the real demonstration effects in a neighborhood are constrained by budgets, the fictional demonstrations in the media are not” (Cynamon & Fazzari, 2008, p. 10). Combinations, which are not in accordance with her budget constraint, are thus likely to appear in the individual’s consumption standard, when based on virtual reference groups. Thus, the development of communication and entertainment technologies reinforced the mechanism described in the present paper, increasing households’ temptation to operate a relaxation of their budget constraint using consumer credit.
5.3 Policy implications

Among all the determinants of the model, only the level of wealth inequality can be influenced by governmental policy. There are two main possibilities to lower wealth inequality: re-distribution, and household credit. There are several points relevant to wealth re-distribution. First, as already highlighted, a decrease in wealth inequality has only a low impact on individual satisfaction when inter-class comparisons are high (high level of imitation). Second, we find that only high levels of wealth taxation are efficient to correct the high levels of inequality. In fact, the surplus of wealth generated by the redistribution from a few rich people to a large number of poor is negligible at the recipient level, so that a contraction in the gap between rich and poor can be achieved only through a significant decrease in upper classes wealth. The second solution, consisting of a direct increase in the purchasing power of the poor by giving them access to credit, is efficient, but generates the symmetric limits as re-distribution. The flip side to this second solution is the emergence of individual indebtedness, which has to be treated with caution. In particular, for high levels of wealth inequality, lower classes have to increase their budget up to the level of the nearest upper class to be significantly better-off. Such a significant increase of the household debt constitutes a threat for the stability of the economic system. Indeed, Cynamon and Fazzari (2008), who have documented the sources of rising purchasing power in the United States since the 1970s, provide evidence on American households’ consumption choices and economic growth. They show that the United States experienced a long period of consumption-driven growth supported by a relaxation of budget constraints through extended credit access; which trend continued until the explosion of household debt, plunged the world economy into recession in 2008.

6 Concluding remarks

In this paper we have developed a simple model of consumption choice built on well-established social behaviours. We find that the process of preferences formation, when based on imitation and differentiation under cognitive limitations, endogenously generates class-specific consumption profiles. In particular, the dynamics reveals two main outcomes of these social processes: situations of consumption specialization by social class, and situations of successive bandwagon phenomena driven by the upper classes continuous desire for distinction. In a model including prices and wealth inequalities, we consider competition
among consumers to obtain social recognition. We find that the rise in the consumption standard of individuals, driven by demonstration effects, creates a dissatisfaction which does not fall proportionally with the reduction of wealth inequality.

Subjective well-being, when based on inter-individual comparisons, implies antagonist decision processes among wealth groups. The resulting dynamics of individual satisfaction shows that, as long as there is wealth inequality, dissatisfaction always exits for lower classes when demonstration effects are high. Dissatisfaction evolves jointly we consumption standard, such that higher standard brings bigger dissatisfaction. This phenomenon is an explanation for consumers indebtedness.

Overall, the present study highlights that social interactions matters and can give rise to welfare loss not only through consumption of pure Veblen goods, such as diamonds or haute couture, but through any type of visible goods. Although the social network we modeled is rudimentary, we would suggest that we have proposed a tractable methodology to formally analyze the impact of social phenomenon, especially imitation and demonstration effects, on economic aggregates such as well-being, prices and household indebtedness.

Appendix

Boundary behaviours, calculus of the dynamics.

\[ \Theta_{t+1} = A \Theta_t + B \]

with \( A = \begin{bmatrix} 1 - \alpha_k & \alpha_k \\ \beta & 1 - \beta \end{bmatrix} \) and \( B = \begin{bmatrix} 0 \\ \beta \delta \end{bmatrix} \)

The profiles are given by the relation: \( \Theta_t = A^t \Theta_0 + \sum_{i=0}^{t-1} A^i B \). For all \( i \geq 0 \),

\[ A^i = P \begin{bmatrix} 1 & 0 \\ 0 & \lambda^i \end{bmatrix} P^{-1} \]

with \( \lambda = 1 - (\alpha_k + \beta) \), \( P = \begin{bmatrix} 1 & \alpha_k/\beta \\ 1 & -1 \end{bmatrix} \)

and

\[ P^{-1} = \frac{1}{1 + \alpha_k/\beta} P \]

From which, for all \( i \geq 0 \),

\[ A^i = \frac{1}{1 + \frac{\alpha_k}{\beta}} \begin{bmatrix} 1 + \frac{\alpha_k}{\beta} \cdot \lambda^i & \frac{\alpha_k}{\beta} \cdot (1 - \lambda^i) \\ 1 - \lambda^i & \frac{\alpha_k}{\beta} + \lambda^i \end{bmatrix} \]

27
and the sum of the $A^t$:

$$
\sum_{i=0}^{t-1} A^i = \frac{1}{1 + \frac{\alpha_k}{\beta} \frac{1-\lambda^i}{1-\lambda}} \left[ 1 + \frac{\alpha_k}{\beta} \frac{1-\lambda^i}{1-\lambda} \right]
$$

Starting from the initial state with $\theta_0^1 = \theta_0^2 = 0$, we obtain that

$$
\begin{align*}
\theta_t^1 &= \frac{1}{1 + \frac{\alpha_k}{\beta} \frac{1-\lambda^t}{1-\lambda}} \cdot \alpha_k \cdot \delta \cdot \left( 1 - \frac{1-\lambda^t}{1-\lambda} \right) \\
\theta_t^2 &= \frac{1}{1 + \frac{\alpha_k}{\beta} \frac{1-\lambda^t}{1-\lambda}} \cdot \beta \cdot \delta \cdot \left( \frac{\alpha_k}{\beta} + \frac{1-\lambda^t}{1-\lambda} \right)
\end{align*}
$$

(13)

References


<table>
<thead>
<tr>
<th>Year</th>
<th>Author(s)</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-01</td>
<td>Raphaël Chiappini</td>
<td>Persistence vs. Mobility in Industrial and Technological Specialisations: Evidence from 11 Euro Area Countries</td>
</tr>
<tr>
<td>2013-02</td>
<td>Kevin D. Hoover</td>
<td>Was Harrod Right?</td>
</tr>
<tr>
<td>2013-03</td>
<td>Kevin D. Hoover</td>
<td>Man and Machine in Macroeconomics</td>
</tr>
<tr>
<td>2013-04</td>
<td>Isabelle Corbett-Etchevers &amp; Aura Parmentier-Cajaiba</td>
<td>Toying with Regulation: 'Strategizing Tools' as Organizational Bricolage</td>
</tr>
<tr>
<td>2013-05</td>
<td>Aura Parmentier-Cajaiba</td>
<td>Research Diary Mapping: Enhancing Reflectivity in Process Research</td>
</tr>
<tr>
<td>2013-06</td>
<td>Richard Arena</td>
<td>Sraffa’s and Wittgenstein’s Crossed Influences: Forms of Life and Snapshots</td>
</tr>
<tr>
<td>2013-08</td>
<td>Cristiano Antonelli &amp; Alessandra Colombelli</td>
<td>Knowledge Cumulability and Complementarity in the Knowledge Generation Function</td>
</tr>
<tr>
<td>2013-09</td>
<td>Marco Grazzi, Nadia Jacoby &amp; Tania Treibich</td>
<td>Dynamics of Investment and Firm Performance: Comparative Evidence from Manufacturing Industries</td>
</tr>
<tr>
<td>2013-10</td>
<td>Anna Calamia, Laurent Deville &amp; Fabrice Riva</td>
<td>Liquidity in European Equity ETFs: What Really Matters?</td>
</tr>
<tr>
<td>2013-11</td>
<td>Laurent Larrouy</td>
<td>Bacharach’s ‘Variable Frame Theory’: A Legacy from Schelling’s Issue in the Refinement Program?</td>
</tr>
<tr>
<td>2013-12</td>
<td>Amel Attour</td>
<td>Adoption et modèles de diffusion régionale de l’innovation dans les gouvernements locaux: le cas du développement de l’e-Gouvernement en Lorraine</td>
</tr>
<tr>
<td>2013-13</td>
<td>Anaïs Carlin</td>
<td>Modeling Luxury Consumption: An Inter-Income Classes Study of Demand Dynamics and Social Behaviors</td>
</tr>
</tbody>
</table>