Changing Your Role Models: Social Learning and the Engel Curve

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ABSTRACT

By relating Engel curves and social learning, this paper explains the existence of differently shaped Engel curves – an interesting phenomenon in the theory of demand. A formal approach to cultural learning within a population of consumers accounts for some of their cognitive foundations. We find that a changing influence of an individual's role models due to her increasing income, which entails new reference groups providing social identity, leads to the diffusion of new consumption behaviors. Thereby, the resulting Engel curves' shape depends on the underlying learning dynamics. The approach contributes to an explanation of structural change and economic development.

Keywords: Consumer Behavior – Engel Curve – Cultural Evolution – Learning – Demand Theory

JEL Classifications: D11, D83, B41, C61

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I. INTRODUCTION

This paper relates social learning and Engel curves. An Engel curve describes how consumers' purchases of a good or service vary as the consumers' total resources such as income vary holding prices fixed (Lewbel, 2008). The existence of differently shaped Engel curves is an interesting phenomenon in the theory of demand (e.g., Hausman et al., 1995; Banks et al., 1997).[1] We present a formal approach that accounts for some of their cognitive and behavioral foundations. Thereby, we contribute to an explanation of structural change and economic development that are, to a great extent, the result of systematically changing consumption patterns as per capita income rises.

Economics has begun to integrate aspects of social learning into the modeling of human behavior (e.g., Kuran, 1987; Frey, 1992; Frank, 1997; Brock and Durlauf, 2007). Accordingly, we postulate that agents' behavioral repertoires are crucially influenced by processes of social learning, especially by certain role models in their environment (Bandura, 1986; Richerson and Boyd, 2005). This accounts for an essential characteristic of human nature, namely that of being subject to change as a result of cultural learning. We explicitly analyze interpersonal and social context effects on consumer demand (e.g., Granovetter and Soong, 1986; Verhallen and Robben, 1995). Moreover, rather than examining utility functions directly, we make assumptions about social learning dynamics in, and cultural specificities of, social groups. Finally, this view underscores the importance of behavioral change and learning in the process of economic development (e.g., Stiglitz, 2002).

By characterizing social learning processes taking place within populations of consumers, we derive differently shaped Engel curves that are close to linear in same cases and highly nonlinear in others. Engel curves also allow us to calculate the income elasticity of demand, which is an important aim of empirical demand analysis. The theoretical model presented below will specify how income elasticities vary with income, thereby differentiating between different classes of commodities including inferior goods in an unified framework. Among other things, it is shown how the changing influence of role models in social learning leads to highly income elastic Engel curves that can explain some empirically observed patterns of demand.

The paper proceeds as follows. Section 2 develops a simple model of cultural evolution within a population of consumers, i.e., consumer behavior is presented in terms of social

[1] Ernst Engel (1895) was the first to study the systematic relationship between household expenditures and income.

learning. Several Engel curves are derived from the model's dynamics in Section 3. Next, Section 4 discusses the model's implications as to income elasticities of demand, nonlinearly varying weights of role models, and inferior goods. Empirical phenomena that can be better understood with the help of the model are the subject matter of Section 5. Section 6 concludes the paper.

2. THE MODEL

We look at the case where the individual is faced with only two commodities or consumption behaviors. To model the cultural transmission of two alternative consumption behaviors via social learning, we begin by labeling the variants, say a and b. For illustration, assume a representing the variant "modern consumption behavior" and b the variant "traditional consumption behavior". Think of, for example, a developing country's society that hitherto has been characterized by a consumption regime based on domestic, traditional commodities and that is now opened to international trade and new, "modern" consumption patterns. The state of the population is determined by the frequency of consumers with the variant a, labeled p. Moreover, the model comprises processes that change the frequency of the two cultural variants: reflecting humans' evolved psychology, cultural transmission processes are biased; people tend to socially acquire some cultural variants rather than others (Richerson and Boyd, 2005, p. 69). The model incorporates two biases of social learning, a role model and a conformity bias.

Anthropological evidence indicates that the adoption of cultural variants is conditioned by the observable attributes of individuals exhibiting the variant (e.g., Harrington Jr., 1999). In human phylogeny, selection favored social learners who were able to evaluate potential models and copy the most successful among them, thereby saving the costs of individual learning (Rogers, 1983; Boyd and Richerson, 1985; Henrich and Gil-White, 2001; Labov, 2001). Hence, in model-based learning there is a predisposition to imitate successful or prestigious individuals, i.e., there exists a *model-based bias* in cultural transmission.

Another evolved learning bias is what anthropologists refer to as the *conformist bias* (Aronson et al., 2002, ch. 8; Cialdini and Goldstein, 2004; Kameda and Diasuke, 2002; Henrich, 2004). Due to this bias, agents pick the cultural variant, i.e., in our context, a certain consumption behavior, that is used and accepted by the majority of models in a population, whereas they discriminate against behaviors that are rare in the local population. Conformist transmission

belongs to the class of frequency-dependent biases. It increases the likelihood of adoption of locally favored cultural variants especially if the environment changes slowly and the information available to an individual is poor (Boyd and Richerson, 1989).

We assume that a consumer is influenced by a set of cultural role models consisting of one "modernizer" and two "traditionalists". The cultural role model M1, the "modernizer", is assumed to always show behavior a, i.e., this agent or medium is exclusively exhibiting the "modern" consumption behavior. On the other hand, role model M3 exclusively exhibits the "traditional" consumption behavior. These two models represent a society's conflicting behavioral forces. Finally, role model M2 may show either behavior, i.e., this "traditionalist" is willing to possibly switch to behavior a. To depict the models' importances in different social roles in the cultural transmission process, we assign different weights to them, A_M for the agent showing the "modern" consumption behavior and A_T for two members of the population when both are proponents of the "traditional" consumption behavior, whereby $A_M + A_T = 1$. A large value of A_i means that the consumer is disproportionately likely to acquire the consumption behavior of this/these model/s. We argue below that the "modernizer's" influence as a role model is increasing with income available to the population of consumers.[2] Therefore, her weight, A_M, is assumed to be dependent on income y:

$$A_M = \frac{y\alpha_M(1 \pm D)}{(\alpha_T + y\alpha_M)(1 \pm D)}, \tag{1}$$

where α_M is the basic weight of the "modernizer" that may depend on an individual's social role, charisma, or prestige. In addition, α_T represents the basic weight of two members of the "traditional" peer group, whose total weight is given by

$$A_T = \frac{\alpha_T(1 \pm D)}{(\alpha_T + y\alpha_M)(1 \pm D)}. \tag{2}$$

[2] We abstract from distributional issues here: an increase in the population's income leads to proportional increase of a single member's income.

Consequently, the actual weight of the ith model depends on (1) her basic weight α_i ($\sum_i \alpha_i = 1$), (2) population income y, and (3) the commonness of her behavioral variant in the set of models, expressed by the conformity bias parameter D. We assume $-1 \leq D \leq 1$, i.e., if $D > 0$, cultural transmission creates a force increasing the "majority model's" weight and thus the frequency of the more common variant in the group (our conformist bias or "bandwagon effect", see Leibenstein, 1950). If $D < 0$, transmission increases the frequency of the rarer variant in the population (which would introduce an "anti-conformist" force or "reverse bandwagon effect"). Finally, the weights of the "modernizer" and the "traditionalists" are normalized by the denominator so that A_i gives the weight of the ith model relative to the other models encountered by the individual in question.

Moreover, we assume that the importance of different cultural role models in an individual's social environment changes with her income.[3] Reaching higher income classes implies new norms as to how people think that they and their reference group should behave/consume.[4] In this context, social identity plays a crucial role for it indicates an agent's social category and corresponding self-image (Akerlof and Kranton, 2005). An individual's reference group functions as a provider of positive social identity through comparing itself with, and distinguishing itself from, other comparison groups along salient dimensions that have an easily observable value differential, such as, for example, income (see Commins and Lockwood, 1979; Tajfel, 1982; Frank, 1997; Neumark and Postlewaite, 1998). Consumption norms, style of living, manner, speech, and transaction partners among other things vary with social categories. Moreover, these characteristics are often described by referring to archetypal role models who represent appropriate behavior in a given social category. If role models are from a "matching identity", their observed behaviors are positively weighted in cultural transmission. After having reached an income class that enables an agent to join, for example, the local golf club, she will get into closer contact with – and will be influenced by – this reference group's role models as well as the corresponding consumption norms and will be likely to adopt great parts of them. As a result, one observes wide commonalities in the style of living among these interacting club

[3] Also demographic changes can modify the influences of role models in cultural transmission.
[4] For ease of formal analysis, we do not consider income classes but a continuous range of income.

members.[5] We claim that an individual's social identity and self-categorization changes as her income increases, which entails a modified influence of cultural role models in social learning.

Next, to characterize the evolution of a population of consumers, the model must allow us to predict the changes in the frequency of consumption behaviors in the course of time. This is done by specifying the probability that a particular set of role models makes an individual acquire a certain consumption behavior. We first assume that the parameter D is greater than zero, i.e., it favors the cultural variant that is more common among the set of role models.[6] Given our assumptions, the cultural transmission table showing the probability of agents acquiring behavior a or b, given a particular set of models (Modernizer M1, Traditionalists M2 and M3) that have different total weights (A_M, A_T) yields:

Table 1 The probability of agents acquiring consumption behavior a or b given a particular set of models (M1, M2, M3) that have different basic weights (α_M, α_T), population income y, and conformist cultural transmission (bias parameter D).

Consumption Behavior of			Probability That Agent Acquires Consumption Behavior	
M1	M2	M3	a	b
a	a	b	$\frac{(y\alpha_M + 0.5\alpha_T)(1+D)}{y\alpha_M(1+D)+1-\alpha_M}$	$\frac{0.5\alpha_T(1-D)}{y\alpha_M + y\alpha_M D+1-\alpha_M}$
a	b	b	$\frac{y\alpha_M(1-D)}{y\alpha_M(1-D)+1-\alpha_M + D(1-\alpha_M)}$	$\frac{\alpha_T(1+D)}{y\alpha_M(1-D)+1-\alpha_M + D(1-\alpha_M)}$

Furthermore, to account for socialization processes that preserve traditional consumption patterns in a society, we assume that sets of models will not be formed at random; rather, among an individual's "cultural parents", conservative individuals showing behavior b will tend to aggregate (Cavalli-Sforza and Feldman, 1981; Boyd and Richerson, 1985, p. 211). For instance, among members of the biological parent generation, traditional or conservative behaviors are likely to be more frequent and among partners characters such as political and religious affiliation or consumption patterns are highly correlated. The model captures assortative formation of sets

[5] On the one hand, a higher income entails the selection of new role models by an agent. On the other, a higher income enables the copying of models that previously were irrelevant for consumption decisions.
[6] We will also look at non-conformist transmission ($D < 0$) in the next section.

of models by a constant correlation, denoted by r ($0 \le r \le 1$), between the consumer behavior of two of the models (M2 and M3), while the behavior of the "modernizer" M1 is uncorrelated with the behavior of the other cultural parents. Then, the probability that each set is formed is as given in Table 2.

Table 2 The probability that each of the possible sets of cultural role models form when the sets may form nonrandomly.

Set of Models			
Uncorrelated Model	Correlated Models		Probability of Formation of Set of Models
M1	M2	M3	
a	a	b	$p(1-r)$
a	b	b	$(1-p)(1-r)+r(1-p)$ $=1-p$

We now derive a recursion equation in discrete time that determines the frequency of p, i.e., the share of a-consumers in the population, in the next time step, given the value of p in this period. For example, from Table 1, let $P(a|aab)$ denote the conditional probability that a consumer acquires behavior a given exposure to models with variants a, a, and b. In addition, from Table 2, the probability of such a constellation of models is given by $p(1-r)$. Then, the frequency of a after transmission, p', given that it was p before transmission, is

$$p' = p(1-r)\{P(a|aab)\} + (1-p)\{P(a|abb)\}. \tag{3}$$

This term computes the frequency of each different set of social models (M1, M2, M3), multiplies this by the probability that a particular set of social models results in an individual acquiring a certain consumption behavior, and then sums over all possible sets of social models.

Note that M1 and M3 show behavior a and b respectively with probability 1. Inserting the conditional probabilities, we can rewrite this equation as follows ($\alpha_T = 1 - \alpha_M$):

$$p' = p(1-r)\left\{\frac{(y\alpha_M + 0.5(1-\alpha_M))(1+D)}{y\alpha_M(1+D)+1-\alpha_M}\right\} + (1-p)\left\{\frac{y\alpha_M(1-D)}{y\alpha_M(1-D)+1-\alpha_M+D(1-\alpha_M)}\right\}. \quad (4)$$

By setting the parameters of the system, we can analyze its long run behavior by iterating equation (4) recursively for many learning steps. Moreover, we can now calculate the equilibrium frequency of consumption behavior a in the population. At equilibrium the population does not change, so $p' - p = 0$. We subtract p from both sides of (4) and determine the equilibrium by solving for $\hat{p}$ denoting the equilibrium frequency of consumption behavior a:[7]

$$\hat{p} = \frac{\alpha_M y(D-1)}{\left[1+D+\alpha_M(y-1+D(-y-1))\right]\left[\frac{\alpha_M y(D-1)}{1+D+\alpha_M(y-1+D(-y-1))} + \frac{(1+D)(1-r)(0.5+\alpha_M(y-0.5))}{1+\alpha_M(y+Dy-1)} - 1\right]}. \quad (5)$$

It is possible to derive some interesting insights concerning agents' changing consumption behaviors from this model, especially as reflected by income-consumption relations or Engel curves to which we turn now.

3. THE ENGEL CURVES GENERATED BY THE MODEL

Dependent on the social learning processes taking place within a population of interacting consumers, we observe differently shaped Engel curves. Figure 1 (a-f) visualizes the Engel curves derived from equation (5) for different parameter values for r, D, and α_M. On the y-axis, the share of consumers of good a, $\hat{p}$, in the population is given. This translates into total amount consumed when we assume that people consume a certain amount of this commodity

[7] The equilibrium at $\hat{p}$ (equation 5) is stable for the value of the derivative of equation 4 with respect to p when $p = \hat{p}$, $\frac{\partial p'}{\partial p}\Big|_{\hat{p}}$, is less than 1 and greater than -1 for $-1 \le D \le 1$, $0 \le r \le 1$, $0 \le y \le 1$, and $0 \le \alpha_M \le 1$.

during a certain time span.[8] On the x-axis, we plot income y ranging from 0 to 1, i.e., we assume a hypothetical maximum income normalized at $y = 1$, where the influence of role model M1 in cultural transmission is maximized. In the following, we discuss several types of societies characterized by different income-specific social learning dynamics. It is shown that these can account for nonlinearities in the shape of Engel curves.

We may call a society an "open society" if the conservative forces, measured by the "socialization" parameter r, are low ($r = 0.01$), the conformity bias D exerts no influence ($D = 0$), and a popular role model M1 ($\alpha_M = 0.7$) can promote the consumption of commodity a, i.e., the "modern" consumption behavior. This would be a society open to innovation, while granting a high degree of autonomy to its members. The new behavior exhibited by the role model M1 then attracts fast diffusion without social opposition. Given these settings, we obtain the Engel curve shown in Figure 1 (a). The increases in the share of a-consumers are decreasing with a growing income y available to the consumers. The rise in $\hat{p}$ is strongest when the variance in the distribution of a- and b-consumers in the population is high, i.e., when there are many pairings of models holding different sets of behavior.[9] Due to the diminishing increases in $\hat{p}$, we observe asymptotic properties of the Engel curve.

An "open, collectivist society" may be characterized by a strong conformity bias ($D = 0.7$), while the conservative forces in socialization are low ($r = 0.01$). The corresponding Engel curve is given by Figure 1 (b). In this case, the society would again be open to innovation. However, the individual consumers are subject to social pressures exerted by the majority. While the initial increases in the share of a-consumers are lower than in the case of the "open society", the level of "modern" consumers finally reached is higher. Conformity first hinders the diffusion of commodity a due to the fact that the sets of role models encountered by an individual mostly consist of a majority of b-consumers. Later on, the bias favors consumption behavior a after it became more common in the population than behavior b.

In contrast, the "modern" consumer behavior a is only adopted by a small share of consumers in a "conservative society", where conformity is strong ($D = 0.8$), the weight of M1 is relatively low ($\alpha_M = 0.4$), and the influence of a conservative "cultural parent generation"

[8] Since we take a population perspective in our approach, we do not face the aggregation problems prominent in the literature on Engel curves. Our Engel curves represent macroeconomic demand relationships.
[9] The variance is maximized when both behaviors are equally common.

favoring the traditional consumption pattern is high ($r = 0.8$). This would be a society with strong social control and a negative attitude toward the introduction of novelty giving rise to rigidities in consumer behavior. Within the range of income observed here, the resulting Engel curve is close to linear, as can be seen in Figure 1 (c). The conformity bias D and the correlation factor r prevent the spreading of the "modern" consumption behavior a.

In an assumed "open, individualistic society" the conformity bias parameter would favor the rarer consumption behavior in the population ($D = -0.8$), i.e., consumers would prefer to not behave like the majority of consumers. Such a "snob effect" or "anti-conformist" force in consumption motivates people to refrain from buying a good *because* others are consuming it (Leibenstein, 1950). This leads to steep increases in the share of a-consumers in the beginning of its dissemination via M1 ($\alpha_M = 0.5$, $\hat{p} = 0$ in the beginning) among members of the population, i.e., a great initial slope of the Engel curve in Figure 1 (d), when consuming commodity a still is an appropriate means to differentiate oneself from the majority of consumers. Finally, given our parameter values here, for two commodities, the market is divided into two roughly equal parts. One can imagine subsequent market partitions taking place in the submarkets if we look at cases with more than two commodities. We would then observe a great variety of goods/behaviors in a population of consumers driven by their desire to differentiate themselves from others.

A close to linear Engel curve is also yielded for "moderate" parameter values ($D = 0.4$, $\alpha_M = 0.3$, $r = 0.2$) as shown in Figure 1 (e). Finally, Figure 1 (f) provides an overview of the Engel curves discussed here. In fact, empirically observed Engel curves are close to linear in some cases, and highly nonlinear in others (see Hausman et al., 1995; Banks et al., 1997).

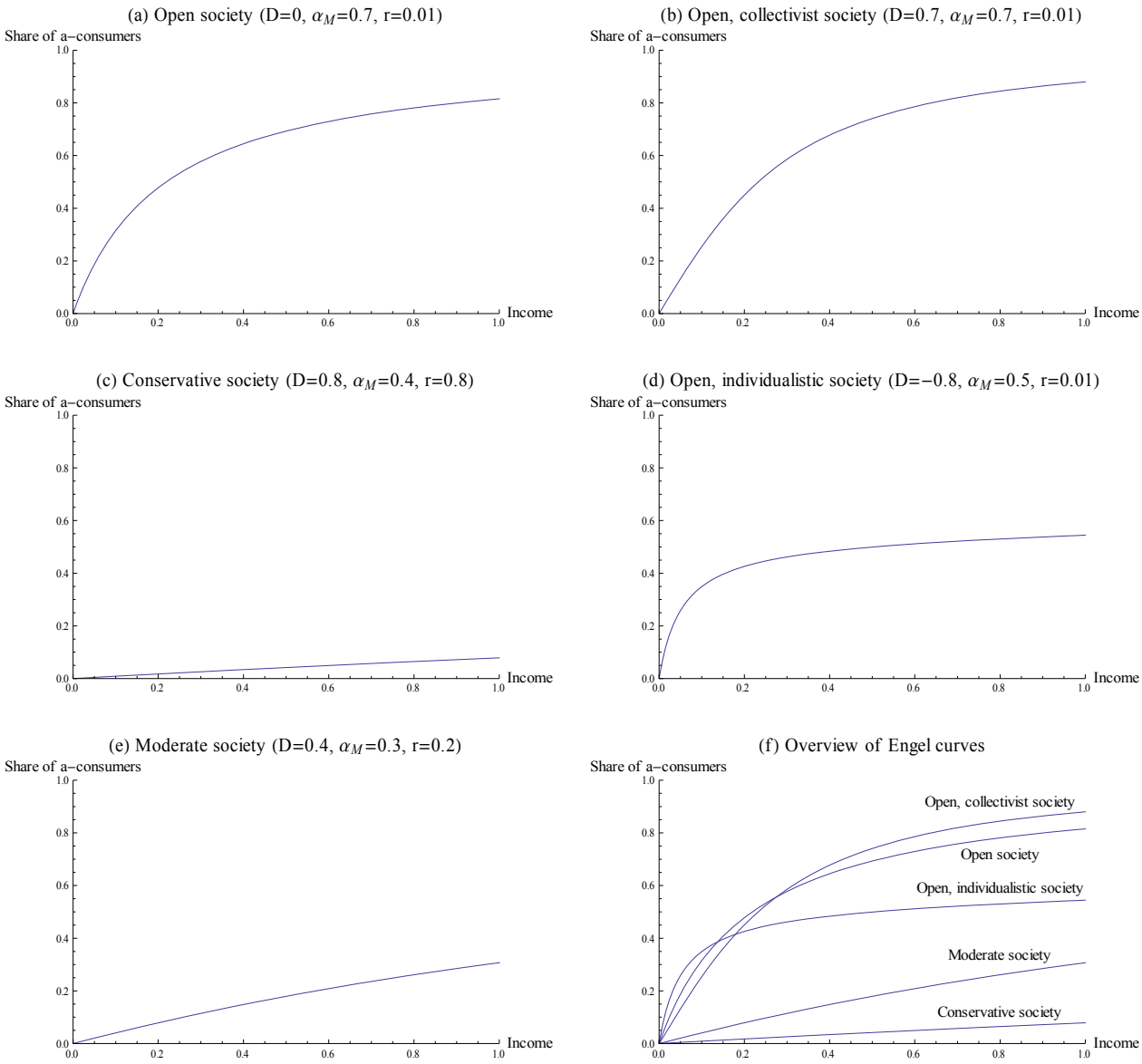

Figure 1 The shapes of the Engel curves generated by the model.

These results constitute the central implication of our theory, which we restate as proposition 1.

Proposition 1: Other things the same, a changing influence of an individual's role models in cultural transmission due to her increasing income, which entails new reference groups providing a matching social identity, leads to the diffusion of new consumption items/behaviors in a population. Thereby, the resulting Engel curves' shape depends on the social learning dynamics in that group of interacting consumers.

Our approach accounts for consumption behaviors that differ across societies and provides a potential theoretical explanation of diverging consumption patterns under converging incomes. Moreover, if Engel curves change substantially over time even during periods of stable prices and incomes, for which there is some evidence, see Härdle and Jerison (1991), we need other explanatory approaches, such as avenues based on social learning dynamics. We may observe evolving Engel curves when the underlying cultural learning forces change over time. Furthermore, the model could be applied to grasp different demand patterns for different goods or services that may be subject to idiosyncratic learning dynamics. Engel curves may be close to linear for some goods and highly nonlinear for others depending on these dynamics.

4. INCOME ELASTICITIES OF DEMAND, NONLINEARLY VARYING WEIGHTS OF ROLE MODELS, AND INFERIOR GOODS

The derivation of income elasticities is an important aim of empirical demand analysis. Engel curves can be used to calculate the income elasticity of demand, which is, in our case, the proportional change in quantity of commodity a purchased measured by $\hat{p}$ divided by the proportional change in income (e.g., Hirshleifer and Glazer, 1992, p. 118). Accordingly, equation (6) measures the income elasticity of demand for commodity a, ε_a, as the percent change in $\hat{p}$ that results from a one percent change in y:

$$\varepsilon_a = \frac{\partial \hat{p}}{\partial y} \cdot \frac{y}{\hat{p}}. \tag{6}$$

Figure 2 (a) and (b) provide overviews of the income elasticity curves for the first four of our stylized societies, whose corresponding Engel curves were shown in Figure 1 (a)-(d). Thus, the theoretical model presented above specifies how elasticities vary with income and social learning dynamics taking effect in a population of consumers, i.e., it generates variable elasticity Engel curves. The social learning processes incorporated in our formal model can, however, give rise to further elasticity functions, as will be shown in the remainder of this section.

It is possible to take account of, for example, inferior goods, i.e., those possessing negative income elasticity ε_a, and highly elastic demand patterns by modifying the model's assumptions

concerning the influence of role model M1. We claim that there are role models that are preferred as a reference for most consumers when these have reached a certain income range. As, however, the population's income rises further, these role models lose weight in cultural transmission again for consumers now orient toward yet other role models providing social identity. For this reason, the influence of M1 varies nonlinearly with changing income. If, for illustration, the influence of M1 is distributed normally over the range of income y with parameters μ_n and σ_n, the distribution function written as $N(y|\mu_n,\sigma_n)$, then the Engel curve for the open, collectivist society following directly from these assumptions and given appropriate parameter values looks like shown in Figure 2 (c). Correspondingly, Figure 2 (e) plots the shape of the function of the income elasticity of demand for this Engel curve. Income influences the shape of elasticity functions by changing the weights of role models in cultural transmission. Thereby, our model is adapted to the case of a commodity that behaves like a necessity ($0 \le \varepsilon_a \le 1$) or luxury ($\varepsilon_a > 1$) in the lower and middle ranges of income and is treated by the rich as an inferior good ($\varepsilon_a < 0$).

In some respects, this idea is – although starting from very different behavioral assumptions – similar to the one suggested by Aitchison and Brown (1954), who use a sigmoid Engel curve in their estimations. Thereby, they find a good empirical fit for this theoretical assumption concerning the Engel curve's shape when analyzing a household expenditure data set. Their approach cannot, however, account for goods that are treated as an inferior good in the upper ranges of income. Hence, the phenomenon of a role model's changing influence with increasing income on the consumption of a certain good can explain Engel curves that display considerable curvature, including S-shapes (e.g., Banks et al., 1997), high elasticities of demand for some income regions, and negative elasticities for others.

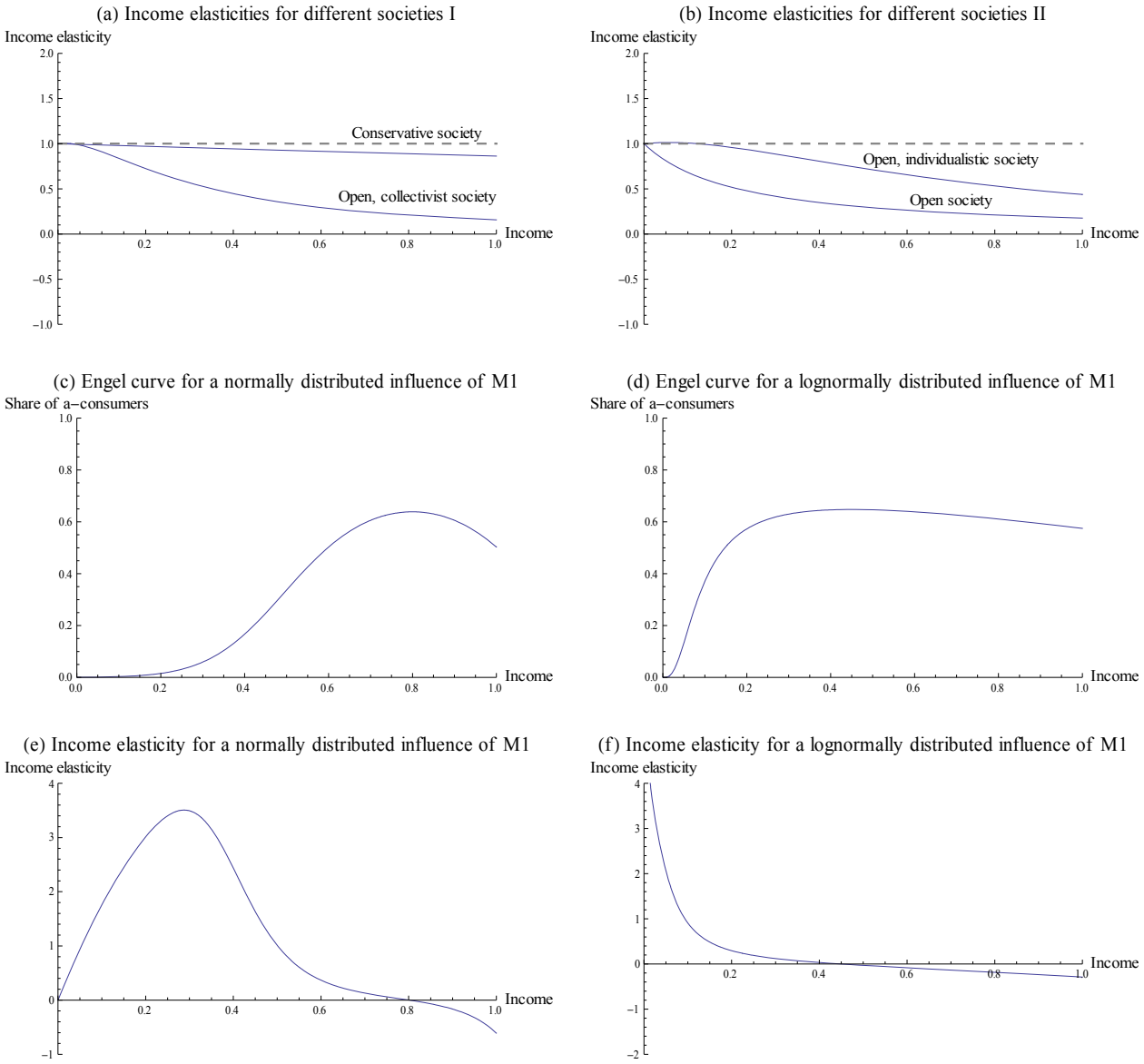

Figure 2 Income elasticities of demand and nonlinearly changing weights of role model M1.

If role model M1's influence is distributed lognormally over y with appropriately chosen parameters μ_l and σ_l, the distribution function being written $LogN\left(y\middle|\mu_l,\sigma_l\right)$, *ceteris paribus* the resulting Engel curve takes on the shape depicted in Figure 2 (d). The elasticity's behavior this setting implies is shown in Figure 2 (f). It exhibits a decline in income elasticity with rising income. Commodity a first is a luxury good ($\varepsilon_a > 1$), then becomes a necessity ($0 \le \varepsilon_a \le 1$), and finally an inferior good with $\varepsilon_a < 0$, i.e., its purchase declines as y increases. The next section will provide a potential real-world example for such a varying weight of a certain consumption

pattern's role model. Finally, the numerical magnitudes of elasticities derived from our model's different variants are plausible and in accordance with the ranges found empirically for income elasticities of demand (see Leser, 1963; Haque, 1993; Hausman et al., 1995).

These thoughts concerning the influence of role models in acquiring consumption behaviors via cultural transmission lead us to the following proposition:

> *Proposition 2*: We expect the elasticity of demand for commodities that are especially prone to social learning dynamics based on the changing influence of role models to vary considerably over the relevant ranges of income and to be significantly greater than unity for some income regions and potentially negative for others.

For instance, according to their elasticities, beer is found to be a necessity ($\varepsilon_{beer} = 0.84$), while wine and spirits are luxuries in Australia (Haque, 1990). Thereby, the income elasticity of wine was found to be around 2.8. Following our argument, we would claim that drinking wine instead of beer is connected to another style of living induced by a new reference group with new archetypal role models. The implied nonlinear social learning dynamics then capture the high value observed for the income elasticity of this commodity. The elasticity curves for food items like, for example, cabbage, that are hardly subject to social influences, can be expected to have very different shapes than those for luxuries like, for example, lobster, where social aspects, such as reference groups, play an important role in consumption.

An early empirical example for this theoretical finding was presented by Houthakker (1957), who found that the elasticity of clothing exceeds unity. This implies, in a technical sense, that clothing is categorized as a luxury good. However, in this context, an explanation of these relatively high elasticities of demand that is based upon cultural transmission forces including fashion role models seems to get closer to the underlying causal factors. Houthakker also discovered that the elasticities of demand for housing in the U.S. are highest for suburbs and smallest in large cities. Again, social learning forces, for example, those relying on social reference groups, might explain a great part of these empirical demand patterns.[10]

These findings concerning differently shaped functions of income elasticities of demand contribute to an explanation and reproduction of stylized facts of, for example, an economy's output and employment structure (e.g., Gundlach, 1994). Moreover, income elasticities are

[10] See also the thought experiment in Frank (1997), who uses housing and social referencing as an example.

helpful for planning and forecasting purposes due to the fact that the future course of real income is easier to predict than that of relative prices.

5. SOME REAL-WORLD EXAMPLES

We now turn to the question of how real-world evidence bears on our theory and claim that the structure of relations in our model corresponds with empirical observations. Social learning dynamics like the ones described by the model therefore contribute to an understanding of, for example, structural changes in consumption and production or patterns in international trade.

The model's Engel curves can capture demand factors accompanying a developing economy's movement toward modern consumption patterns. For instance, an increasing income in combination with rural-urban migration results in modified influences of an individual's consumption role models: while more conservative rural areas are characterized by traditional consumption patterns, which would be reflected by a "rural" Engel curve like the one shown in Figure 1 (c), more open urban societies provide a social environment that facilitates the propagation of modern consumption behavior, a situation that potentially leads to an "urban" Engel curve as shown in Figure 1 (a). The underlying learning dynamics in these cases are different: given the same income y, a high conformist bias D together with a conservative society's high value for r, which implies the passing on of mostly traditional behaviors via the "cultural parents", prevent the spreading of modern consumption behaviors by means of cultural transmission in the rural area. In contrast, a low conformity parameter D and a low value for r entail easy dissemination of these behaviors in the case of the urban society.[11] In this case, we have cross-sectional Engel curves describing demand behavior in urban and rural areas.

In addition, the sheer availability of role models for social learning plays a crucial role for it influences the value of the parameter α_M : members of urban societies, for example, frequently get into closer contact with domestic high-status role models and those from abroad. Furthermore, access to mass media and advertising leads to behaviors tending to emulate role models presented therein. The switching from one Engel curve type to another in the course of these learning processes in consumption influences a country's industrial structure and should be of interest for economic models of growth and development (e.g., Kelley, 1969). The shift out of

[11] Joseph Stiglitz (2002) suggested seeing the issue of economic development as "…transformation of a society from traditional relations, traditional ways of thinking…to more modern ways."

agriculture into industrial production, for example, is also a result of changing social identities of consumers with rising income.

Moreover, in developing countries, imported goods are often connected to modern, western life styles including their role models that enjoy a high prestige. When income increases, people get into closer contact with these influential role models and change their reference group in consumption. This is part of a "demonstration effect" (Duesenberry, 1949) that assumes an imitation of western consumption patterns in developing countries as knowledge of and contact with these consumption behaviors makes agents aware of previously unrecognized possibilities, desires, and social categories (Nurske, 1953). As a consequence, domestic products – although comparable in price and quality – are crowded out by imported consumption items associated with foreign role models. This effect should account for some patterns in international trade for the direction in which a country's trade balance moves over time depends on its income elasticity of demand for imports that is partially determined by cultural characteristics (see Houthakker and Magee, 1969; Lewer and Van den Berg, 2007).

Chandrasekhar and Bhaduri (2005) studied societies in the trans-Himalayan regions of India and found that the displacement of the traditional cultivation of barley by green-pea cash crops could not be explained by economic forces alone. Food habits in these regions switched from barley toward rice, largely due to high status associated with the latter's consumption. Especially dishes made with rice and provided at social occasions were a symbol of social prestige. Rice cannot be cultivated in these regions because of harsh climatic conditions, so it is imported and only wealthy agents that engage in profitable market transactions had access to it. With the growing availability of money to the population due to the growing cultivation and marketing of cash crops, rich peoples' consumption behavior and style of living became the norm to be copied by many more agents. This replacement of a traditional consumption item took place although rice has considerably less protein, energy content, and lower disease preventing effects (and also lower folk medicinal value) compared to barley.

Gray et al. (1954) present a relationship between potato vs. wheat consumption and changes in income for developing and advanced economies, which is based on an international food consumption comparison, as shown in Figure 3 below.

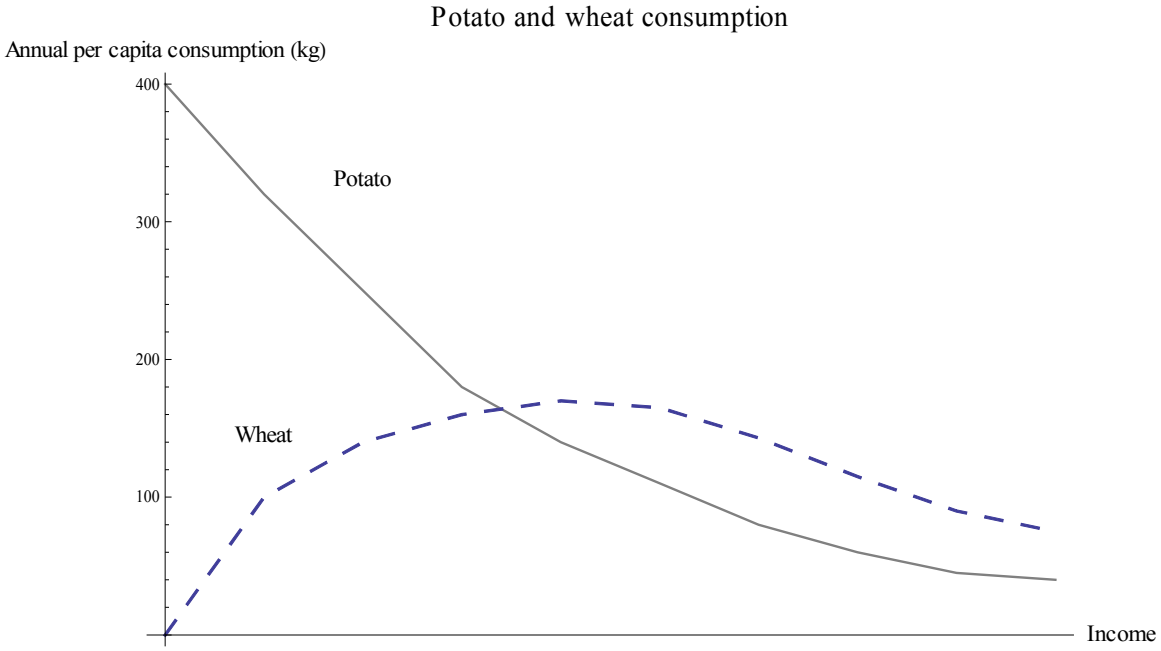

Figure 3 Source: Adapted form Gray et al., 1954, p. 16.

Here, consumption of potatoes is relatively high at the lowest income levels of countries and steadily declines with higher income in more developed countries. On the other hand, the demand for wheat first steeply increases with growing income, reaches a maximum, and then declines again as income rises further, i.e., it becomes an inferior good. This pattern of wheat consumption may be explained by a changing influence of role models as representatives of different reference groups: the more "modern" consumption of bread – especially status-signaling light cereals – was preferred by a few more wealthy (domestic) consumers and was adopted by more and more agents as the population's income increased. Then, the influence of this reference group lost weight in cultural transmission and new (foreign) role models introduced further dietary elements, which entails a shift away from both cereals and potatoes in the upper ranges of income. Therefore, the shape of the curve describing wheat consumption over income in Figure 3 could be approximated by the Engel curve shown in Figure 2 (d), where the role model's influence follows a lognormal distribution.

After the German unification, to provide another example, the general availability of German mark to East Germans enabled them to follow prestigious western consumption role models that were now taken as the reference group for social identity in the unified country. East German products were – even when comparable in price and quality – avoided by the consumers for they represented the outdated socialistic consumption patterns and their representatives. The diffusion

of western consumption behavior was widespread, a situation potentially reflected by an Engel curve as shown in Figure 1 (b), where the society is very open to new consumption behaviors ($r = 0.01$) and a high conformity bias ($D = 0.7$) spurs the wide final adoption of theses behaviors due to social discrimination against past styles of living after an influential role model rapidly convinced a majority of agents to switch.

However, external agents may also fail to transform existing behaviors in a population on a larger scale (e.g., Rogers, 1983). This can be explained by a relatively low weight assigned to these external models in cultural transmission, i.e., a low value of α_M implying a high value of α_T, the traditionalists influence in the set of models, together with rather high values for the conformity bias D and the "socialization" parameter r. Consequently, even in a "moderate" society (with $D = 0.4$ and $r = 0.2$), whose Engel curve is shown in Figure 1 (e), the significantly lower weight of M1 ($\alpha_M = 0.3$) prevents the widespread dissemination of this role model's behavior. In many societies, religion leads to an explicit rejection of western consumerism and its role models. Only a minority of agents – often living in comparatively more open urban areas – then adopt the modern consumption behavior. Such a society's consumption pattern would be captured by an Engel curve similar to the one presented in Figure 1 (c).

6. CONCLUSIONS

We presented a simple model of cultural evolution that is capable of explaining differently shaped Engel curves. Following the tradition of Engel curve analysis, our model's demand-originating elements are based on income changes to which we added social learning dynamics. In particular, we argued that a rising income is accompanied by changing reference groups and modified weights of cultural role models providing social identity.

Moreover, we imagined different stylized societies characterized by varying social learning dynamics that resulted in different income-consumption curves and corresponding income elasticity of demand functions. Our findings suggest that cultural transmission factors are – under plausible assumptions concerning human learning psychology – an important element in explaining changing patterns in demand. We also showed how some broad patterns of changing demand in the course of economic development observed empirically can be theoretically explained by our model.

This demand analysis draws attention to factors that influence consumption not included in the classical categories of economics and helps to substantiate assumptions of a theory of demand. What is more, it may serve as a conceptual framework for comparative empirical research.

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