The Market for Apples:
A Theory of Identity and Consumption

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Abstract

This paper presents an economic model of the effects of identity and social norms on consumption patterns. By incorporating qualitative studies in psychology and sociology, I propose a utility function that features two components – economic (functional) and identity elements. This setup is extended to analyze a market comprising a continuum of consumers, whose identity distribution along a spectrum of binary identities is described by a Beta distribution. I also introduce the notion of salience in the context of identity and consumption decisions. The key result of the model suggests that fundamental economic parameters, such as price elasticity and market demand, can be altered by identity elements. In addition, it predicts that firms in perfectly competitive markets may associate their products with certain types of identities, in order to reduce product substitutability and attain price-setting power.

JEL codes: *D11, D21*

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On January 24th, Apple Computer will introduce Macintosh.
And you'll see why 1984 won't be like "1984".[1]
—Apple Super Bowl Commercial, 1984

1. Introduction

Apple's 1984 commercial marked the start of its aggressive campaign to define the Apple computer as the hallmark of contrarian identity. The campaign characterized Mac users as creative, revolutionary and non-conforming, as opposed to brainwashed 'proles' in George Orwell's *1984* (Livingstone, 2011). Following "1984", Apple's subsequent advertisements, such as "Think Different" and "Get a Mac" in 2007, were so successful that it gave rise to a brand community that Belk and Tumbat (2005) termed "the cult of Macintosh."

Olins (2000, as cited in Livingstone, 2011) attempted to provide an explanation for the success of Apple's campaigns: not only does branding alert consumers to the existence of new products and signal product quality under asymmetric information, but it also gives consumers the opportunity to define and express their identity. In other words, Apple's success in reshaping consumption behavior was predicated upon factors *beyond* product functionality; it won the battle in consumer psychology and appealed to the identities of its market population. In the short run, Apple positioned itself as a contrarian product and appealed to consumers who adopt or wish to adopt contrarian identities. In the long run, by describing conformity as Orwellian, Apple is pushing more consumers to adopt contrarian identities, which it described as 'creative' and 'revolutionary'.

Today, we observe a systematic difference in computer purchase patterns across different populations. For example, while the total market share of Apple operating systems is 5.08% in 2010 (Net Market Share, 2015), in the same year, 27% of college student-owned laptops and 14% of college student-owned desktop computers are Macs (Elmer-DeWitt, 2010). Theories exist to explain this disparity (e.g. different technical specifications might make the different laptops useful for different purposes). However, it

[1] Apple Inc (1984), 1984. https://www.youtube.com/watch?v=2zfqw8nhUwA.

might also be possibly caused by identity and social norm – colleges are perceived to be places of creativity and its students more likely to identify with traits that are associated with the Apple computer. This hypothesis is supported by research in other social sciences like consumer psychology. Oyserman (2009), for example, asserted that identity-based motivation has rich implications for consumer behavior, observing that "identity-congruent choices are more likely than identity-incongruent choices, no matter if these choices are perceived as beneficial or not."[2]

The market for Apples suggests that short and long-term consumption patterns are shaped by forces beyond prices, quality and income – variables commonly used in the formal economic analysis of consumption. More likely, there exists a host of determinants for consumption behavior, including identity and social norms. Incorporating identity considerations into economic analysis will be a step towards explaining why consumption behavior shifts, beyond saying that they simply do, due to some exogenous factors.

Indeed, econometrics have long relied on observable traits such as distribution of identities and shifting demographic trends to predict economic outcomes. Yet, standard economic theory has not fully taken into account this social dimension of choice, and falls behind other social sciences in this respect. Akerlof and Kranton (2002) lamented that economists have traditionally stayed away from these concepts, because they are "too fuzzy to inform either theory or empirical work."[3] The current state is regrettable, because "without a model that mirrors this sociology, economic analysis produces only partial answers to key questions."[4] Indeed, that an economic concept as fundamental as consumption choice fails to take into account important social dimensions diminishes and limits the potential of economic analysis. This paper attempts to fill this gap.

Hence, this paper will present an economic model of the effects of identity and social norms on consumption patterns. Using assumptions that are guided by qualitative studies in psychology and sociology, I first develop a utility function for a consumer choosing between two goods which are functional substitutes. This utility function

[2] Oyserman (2009), p 257.
[3] Akerlof and Kranton (2002), p 1168.
[4] Ibid.

features two components – economic (functional) and identity elements. I choose functional substitutes to establish a ceteris paribus condition, so that identity effects may be easily analyzed. I then extend this basic model to analyze a market comprising a continuum of consumers, whose identity distribution along a spectrum of binary identities (e.g. gender, race[5], sexual orientation) is described by a Beta distribution. Having produced an analytical form for market demand and relative price elasticity[6], I proceed to analyze how the salience[7] of an identity to a consumption decision can shape consumption patterns. I also discuss possible ways future research may model the dynamics of shifting identities.

There are two key results. First, identity elements can result in consumers being less sensitive to changes in prices. Furthermore, if identity effects are sufficiently large, there exists parameters for which an individual's consumption decision ceases to be influenced by price. While identity effects can shape the price elasticity of demand, the exact relationship is dependent on two parameters – distribution of identity and prevailing prices. For the case where relative prices are reflective of the relative marginal *functional* utility of the goods and the distribution of identity is symmetric, an interesting result arises. In Scenario 1, where the population is polarized in their identities (i.e. a majority of consumers adopt extreme identities), both goods tend to be relative price inelastic. In Scenario 2, where the population is neutral in their identities (i.e. a majority of consumers has moderate identities), both goods tend to be relative price elastic. In the extreme case where every consumer has the neutral identity, the problem resolves into one where there are no identity effects. We know from standard economic models of substitutes that goods are perfectly price elastic under this circumstance.

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[5] In this analysis, we will simplify race into two categories, e.g. Black and White. In reality, race is a complex issue. Section 5 offers speculation on how we may deal with multiple dimensions of identities.

[6] Because this analysis relies on the relative price between two substitutes, the price elasticity function necessarily contains the possibility for substitution. Relative price elasticity may be interpreted as a hybrid of price elasticity and cross price elasticity.

[7] Salience, as in behavioral economics, is the relevance of a certain consideration to a decision. To provide an example in the context of identity, we see that gender could be a relevant consideration when an individual decides whether to buy a dress or pants. But in other consumption decisions, such as whether to purchase a cup of coffee or tea, gender could become irrelevant.

Second, if third parties can shape the salience of an identity to the consumption of a good, they can, in doing so, alter the relative price elasticity of the good. Furthermore, for the special case, where the identity distribution is symmetric and relative prices reflective of marginal functional utility, the limit to which third parties can influence the price elasticity is greatest for the case when the population is polarized.

These results have implications for firm theory and public policy. Identity elements open up a new dimension in which firms may compete to maximize their profits. This model predicts that firms whose products are easily substitutable may engage in strategies to associate their products with a polarized identity, in order to generate relative price inelasticity through identity effects and thereby maximize profits. For example, Coca-Cola, whose competitors produce substitutable goods (soft drinks), would want to associate their product with certain sports teams or celebrities so as to appeal to individuals who identify as fans. In addition, it is conceivable that policymakers would like to shape certain consumption patterns, e.g. discourage consumption of unhealthy food, or encourage uptake of healthcare policies. Appealing to identity elements could become a policy tool for such purposes.

The potential for such applications suggest that there are compelling reasons for wanting to understand the interaction between identity and consumption. Section 2 provides a review of studies in psychology and identity economics necessary to form assumptions about this interaction. In Section 3, I introduce an identity-utility model for a single consumer choosing from two functionally substitutable goods that have different identity associations. In Section 4, I extend this basic model to a multiple-consumer case, in order to understand the interaction between market demand, price and identity. In Section 5, I introduce the concept of salience with respect to identity. Section 6 outlines a worked example in which this model may be applied. Section 7 concludes.

2. Literature Review

The work of incorporating social dimensions into economics was first taken up by Akerlof and Kranton (2000), which formalizes *identity economics*. The idea that underscores identity economics is that social groups – even arbitrarily constructed ones – can impact behavior and economic outcome. Akerlof and Kranton (2000) constructed a

neoclassical model[8] that incorporates identity-motivated behavior. Specifically, their model relies on four key observations documented by sociology and psychology: (1) an individual's own actions give rise to identity-based payoffs, (2) actions have identity-based externalities on others, (3) third parties can shape an individual's payoffs, and (4) whether a person has choice in her own identity varies across persons and situations. Their model successfully explained phenomenon unaccounted for by standard economic theory, such as gender-based occupational segregation in the workplace, and 'self-destructive' behavior among the socially marginalized.

Since Akerlof and Kranton (2000), other studies have refined and extended the model to examine education policies (Akerlof & Kranton, 2002), review principle-agent and economic organization (Akerlof & Kranton, 2005), explain income inequality in China (Afridi, Li, & Ren, 2015), and account for behavioral economic observations such as altruism (Chen & Li, 2009). To the best of my knowledge, Sexton and Sexton (2014) is the only study to provide a *formal treatment* on how identity and social norms may affect consumption behavior. Sexton and Sexton (2014) restricts their analysis to the consumption of green products. According to their theory, consumers would be willing to pay more for green products if their purchases were observable and rewarded with affirmation by other environmentally conscious individuals. This assumption deviates from other studies in identity economics, which emphasize the intrinsicality of identity-derived utility.

While research on the connection between identity and consumption has been limited in the field of economics, other social sciences, such as consumer psychology have found evidence on the connection through marketing data (Lamont & Molnár,

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[8] Akerlof and Kranton (2000) modelled identity-motivated behavior in the following manner. They construct the following utility function an individual j.

$$U_j = U_j(\mathbf{a}_j, \mathbf{a}_{-j}, U_{ij})$$

We can interpret this equation in the following way: the utility of an individual j depends on the economic consequence of his own actions $\mathbf{a}_j$, and on others' actions $\mathbf{a}_{-j}$. In addition, utility depends on j's identity utility U_{ij}, which is in turn represented as:

$$U_{ij} = U_{ij}(\mathbf{a}_j, \mathbf{a}_{-j}; \mathbf{c}_j, \varepsilon_j, \mathbf{P})$$

This means that identity-derived utility is dependent on j's own actions and others' actions, given j's assignment of people to social categories $\mathbf{c}_j$, the prescribed actions for each social category $\mathbf{P}$, and her own characteristics ε_j.

2001). The psychology literature in identity and consumption that I surveyed is founded on Higgins (1987)'s work on self-discrepancy theory. In simplified terms, the self-discrepancy theory states that individuals want to engage in behavior that is consistent with their personal and social identities, failing which they could experience negative feelings such as guilt and shame. My work will focus on social identity, which is how we view ourselves in the context of our social groups and relationships.

Self-discrepancy theory gives rise to three key insights about identity and consumption behavior.

Observation 1	Consumers prefer goods that "express and define (their) group membership through shared consumption symbols."[9]
Observation 2	Consumption decisions become reflexive once they are established around an identity (Oyserman, 2009). Higgins (2005) suggests that this phenomenon stems from a "feel right" experience, known in psychology as *regulatory fit*.
Observation 3	Consumers prefer goods (or brands) that align with their identity, but only when this identity is made salient (Aaker, 1999; Loken, 2005; Oyserman, 2009).

In the rest of the paper, I will present a consumption model that is consistent with these three observations. In the next section, we begin with a basic model that considers a one-consumer, multiple good scenario.

3. Basic Model

In order to isolate the effects of identity, we will focus our analysis on goods that have equal functionalities. First, let us consider a standard neoclassical model, describing three goods X, Y and Z. X and Y are perfect substitutes in terms of functionality, e.g. two different brands of computers of exactly the same quality, while Z is a composite good,

[9] Boorstin (1973), as quoted in Belk (1988), p 152.

representing all other consumption. We can specify a Cobb-Douglas economic utility function for an individual, j, that is a function of her consumption of *X*, *Y* and *Z*:

$$U_{ej} = (x + y)^{\gamma} z^{1-\gamma} \quad (1)$$

where $\gamma \in [0, 1]$

Let I_j be the income for individual j. To simplify the problem, we can normalize the price of *Y* to 1. We can then interpret p_x, as the ratio of the price of *X* to the price of *Y*. Hence, individual j will have the following budget constraint:

$$p_x x + y + p_z z \leq I_j \quad (2)$$

Solving this utility maximization problem, we find that individual j would consume only good *X* if the ratio of price of *X* to that of *Y* is less than or equal to their relative marginal utilities, and only good *Y* otherwise. We conclude that using standard microeconomic models, for a specified utility function, the relative prices of goods *X* and *Y* are the sole determinants of her consumption pattern – a notion that is already intuitive to us.

In the next step, we introduce identity-based motivation into the model, and examine the implications. Let us define two social categories $\boldsymbol{C} = \{S^Y, S^X\}$, with prescribed consumption $\{Y, X\}$ respectively. Let s be a variable such that $s \in [-1, 1]$. For an individual j, $s_j > 0$ implies that individual j identifies with social category S^X, while the converse is true. Also, $s_j = 0$ if and only if individual j identifies with neither social category. This specification allows us to interpret $|s_j|$ as the strength with which individual j identifies with her social category. To give an illustration, say $S^Y = male$ and $S^X = female$. If an individual has $s_j = -0.5$, he identifies with being male with a strength of 0.5.

The studies presented in Section 2 demonstrate that an individual gains utility by consuming her prescribed good, and suffers utility loss for doing otherwise. We incorporate Observation 1 into our model in following way. In addition to the economic utility that the functionality of good *X* and *Y* confers, they also produce identity utility (U_{ij}). We can represent individual j's identity utility as follows:

$$U_{ij} = \frac{s_j}{|s_j|} \cdot (x - y) \quad (3)$$

where $s_j \neq 0$

Note that $\frac{s_j}{|s_j|}$ is an indicator function. For example, when $s_j < 0$, $\frac{s_j}{|s_j|} = -1 \Rightarrow U_{ij} = -x + y$. Hence, individual j obtains positive utility for consuming her prescribed good (good Y in this case) and negative utility for consuming good X. For cases where $s_j = 0$, we intuitively conclude that there is no identity utility conferred, i.e. $U_{ij} = 0$. These outcomes are consistent with Observation 1.

To obtain the total utility, we can introduce a weight to the economic and identity utility. Let the weight of identity utility in total utility be represented by the function $w(s_j)$, that is strictly increasing on identity strength. Consequently, the weight on the economic utility is $1 - w(s_j)$.[10] One possible function for $w(s_j)$ is:

$$w(s_j) = {s_j}^2 \tag{4}$$

Notice that this function satisfies $w'(|s_j|) \geq 0$, and $0 \leq w(s_j) \leq 1$ for domain of s_j. Hence, we obtain the total utility function for individual j:

$$U_j = \left[(1 - w(s_j))(x + y) + \frac{s_j}{|s_j|} \cdot w(s_j)(x - y)\right]^{\gamma} [z]^{1-\gamma} \tag{5}$$

In order to solve the maximization problem for individual j, we first make a simplifying assumption.

Assumption 1 Assume only corner solutions for X and Y. That is, individuals will never choose to consume both X and Y. Formally, $x_j^* \cdot y_j^* = 0$.

We will postpone the justification for Assumption 1 to Section 4, where it will become clear why it holds in a market with a continuum of consumers. Given Assumption 1, we can derive Lemma 1.

[10] Notice that the model could have simply used s_j instead of $w(s_j)$ to reflect the weight in the utility function, since the degree of an identity strength may be arbitrarily determined, as long as it is monotonic. However, I decide to introduce a separate mapping function, to allow for the possibility that s_j is an empirically obtained variable that does not vary proportionately with its weightage in the utility function. In this case, a mapping function is useful.

Lemma 1 Individual j will devote γ of her income to either good X or Y, under utility maximizing conditions:

$$p_x x + y = \gamma I_j \tag{6}$$

Proof Found in Appendix ■

Lemma 1 tells us that expenditure on good X and Y is independent of composite good Z. This leads us to Lemma 2, which simplifies the maximizing problem.

Lemma 2 Solving the following problem maximizes individual's j's utility:

$$\max_{x,y} U_{\gamma j} \tag{7}$$

$$\text{where } U_{\gamma j} = \big(1 - w(s_j)\big)(x + y) + \frac{s_j}{|s_j|} \cdot w\big(s_j\big)(x - y)$$

subject to constraint $p_x x + y \leq \gamma I_j$

Proof Found in Appendix ■

Proposition 1 The Marshallian demand for an individual j is described by the following equation:

$$x_j^*\big(p_x, s_j, I_j\big) = \begin{cases} \dfrac{\gamma I_j}{p_x}, & p_x < \dfrac{1 - w\big(s_j\big) + \dfrac{s_j}{|s_j|}\Big(w\big(s_j\big)\Big)}{1 - w\big(s_j\big) - \dfrac{s_j}{|s_j|}\Big(w\big(s_j\big)\Big)} \\ \dfrac{\gamma I_j}{p_x}, & 1 - w\big(s_{\mathrm{j}}\big) - \dfrac{s_j}{|s_j|}\Big(w\big(s_j\big)\Big) < 0 \\ 0, & \text{otherwise} \end{cases} \tag{8}$$

Proof Found in Appendix ■

From Proposition 1, we observe that identity effects cause demand to become less price sensitive. More accurately, a consumer who identifies more strongly with identity S^X will face greater inertia in substituting Good X away for Good Y in response to increase in relative price of Good X. This result is consistent with Observation 2, that consumption decisions become reflexive after they are established around an identity.

Furthermore, Proposition 1 suggests that it is possible to obtain complete price inelasticity in the presence of identity effects. More specifically, there exists a threshold or *critical* identity strength above which an individual's consumption decision between goods *X* and *Y* becomes independent of price, if price cannot take negative values. Above the threshold identity strength, the individual will consume only her socially prescribed good, even if she derives identical non-zero economic utility from consuming either good. Corollary 1 is a formal statement of this result.

Corollary 1 There exists some $w(s_j)$ where $\left(1 - w(s_j)\right) > 0$ such that the optimal consumption of Good *X*, $x_j^* = 0 \; \forall \; p_x \geq 0$.

Proof Found in Appendix ■

Standard models suggest that consumption decisions between two functionally substitutable goods are contingent on relative price. The identity model, however, allows for the possibility that price becomes an *irrelevant* factor in a consumer's consideration, should social pressure against consuming the good be sufficiently large. The model also provides an explanation for phenomenon such as price disparity between two economically identical products, and might even account for behavior such as boycotts. [11]

[11] To help the reader visualize how this phenomenon might take form, I offer a brief but prominent example: the boycott of sugar in England during the 1800s. As the anti-slave trade movement gained momentum, a growing number of people began to identify strongly with the movement. Sugar, viewed as the cruel product of slavery, became objectionable to individuals in this social category (Hochschild, 2006). In terms of the model, we can think of the anti-slavery identity as S^+, and sugar as good *Y*. For these individuals, $w(s_j)$ is sufficiently high such that no price could convince them to consume sugar.

We looked at the case for a single consumer, and examined her consumption behavior. The natural next step is to expand the one-consumer model, and examine the implications for the many-consumer case.

4. Market Demand

Section 4 is divided into 4 sub-sections. Section 4.1 lays out the model specifications and introduces the Beta distribution for modeling population identity distribution, Section 4.2 provides an interpretation for the variables, Section 4.3 solves the model and produces an analytic expression for the market demand for good *X,* and Section 4.4 illustrates the interaction between identity and market demand.

4.1. Model Specification

We consider a market with a continuum of consumers, who have utility functions described by Equation (5) – note that this does not assume that consumers have the same identity. For convenience, we normalize the number of consumers to 1, and assume that each consumer has income *I*. We can then attempt to describe the distribution of identity strength of consumers in the market. For that purpose, this paper has chosen to model after a Beta distribution because of the following:

i. The Beta distribution is a bounded distribution (between 0 and 1). This property allows for a simple transformation of a Beta distributed random variable to identity strength, which takes on a bounded value between -1 and 1.

ii. The shape of the Beta distribution is variable. This property has two advantages. First, we have a model that allows for a higher degree of generality in terms of how identity strength is distributed. Hence, the model is versatile and applicable under a wider range of circumstances. Second, we can model shifts in identity distribution by altering the shape parameters of the Beta distribution.

Let $\widetilde{s_j}$~Beta(α, β), where α and β are shape parameters and $\alpha, \beta > 0$. The probability distribution function (PDF) of $\widetilde{s_j}$ is defined by the Beta distribution function:

$$PDF\left(\widetilde{s_j}; \alpha, \beta\right) = f(\widetilde{s_j}; \alpha, \beta) = \frac{\widetilde{s_j}^{\alpha-1}\left(1-\widetilde{s_j}\right)^{\beta-1}}{B(\alpha, \beta)} \tag{9}$$

where $B(\alpha,\ \beta) = \int_0^1 \widetilde{s_j}^{\alpha-1}\left(1-\widetilde{s_j}\right)^{\beta-1} ds_j$

We adopt the following notation for the cumulative distribution function (CDF) of $\widetilde{s_j}$:

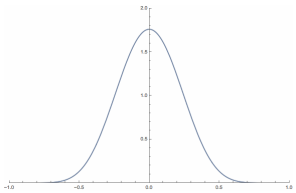
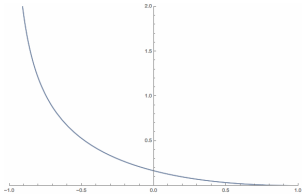
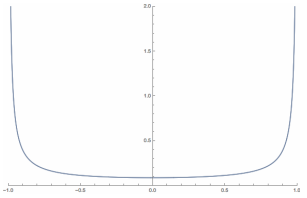
$$CDF\left(\widetilde{s_j}; \alpha, \beta\right) = F(\widetilde{s_0}; \alpha, \beta) = \int_0^{\widetilde{s_0}} f\left(\widetilde{s_j}; \alpha, \beta\right) d\widetilde{s_j} \tag{10}$$

In order to map the Beta distributed random variable ($\widetilde{s_j}$) to identity strength s_j, consider $T: \widetilde{s_j} \to s_j$, a change of variable transformation described by $T\left(\widetilde{s_j}\right) = 2\widetilde{s_j} - 1$. By inspection, T is an isomorphic and monotonic transformation. Consequently, we can derive an inverse function $T^{-1}: s_j \to \widetilde{s_j}$, given by $T^{-1}\left(s_j\right) = \frac{1+s_j}{2}$. Applying transformation T to $\widetilde{s_j}$, we obtain a transformed Beta distribution of identity strength across consumers in the market.

4.2. Interpretation of Shape Variables

In this subsection, I give an interpretation for the shape variables α and β. We may interpret $\frac{1}{\alpha}$ as the *pressure* on the population identity distribution towards S^-. C*eteris paribus*, a higher $\frac{1}{\alpha}$ represents a higher proportion of the population adopting the S^Y identity with greater strength. Conversely, $\frac{1}{\beta}$ represents the *pressure* towards S^X. For illustration consider the following scenarios represented in Figure 1.

Figure 1 Scenarios illustrating the interpretation of pressure

Scenarios	Low pressure to both	High pressure to S^Y Low pressure to S^X	High pressure to both
Values of α and β	$\frac{1}{\alpha} < 1 ; \frac{1}{\beta} < 1$ or $\alpha > 1 ; \beta > 1$	$\frac{1}{\alpha} > 1 ; \frac{1}{\beta} < 1$ or $\alpha < 1 ; \beta > 1$	$\frac{1}{\alpha} > 1 ; \frac{1}{\beta} > 1$ or $\alpha < 1 ; \beta < 1$
Distribution			
Description	Identity distribution is flushed towards the middle. Few adopt strong identities, most are moderate.[12]	Identity distribution is flushed towards the left. A large proprotion of the population adopts strong S^Y identities.[13]	Identity distribution is flushed towards both sides. Population is polarized in terms of their identities.[14]

We will return to using this notion to describe the interaction between consumption and the dynamics of identity. Prior to that, it is appropriate to solve the model and derive an analytic form for the market demand curve, in order that we may begin to understand the impact of identity.

[12] An example is socioeconomic status. A relatively large proportion of the population would identify as middle class; of course, with rising inequality, the pressure towards both ends may be increasing, i.e. higher kurtosis.

[13] For example, views on slavery in modern times, where S^Y represents anti-slavery, while S^X represents pro-slavery

[14] For example gender – a large majority of the population identifies as male or female in approximately equal proportions.

4.3. Solving the Model

Using these specifications, we obtain an expression for the market demand for Good *X,* by summing up individual consumption demand across the market, that is:

$$X = \sum x_j^*(s_j, p_x, I_j) \tag{11}$$

Lemma 3 Market demand can be written as the expectation of x^*, given the distribution of consumer identity strength in the market:

$$\begin{aligned} X(p_x; \alpha, \beta) &= E(x^*) \\ &= \int_{-1}^{1} {x_j}^*(s_j, p_x, I_j) \cdot f\left(T^{-1}(s_j); \alpha, \beta\right) ds_j \end{aligned} \tag{12}$$

Proof Found in Appendix ■

To solve Lemma 3, we consider the following approach. From Proposition 1, we know that for a given identity strength s_0, there exists a price $p_{x0}\big|_{s_0}$, above which the consumer stops consuming good *X*. Conversely, she consumes $\frac{\gamma I_j}{p_x}$ units of good *X* and zero units of good *Y* when $p_x < p_{x0}\big|_{s_0}$. We will thereafter refer to this price p_{x0} for a given s_0 as the *critical price*. From Proposition 1, we can derive Equation (13), which tells us the critical price for given $-\frac{1}{\sqrt{2}} \leq s_0 < \frac{1}{\sqrt{2}}$.

$$p_{x0}\big|_{s_0} = \begin{cases} \dfrac{1}{1 - 2w(s_0)}, & 0 \leq s_0 < \dfrac{1}{\sqrt{2}} \\ \\ 1 - 2w(s_0), & -\dfrac{1}{\sqrt{2}} \leq s_0 < 0 \end{cases} \tag{13}$$

Figure 2 Critical price-identity strength curve defined by Equation (13). On the line, consumers are indifferent between consuming good *X* and *Y*. Above the curve, consumers only consume good Y; below the curve, consumers only consume good X.

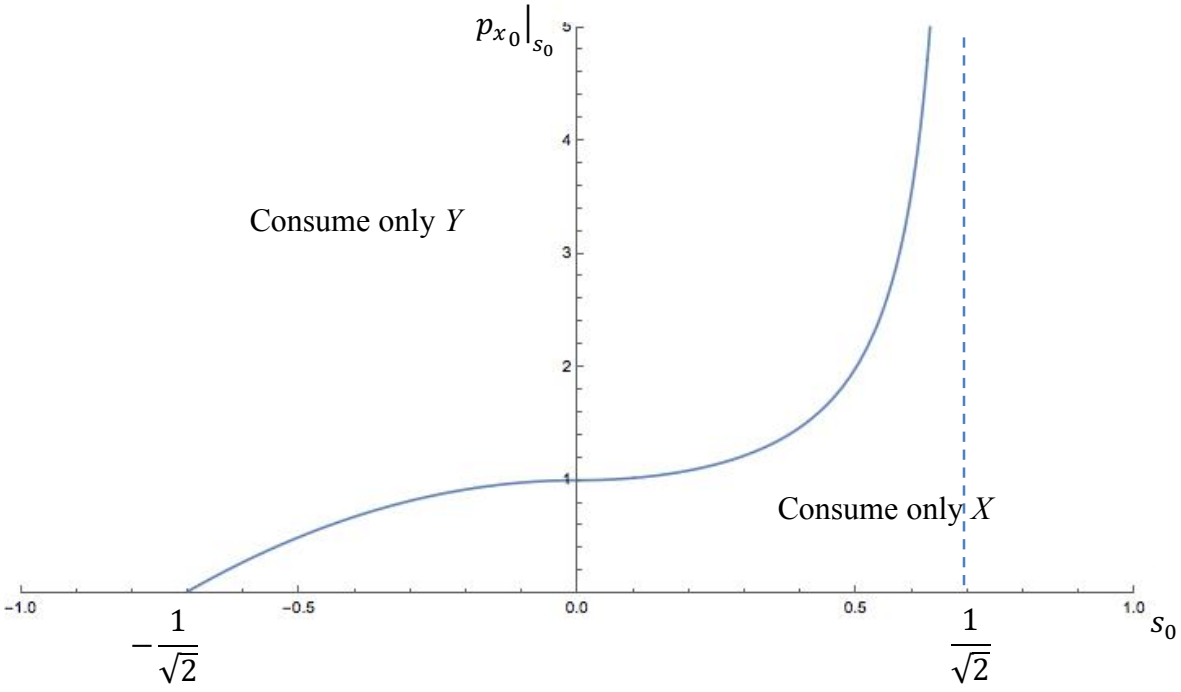


Figure 2 illustrates Equation (13); it traces the set of $p_{x_0}|_{s_0}$ for each s_0, at which a consumer is indifferent between good *X* and *Y*. Above the line, where $p_x > p_{x_0}|_{s_0}$, the consumer consumes only good *Y*. Conversely, the consumer consumes only good *X* below the line, i.e. $p_x < p_{x_0}|_{s_0}$. The unrepresented domains, $s_0 > \frac{1}{\sqrt{2}}$ and $s_0 < -\frac{1}{\sqrt{2}}$ is a consequence of Proposition 1 and Corollary 1, which tells us that price ceases to matter beyond a certain threshold identity strength. For example, when an individual's identity strength is larger than $\frac{1}{\sqrt{2}}$, she only consumes good X, as illustrated in Figure 2.[15]

From Figure 2, we note that the relationship between p_{x_0} and s_0 is monotonic. To express this relationship in a convenient manner, let us denote the mapping from s_0 to

[15] More accurately, the consumer might consume good *Y* if they were compensated to do so, i.e. the price ratio $p_{x_0}|_{s_0} < 0$, denoting that the price of good *Y* is negative. In reality, negative prices can and have occurred. However, for simplicity, we will assume that prices cannot take on negative values.

$p_{x_0}|_{s_0}$ as $R: s_0 \rightarrow p_{x_0}|_{s_0}$, for $s_0 \in \left[-\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right)$. For $s_0 \geq \frac{1}{\sqrt{2}}$, we take $p_{x_0}|_{s_0} = \infty$ to represent that the consumer will consume Good *X* regardless of price, i.e. there is no effective threshold price, as noted in Result 1. For $s_0 < -\frac{1}{\sqrt{2}}$, $p_{x_0}|_{s_0} < 0$, implying that good *X* will not be consumed.

The duality to the above proposition is that, for a given finite and non-negative p_{x_0}, there exists an identity strength $s_0|_{p_{x_0}}$, above which a consumer consumes only Good X. Hence, there exists an inverse function for R, such that $R^{-1}: p_{x_0} \rightarrow s_0|_{p_{x_0}}$, within the domain $0 \leq p_{x_0} < \infty$. We will thereafter refer to this $s_0|_{p_{x_0}}$ as the critical identity strength.

At this point, we make a short digression, to revisit the justification for Assumption 1. We note that for a given non-zero and finite p_{x_0}, consumers will only consume both good *X* and *Y* if their identity strength coincides with the critical identity strength, i.e. $s_j = s_0|_{p_{x_0}}$. Since s_j follows a continuous distribution, the probability that s_j is exactly $s_0|_{p_{x_0}}$, $P\left(s_j = s_0|_{p_{x_0}}\right) \approx 0 \Longrightarrow N|_{s_j = s_0} \approx 0$, where $N|_{s_j = s_0|_{p_{x_0}}}$ denotes the number of consumers with identity strength exactly equal to $s_0|_{p_{x_0}}$. Therefore, we can assume, to first approximation, that no individual will consume both good *X* and *Y*.

We can derive the market demand for *X* by noting the following two observations:

i. For a given p_{x_0}, consumers with $s_j > s_0|_{p_{x_0}}$ will consume only good *X*, while the others will consume 0 units of good *X*. Hence, we can find the number of consumers who consume good *X* (denoted as N_x) by finding the number of consumers with identity strength above $s_0|_{p_{x_0}}$ ($N|_{s_j > s_0|_{p_{x_0}}}$). Hence, using the Beta distribution, we can obtain N_x as follows:

$$N_x = N|_{s_j > s_0|_{p_{x_0}}} = 1 - F\left(T^{-1}\left(s_0|_{p_{x_0}}\right); \alpha, \beta\right) \tag{14}$$

We can rewrite Equation (14) in terms of a given price p_{x_0}, using the transformation *R*:

$$N_x\left(p_{x_0}; \alpha, \beta\right) = 1 - F\left(T^{-1}\left(R(p_{x_0})\right); \alpha, \beta\right) \tag{15}$$

ii. Recall from Proposition 1 that, above the critical identity strength, consumers will consume $\frac{\gamma I}{p_x}$ units of good *X*, regardless of the degree by which their identity strength s_j exceeds the critical level.

Proposition 2 The solution to the market demand for Good *X* is:

$$X(p_x, I; \alpha, \beta, \gamma) = \left(1 - F\left(T^{-1}\left(R(p_x)\right); \alpha, \beta\right)\right) \cdot \frac{\gamma I}{p_x} \tag{16}$$

Proof Found in Appendix ■

Next, we would like to understand how characteristics of the market demand is shaped by the identity pressures in the population.

4.4. Interaction between Identity and Market Demand

In the context of this problem, where we are understanding the effects of identity and prices on the consumption decision between two products, it is perhaps most important to consider the relative price elasticity under the various scenarios described in Figure 1. Note also that p_x is the relative price of Good *X* to *Y*.

Proposition 3 The relative price elasticity for good *X* is given as:

$$\begin{aligned} \frac{\partial X(p_x, I; \alpha, \beta, \gamma)}{\partial p_x} & \\ = -\frac{\partial F(\tilde{s}; \alpha, \beta)}{\partial \tilde{s}} \cdot \frac{\partial T^{-1}(s)}{\partial s} \cdot \frac{\partial R(p_x)}{\partial p_x} \cdot \frac{\gamma I}{p_x} & \\ - \left(1 - F\left(T^{-1}\left(R(p_x)\right); \alpha, \beta\right)\right) \cdot \frac{\gamma I}{{p_x}^2} & \end{aligned} \tag{17}$$

Proof By partial differentiation, noting that T^{-1} maps s to $\tilde{s}$, and R maps a given p_x to s. ■

It follows from Proposition 3 that identity elements modify relative price elasticity, but the exact outcome depends on the distribution of identity and the initial relative price of Good X and Y. Corollary 2 describes results for a special case, where the initial relative price is equal to the relative marginal functional utilities of Good X and Y, in this case, $p_x = 1$, and the distribution of identity strength is symmetric.

Corollary 2 For the case of $p_x = 1$, i.e. the 'neutral' price, Good X and Y are less price elastic if there is an equally *strong* identity pressure towards both goods. Conversely, Good X and Y are more price elastic in a market with equally *weak* identity pressure towards both identities. Formally,

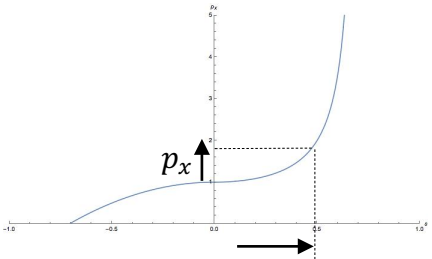
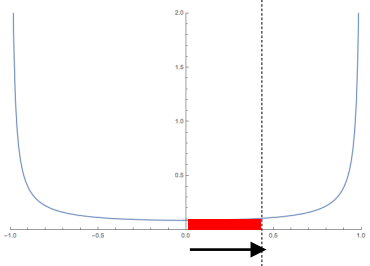
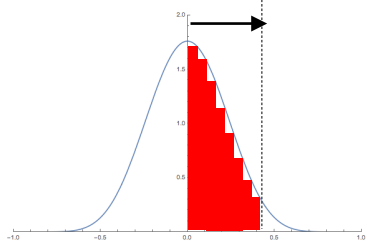
$$\left|\frac{\partial X(p_x, I; \alpha^h, \beta^h, \gamma)}{\partial p_x}\right| < \left|\frac{\partial X(p_x, I; \alpha^l, \beta^l, \gamma)}{\partial p_x}\right| \quad (18)$$

$$\text{where } p_x = 1, \alpha^h = \beta^h > \alpha^l = \beta^l$$

Proof Found in Appendix ■

Corollary 2 builds on Corollary 1, by generalizing the effects of identity on price sensitivity of demand to the market level. The 'neutral' case put forth in Corollary 2 offers us intuition about such effects. In a high pressure condition, the consideration given by consumers to identity outweighs that to price. Hence, changes in price results in a marginal change in quantity demanded of a good. Figure 3 provides a graphical interpretation of this intuition.

Figure 3 Graphical representation of the price elasticity of Good *X* in low and high pressure markets

	Graph	Description
Initial Condition	 Corresponding increase in s_0	Initially, $p_x = 1$. At this price level, the critical identity strength is neutral, i.e. $s_0\|_{p_x=1} = 0$. Consider a marginal increase in p_x to $p_{x,1}$. The corresponding critical identity strength increases to $s_0\|_{p_x=p_{x,1}}$ so that $s_0\|_{p_x=p_{x,1}} > 0$.
Impact on High Pressure Market		At first, when $s_0 = 0$, half of population has $s_j > 0 = s_0$, hence half of population consume good *X*, at $\frac{\gamma I}{p_x}$ unit per person. After price increases, s_0 (indicated by extended vertical line) shifts right to $s_0 > 0$. The proportion of the consumers with $s_j > s_0$ decreases by the amount represented by the red shaded area. Change in consumption of Good *X* is represented by the product of the shaded area and $\frac{\gamma I}{p_x}$.
Impact on Low Pressure Market		Likewise, in the low pressure market, the proportion of consumers who consume Good *X* decreases, but by a far larger number given by the shaded area. Note that the decrease in consumption of Good *X* falls by a much greater amount.

5. Salience

At this point, we have developed an intuition and nature of the interaction between identity and the characteristics of the market demand, specifically price elasticity of demand. We also observed that starting from a neutral point, demand is inelastic in a high pressure market, and elastic in a low pressure market. We immediately see implications for firm strategy, among other phenomenon – in a perfectly competitive market or oligopoly, firms might attempt to associate their product with identities that have high pressure in order to reduce their price elasticity and therefore their ability to set prices.[16] This section introduces parameters that describes the association of a product with an identity.

Oyserman (2009) asserts that multiple social identities can functionally add together, such as being white and male. It is appropriate to isolate a set of identities, insofar as it is *salient*, or "relevant in a particular context." Under different cues and situations, identities can increase in temporary relevance. McGuire, McGuire, Child and Fujiota (1978, as quoted in Oyserman, 2009), for example, show that ethnicity becomes salient when one's ethnicity stands out in a social environment. In addition, consumers prefer goods (or brands) that align with their identity, but only when this identity is made salient (Aaker, 1999; Loken, 2005; Oyserman, 2009) – Observation 3. Hence, identity can only affect consumption behavior if the identity in question is relevant or *salient* to the consumption decision.[17] For example, under ordinary circumstances, our choice of

[16] For illustration, consider Coca-Cola, which sponsors sports events, such as the Olympics. Coca-Cola advertises itself as the drink for athletes (whether this is a recommended option from the health perspective is a separate question). We may think of the S^X identity as 'sporty' and S^Y as otherwise. Having established itself as the prescribed good for the S^Y identity, Coca-Cola could transform its market from perfectly competitive (for soft drinks) to one where it has some pricing power. Future research may consider undertaking a survey of similar markets to verify whether this prediction is consistent with observations.

[17] The notion of salience is not new in economics. In fact, some studies in identity economics such as Benjamin, Choi, and Strickland (2010) have employed salience to conduct laboratory experiments to verify the role of identity effects in economic behavior and outcomes. To study whether social norms associated with gender and race affect time and risk preferences, Benjamin et al. (2010) performed social "category-salience manipulations" using suggestive questionnaires, to prime gender and racial identity. It found that identity-related effects were significant when subjects were primed, but were insignificant otherwise. In response to this finding, Benjamin et al. (2010) offered the explanation that subjects who are primed conform to their social category's social prescriptions, as Akerlof and Kranton (2000) and Higgins (1987) suggested.

laptop brands is independent of whether we adopt contrarian or conformist identities; we may very well ignore the effects of identity on consumption. However, identity elements become relevant after Apple successfully frames its product as a prescribed good for contrarians.

To model this effect, we introduce a new variable, σ_X, such that $0 < \sigma_X \leq 1$, to represent salience of an identity to the consumption decision of Good *X*. Let $\sigma_X = 1$ if the identity in question is fully salient, and $\sigma_X \to 0$ if it is irrelevant to the consumption decision. To model the interaction between salience and pressure, we may introduce a concept called *salient pressure*, denoted by $\frac{1}{\alpha}\sigma_X$ and $\frac{1}{\beta}\sigma_X$, such that the modified shape parameters take on the following form:

$$\alpha_X = \frac{\alpha}{\sigma_X} \tag{19}$$

$$\beta_X = \frac{\beta}{\sigma_X} \tag{20}$$

Notice that salient pressure is increasing on salience and pressure. In the scenario where an identity lacks salience in the decision in question, salient pressure takes on the value 0, while the modified shape parameters $\alpha_X, \beta_X \to \infty$. Under this condition, the PDF of the Beta distribution is such that the entire population has identity $s = 0$. Mathematically, this simplifies into the neoclassical microeconomic model involving perfect substitutes, where above a certain p_X, consumers demand only Good *Y*, and below the certain p_X, only Good *X*. This is consistent with the notion that standard models should hold in the absence of identity elements.

Proposition 4 Taking into account salience effects, we would like to re-define the solution to the market demand as:

$$X(p_x, I; \alpha_x, \beta_X, \gamma) = \left(1 - F\left(T^{-1}\left(R(p_x)\right); \alpha_x, \beta_X\right)\right) \cdot \frac{\gamma I}{p_x} \tag{21}$$

Also, the relative price elasticity for Good *X* may be re-defined as:

$$\begin{aligned} &\frac{\partial X(p_x, I; \alpha_X, \beta_X, \gamma)}{\partial p_x} \\ &\quad = -\frac{\partial F(\tilde{s}; \alpha_X, \beta_X)}{\partial \tilde{s}} \cdot \frac{\partial T^{-1}(s)}{\partial s} \cdot \frac{\partial R(p_x)}{\partial p_x} \cdot \frac{\gamma I}{p_x} \\ &\quad - \left(1 - F\left(T^{-1}\left(R(p_x)\right); \alpha_X, \beta_X\right)\right) \cdot \frac{\gamma I}{{p_x}^2} \end{aligned} \tag{22}$$

Corollary 3 If third parties can shape the salience of an identity $\boldsymbol{C}$ to the consumption of a Good *X* (and its functional substitute Good *Y*), they can shape the relative price elasticities of Good *X* and *Y*. Furthermore, in the 'neutral' case (as presented in Corollary 2), the limit to which third parties can cause Good *X* and *Y* to be price inelastic increases with the pressure of $\boldsymbol{C}$, i.e. when as $\alpha = \beta$ decreases. Mathematically, we have:

$$\min_{\sigma_X} \left| \frac{\partial X(p_x, I; \alpha_x^h, \beta_x^h, \gamma)}{\partial p_x} \right| < \min_{\sigma_X} \left| \frac{\partial X(p_x, I; \alpha_x^l, \beta_x^l, \gamma)}{\partial p_x} \right| \tag{23}$$

$$\text{where } \alpha_x^i = \frac{\alpha^i}{\sigma_X},\ \beta_x^i = \frac{\beta^i}{\sigma_X}, i = \{l, h\}$$

$$\text{and } p_x = 1, \alpha^h = \beta^h > \alpha^l = \beta^l$$

Proof Found in Appendix ■

Corollary 3 reflects Observation 3, that identity effects are present only if the identity in question is salient to the consumption of Good *X*. Corollary 3 also reflects the intuition that we stated in the introduction of Section 5. Assuming that a firm would like to gain price-setting power by decreasing the price elasticity of its product, it might

consider anchoring its product in an identity of high pressure through the means such as advertisement. Hence, our model predicts that firms with highly substitutable products may engage in such advertisements, if the costs of doing so outweighs the additional revenue resulting from its newly attained price-setting ability. Future research may verify if this prediction is consistent with observations. And if the prediction is correct, Corollary 3 may allow us to gain new understandings about firm strategy.

In addition, the notion of *salient pressure* also allows us to model a world with *n* dimensions of identities, where each dimension is salient to different extents in different consumption decisions. Instead of a one-dimensional Beta distribution, we would obtain a multi-dimensional joint probability distribution, weighted by the salience of the choice in each dimension of identity. However, in order to focus the discussion on the dynamics of identity and its relation to consumption patterns, we will leave the generalization to multiple dimensions of identities to future studies. Further studies might also examine the decay of *salience* over time.

6. Chick-fil-A

In this section, I employ a worked example to illustrate the potential applications of this model in firm strategy.

Consider the chicken sandwich market. Let be good X represent Chick-fil-A chicken sandwiches, and Y represent chicken sandwiches from a comparable competitor. For simplicity, we take the ratio of the price of Chick-fil-A to Brand Y chicken sandwiches to be given and equal to 1, i.e. $p_x = 1$. As in Section 4, consider a continuum of consumers with a utility function described by Equation (5). Let S^Y denote the social category of people who are pro-gay rights and S^X, those who are anti-gay rights. The distribution of the identity strength of the consumer population is given by a transformed Beta distribution with shape parameters α and β.

At first, whether one is pro or anti-gay rights is irrelevant to the consumption decision of chicken sandwiches. Therefore, $\sigma_X \to 0$, and the corresponding *salient pressure* is 0. The market equilibrium problem simplifies into a standard neoclassical problem. For simplicity, let us assume that market share between Chick-fil-A and Brand Y chicken sandwiches is evenly split.

However, in 2012, Chick-fil-A announced that it opposes gay rights (Horovitz, 2012). Standard economic analysis does not predict any changes in the market share of Chick-fil-A and Brand Y sandwiches, because one's taste and preference for chicken sandwich is functionally independent of one's views on gay rights. Moreover, even if we were to say that market share changes due to changing taste and preferences, we are unable to comment on the direction of the change in market share. Instead, we can analyze the situation using the identity model.

After the announcement using the model, one's views on gay rights become relevant to the consumption decision of chicken sandwiches. We may represent the event as an increase of σ_X from 0 to 1. Chick-fil-A became associated with the anti-gay rights identity, and for simplicity, we will take Brand Y as being associated with the pro-gay rights identity. In this way, Chick-fil-A and Brand Y sandwiches become prescribed goods for their respective social groups. As a result, *salient pressure* becomes non-zero.

From Proposition 1 and Corollary 2, we expect that consumers with $s_j < -\frac{1}{\sqrt{2}}$ will stop consuming Chick-fil-A sandwiches, regardless of p_x. This prediction is consistent with observations; after the announcement, "many gay rights groups called for boycotts" of Chick-fil-A sandwiches.[18]

The next question we can ask is, how is the market demand for Chick-fil-A and Brand Y sandwiches affected? The natural instinct is to jump to the conclusion that the market demand for Chick-fil-A sandwiches decreased, given bad publicity. However, the opposite happened; after the announcement, "consumer use of the chain was up by 2.2%" while "market share was up by 0.6%."[19, 20]

This apparent paradox is in fact resolvable. We note that Chick-fil-A operates largely in southern states, where a more conservative stance towards gay rights is in

[18] Horovitz (2012).
[19] Ibid.
[20] The disparity between the increase in consumer use and market share might be explained by new entry of consumers into the chicken sandwich market. It is conceivable that consumers may begin consuming previously unconsumed goods to support their identity and beliefs. More robust models may take into account this possibility. One possible model would allow γ in Equation (1) to depend on identity strength, to reflect how consumers might shift some proportion of their income from other goods to the good in question – chicken sandwiches in this case.

general adopted. Hence, we would expect more individuals to belong to S^X (anti-gay rights) than S^Y (pro-gay rights). To model this observation in the Beta distribution, we choose values for the shape parameters, such that $\alpha > \beta$, i.e. $\frac{1}{\alpha} < \frac{1}{\beta}$, meaning that the salient pressure towards anti-gay rights ($\frac{1}{\beta}\sigma_X$) is larger that than towards pro-gay rights ($\frac{1}{\alpha}\sigma_X$). Let us pick $\alpha = 3, \beta = 2$, in order to demonstrate using a concrete example. Since we have assumed, for simplicity, that $\sigma_X = 1$, the modified shape parameter (taking salience into consideration) equals the value of the unmodified shape parameter. The PDF of the transformed Beta distribution of salient identity strengths is illustrated in Figure 4b.

Given that $p_x = 1$, we obtain the critical identity strength by taking the transformation $R^{-1}(p_x)$ – as described by Equation (13) – as $s_0|_{p_{x_0}} = 0$. We apply Proposition 2, and obtain that the quantity demanded for Chick-fil-A sandwiches is $X^* = 0.688 \cdot \gamma I$ (refer to Graph 4 for a graphical illustration). By symmetry, we can obtain the demand for Brand Y sandwiches as $Y^* = 0.312 \cdot \gamma I$. The result is consistent with observations that the demand and market share for Chick-fil-A sandwiches increased.

Recently, Chick-fil-A is "recalibrating its moral and culinary compass" as it intends to move into more liberal cities, such as "Chicago, New York and Los Angeles," where we expect individuals to be friendlier to the gay rights movement.[21] This phenomenon is consistent with Corollary 3. In addition, it is likely that the pressure towards pro-gay rights ($\frac{1}{\beta}$) will increase as society becomes more progressive. Short of flipping its position on gay rights, Chick-fil-A's interest is to decouple itself from the issue, i.e. reducing the salience of the issue to the consumption of its products.

[21] Horovitz (2014)

Figure 4a **Critical price-identity strength curve**. Relative price p_x is taken as given and the critical identity strength $s_0|_{p_x}$ is in turn conditional on p_x. In this example, $p_x = 1$, which corresponds to $s_0|_{p_x} = 0$ on the curve. The dotted line from Figure 4a through Figure 4b indicates the critical identity strength.

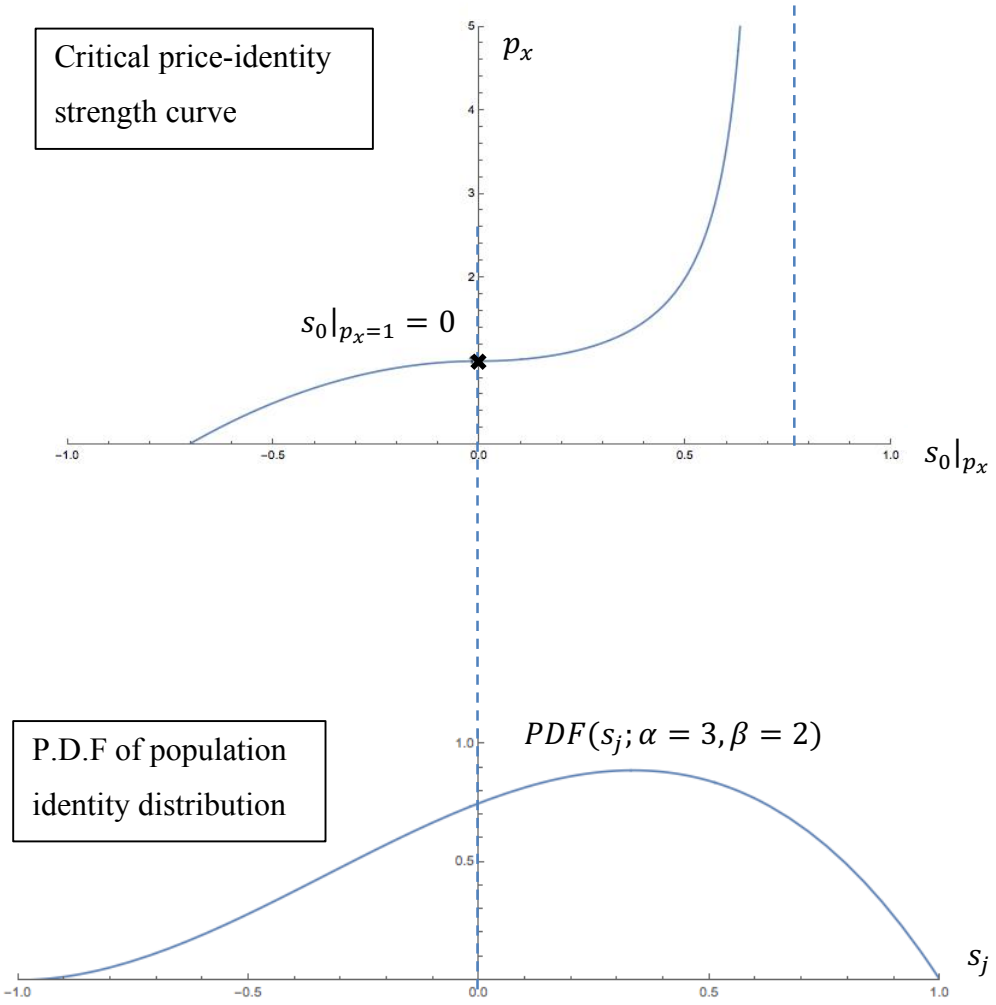


Figure 4b The probability distribution function of s_j follows a transformed Beta distribution with shape parameters $\alpha = 3, \beta = 2$. $s_0|_{p_x=1} = 0$ corresponds to an area under the graph of 0.312, or $CDF = 0.312 = N_Y$, the number of consumers who only consume Brand Y sandwiches. From Proposition 2, $N_X = 1 - CDF = 0.688$, and the market demand for Chick-fil-A sandwiches is $X^* = 0.688 \cdot \gamma I$.

7. Conclusion

Studies in consumer psychology and sociology have, for a long time, recognized the role of identity and social norms in consumption patterns. In this paper, I attempt to incorporate these observations into an economic model that describes their effects on consumption pattern.

The key result of the model suggests that fundamental economic parameters, such as price elasticity and market demand, can be profoundly altered by identity elements. We note in Section 5 and 6 that such an effect could have potential applications in firm theory. For example, firms may compete on the identity dimension to maximize their profits. This model predicts that firms in perfectly competitive markets may associate their products with high-pressure identities, in order to reduce product substitutability and attain price-setting power. Future work could use empirical data on observable identity distribution, relative price and market share to estimate the values of α_X, β_X in different markets. Identity elements also offer a new approach to understanding how firms such as Apple optimize their level of advertising and their impact on the consumption of other goods. It is also conceivable that policymakers are interested in influencing the level of consumptions of certain goods, e.g. discouraging unhealthy food. Hence, understanding the effects of identity on consumption patterns could open up a new set of policy tools.

In this model, we assumed identity to be a static construct. But over time, third parties and changing social contexts can cause shifts in a person's social identity (Oyserman, 2009). Marketing campaigns, such as Apple's, are immediate examples of how third parties are able to and have the incentives to reshape identities in the long run. And there exist a host of examples where social norms can shift, including changing perception of gender roles, attitude towards environmental conservation, and tolerance of alternative lifestyles. In addition, changing fertility rates can, and have caused shifting demographics. Future research may consider extending this model to account for shifting identity distributions. Such an extension would allow us to predict changes in consumption pattern *over time*, which could be of value to firms and policymakers.

Economics is the study of choice. And the choices we make are inevitably influenced by our beliefs, our community – our identity. The use of certain observable identity distributions to predict and explain consumption decisions promises to expand

the scope of economic analysis. This paper presents a consumption model that attempts to robustly account for such social dimensions. While this model remains incomplete amidst the complications and nuances of human interaction, it is nonetheless a step towards unravelling the complexity of our choices.

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Appendix

Proof to Lemma 1

Lemma 1 Individual j will devote γ of her income to either good *X* or *Y*, under utility maximizing conditions:

$$p_x x + y = \gamma I_j$$

Proof Using Assumption 1, that only corner solution exists, say that individual j only consumes good *X*, i.e. $y = 0$. We can rewrite utility function of individual j as:

$$U_j = \left[(x)\left(1 - w(s_j) + \frac{s_j}{|s_j|} \cdot w(s_j)\right)\right]^{\gamma} [z]^{1-\gamma}$$

Consider the case where $s_j \geq 0$, then the function simplifies to:

$$U_j = x^{\gamma} z^{1-\gamma}$$

which is a simple Cobb-Douglas specification, from which we know $p_x x = \gamma I_j$. And for cases where $s_j < 0$, the utility function simplifies to:

$$U_j = \left(1 - 2w(s_j)\right)^{\gamma} x^{\gamma} z^{1-\gamma}$$

Again, we have a simple Cobb-Douglas specification, and we conclude that $p_x x = \gamma I_j$, when $y = 0$. We can hence also write that as $p_x x + y = \gamma I_j$. By symmetry, we can show the same for when $x = 0$. Hence, Lemma 1 holds for all corner solutions of *X* and *Y*. ■

Proof to Lemma 2

Lemma 2 Solving the following problem maximizes individual's j's utility:

$$\max_{x,y} U_{\gamma j}$$

$$\text{where } U_{\gamma j} = \left(\big(1 - w(s_j)\big)(x + y) + \frac{s_j}{|s_j|} \cdot w\big(s_j\big)(x - y) \right)$$

subject to constraint $p_x x + y \leq \gamma \cdot I$

Proof The corollary to Lemma 1 is that individual j will devote $(1 - \gamma)I_j$ to consuming good Z, hence,

$$z^* = \frac{(1 - \gamma)I_j}{p_z}$$

We note that $z^* \geq 0 \Rightarrow z^{1-\gamma} \geq 0$. Rewriting the utility function under optimizing conditions, we obtain:

$$U_j = {U_{\gamma j}}^{\gamma} z^{*1-\gamma}$$

Taking partial differential of U_j with respect to $U_{\gamma j}$:

$$\frac{\partial U_j}{\partial U_{\gamma j}} = \gamma {U_{\gamma j}}^{\gamma - 1} z^{*1-\gamma}$$

If we can show that $U_{\gamma j} \geq 0$ at the optimizing points, then $\frac{\partial U_j}{\partial U_{\gamma j}} \geq 0$. We know that $\big(1 - w(s_j)\big)(x + y) \geq 0$. We note in the second term that the consumer can always choose between x and y, such that term takes on a non-negative value. Hence, under optimizing conditions, maximizing $U_{\gamma j}$ will maximize U_j. ■

Proof to Lemma 3

Lemma 3 The market demand can be written as the expectation of x^*, given the distribution of consumer identity strength in the market:

$$X(p_x; \alpha, \beta) = E(x^*) = \int_{-1}^{1} {x_j}^*(s_j, p_x, I_j) \cdot f\left(T^{-1}(s_j); \alpha, \beta\right) ds_j$$

Proof Having normalized number of consumers *N* to 1, we can use the convenient property that the area under the Beta distribution is also 1. We can then interpret the PDF, $f(\tilde{s}; \alpha, \beta) = f(T^{-1}(s); \alpha, \beta)$, as the number of consumers with identity strength s. By this construct, the market demand for good *X* becomes synonymous with the expectation of x^* across the Beta function. ■

Proof to Proposition 1

Proposition 1 The Marshallian demand for an individual j is described by the following equation:

$$x_j^*(p_x, s_j, I_j) = \begin{cases} \dfrac{\gamma I_j}{p_x}, & p_x < \dfrac{1 - w(s_j) + \dfrac{s_j}{|s_j|}\left(w(s_j)\right)}{1 - w(s_j) - \dfrac{s_j}{|s_j|}\left(w(s_j)\right)} \\ \dfrac{\gamma I_j}{p_x}, & 1 - w(s_j) - \dfrac{s_j}{|s_j|}\left(w(s_j)\right) < 0 \\ 0, & \text{otherwise} \end{cases}$$

Proof From Lemma 2, we can obtain the ratio of marginal utility of X to marginal utility of Y as:

$$\frac{MU_X}{MU_Y} = \frac{\partial U_{\gamma j}/\partial x_j}{\partial U_{\gamma j}/\partial y_j} = \frac{1 - w(s_j) + \dfrac{s_j}{|s_j|}\left(w(s_j)\right)}{1 - w(s_j) - \dfrac{s_j}{|s_j|}\left(w(s_j)\right)}$$

Notice that the numerator and denominator cannot be negative at the same time.

Case 1: both numerator and denominator are positive. Consumer consumes only good X if $\frac{MU_X}{MU_Y} > p_x$.

Case 2: numerator is positive and denominator is negative. Since $MU_X > MU_Y$, consumer only consumes good X.

Case 3: numerator is negative and denominator is positive. Since $MU_X < MU_Y$, consumer consumes zero unit of good X. ■

Proof to Proposition 2

Proposition 2 The market demand can be written as

$$X(p_x, I; \alpha, \beta, \gamma) = \left(1 - F\left(T^{-1}\left(R(p_x)\right); \alpha, \beta\right)\right) \cdot \frac{\gamma I}{p_x}$$

Proof From Lemma 3, we have:

$$X(p_x; \alpha, \beta) = E(x^*) = \int_{-1}^{1} {x_j}^*\left(s_j, p_x, I_j\right) \cdot f\left(T^{-1}\left(s_j\right); \alpha, \beta\right) ds_j$$

Considering the integral piecewise gives us:

$$X(p_x, I; \alpha, \beta) = \int_{-1}^{s_0|_{p_x}} x^*\left(s_j, p_x, I_j\right) \cdot f\left(T^{-1}\left(s_j\right); \alpha, \beta\right) ds_j + \int_{s_0|_{p_x}}^{1} x^*\left(s_j, p_x, I_j\right) \cdot f\left(T^{-1}\left(s_j\right); \alpha, \beta\right) ds_j$$

where $s_0|_{p_x}$ is the critical identity strength for p_x, above which a consumer consumes only good *X*. From Equation (13), we have $x^*\left(s_j, p_x, I_j\right)\big|_{-1 \le s_j < s_0|_{p_x}} = 0$ and $x^*\left(s_j, p_x, I_j\right)\big|_{s_0|_{p_x} < s_j \le 1} = \frac{\gamma I}{p_x}$. Then, we can write the piecewise integral:

$$X(p_x, I; \alpha, \beta, \gamma) = \int_{-1}^{s_0|_{p_x}} 0 \cdot f\left(T^{-1}\left(s_j\right); \alpha, \beta\right) ds_j + \int_{s_0|_{p_x}}^{1} \frac{\gamma I}{p_x} \cdot f\left(T^{-1}\left(s_j\right); \alpha, \beta\right) ds_j$$

Simplifying, we obtain:

$$X(p_x, I; \alpha, \beta, \gamma) = \frac{\gamma I}{p_x} \cdot \int_{s_0|_{p_x}}^{1} f\left(T^{-1}\left(s_j\right); \alpha, \beta\right) ds_j$$

We recognize that $\int_{s_0|_{p_x}}^{1} f\left(T^{-1}\left(s_j\right); \alpha, \beta\right) ds_j$ is the probability that $s_0|_{p_x} < s_j \le 1$, which is equivalent to $1 - CDF(s_0|_{p_x})$. We can thus rewrite the market demand for good X as:

$$X(p_x, I; \alpha, \beta, \gamma) = \left(1 - F\left(T^{-1}\left(R(p_x)\right); \alpha, \beta\right)\right) \cdot \frac{\gamma I}{p_x} \quad \blacksquare$$

Proof to Corollary 1

Corollary 1 There exists some $w(s_j)$ where $\left(1 - w(s_j)\right) > 0$ such that the optimal consumption of Good *X*, $x_j^* = 0 \; \forall \; p_x \geq 0$.

Proof Consider $s_j < 0$, that is individual j is prescribed *Y*. From Proposition 1, rewrite condition for $x_i^* = 0$ as

$$p_x > 1 - 2w(s_j)$$

$\Rightarrow \; x_j^* = 0 \; \forall \; p_x \geq 0$ when $w(s) > 0.5$, or $\left(1 - w(s_j)\right) > 0$. By symmetry, the same can be shown for *Y*. ■

Proof to Corollary 2

Corollary 2 For the case of $p_x = 1$, i.e. the 'neutral' price, Good *X* and *Y* are less price elastic if there is an equally *strong* identity pressure towards both goods. Conversely, Good *X* and *Y* are more price elastic in a market with equally *weak* identity pressure towards both identities. Formally,

$$\left|\frac{\partial X(p_x, I; \alpha^h, \beta^h, \gamma)}{\partial p_x}\right| < \left|\frac{\partial X(p_x, I; \alpha^l, \beta^l, \gamma)}{\partial p_x}\right|$$

$$\text{where } p_x = 1, \alpha^h = \alpha^l, \beta^h > \alpha^l = \beta^l$$

Proof From Proposition 3, we have

$$\frac{\partial X(p_x, I; \alpha, \beta, \gamma)}{\partial p_x}$$

$$= -\frac{\partial F(\tilde{s}; \alpha, \beta)}{\partial \tilde{s}} \cdot \frac{\partial T^{-1}(s)}{\partial s} \cdot \frac{\partial R(p_x)}{\partial p_x} \cdot \frac{\gamma I}{p_x}$$

$$- \left(1 - F\left(T^{-1}\left(R(p_x)\right); \alpha, \beta\right)\right) \cdot \frac{\gamma I}{{p_x}^2}$$

For $p_x = 1$, $F\left(T^{-1}\left(R(p_x)\right); \alpha, \beta\right) = 0.5 \ \forall \ \alpha = \beta$. Hence, the only term that differs is $\frac{\partial F(\tilde{s}; \alpha, \beta)}{\partial \tilde{s}}$ .Recall that $\frac{\partial F(\tilde{s}; \alpha, \beta)}{\partial \tilde{s}} = f(\tilde{s}; \alpha, \beta)$. Substitute $\tilde{s} = T^{-1}\left(R(p_x)\right) = 0.5$. Then, we may write $f(\tilde{s}; \alpha, \beta)$ as

$$f(0.5; \alpha, \beta = \alpha) = \frac{0.5^{2(\alpha-1)}}{\int_0^1 (x - x^2)^{\alpha-1} dx}$$

Using numerical methods, we may evaluate that $f(0.5; \alpha, \beta = \alpha)$is strictly increasing in α for $\alpha > 0$. Hence,

$$\frac{\partial F(\tilde{s}; \alpha^h, \beta^h)}{\partial \tilde{s}} > \frac{\partial F(\tilde{s}; \alpha^l, \beta^l)}{\partial \tilde{s}}$$

Then the price elasticity when $\alpha = \alpha^h$, $\beta = \beta^h$ is more negative than when $\alpha = \alpha^l, \beta = \beta^l$. Hence, when we take the absolute:

$$\left|\frac{\partial X(p_x, I; \alpha^h, \beta^h, \gamma)}{\partial p_x}\right| < \left|\frac{\partial X(p_x, I; \alpha^l, \beta^l, \gamma)}{\partial p_x}\right| \ \blacksquare$$

Proof to Corollary 3

Corollary 3 If third parties can shape the salience of an identity $\boldsymbol{C}$ to the consumption of a Good X (and its functional substitute Good Y), they can shape the price elasticities of Good X and Y. Furthermore, in the 'neutral' case (as presented in Corollary 2), the limit to which third parties can cause Good X and Y to be price inelastic increases with the pressure of $\boldsymbol{C}$, i.e. when as $\alpha = \beta$ decreases. Mathematically, we have:

$$\min_{\sigma_X} \left| \frac{\partial X(p_x, I; \alpha_x^h, \beta_x^h, \gamma)}{\partial p_x} \right| < \min_{\sigma_X} \left| \frac{\partial X(p_x, I; \alpha_x^l, \beta_x^l, \gamma)}{\partial p_x} \right|$$

$$\text{where } \alpha_x^i = \frac{\alpha^i}{\sigma_X},\ \beta_x^i = \frac{\beta^i}{\sigma_X}, i = \{l, h\}$$

and $p_x = 1, \alpha^h = \beta^h > \alpha^l = \beta^l$

Proof From Corollary 2, we know that $\left| \frac{\partial X(p_x, I; \alpha_x^i, \beta_x^i, \gamma)}{\partial p_x} \right|$ is minimized when $\alpha_x^i = \beta_x^i$ is minimized. For a given α^i, $\alpha_x^i = \frac{\alpha^i}{\sigma_X}$ is minimized when σ_X takes on the maximum possible value, i.e. $\sigma_X = 1$. Hence, $\min_{\sigma_X}(\alpha_x^i) = \alpha^i$. Therefore, $\min_{\sigma_X} \left| \frac{\partial X(p_x, I; \alpha_x^i, \beta_x^i, \gamma)}{\partial p_x} \right| = \left| \frac{\partial X(p_x, I; \alpha^i, \beta^i, \gamma)}{\partial p_x} \right|$. From Corollary 2, we know that $\left| \frac{\partial X(p_x, I; \alpha^h, \beta^h, \gamma)}{\partial p_x} \right| < \left| \frac{\partial X(p_x, I; \alpha^l, \beta^l, \gamma)}{\partial p_x} \right|$.

■