BUNDLED PRICES:
THE EFFECT OF CURRENCY ON CONSUMER WILLINGNESS TO PAY

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ABSTRACT

The rising popularity of loyalty programs and related marketing promotions has resulted in the introduction of a number of new currencies (e.g., frequent flier miles, HHiltons Honor points) that people accumulate, budget and spend much like traditional paper money. As consumers are increasingly able to pay for goods and services (e.g., airline travel, hotel stays, groceries) in more than one currency, the importance of understanding how shoppers respond to “bundled prices,” or prices comprised of payments delivered in multiple currencies, has become increasingly important to marketers. This research is the first to explore how people evaluate transactions involving prices issued in multiple currencies and when bundled prices might be superior to prices issued in a single currency.

In this research, we explore how consumers respond to bundled prices and determine the conditions under which a bundled price can be superior to prices charged in a single currency. We consider a bundled price superior if it either (a) lowers the psychological cost associated with a particular revenue objective (i.e., price), or (b) raises the amount of revenue collected given a particular psychological cost.

First, we demonstrate how non-linear value functions open the door for optimal bundled prices. Next we present a formal mathematical proof that outlines the conditions under which a bundled price is superior. In Study 1, we offer experimental evidence supporting the proposition that the subjective value of a currency other than money (frequent flier miles) is non-linear and most likely S-shaped. In Study 2, we test the external validity of our proofs by having real consumers (i.e., actual airline travelers) evaluate and make choices among prices issued in single and combined currencies. The results illustrate how bundled prices often can be superior to standard, single currency prices.

KEY WORDS: Loyalty Programs, Pricing, Bundling, Bundled Prices, Utility Theory, Incommensurate Resources, Mental Accounting.

"For millions of Americans, frequent-flier miles have become a second currency. In addition to piling them up by hopping on a plane, you can get them by making phone calls, buying toys, investing in mutual funds, taking out a mortgage, or renting cars."

"Meanwhile, don't be tempted by airline offers to sell you a ticket for a combination of miles and money. The deals are usually terrible."

Business Week
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Money has been around in one form or another since at least 9000 BC, and at one time or another cigarettes, cattle, stones, eggs, salt and porpoise teeth each has served as a negotiable instrument (Davies 1996). Today, almost all economies run on "fiat" money, paper notes the government says are worth something. Yet the immense popularity of marketing promotions and loyalty programs has resulted in the introduction of several new forms of currency that people appear to accumulate, budget and spend much like paper money. Perhaps the most ubiquitous alternative currency in the U.S. is frequent flier miles. More than 67 million Americans collect frequent flier miles (InsideFlyer 2001) and more than 18,500 U.S. businesses distribute miles to their customers (Business Week 1999).

One consequence is that consumers are increasingly able to pay for things in a combination of currencies, not just dollars. Diners Club awards two Club Rewards points for every dollar charged, but when members don't have enough for a reward they desire, they can charge the difference at $0.015 per point.[1] Milepoint.com is an Internet exchange site backed by a group of prominent airlines that boasts consumers can apply frequent flier miles as partial payment towards the purchase of more than 20 million products offered at participating merchants' sites.[2] MileShopper^{SM} emerged as an online catalog claiming to sell more than 300,000 brand name items from companies like Toshiba, Samsonite and Spalding for which shoppers could apply miles for up to 30% of their purchases. Perhaps most familiar to frequent fliers, however, are the deals offered by the airlines themselves. For example, American Airlines is only one of a number of airlines that offers airline tickets for a combination of money and miles. One NetSAAver fare advertised on their web site during the summer of 2001 offered any ticket normally priced at $209 for the combined or "bundled price" of $49 plus 17,000 miles.

Despite the increasing popularity of prices issued in more than one currency, we know of no work that examines how consumers evaluate "bundled prices" per se. The concept of "bundled prices" involves combining payments in different currencies for a single good or service, as opposed to the more common practice of "product bundling," in which sellers offer single units of multiple products or multiple units of the same product for one price issued in a single currency. The two concepts are very different in how the firm might utilize each to increase revenues. To be effective, product bundling requires consumer heterogeneity as it is designed to take advantage of different values for like goods across customers. In contrast, price bundling can be effective for a single customer as a price is constructed based on the shapes of his or her idiosyncratic valuations for the currencies involved.

In this research, we explore how consumers respond to bundled prices and determine the conditions under which a bundled price can be superior to a price charged in a single currency. We consider a bundled price superior if it either (a) lowers the psychological cost associated with a particular revenue objective (i.e., price), or (b) raises the amount of revenue collected given a particular psychological cost. In other words, firms can benefit by either making customer feel better about what they are paying, or charging more given the psychological cost already involved. It follows logically that a bundled price is optimal if it minimizes the psychological cost associated with the maximum revenue collected, or maximizes the revenue collected associated with a given psychological cost.

CONCEPTUAL BACKGROUND

The Value of Money and other Currencies

The idea that an optimal bundled price can exist rests on a number of well-established economic and psychological principles. First, according to Prospect Theory (Kahneman and Tversky 1979), an individual's value function is believed to be concave such that there are diminishing increases in utility for each additional equal increment in wealth. Kahneman and Tversky take the same perspective as Bernoulli (1954), in which (a) the particular perceptual properties are such that subjective experience is a concave function of the magnitude of physical change, which is the same assumption made by cardinal utility, and (b) the perceptual system is sensitive to changes in stimulus level rather than absolute magnitudes. The assumption of diminishing marginal utility for money is rarely contested in either psychology or economics today.[3] Accordingly, a price increase from $10 to $15 inflicts a greater psychological cost than an increase from $120 to $125 (Tversky and Kahneman 1981).

Second, research in mental accounting (Kahneman and Tversky 1984, Thaler 1980, 1985) has explored how personal financial transactions are tracked, booked (i.e., recorded) and posted to specific mental accounts or categories, principally in dollar terms. Consumers are believed to set budgets for various expense accounts and as they spend, periodically re-compute the amount of money remaining in their budgets (Heath 1995, Heath and Soll 1996). Based on how Prospect Theory's value function compresses large monetary magnitudes together during encoding, the marginal propensity to spend depends on the increment (i.e., price) and its relation to one's perceived wealth, asset position, or budget within a particular mental account (Thaler and Shefrin 1981, Heath and Soll 1996). In other words, the psychological pain associated with paying an additional $5 is expected to be greater the smaller the original amount due ($10 versus $125), but can also be expected to seem larger the less money there is to spend, or the smaller the amount earmarked for such expenses in an individual mental account.

Finally, research on incommensurate resources (Nunes and Park 2001) suggests consumers react to changes in alternative currencies much like they do for money, yet incremental costs incurred in one currency may not be judged relative to charges issued in another currency. For example, Nunes and Park found the psychological cost associated with surrendering 5,000 frequent flier miles on top of 50,000 miles was far less severe than surrendering 5,000 miles on top of $500. It appears that the pain involved in surrendering an additional 5,000 miles depends on the total miles that must be surrendered and the number of miles in one's frequent flier account, rather than the amount of money one might spend or the amount of money in one's bank account. These results suggest consumers do not spontaneously encode frequent flier miles in dollar terms, or vice-versa, and the units of measures or scales are not compatible (Tversky, Sattath and Slovic 1988; Slovic, Griffin & Tversky 1990; Shafir 1995).

Consequently, just as mental accounting and mental budgeting has demonstrated that consumers often behave as if their money were not perfectly fungible, assets accounted for in different currencies are expected to have their own mental accounts and be similarly non-interchangeable. Taken together, previous research suggests three important aspects of pricing that provide the basis for bundled pricing. First, the value of money is subject to diminishing marginal returns. Second, the marginal propensity to spend in one currency would depend on the amount due or the perceived asset position within that currency. Third, the marginal propensity to spend in one currency does not depend on the amount due or the perceived asset position in an alternative, incommensurate currency. Therefore, opportunistic sellers can shift the balance of payments among the currencies such that the total amount due minimizes the psychological pain associated with the purchase.

Finally, in order for bundled prices to be effective, the firm must possess a stable transfer function. In other words, the exchange rate must be linear for the firm (e.g., one frequent flier mile is always equivalent to $0.02), which it uses to optimize globally over thousands of exchanges. In 1999, Business Week (1999) advised fliers to value each of their miles at 2 cents – most airlines' standard selling price.[4] Yet consumers who engage in infrequent transactions (do not regularly have the opportunity to accumulate or spend miles), or are unaware of this exchange rate, are unlikely to value their miles as such. Just consider that consumers who paid American Airline's fare of $49 plus 17,000 miles for a $209 ticket received less than one cent (exactly 0.95 cents) per mile. Meanwhile, a simultaneous offer of $79 tickets for $49 and 4,000 miles suggests someone surrendering one-fourth the miles values each mile even less, at closer to 0.75 cents. These differences in buy and sell rates, and among various bundled prices (see Table 1) support the arguments that: (1) consumers don't always utilize the value of a mile to the seller or some stable market rate when evaluating bundled prices, and (2) a consumer's subjective value for miles is likely to change depending on the quantity to be surrendered.

The following example illustrates how a bundled price can be used by an airline and be superior to one issued in a single currency. Imagine a consumer with an S-shaped value function for miles, such that the psychological cost associated with surrendering

1,000 miles seems negligible in dollar terms. Suppose turning over 12,500 miles feels similar to spending $250, yet surrendering twice that amount, or 25,000 miles, is akin to spending $600, the price of the average airline ticket. Consequently, this consumer's value function is convex over the range of 0 to 25,000 miles. The airline could offer a 25,000-mile ticket for the bundled price of 12,500 miles and $250, which at 2-cents per miles brings in the equivalent revenue to the airline, yet inflicts a smaller psychological cost to the consumer (i.e., the equivalent of $500 rather than $600).

It is critical to point out that our results depend only on non-linear valuations for the currencies involved, and that the underlying cause or causes (e.g., wealth effects, relativistic processing, mental accounting or budgeting, risk aversion) have no impact on whether an optimal bundled price exists or its derivation. It is only important that (1) the consumer does not value each unit within a currency equally; and (2) does not spontaneously convert charges issued in one currency into increments of the other currency, nor should they convert both simultaneously into some third currency while evaluating a bundled price. Consequently, if the firm understands the basic shape of the value functions for each currency (e.g., dollars and miles), using its own stable transfer function it can determine whether a bundled price would be superior to a price issued in a single currency. This research proves this mathematically and demonstrates it experimentally.

The rest of this paper is organized as follows. First, we present a formal mathematical proof that outlines the conditions under which a bundled price is superior and alternatively when a price issued in one currency would be superior. In this section, we outline how non-linear value functions open the door for optimal bundled prices: those that maximize revenues while minimizing the psychological cost. Next, we present

Study 1, which offers experimental evidence supporting our proposition that the subjective value of a currency other than money (frequent flier miles) is non-linear, at least for the population sampled. The results from two surveys suggest that very small amounts of miles are not valued proportionately with large amounts, which are not valued equivalently with much larger amounts, implying an S-shaped value function. In Study 2, we test the external validity of the proofs by having real consumers (i.e., actual airline travelers) evaluate and make choices among prices issued in single and combined currencies. The results illustrate how a bundled price can be superior and how marketers can extract higher prices from their customers, or minimize the psychological cost associated with a particular price, through the use of bundled prices. The paper concludes by pointing out some of the limitations of this research and offering some managerial implications, as well as suggestions for future research.

THE USE OF BUNDLED PRICES IN MINIMIZING PERCEIVED COSTS

In this section, we show how non-linear valuations result in many instances where marketers – in order to secure the same amount of revenue with the least amount of psychological pain – should charge prices in a mixture of currencies (i.e., bundled prices). We also describe situations in which a price charged in a single currency is optimal. For simplicity and ease of exposition, we work with only two currencies: c_1 and c_2. We begin by examining the case in which the value function for both currencies is concave, followed by the case in which both are convex. We extend the discussion by describing the case in which one is concave while the other convex, and conclude by describing how the results differ when one currency's value function is S-shaped.

We assume the company possesses some transfer function (i.e., exchange rate) for the two currencies, c_1 and c_2, which is linear (i.e., $c_1 = \alpha c_2$). Without a loss of generality, we can set α=1.[5] The firm's target price or revenue objective can be described as a combination of c_1 and c_2:

$$R = c_1 + c_2 \tag{1}$$

From the consumer's perspective, based on our assumption that consumers either do not or cannot easily convert the two into any meaningful common unit of measurement, the subjective value of c_1 and c_2 vary independently. Thus, the subjective loss or psychological cost associated with surrendering some combination of c_1 and c_2 can be written as:

$$E = f(c_1) + g(c_2) \tag{2}$$

where f and g are strictly monotonically increasing continuous functions of c_1 and c_2, respectively, defined over the interval $[0,\infty]$ (i.e., $f' > 0$ and $g' > 0$). Further, $f(0) = g(0) = 0$, and f', g', f'', and g'' exist over their whole domain.

Let's assume the goal of the firm is to set a price that secures their revenue objective while minimizing the psychological cost to the consumer. The goal could just as easily be to maximize the revenue received given a fixed psychological cost, but practically speaking, we expect firms to begin with established revenue objectives, not perceived values, when developing bundled prices. Thus, the firm must solve the optimization problem:

$$\begin{aligned} &Min\ E = f(c_1) + g(c_2) \\ &st: c_1 + c_2 = r \end{aligned} \tag{3}$$

A well-known mathematical result is that, for any given r, the solutions (c_1^*, c_2^*) to equation (3) will be such that:

$f^{'}(c_1^*) = g^{'}(c_2^*)$ for an interior solution, and

$f^{'}(0) > g^{'}(c_2^*)$ or $g^{'}(0) > f^{'}(c_1^*)$ for a corner solution (see Appendix A).

An interior solution will give rise to price bundling (i.e., a price charged in some combination of both currencies), while a corner solution will give rise to a price assessed in only one currency. Therefore, the firm must determine when they are facing a corner solution and when they face an interior solution. This will depend on consumers' subjective valuations (i.e., the shape of the value functions) for currencies c_1 and c_2.

In what follows, we show mathematically when a firm should charge a bundled price issued in some combination of currencies c_1 and c_2, rather than a price issued in one currency (c_1 or c_2) alone in order to extract the objective revenue, r, with the minimum psychological cost to the consumer. We will assume that $f(r) \leq g(r)$ purely for expositional purposes, as all claims can be transposed for those situation in which $g(r) \leq f(r)$. We proceed by first examining the case in which the value functions for both currencies are concave, before proceeding to the case in which both are convex. We then examine the case in which f is strictly concave and g is strictly convex over $[0, r]$, as well as the case in which f is strictly concave and g is S-shaped over $[0, r]$.

CASE 1: Both *f* and *g* are strictly concave over [0,*r*]

Proposition 1: When both f and g are strictly concave (i.e., $f'>0$, $g'>0$ and $f''<0$, $g''<0$) we have a corner solution. The solution is $(r, 0)$, the price should be assessed entirely in one currency (c_1).

We proceed in two steps in order to prove Proposition 1. First, we show that when both *f* and *g* are strictly concave, there are no interior solutions. Second, we show that when $f(r) \leq g(r)$, $(r, 0)$ is optimal.

Step 1 There are no interior solutions. If there is an interior solution (c_1^*, c_2^*) then it has to be the case that:

$$f'(c_1^*) = g'(c_2^*)$$
$$f'' < 0 \Rightarrow \forall \varepsilon > 0, f'(c_1^* - \varepsilon) > f'(c_1^*)$$
$$g'' < 0 \Rightarrow \forall \varepsilon > 0, g'(c_2^* + \varepsilon) < f'(c_1^*)$$
$$\Rightarrow f'(c_1^* - \varepsilon) > g'(c_2^* + \varepsilon)$$
$$\Rightarrow f(c_1^* - \varepsilon) + g(c_2^* + \varepsilon) < f(c_1^*) + g(c_2^*)$$

The last inequality contradicts the premise that (c_1^*, c_2^*) minimizes E since $(c_1^* - \varepsilon, c_2^* + \varepsilon)$ is a better solution and $c_1^* - \varepsilon + c_2^* + \varepsilon = c_1^* + c_2^*$. Hence, no interior solutions exist when both *f* and *g* are strictly concave (QED).

Step 2. If $f(r) < g(r)$ then $(r, 0)$ is optimal. If there are no interior solutions then either $(r, 0)$ or $(0, r)$ is optimal. It follows that $(r, 0)$ is optimal when $f(r) < g(r)$.

Hence, when the psychological costs associated with each currency are strictly concave, the seller's decision is simple. For any given desired revenue, charge a price in one currency, the one that is valued least by the customer for the associated level of expenditure, *r*. For any level of revenue, one currency will always weakly dominate the other. The best currency might however differ depending on the desired level of revenue (see Figures 1 & 2).

A corollary to this result is the following. The only time an individual will prefer a bundled price to a pure payment (one made in either currency alone) is when the psychological cost for the individual is convex over at least part of [0,r]. Next we look at those cases in which the value function of either both, or only one currency is convex.

CASE 2: Both *f* and *g* are strictly convex over [0,*r*]

Proposition 2: When both *f* and *g* are strictly convex, a corner solution will exist only if $g'(0) \geq f'(r)$.

When $g'(0) \geq f'(r)$, we are in Situation 1, where a price issued in a single currency is optimal.

Situation 1: If $g'(0) \geq f'(r)$ then $(r, 0)$ is a corner solution

$$g'' > 0 \Rightarrow g'(\varepsilon) > f'(r), \forall \varepsilon > 0$$

$$f'' > 0 \Rightarrow f'(r-\varepsilon) < f'(r), \forall \varepsilon > 0$$

$$\Rightarrow g(\varepsilon) + f(r-\varepsilon) > g(0) + f(r)$$

(QED)

When $g'(0) < f'(r)$, we are in Situation 2, where a bundled price is optimal.

Situation 2: If $g'(0) < f'(r)$ there are no corner solutions. Since $g(r) > f(r)$, then $(0, r)$ is not an optimal solution. Further, $(r, 0)$ is not optimal either because:

$$g'(0) < f'(r) \Rightarrow \exists \varepsilon > 0 : g(\varepsilon) + f(r-\varepsilon) < g(0) + f(r)$$

(QED)

Hence, when $g'(0) < f'(r)$, the only optimal solution will be to use both currencies in order to minimize the perceived or psychological cost (See Figures 3 & 4).

CASE 3: Either *f* or *g* is concave while the other is convex over [0, *r*]

Let us examine the case in which *f* is strictly concave and *g* is strictly convex over [0,*r*]. When one of the two functions is concave (*f*), while the other is convex (*g*), we can have three possible situations:

1. We have a corner solution $(0, r_g)$ $\forall r_g : g'(r_g) \leq f'(0)$
2. We have a corner solution $(r_f, 0)$ $\forall r_f : f'(r_f) \leq g'(0)$
3. We have an interior solution in all other cases.

To more fully understand when each situation might apply, examine what happens to *E* as r increases. At 0, no payment is made in either currency. If $f'(0) \leq g'(0)$, then all payments are always made in currency c_1 (situation 2) as $f(r) < g(r)$ and

$\int_0^{\varepsilon} g'(x)dx > \int_{r-\varepsilon}^{r} f'(x)dx$ for $\forall \varepsilon < r$. This is a rather uninteresting case. In contrast, when $f'(0) > g'(0)$, we begin in situation 1, where all payments are made in the second currency (c_2). As r increases, we move to situation 3, where payments are made in some combination of currencies c_1 and c_2, and finally progress into situation 2, where all payments are made in currency c_1.

Indeed, when r moves away from 0, the firm will be better off asking for payment in only c_2 as $g'(x) < f'(0)\ \forall x < r_g$. This will hold true until $g'(r_g) = f'(0)$ (as $g'' > 0$, this cannot hold indefinitely). After r_g the firm will minimize the psychological cost to the consumer by asking for payments made in a combination of both currencies (c_1 and c_2) as $f'(\varepsilon) < g'(r-\varepsilon)$. As r increases, the firm will reduce the amount to be paid in c_2 and increase the amount to be paid in c_1 until r_f, the point at which the portion of the payments that are made in c_2 have shrunk to 0. For any payment bigger than r_f, only payments in c_1 should be requested (See Figures 5 & 6).

CASE 4: Either *f* or *g* is S-shaped while the other is concave or convex over [0,*r*]

Finally, we examine two extensions which directly pertain to Study 1 and our earlier discussion of bundled prices: (1) the case where *f* is strictly concave and *g* is S-shaped over [0,*r*] (see Figures 7 and 8), and (2) the case where *f* is S-shaped and *g* is strictly convex over [0, *r*].

First, when *f* is concave and *g* is S-shaped over [0, *r*], the form of payment will depend on the derivatives of *f* and *g* at 0.

Situation 1: If $f'(0) \leq g'(0)$, then we revert to the concave-concave situation (corner solutions where payments are made exclusively in c_1 and c_2 depending on whether $f(r)$ is smaller than $g(r)$).

Situation 2: If $g'(0) < f'(0)$ then we have a situation analogous to the concave-convex case:

a. We have a corner solution: $(0, r_g)$ $\forall r_g : g'(r_g) \leq f'(0)$
b. We have a corner solution: $(r_f, 0) \forall r_f : f(r) < g(r) \; and \; f'(r) < g'(0)$
c. We have an interior solution in all other cases.

When f is S-shaped and g is strictly convex over $[0, r]$, the solution will depend on the derivative of g at its inflexion point. If g'(inflection) $\leq f'(0)$, then the situation is analogous to the concave-convex case where $f'(0) < g'(0)$. All payments should always be required to be made in currency 1 (c_1).

If g'(inflection) $> f'(0)$ then we have three payment schedules:

1. split payment increasing in both $c1$ and $c2$ (a la convex-convex case) up to the point where $f'(r_{c1}) = g'(r_{c2}) =$ g'(inflection).

2. split payment increasing in c_1, decreasing in c_2 (a la concave-convex) up to the point where $f'(r_f) = g'(0)$.

3. Payment in c_1 only (corner solution) for $r > r_f$.

We should also point out that when both f and g are S-shaped over $[0, r]$, we have a situation analogous to the S-shaped-convex case. For the purposes of this research, it is important only to show that in numerous instances, the optimal price in terms of minimizing the subjective cost (i.e., negative subjective value) to the consumer requires setting a price that mixes c_1 and c_2, the two currencies involved. This could easily occur when the amount charged in c_1 falls in the concave region of its S-shaped value function and the charge in c_2 falls in the convex region.

In study 1, we illustrate how the subjective value that consumers ascribe to differing amounts of an individual currency (i.e., money, miles) is not linear and, in fact, is probably S-shaped such that negative changes in wealth at the extremes are relatively less painful. Study 2 extends the results of study 1 by demonstrating the external validity of the proofs with choice data collected from actual airline customers who evaluated prices issued in single and combined currencies and revealed their preferences.

STUDY 1

Study 1 demonstrates that people act as if they possess an S-shaped value function for frequent flier miles, and therefore small amounts of miles are not valued proportionately with large amounts, which are not valued proportionately with much larger amounts. If, for example, 10,000 miles is deemed more than 10 times as valuable as 1,000 miles, and more than $1/10^{th}$ as valuable as 100,000 miles, this implies an S-shaped value function for miles. We apply the logic of the S-shaped utility function proposed by Friedman and Savage for money (1948), without the constraint that most consumers maintain incomes in miles that place them squarely in the concave region.

Two surveys were designed to illustrate two key points. First, when combining dollars and miles, an interior solution can exist where a bundled price is preferred. The implication is that the value function for miles is convex for at least a portion of the curve, in this case for relatively small amounts of miles. Second, the study also shows that a corner solution can exist, where a price in one currency dominates, and hence the value function for miles must be concave. In this case, the marginal value of miles diminishes for relatively large amounts of miles. Taken together the results show the exchange rate between the two currencies is not constant (i.e., not linear), and is likely S-shaped for a single consumer. This is exactly what we find within a sample population of undergraduate business students.

As described earlier, if one's value function is concave for one currency (money) and convex or S-shaped for another (miles), or the amount charged in c_1 falls in the concave region of its S-shaped value function and the charge in c_2 falls in the convex region, marketers can extract the greatest revenue given a fixed psychological cost, or impose the minimum psychological cost associated with a particular revenue objective, through the use of bundled prices.

Method

Subjects. Participants in this study were 600 undergraduate business students enrolled in an introductory marketing course at a major West Coast university. Respondents participated as part of a course requirement.

Stimuli and design. Participants completed a scenario-based, paper and pencil study in which they were asked to imagine they were purchasing an airline ticket with either dollars or frequent flier miles. At the onset of the experiment, each respondent was asked whether he or she had a frequent flier account and if so to indicate how many miles they had in their account. The cost of the ticket was either low ($250 or 25,000 miles) or high ($1,000 or 100,000 miles). The price did not include a mandatory surcharge (20% or 5%), which could be paid in either dollars ($50) or miles (5,000). Respondents' task was to choose between paying in dollars or miles. A pilot test found respondents from the same sample population valued 5,000 at almost exactly $50, or at approximately $0.01 per mile. The basic scenario read as follows:

> You are on the phone with an airline securing a round-trip ticket across country to attend the funeral of an uncle you really liked and admired. While you can't leave town for two days, you must pay for the ticket today. The price of the ticket is 25,000 [100,000] miles. The agent on the phone tells you that in order to have your ticket request expedited, which would be necessary to receive your ticket in time for your departure, you will need to surrender either an additional 5,000 miles or pay $50. How would you prefer to pay?

An additional choice scenario required respondents to choose between paying entirely in dollars or entirely in miles. The scenario for the small base cost included the following:

> …You are on the phone with an airline securing a round-trip ticket. There are two possible price combinations with which you can pay for your ticket. First, you can pay $250 for the ticket plus an extra $50 to have your ticket order expedited, which would be necessary to receive your ticket in time for your departure. Or you can surrender 25,000 miles for the ticket, and an additional 5,000 miles to have your ticket expedited. How would you prefer to pay?

The remaining two choice combinations were included for completeness, which forced respondents to choose between paying either $250 + 5,000 or 25,000 + $50, and $1,000 + 5,000 or 100,000 + $50. Each respondent answered a series of possible choice questions, which were rotated and counterbalanced.

If respondents possess a linear transformation function between money and miles and the exchange rate were constant at one mile equaling one cent, they should always be indifferent between the two pricing schedules. If the value function is linear, and on average respondents valued each mile at more (less) than one cent, they should always prefer to pay the price that includes more (less) money. Our prediction, however, was that for smaller prices ($250 or 25,000 miles), respondents would prefer a combination of miles and dollars to payments exclusively in one currency, as an S-shaped value function implies convexity for miles over this range. This implies an interior solution. On the other hand, when the base price was relatively large ($1,000 or 100,000 miles), we expected respondents to prefer paying in one or the other currency alone as an S-shape implies the value function is concave in this region. This implies a corner solution.

In the second part of Study 1, each respondent was presented with five separate gambles and were asked to express their willingness to accept a fair bet on a 7-point scale where "7" indicated *definitely willing* and "1" indicated *not at all willing*. Each question asked how willing the respondent would be towards accepting a gamble in which they wagered a fixed sum of miles (250, 1,000, 10,000, 25,000 and 50,000) with a 50-50 chance of winning twice as many miles (i.e., a fair bet). In other words, the expected value always equaled the amount wagered. If individuals' subjective valuations of miles were to remain constant, we'd expect the percentage of people accepting the bet not to differ significantly across the size of the wager. The risk-neutral decision-maker would always be indifferent between the sure thing and the gamble, while risk seekers would always favor the gamble and risk avoiders would always favor the sure thing.

A priori, our prediction was that the value of the miles would not remain stable, and this would be reflected in respondents' propensity to accept the gamble. More specifically, for relatively trivial amounts (250 and perhaps 1,000 miles), we expected respondents to be risk-seeking, with significantly more than 50% accepting the gamble. For medium amounts (10,000), we expected them to act more risk-neutral, with nearly 50% accepting and 50% rejecting. And for relatively large amounts of miles (50,000, 100,000), we expected respondents to act risk-averse, with significantly more than 50%of respondents rejecting the gamble.

Results

The results for the first survey, or component of Study 1, are summarized in Table 2. As predicted for Part 1 (column 1) of the study, for combined payments in the Relatively Low Total Cost conditions, a significant majority of respondents preferred the *bundled price* (payments in mixed currencies) to charges issued in a single currency. This suggests that for expenditures involving 0-5000 miles, respondents preferred paying in miles, while for expenditures from 25,000 to 30,000, respondents preferred paying in dollars. This increase in the value of miles implies the marginal value of miles increases at an increasing rate (convexity).

Conversely, in the Relatively High Total Cost conditions, respondents always preferred paying in a single currency (i.e., $1,050 and 105,000 miles respectively), implying 0-5000 miles is worth more than 100,000 to 105,000, and the value of miles increases at a decreasing rate (concavity). These results, while confirming our predictions and suggesting an S-shaped value function for miles, also conform to the predictions from our mathematical proofs. Given that the value function is convex over small amounts of miles, and the value function for money is assumed to be concave, we expected an interior solution (respondents preferring to pay in bundles of money and miles) rather than a corner solution (a preference for a price in either solely money or miles). And, given that the value function is concave for large amount of miles, we expected the opposite to occur in the $1,000 and 100,000 conditions. Most respondents did indeed prefer prices in one currency alone (a corner solution).

It also appears that for relatively small prices ($250, 25k miles), respondents displayed a preference for paying entirely in dollars, on average, rather than entirely in miles (See Table 2, Part 2). Conversely, for higher prices, when limited to paying entirely in dollars or miles, people preferred paying in miles, on average, implying their valuation for miles diminished faster than for dollars as the amount to be spent increased. Not surprising then, when limited to choosing between relatively small mixed bundles, such as $250 and 5,000 miles versus 25,000 and $50 (See Part 3 of Table 2) subjects favored the payment with the larger amount of dollars (67% versus 33%). On average, they prefer to pay small amounts in dollars and large amounts in miles.

The correlations between the amount of frequent flier miles respondents possessed and preferences for price structures averaged less the 0.30, suggesting wealth effects were not driving these results. Again, for our purposes it does not matter why the marginal value changes, only that it does. While the exact turning point where people switch from preferring to pay in dollars to paying in miles may depend on the exchange rate we utilized ($0.01), we expect the general result to hold; the exchange rate between the two currencies is not constant. Again, the reverse was true when the mixed bundles were relatively large ($1,000 and 5,000 miles versus 100,000 miles and $50) with more respondents preferring the pricing schedule comprised principally of miles (83% versus 27%).

Regarding the second part of Study 1, the results are summarized in Table 3. If respondents valued each mile equally, they should exhibit the same risk-seeking or risk-averse behavior for small, medium and large amounts of miles. If, however, people are risk-seeking for small amounts, risk-neutral for medium amounts, and risk-averse for relatively large amounts, as our data suggests, this would suggest that their valuation would depend on the quantity involved and value associated with a unit change is not constant (i.e., the value function is not linear).

The data are presented in two ways. First, we categorized individuals by how likely they were to accept the gamble; those who circled a "4" were considered neutral, while those responding with a "5" and above were categorized as inclined to accept, and those responding with a "3" or below were labeled disinclined. Next, we calculated an average score on the 7-point scale to assess the overall inclination of the group to take the gamble. As expected, respondents behaved as if their valuation for miles was not stable.

If we look at the percentages of people who were willing to accept each gamble, at 1,000 (56%) and 10,000 miles (47%), respondents appeared indifferent or risk-neutral, as neither is significantly different from 50% ($z = 1.039$ and $z = -0.577$, respectively, $z_{\alpha=0.05} = -1.645$). Yet for larger amounts (25,000 and 50,000 miles) the average willingness to accept the gamble fell significantly below 50% (37%, $z = -2.194$, and 31%, $z = -3.345$ respectively). Conversely, the percentage of respondents willing to risk 250 exceeded 50% (66%, $z = 2.887$) suggesting a 50-50 chance of winning twice as many miles was worth more than holding onto this small quantity.

If we compare the mean score on the semantic scale we get similar results. As the amount gambled grew, the average willingness to accept the gamble declined from a high 4.96 ("7.0" corresponds to definitely willing) to a low of 3.47 (see Table 3). For 250 miles and 1,000 miles, on average, people were inclined to gamble ($\mu_{500} = 4.96$, $t = 6.04$, $p < 0.05$; $\mu_{1000} = 4.57$, $t = 3.74$, $p < 0.05$). For 25,000 miles and 50,000 miles people were disinclined ($\mu_{25,000} = 3.56$, $t = -2.73$, $p < 0.05$; $\mu_{25,000} = 3.47$, $t = -3.17$, $p < 0.05$). For 10,000 miles people's responses did not differ significantly from neutrality (($\mu_{10,000} = 4.12$, $t = 0.755$, $p > 0.05$).

Discussion

Our intent with Study 1 was to illustrate two things. First, the value function for frequent flier miles is not linear, at least for the population surveyed, but rather is more likely S-shaped. This was supported by results from two surveys. Second, if the subjective value of money is assumed to be concave, this implies a convex value function for miles over small amounts. Therefore, a range of prices will exist for which an interior solution exists and a bundled price is superior. It also implies a concave value function over large amounts, in which a corner solution exists and a price in a single currency is superior. This is exactly what we found; people's preferences for pricing schedules changed, shifting predictably from bundled prices to prices in a singular currency. This occurred even though, on average, people preferred paying in dollars in the low total cost condition and miles in the high total cost condition.

In the second part of Study 1, we accumulated further evidence supporting the notion of a non-linear valuation for miles. Respondents' willingness to accept a fair gamble changed (i.e., decreased) as the amount to be gambled increased. While this is not a novel result, it does add corroborating evidence that the pain associated with losing various quantities of miles was not stable over the range presented.

STUDY 2

Study 1 was designed to show people often value alternative currencies in a non-linear fashion and how this can result in conditions where there is an interior solution (a bundled price is superior) and a corner solution (a price in a single currency is superior). Extending these results while incorporating the notion that the value function for money is concave, we test our mathematical conclusions empirically by allowing members of a particularly relevant test population to make explicit choices between paying in either of two currencies (money or miles) or a bundled price comprised of partial payment in each of the two currencies (money and miles). The primary focus of Study 2 was to examine people's preferences among three pricing options (dollars only, 50% dollars/50% miles, or miles only) based on the price of a ticket.

Given our findings from Study 1, and our mathematical derivations, we hypothesized a priori that at relatively low prices and relatively high prices, consumers would prefer paying in one currency alone (most probably dollars), but across some range in-between, they would prefer a bundled price, comprised of a partial payment in each currency. As the price becomes relatively large, we'd again expect a preference for paying in one currency (most likely miles).

Method

Subjects. This experiment was run in a real world setting in an attempt to insure a degree of external validity. Participants were 164 passengers on commercial flights that were scheduled to depart from a major west coast airport. The passengers were approached at the airport prior to their departure and asked to participate voluntarily in an academic study of airline ticket purchasing behavior. Participants were screened on the basis of whether or not they maintained a frequent flier account in which they accrued miles – only those who possessed frequent flier accounts participated.

Stimuli and design. At the onset of the experiment, respondents were asked to recall what they had paid for the ticket that brought them to the airport at the time of the survey (all participants were waiting to take a flight when asked to participate). After stating the price paid in either dollars or miles (less than 2% were traveling using miles), the experimenter surreptitiously converted this amount into an equivalent price in the opposing currency at a rate of $0.02 per mile (e.g., $200 and 10,000 miles), as well as a combined price with 50 percent paid in each currency (e.g., $100 and 5,000 miles). For simplicity, we limited their choices to dollars only, 50% dollars/50% miles, or miles only. The participant was then asked which of three prices they would have preferred to pay if they had been offered the choice (e.g., $200, $100 and 5,000 miles or 10,000 miles).

Results

The primary focus of Study 2 is to demonstrate how and when people's preferences shift among pricing options (dollars only, a bundled price, or miles only) across the various amounts to be paid. Therefore, we examine the probability that a person surveyed would choose a particular pricing option as a function of the price paid. The data were analyzed using the categorical modeling procedure of the SAS statistical software package (CATMOD), which allowed us to fit a multinomial logit model using choice, or the probability of choosing a particular pricing schedule, as the dependant measure and price as independent variable.

As the regression statistics in Table 4 clearly indicate, the choice of one payment option over another varied significantly with price. In order to more easily interpret the results we computed the choice probability for tickets ranging from $0 to $3,000, the highest price reported among those surveyed and graphed them in Figure 2. As is clear from the figure, for small dollar amounts (Price < approximately $300), straight dollar payments were the most likely option. For intermediate ticket values ($300 < Price < $1,200), mixed payments were preferred. Finally, for relatively more expensive tickets

(Price > $1,200), consumers preferred to purchase the tickets using miles alone. Hence, we find support for our hypothesis, which is consistent with the results from Study 1 and our general framework.

We should note two caveats regarding the interpretation and generalization of these results. First, we used an exchange rate of two cents per mile. This will tend to make miles an attractive form of payment relative to dollars. A lower value, such as one cent per mile, would be likely to shift the curves depicted in Figure 2 to the right, such that strict dollars payments are preferred over a larger domain, and strict miles payment are preferred over a smaller domain. We would also expect the net impact on mixed payments to be a shift to the right, but it is not possible to tell whether they would be preferred over a wider or narrower range of ticket prices without collecting more data.

Second, the only form of mixed payments we investigated were equally balanced, or a 50/50 split. It is possible that other mixtures (e.g., 90/10) would be preferred to any of the three forms tested. Hence, it is likely that the range of prices over which a bundled price is preferred may be wider than highlighted by our experiment.

Limitations and Future Research

This research has shown how non-linear valuations for distinct currencies can result in occasions where marketers should charge prices in a mixture of currencies (i.e., bundled prices). The optimal price would maximize the amount of revenue collected with a given psychological cost, or minimize the psychological cost associated with a given price. The objective of this research was to determine the conditions under which a bundled price can be superior to a price charged in a single currency and explore how a firm might determine when bundled price would be appropriate. The mathematical proofs show how non-linear valuations result in many instances where marketers should charge bundled prices. Study 1 offers evidence that the value function for miles is not linear and might best be represented by an S-shaped curve, demonstrates how people's preferences for pricing schedules changed, shifting predictably from bundled prices to prices in a singular currency. Study 2 demonstrated how choices made by actual fliers conform to the general predictions laid out in our proofs.

While this work highlights the importance of bundled prices and illustrates the advantages to firms that implement them well, it is limited in the sense that it does not go into detail as to how the firm can derive a precise price for a particular customer or set of customers. While we infer an S-shaped value function for miles from our results in Study 1, we did measure this function with precision. Practically speaking, methods for accurately measuring the shape of a particular population's value function for specific currencies and subsequently deriving the optimal bundled are ripe areas for future work. This is something we feel is important for future work.

In addition, bundled prices are designed to minimize the psychological cost associated with a particular revenue objective by taking advantage of people's inability or reluctance to convert amounts assessed in one currency into denominations of the other currency. We acknowledge that with increased exposure and experience, the conversion between two or more particular currencies could become second nature. If this were the case, bundled prices would lose their efficacy. However, we do not expect this to be the case for frequent flier miles any time soon for many reasons, though one in particular stands out. Imagine a particular conversion rate between miles and dollars became the standard. The result would be a universally accepted dollar valuation for loyalty program perquisites like frequent flier tickets, which if they exceeded $600 would be subject to gift taxes in the United States. Consumers would likely balk at the idea of paying taxes on promotional awards, which have a severely negative impact on the most ubiquitous and perhaps effective consumer loyalty programs. We doubt airlines would let that happen.

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APPENDIX A

The problem faced by the firm is whether to set a price using one or both of two possible currencies will minimize the psychological cost to the consumer while still yielding the desired revenue objective. In mathematical terms, the problem can be defined as follows:

$$
\begin{aligned}
&Min\ E = f(c_1) + g(c_2) \\
&st. \quad h_1 : c_1 \geq 0 \\
&\qquad\ \ h_2 : c_2 \geq 0 \\
&\qquad\ \ h_3 : c_1 + c_2 = r
\end{aligned}
\qquad \text{(A.1)}
$$

The first two constraints, h_1 and h_2, simply insure prices are non-negative; the third constraint, h_3, is the revenue constraint.

Since the domain over which we minimize the psychological cost is limited to [0, r] in both c1 and c2, and both f and g are continuous over this domain, we know by the Weierstrass Theorem (Sundaram 1996) that a minimum exists and we can combine the Lagrange theorem and the Kuhn and Tucker theorem to characterize it. The Lagrangean for the minimization is as follows:

$$L(c_1, c_2, \lambda_1, \lambda_2, \lambda_3) = f(c_1) + g(c_2) - \lambda_1 c_1 - \lambda_2 c_2 - \lambda_3 (c_1 + c_2 - r) \qquad \text{(A.2)}$$

The critical points of this Lagrangean are the solution to the following system of equations:

$$\frac{\partial L}{\partial c_1} = f'(c_1) - \lambda_1 - \lambda_3 = 0 \qquad \text{(A.3)}$$

$$\frac{\partial L}{\partial c_2} = g'(c_2) - \lambda_2 - \lambda_3 = 0 \qquad \text{(A.4)}$$

$$\lambda_1 \geq 0,\ c_1 \geq 0,\ \lambda_1 c_1 = 0 \qquad \text{(A.5)}$$

$$\lambda_2 \geq 0,\ c_2 \geq 0,\ \lambda_2 c_2 = 0 \qquad \text{(A.6)}$$

$$\frac{\partial L}{\partial \lambda_3} = c_1 + c_2 - r = 0 \qquad \text{(A.7)}$$

In this system, constraint h_3 will always be binding, while constraints h_1 and h_2 may or may not be binding. (It is clear that h_1 and h_2 cannot be binding simultaneously since this would not yield any revenue for the firm). Hence, we have three candidates for the minimum, one where only h_3 is binding, one where both h_1 and h_3 are binding, and finally one where both h_2 and h_3 are binding.

Case 1: only h_3 is binding

Since only h_3 is binding, then we have $c_1>0$ and $c_2>0$, and thus per equations (A.5) and (A.6), we have $\lambda_1=0$ and $\lambda_2=0$. This yields:

$$\begin{aligned} &f'(c_1) = \lambda_3 \\ &g'(c_2) = \lambda_3 \\ &\Rightarrow f'(c_1) = g'(c_2) \end{aligned} \qquad \text{(A.8)}$$

In other words, a set of prices (c_1, c_2) that satisfy the constraint that $c_1+c_2 = r$ such that both c_1 and c_2 are strictly positive are local minimums if and only if $f'(c_1) = g'(c_2)$.

Case 2: both h_1 and h_3 are binding

If both h_1 and h_3 are binding then we have $c_1 = 0$, and $c_2 = r$ and per equation (A.6) we also have $\lambda_2=0$. This yields:

$$\begin{aligned} &f'(0) - \lambda_2 = \lambda_3 \\ &g'(r) = \lambda_3 \\ &\Rightarrow f'(0) - \lambda_2 = g'(r) \\ &\Rightarrow f'(0) > g'(r) \end{aligned} \qquad \text{(A.9)}$$

In other words, for (0, r) to be a possible minimum, it has to be that $f'(0) > g'(r)$.

Case 3: both h_2 and h_3 are binding

Case 3 is symmetrical to case 2. It yields $c_1=r$, $c_2=0$ and $g'(0)>f'(r)$.

ENDNOTES

1. For example, a 6,000-point shortfall on a Bose® Wave® Radio with CD that sells for 85,000 points would cost $90 in addition to 79,000 points.

2. The claim was made on its web site in July 2001. At the time the airlines Milepoint.com partnered with included Delta Air Lines, Northwest Airlines, Continental Airlines, US Airways, America West Airlines, Midwest Express Airlines, Hawaiian Airlines, Hilton Hotels, and American Express *Membership Rewards*. Members could spend their miles at outlets including Amazon.com and Skymall, which at the time included such premium retailers as Hammacher Schlemmer and The Sharper Image.

3. Kahneman and Tversky (1979) argue that the marginal value of both gains and losses in monetary terms generally decrease with their magnitude. They offer work by Galanter and Pliner (1974) on the perceptions of money as support. Long before, Friedman and Savage (1948) concluded that consumers behave as if the utility of money income is:

   > "convex from above below some income, concave between that income and some larger income, and convex for all higher incomes, i.e., diminishing marginal utility of money incomes for income below some income, increasing marginal utility of money income for incomes between that income and some larger income, and decreasing marginal utility of money income for all higher incomes…"

   Friedman and Savage also pointed out that:

   > "Most consumer units tend to have incomes that place them in the segments of the utility function for which marginal utility of money income diminishes."

4. Business Week (1999) reports that "conventional wisdom says a mile is worth about 2 cents - around what major airlines charge companies that buy mileage for incentive awards to employees or clients." MilePoint has come up with the following formula for valuing HHonors Points, "Every 5 Hilton HHonors points are worth 1 mile - for example: 1000 Hilton HHonors points equals 200 miles (1000/5=200). When we collect your account balance from Hilton, we display the equivalent in miles, and continue to calculate the MilePoint Money at 2 cents per mile."

5. We can always set $c_1 = c_2' = \alpha c_2$.

TABLE 1

COMMON REWARDS AND THEIR VALUE IN DOLLARS

Reward	Provider	Miles	Dollars	Exchange Rate
Palm Pilot VII	American Airlines/AOL Program	78,500	$227*	$0.0029
Admirals club Membership	American Airlines	40,000	$300	$0.0075
(add a spouse)	American Airlines	25,000	$150	$0.0060
$500 of closing	Citibank Home Mortgage	25,000	$500	$0.02
Time Magazine	Milepoint.com	900	$24.95**	$0.027
Upgrade Award	United Airlines	2,000	$125	$0.0625***

*Average price on CNET.com on 11/28/01
**Subscription price for ½ year at Time.com and price in miles for 27 issues.
***This is UAL's selling price for four 500-mile upgrades.

TABLE 2

Study 1: Percentage Preferring Pure versus Bundled Prices

Relatively Low Total Cost	Part 1 % preferring payment option	Part 2	Part 3
$300 or 30,000 miles			
$250 + $50	43%[a]	65%[b]	
$250 + 5,000 miles	<u>57%</u>[b]		67%[b]
25,000 miles + $50	63%[b]		33%[a]
25,000 + 5,000 miles	37%[a]	35%[a]	
Relatively High Total Cost			
$1,050 or 105,000 miles			
$1,000 + $50	69%[c]	26%[d]	
$1,000 + 5,000 miles	<u>31%</u>[d]		17%[e]
100,000 miles + $50	40%[a]		83%[f]
100,000 + 5,000 miles	60%[b]	74%[c]	

Note: (N = 75) Proportions with different superscripts differ significantly at $p < 0.05$.

TABLE 3

Study 1: Willingness to Accept a Fair Bet w/ 50% Chance of Winning 2x Wager

Miles Wagered	μ	Inclined	Neutral	Disinclined	N
250	4.96	67%*	13%	21%	134
1,000	4.57	56%	17%	27%	134
10,000	4.12	47%	19%	34%	134
25,000	3.56	37%*	13%	51%	134
50,000	3.47	31%*	20%	49%	134

Note: μ on a 7-point scale where 7 = extremely willing.
*Significantly different than 50%.

TABLE 4

STUDY 2: ANALYSIS OF VARIANCE TABLE
Dependent Variable: Favored Price (Dollars, Miles, 50% each)

Independent Measure	DF	Chi-Square	Prob. > χ^2
Intercept	2	9.76	0.0076
Price	2	18.23	0.0001

Figure 1: Psychological Cost (Concave-Concave)

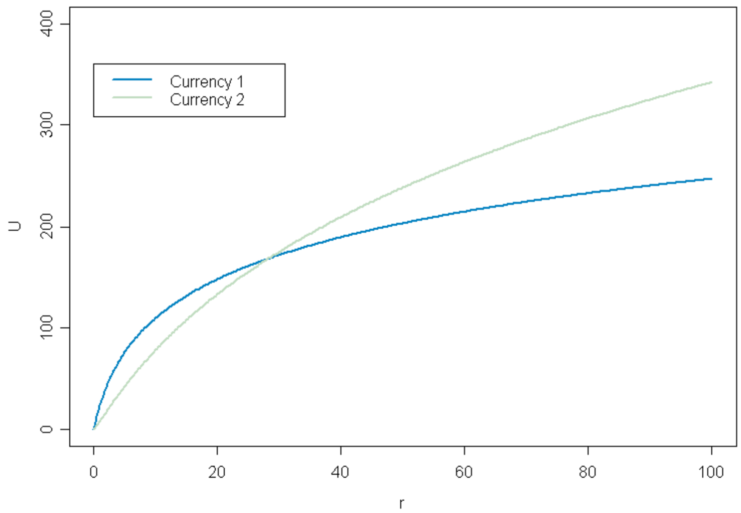

Figure 2: Optimal Prices (Concave-Concave)

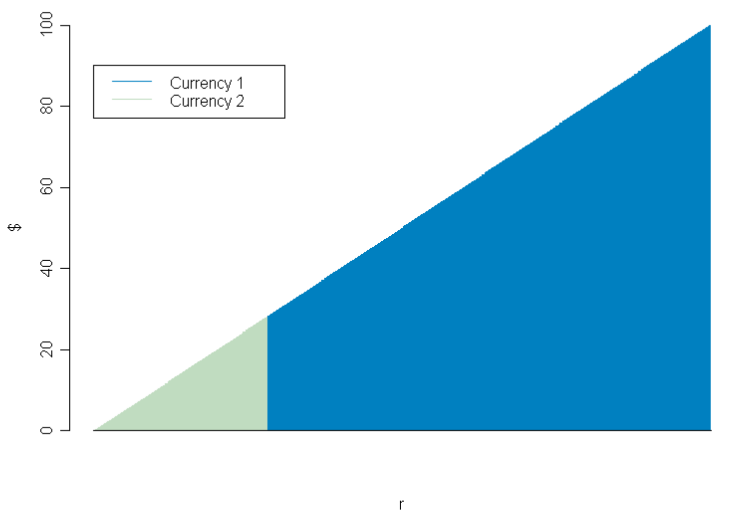

Figure 3: Psychological Cost (Convex-Convex)

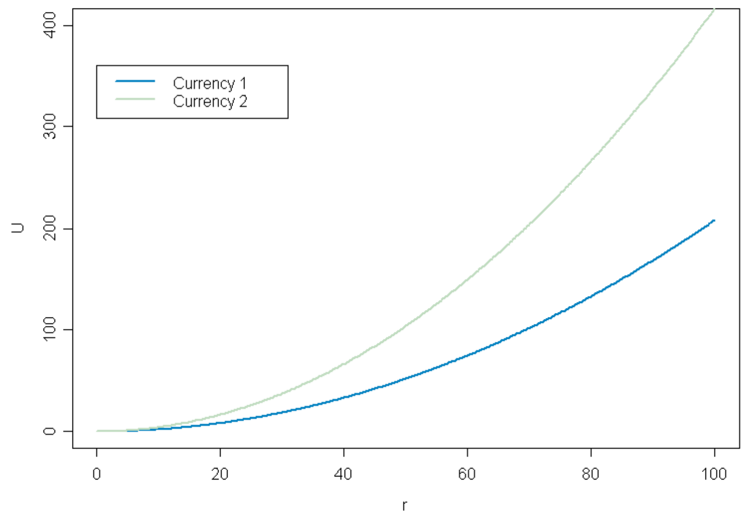

Figure 4: Optimal Prices (Convex-Convex)

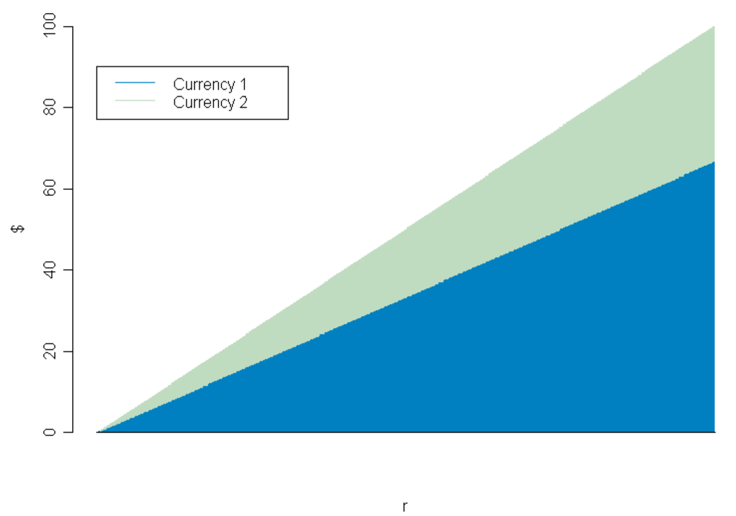

Figure 5: Psychological Cost (Concave-Convex)

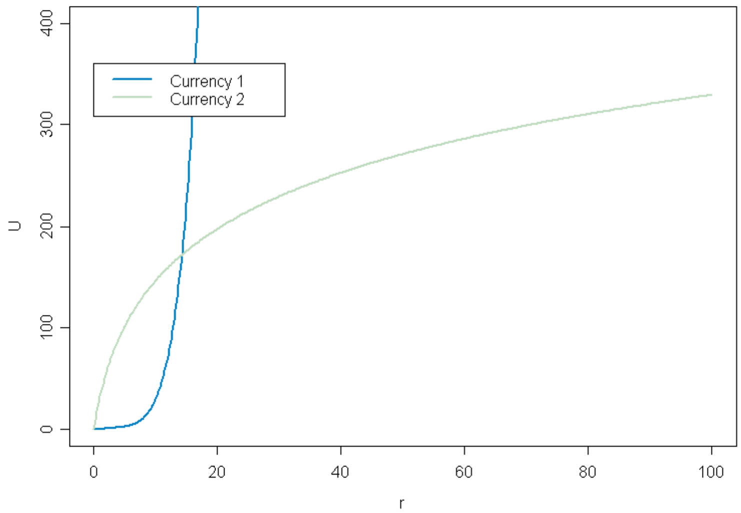

Figure 6: Optimal Prices (Concave-Convex)

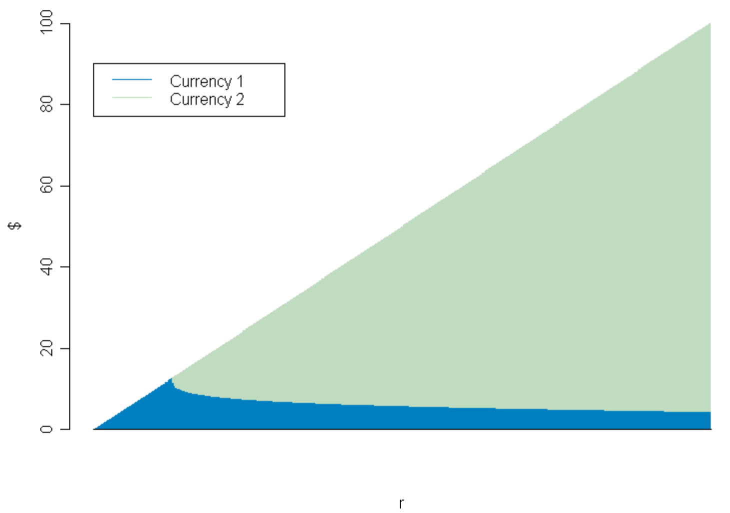

Figure 7: Psychological Cost (Concave-S-shaped)

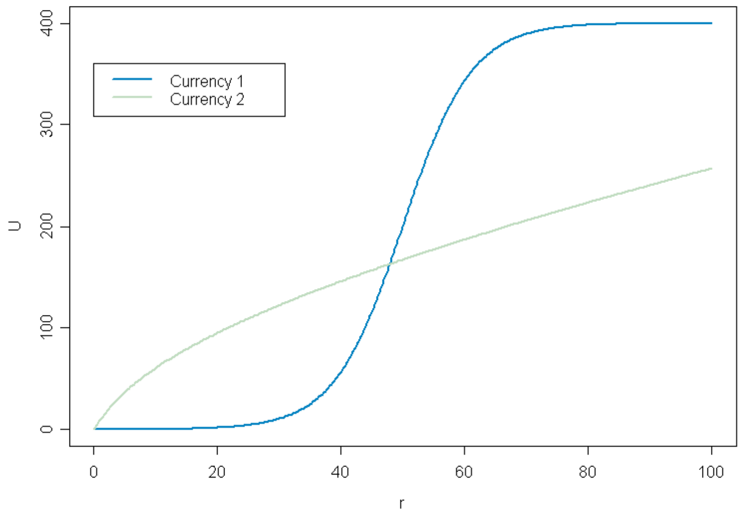

Figure 8: Optimal Prices (Concave-S-shaped

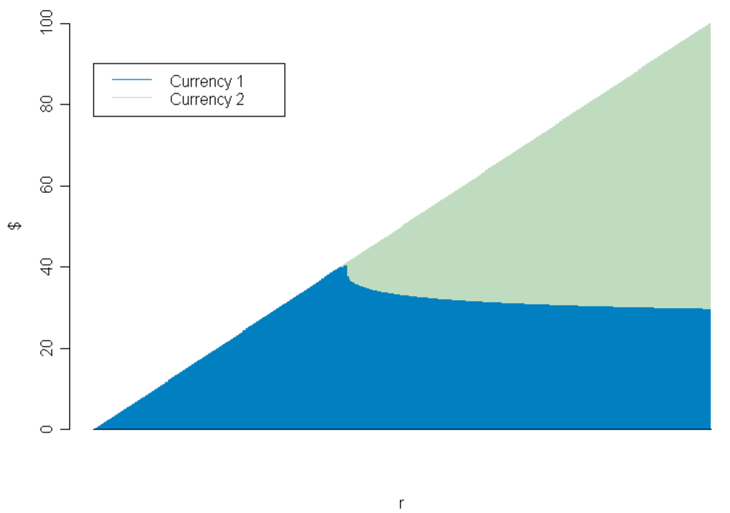

FIGURE 9

Study 2: Probability of Choosing a Particular Pricing Plan as a Function of Price