2006

How Promotions Effect Consumer Purchases

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Thesis submitted to the faculty of
Virginia Commonwealth University
in partial fulfillment of the
requirements for the degree

Master of Arts
In
Economics

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11 May 2006
Richmond, Virginia

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(Abstract)

Rational choice theory provides a blueprint for predicting individual behavior under the assumption that objectives and decisions are rationally identified and executed. Under certain conditions, actions reveal preferences and the ability to observe these preferences allows for the possibility to study the effects of subtle changes in individual constraints such as price and wealth affect preferences. For instance, recent work by Eckel and Grossman (2003), Davis, Millner and Reilly (2003), and Davis and Millner (2004) observe a preference for matching promotions over coupon rebates even when the two promotions types are strictly equivalent. An important question remaining is whether this result persists. This paper analyzes whether this seemingly anomalous behavior persists as individuals gain experience through repeated decisions in a controlled environment.

Acknowledgements

My heartfelt thanks go to Dr. Edward Millner, who guided me with intelligence and expertise which, with each meeting, shed more light on my thesis path. With persistence and patience, he challenged me to learn, question, think, experiment, critically analyze, and "say what I mean".

I am fortunate indeed to have had such a supportive and knowledgeable co-advisor. My sincere thanks to Dr. David Harless, who contributed an important and unique perspective throughout the research development, analysis, and reporting phases. His advice and feedback has been more helpful than he may realize.

I am grateful to many family and friends who helped preserve, protect, and defend my sanity:

To God, for giving me the words when needed. Thank you for giving me the knowledge and determination to finish the journey.

To Becky and Mason, without whom there would have been no journey. Thank you for helping me keep the priorities straight and to maintain proper perspective.

To my mom for the numerous times you had Mason for the day so I could write.

To Steve, Weldon, and Amy for allowing me to vent when needed.

To Dr. Steve Peterson for being more than a teacher.

To Larry and Mickie for their continued prayer.

The support, understanding, encouragement, and wisdom of these individuals helped sustain and inspire me throughout. While completing this thesis has been an intense and solitary adventure, it is attainable only with the assistance of the many treasures and gems that surround you.

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Introduction

Rational choice theory provides a blueprint for predicting individual behavior under the assumption that objectives and decisions are rationally identified and executed. Under certain conditions, actions reveal preferences and the ability to observe these preferences allows for the possibility to study the effects of subtle changes in individual constraints such as price and wealth affect preferences. For instance, recent work by Eckel and Grossman (2003), Davis, Millner and Reilly (2003), and Davis and Millner (2004) observe a preference for matching promotions over coupon rebates even when the two promotions types are strictly equivalent. An important question remaining is whether this result persists.

This paper analyzes whether this seemingly anomalous behavior persists as individuals gain experience through repeated decisions in a controlled environment. Specifically, we give participants the opportunity to make repeated purchase decisions for a hypothetical good under various prices and under matching and rebate promotion conditions. This paper is organized as follows. Chapter 1 uses standard utility theory to investigate whether functional equivalence between promotions leads to strict equivalence. Chapter 2 looks at recent experimental literature regarding the effects of promotions on consumer choice. Chapter 3 looks at literature on how consumers process information in terms of promotion evaluation. Chapter 4 describes some of the benefits and criticisms of relying on experiments as a tool for evaluating the descriptive validity of economic theory. Chapter 5 explains the experimental design and procedures. Chapter 6 describes the results of the experiment. A final section concludes.

Chapter 1: Economic Theory and the Use of Promotions

This chapter contains a theoretical examination of the effects of two promotion types on consumer purchases. The initial analysis is based on the assumptions that people are able to spend the potential savings they gain from a rebate promotion and that the good is infinitely divisible. We will relax these assumptions as the analysis proceeds.

Functional Equivalence

The foundation of this paper relies on the concept of functional equivalence, which occurs when the effective prices between two promotions are equal. Controlling for quality and variety, an economic good's effective price should be a major determining factor in an individual's purchase decision. Consider Table 1, where an example has been constructed to explain functional equivalence. Assume there is a hypothetical product offered at a regular price of $6.00 and there are two possible promotions, a 50% off rebate and a 1:1 matching promotion. Under the rebate promotion, the consumer obtains 4 units with net expenditures equal to $12.00 ($24 – (0.5*24)). Therefore, the effective price is equal to $3.00 ($12 / 4 units). Under the matching promotion, the consumer obtains a total of 6 units (purchase 3 units plus 3 free units) with net expenditures equal to $18.00. Therefore, the effective price under the matching promotion is also equal to $3.00 ($18 / 6 units) and the two promotions are functionally equivalent. In general, the effective price under a rebate promotion is $P_R = P(1-R)$; where P = list price and R = rebate percentage. The effective price under a matching promotion is $P_m = P/(1-R)$; where M = matching percentage. Therefore, the effective prices between to promotions are equal when $M = R/(1-R)$.

Rebate Promotion:

Price	Rebate Rate	Eff. Price	Purchase	Gross Expend	Refund	Net Expend
6	0.5	3	4	24	12	12

Matching Promotion:

Price	Match Rate	Eff. Price	Purchase	Match	Tot. Purch. Obtained	Net Expend
6	1.00	3	3	3	6	18

Eff. Price	----------	Effective Price
Purchase	----------	Purchases
Gross Expend	----------	Expenditures (Pre-Adjustment)
Net Expend	----------	Expenditures (Post-Adjustments)
Match	----------	Matched Units
Tot. Purch. Obtained	----------	Total Units Obtained

Table 1: Functional Equivalence of Rebate and Matching Promotions

Now, consider Table 2, where the scenario in Table 1 has been slightly adjusted in order to explain strict equivalence. Assume the individual still obtains 4 units under rebate promotion, thereby still resulting in an effective price of $3.00. However, the consumer obtains 2 units under the matching promotion this time resulting in a total of 4 units obtained. Again, the effective prices were equal but this time so was the number of units the consumer obtained under each promotion. In this case, the two promotions are strictly equivalent when the effective prices and the number of units obtained are equal across promotions. The important question is whether functional equivalence leads to strict equivalence.

Rebate Promotion:

Price	Rebate Rate	Eff. Price	Purchase	Gross Expend	Refund	Net Expend
6	0.5	3	4	24	12	12

Matching Promotion:

Price	Match Rate	Eff. Price	Purchase	Match	Tot. Purch. Obtained	Net Expend
6	1.00	3	2	2	4	12

Eff. Price	----------	Effective Price
Purchase	----------	Purchases
Gross Expend	----------	Expenditures (Pre-Adjustment)
Net Expend	----------	Expenditures (Post-Adjustments)
Match	----------	Matched Units
Tot. Purch. Obtained	----------	Total Units Obtained

Table 2: Strict Equivalence of Rebate and Matching Promotions

Utility Theory and Promotions

The central focus of this chapter is the effect of promotions on consumer purchases. The use of indifference curve maps and budget curves allows us to investigate the topic. Figure 1 is an indifference curve map illustrating the concept of constrained utility maximization.

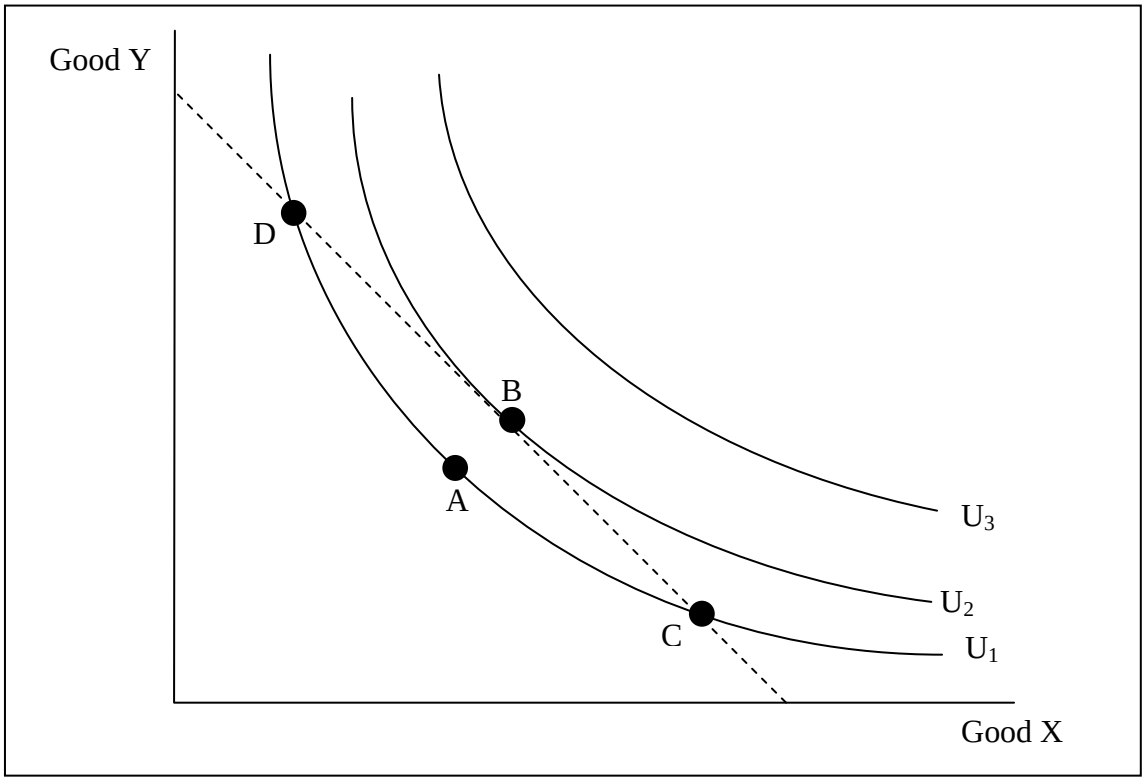

Figure 1: Constrained Maximization

In Figure 1, U_1, U_2, and U_3 represent three indifference curves for an individual associated with two economic goods, Good X and Good Y, and the dashed line is the budget curve. If $U_1 < U_2 < U_3$, then bundles that lie on the budget curve will potentially maximize total satisfaction. In this case, bundles B, C, or D satisfy this constraint.

When a budget curve intersects an indifference curve, the individual can increase total satisfaction by moving along the budget curve. For instance, the individual can increase their total level of satisfaction by moving up the budget curve from bundle C or move down the budget curve from bundle D. However, total satisfaction declines if the individual moves up or down the budget curve from bundle B. Therefore, bundle B is the combination of Good X and Y that maximizes total satisfaction and is affordable. Therefore, the utility maximizing point is where the budget curve is tangent to an

indifference curve. A mathematical illustration of constrained utility maximization can be found in Append A on page A-1.

Figure 1 illustrated that an individual's purchase decision is directly affected by the budget curve. An important question remaining is how a particular promotion type affects the budget curve, thereby influencing purchase decisions. Consider Figure 2, which illustrates the effect of a 50% rebate, a 1:1 match, or a 50% straight price reduction on the budget curve. In Figure 2, there is a choice between Good X and money available for other goods (MOG). If Good X is infinitely divisible, then the budget constraint is linear. Therefore, the solid line is the budget curve with no promotion and the dashed line represents the budget curve under the respective promotion. Based on our assumptions and the fact that the promotions are functionally equivalent, the budget curve is the same under both promotions. Point B represents the number of units the person would obtain if there were no promotion used. Points C, D, and E represent the number of units obtained under a 1:1 matching promotion, a 50% rebate promotion, and a straight 50% reduction in price, respectively.

Figure 2 leads to the conclusion that a person can obtain more units of an economic good under the respective promotions with the same level of income as in the scenario where no promotion was present. Therefore, a promotion is effectively a price reduction, thereby increasing real income. Figure 2 also shows that the number of units obtained under either promotion is equal and since the promotions are functionally equivalent, we can conclude there is strict equivalence between a 50% rebate, a 1:1 matching promotion, and a 50% straight price reduction.

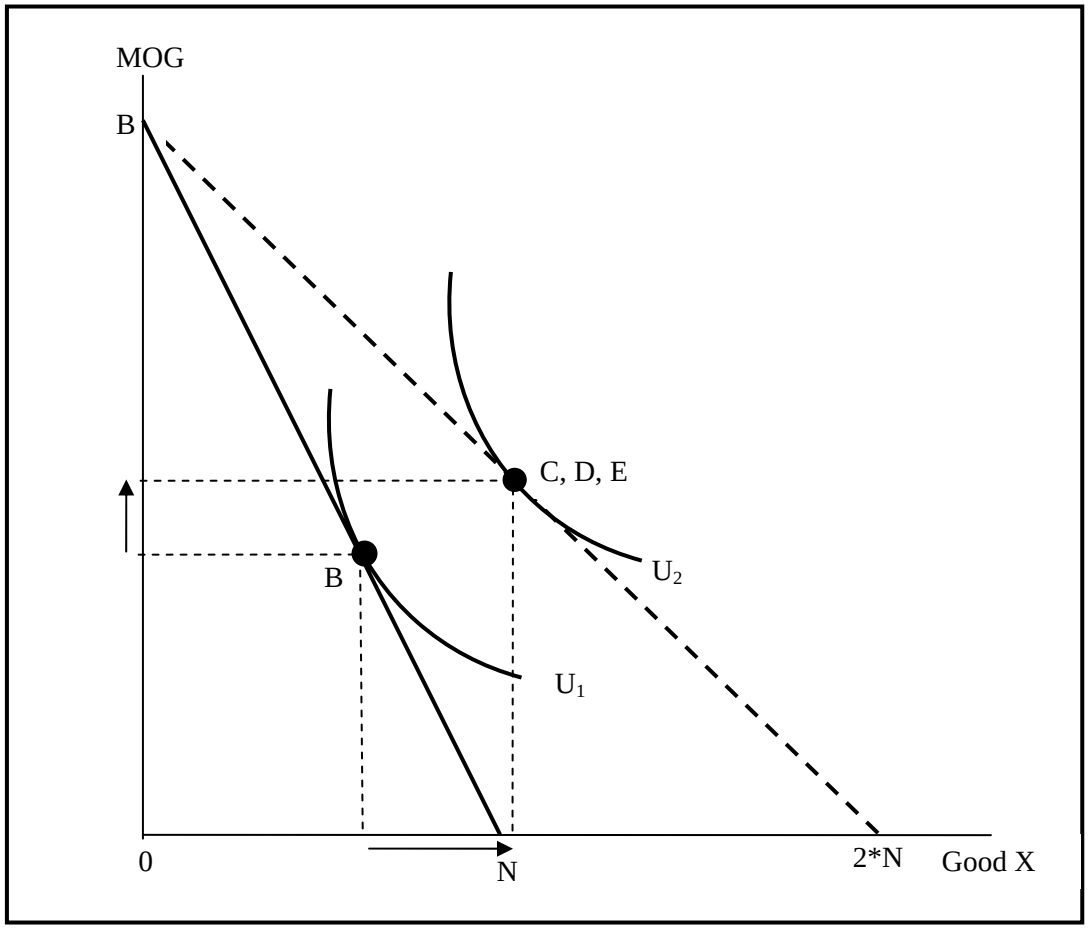

Figure 2: Effects of a 50% Rebate or 1:1 Matching Promotion

Now consider the budget curve if we relax our assumption that individuals are able to spend the potential savings from a rebate promotion. Does this relaxation affect the strict equivalence of two promotions? Again, assume there is a 50% off rebate but the person is unable to spend the potential savings. Figure 3a illustrates such a situation.

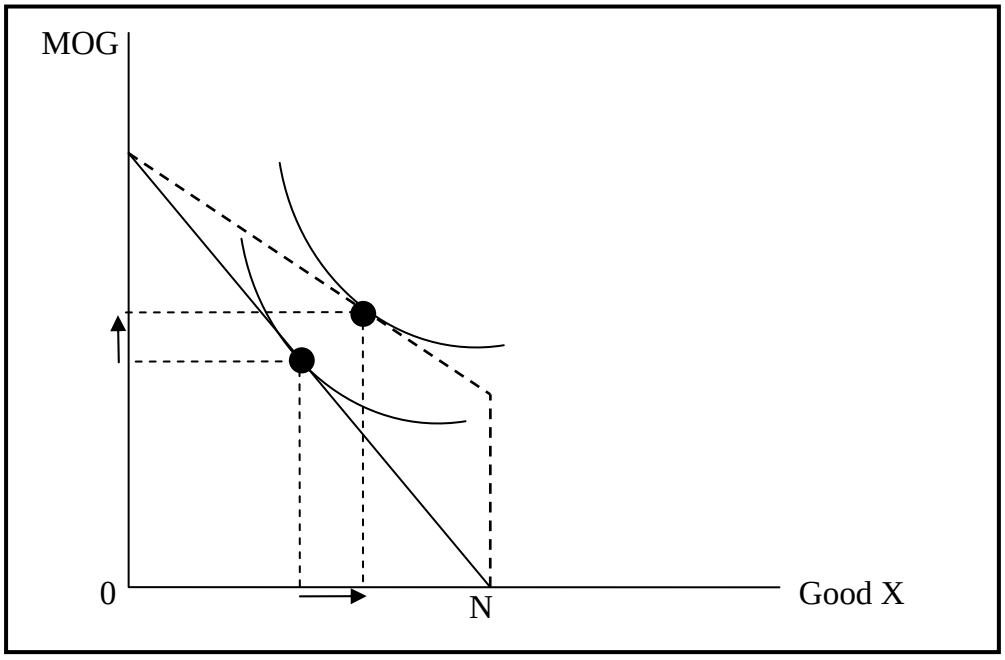

Figure 3a: Effects of a 50% Rebate Promotion without the Ability to Spend Potential Savings

The presence of the 50% off rebate still results in an effective price that is less than the listed price under no promotion. However, the individual is limited by the inability to spend potential savings and can only obtain the same maximum number of units as under no promotion. Therefore, the individual is limited by the kink in the budget curve. Now assume there is a 1:1 match promotion. Figure 3b illustrates such a situation.

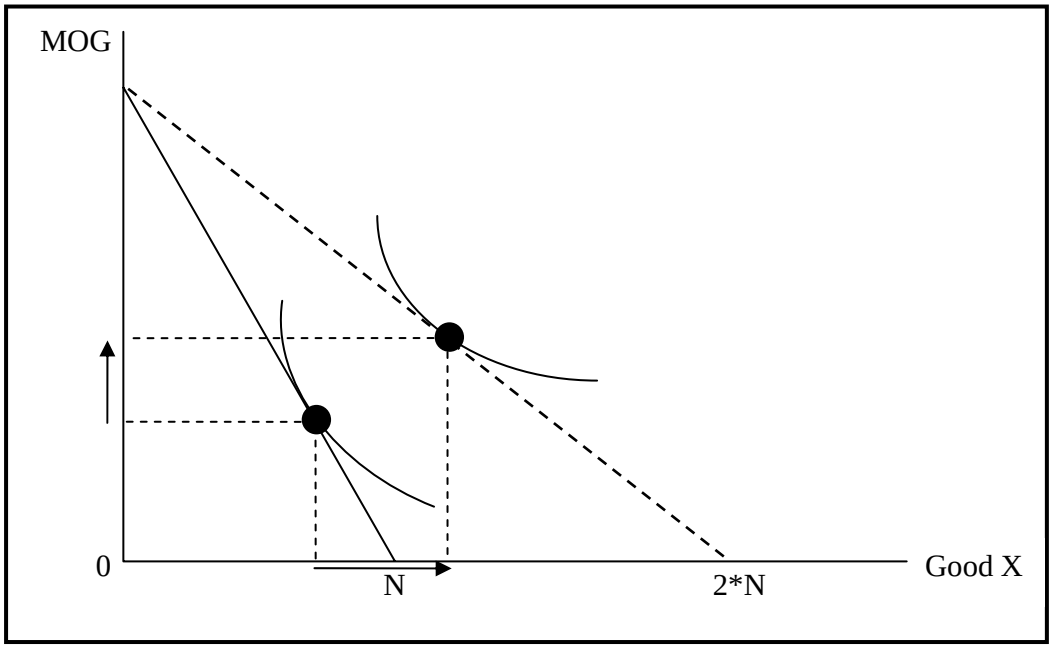

Figure 3b: Effects of a 1:1 Match Promotion without the Ability to Spend Potential Savings

Again, the effective price of Good X under a 1:1 match is less than the listed price under no promotion. However, the individual is not limited like in Figure 3a and is able to obtain a maximum of 2*N units under the promotion than under no promotion.

These results lead to the conclusion that functional equivalence does not necessarily lead to strict equivalence. Using Figures 3a and 3b for reference, if the number of units obtained under the matching promotion is less than N, then strict equivalence will still hold. However, if the number of units obtained under the matching promotion is greater than N, then strict equivalence does not hold and behavior will not be consistent across promotions.

Consider the affect on the budget curve if we relax our assumption that the private good is infinitely divisible. Does this relaxation also affect the strict equivalence of two promotions? If Good X is not infinitely divisible, then budget constraint is a step function. Again, assume there is a 50% off rebate promotion, a 1:1 matching promotion,

and a 50% straight price reduction. Figures 4a and 4b illustrate the scenario where the good is not infinitely divisible. The solid line represents the budget under no promotion. The dashed and dotted lines represent the budget under a 50% rebate[1] and a 1:1 matching promotion, respectively. The most important aspect of Figures 4a and 4b is that only even numbers of units can be obtained under the matching promotion. The rebate and straight price reduction promotions are more "flexible" for the individual than the matching promotion. This flexibility allows for a higher level of satisfaction, given a specific budget constraint.

In Figure 4a, the individual, by construction, obtains more units under the matching promotion (Point B) than under the rebate and straight price reduction promotions (Points C and D). There is also a possibility that fewer units could be obtained under the matching promotion than under the rebate or straight price reduction promotions. Figure 4b illustrates such a scenario.

[1] There is one caveat in terms of the equality between rebates and straight price reductions. In this case, it is assumed they are equal. However, their equality no longer holds if we again relax the first assumption regarding the individual being able to spend potential savings.

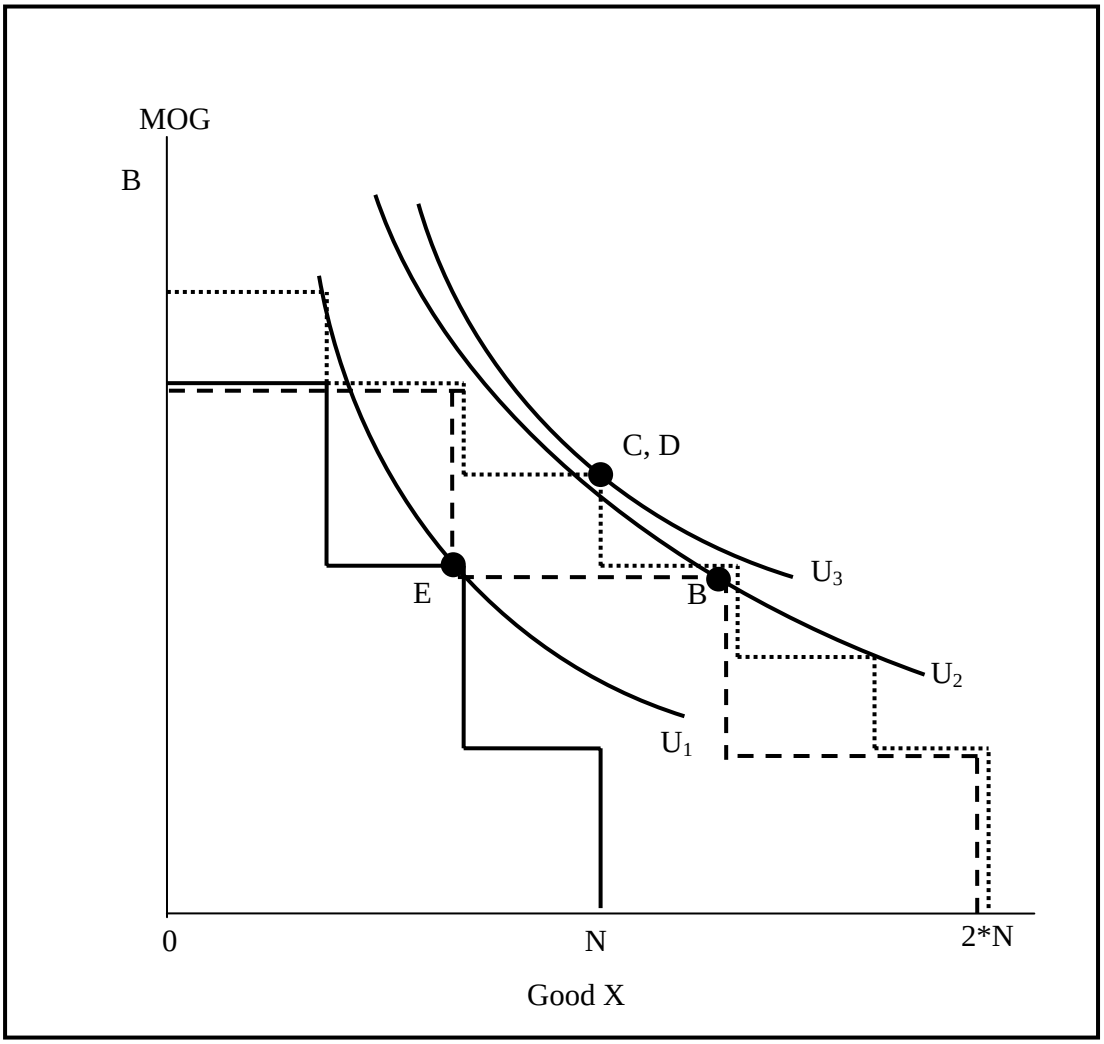

Figure 4a: Indifference Curves Assuming Discrete Unit Intervals: Units Obtained Under a Matching Promotion Greater than the Units Under a Rebate Promotion.

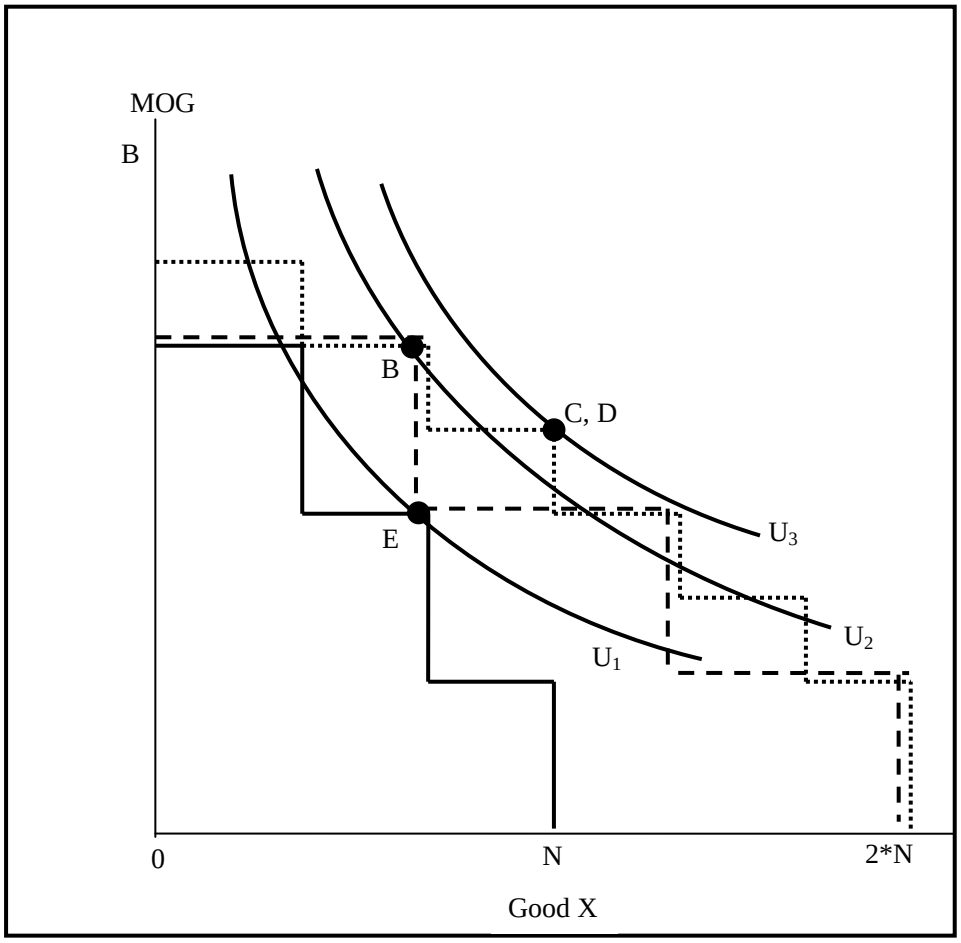

Figure 4b: Indifference Curves Assuming Discrete Unit Intervals: Units Obtained Under a Matching Promotion Less than the Units Under a Rebate Promotion.

Figures 4a and 4b illustrate that functional equivalence does not necessarily lead to strict equivalence when goods are not infinitely divisible. Specifically, the assumption of finite divisibility injects a "lumpiness" characteristic into the analysis by completely changing the shape of the budget curve.

Conclusion

The analysis in this chapter explored the effect of promotions on consumer purchases, using standard utility theory. Specifically, we investigated how the budget curve is affected by the use of promotions. We showed that a promotion is effectively a price reduction, thereby increasing real income.

This chapter also investigated if functional equivalence leads to strict equivalence. It was concluded that strict equivalence holds across promotion types, given the assumptions of infinite divisibility and that individuals can spend the potential savings associated with a specific promotion. However, once these assumptions were relaxed, it was concluded that functional equivalence does not lead to strict equivalence.

Chapter 2: Experimental Literature Review

Recent literature on the strict equivalence of rebate and matching promotions in the context of both public and private goods reveals an observed preference[2] toward matching promotions over rebate promotions in a controlled laboratory environment. This chapter will investigate the validity of potential reasons behind this seemingly anomalous behavior.

Subsidy Effects and Charitable Giving

Eckel and Grossman (2003) were interested in determining if charitable donations are affected by the framing of a subsidy[3] as either a rebate or a match. Table 3 contains a summary of expenditure definitions, which will be referred to throughout this paper.

	Match	Rebate	Equivalency
Pass Amount	Subject Expenditures Exclusive of Match Amount	Subject Expenditures Exclusive of Rebate Amount	Equivalent to the subject's gross expenditures.
Private Contributions	Subject Expenditures Exclusive of Match Amount	Subject Expenditures Inclusive of Rebate Amount	Equivalent to the subject's net expenditures.
Charitable Receipts	Subject Expenditures Inclusive of Match Amount	Subject Expenditures Exclusive of Rebate Amount	Equivalent to the dollar amount the Charity receives.

Table 3: Summary of Expenditure Definitions

To illustrate, assume an individual donates $2.00 to a charity. If a 50% rebate subsidy is applied, then the $2.00 is the person's pass amount. However, the net expenditures, otherwise referred to as the person's private contribution, is only $1.00. If a 1:1 match subsidy is applied, the $2.00 is still the individual's pass amount, but the charitable receipt is the $4.00 ($2 donation plus $2

[2] The matching subsidy generated higher charitable receipts and higher number of purchases for a public and private good, respectively.
[3] Eckel and Grossman (2003) refer to promotions as subsidies because of the charitable context.

match). Eckel and Grossman hypothesized charitable receipts should be equal when an individual faces two functionally equivalent subsidies.

In an experiment using 168 undergraduate and graduate students of varying backgrounds from the University of Texas in Arlington, subjects allocated an endowment under varying subsidies. Specifically, subjects decided how much of an endowment, denominated in "lab dollars[4]", to keep for themselves and how much to pass onto a charity from a predetermined list. Table 4 contains the subsidies and endowment levels used. An example of the allocation decision sheet[5] is included in Appendix B on page B-1.

Endowment	Match	Rebate	No Promotion
40	1:0.25 1:1	20% 50%	No
60	1:0.33	25%	Yes
75	1:1 1:0.33	50% 25%	No
100	None	None	Yes

Table 4: Allocation scenarios in Eckel and Grossman (2003)

Subjects were confronted with twelve allocation decisions, and once the subject finished, one decision was chosen at random and the subject was paid accordingly.

Results from the experiment indicated that charitable receipts under a matching subsidy were 1.2 to 2 times higher than the amount contributed under a functionally equivalent rebate subsidy. For instance, with an endowment of 75 lab dollars ($7.50), a rebate subsidy of 25%, and a 1:0.33 matching subsidy, charitable receipts were approximately 21% more under the matching subsidy than under the rebate subsidy.

[4] Eckel and Grossman (2003) used tokens to represent lab dollars and the exchange rate was 1 lab dollar = $0.10. The amount "passed" onto the charity is synonymous with charitable contributions.
[5] There were eight variations of the decision allocation sheet, each with a different random ordering of the decision questions.

The results from Eckel and Grossman's experiment verified that private contributions were negatively correlated with price and positively correlated with income, which is consistent with a normal good.

When individuals are faced with choices between alternatives, they often disregard similarities and focus on the characteristics that differentiate the choices. There are several potential explanations why two functionally equivalent promotions may be perceived as dissimilar. In a charitable context, a rebate subsidy can be thought of as an individual effort, where charitable receipts are attributable to a single individual. On the other hand, a matching subsidy can be thought of as a cooperative effort, where charitable receipts are a function of two individuals contributing. Another potential reason is that a rebate may be perceived as a 'reward-frame' where the individual is rewarded for contributing by receiving a proportion of the donations they made to the charity from a third party. However, a match may be perceived as a 'cooperative-frame' where a proportion of the individual's private contribution is matched by a third party. Therefore, under a matching subsidy, an individual knows their contribution will result in some level of giving by another person and charitable receipts would be equal to the sum of the individual's private contribution and the resulting matching contribution. Taking into account the expected match, if the individual does not discount the amount they pass to the charity, then charitable receipts would be higher under a matching subsidy than under a functionally equivalent rebate subsidy.

If individuals perceive the matching subsidy as a "cooperative frame", then charitable giving lends itself to the possibility that altruism may be a significant factor in the observed behavior. Altruism is generally thought of as a reason for giving, regardless if there is a subsidy in effect. This implies individuals may receive utility from their specific charity and from the act

of giving. For instance, an individual is more inclined to contribute to a charity for cancer research if that individual knows someone (family member or friend) who suffered from a specific cancer. The individual may perceive the matching promotion as a "good deal" for a specific charity because as a result of the match, the charity receives more than what the donor contributes. This does not imply that altruism is not present when there is a rebate subsidy in effect. However, under a rebate subsidy, the donor may perceive the donation as "buying" something rather than giving. Therefore, the utility the individual receives from the act of giving is diminished and the motivation to give is reduced.

Davis, Millner and Reilly (2003), hereafter DMR, focus on pass ratios to explore further the effects of subsidy types on charitable contributions. They hypothesized that although changing subsidy conditions affect charitable receipts substantially, it does not affect the pass ratios[6]. They note as well that the pass rates observed by Eckel and Grossman are relatively constant and examine the extent to which constant allocation rules account for that behavior.

[6] A pass ratio is a ratio of the percentage of an endowment the individual passes onto a charity under a matching condition and the percentage of an endowment passed onto a charity under a functionally equivalent rebate condition.

Constant Percentage Behavior

Endowment	Pass Amount ($) Match$_{1:1}$	Pass Amount ($) Rebate$_{50\%}$	Pass Ratio	Private Contributions ($) Match$_{1:1}$	Private Contributions ($) Rebate$_{50\%}$	Charitable Recipts ($) Match$_{1:1}$	Charitable Recipts ($) Rebate$_{50\%}$
8.00	6.00	6.00	1.0	6.00	3.00	12.00	6.00
10.00	7.50	7.50	1.0	7.50	3.75	15.00	7.50

Optimal Behavior

Endowment	Pass Amount ($) Match$_{1:1}$	Pass Amount ($) Rebate$_{50\%}$	Pass Ratio	Private Contributions ($) Match$_{1:1}$	Private Contributions ($) Rebate$_{50\%}$	Charitable Recipts ($) Match$_{1:1}$	Charitable Recipts ($) Rebate$_{50\%}$
8.00	3.00	6.00	0.50	3.00	3.00	6.00	6.00
10.00	3.75	7.50	0.50	3.75	3.75	7.50	7.50

In this case, a pass ratio is the proportion of the endowment that is passed to a charity under the match subsidy and the proportion of the endowment that is passed under the rebate subsidy. Therefore, if the subjects pass the same percentage of their endowment across both subsidy types, the pass ratio would equal unity. A mathematical representation of the pass ratio would be:

$$\text{Pass Ratio} = \frac{\%Passed_M}{\%Passed_R}$$

Table 5: Constant Percentage Verses Optimal Behavior

Table 5 was constructed to illustrate the differences between two behavior hypotheses: optimal and constant percentage. Constant percentage behavior assumes the subject donates the same percentage of their endowment regardless of price and subsidy condition. Optimal behavior assumes the individual has a predetermined amount they wish to donate. When confronted with a subsidy, they adjust the dollars passed onto the charity in order for the charitable receipts to be equal across functionally equivalent subsidies. For both behavior scenarios, it was assumed that 75% of the endowment is donated.

Under the hypothesis of constant percentage behavior, the individual donates $6.00 and $7.50, dependent on the endowment level. However, charitable receipts are not equal across subsidy types since the subsidy was not taken into consideration when deciding how much to pass onto the charity. Specifically, charitable receipts are higher under the matching subsidy than under the rebate subsidy. This result is consistent with the observations of Eckel and Grossman (2003). A pass ratio of unity is an indication that constant percentage behavior is present.

Under the optimal behavior hypothesis, the pass amount under the matching subsidy gets discounted in order for charitable receipts to equal $6.00 and $7.50, depending on the endowment. The amount passed under the rebate subsidy is equal to charitable receipts, but the donation only cost the individual the same amount as it did under the matching subsidy.

DMR (2003) conducted a control experiment where forty-three undergraduate students, from Virginia Commonwealth University, made a series of ten allocation decisions regarding charitable contributions. The experiment was similar in nature to the experiment in Eckel and Grossman (2003) with two minor adjustments that simplified procedures. The endowments and decisions were denominated in dollars rather than tokens and there was only one charity used ("Feed the Children"). Table 6 contains the subsidies and endowment levels used. An example of the allocation decision sheet is included in Appendix B on page B-2

Endowment	Match	Rebate	No Promotion
$8	1:0.5 1:1	33% 50%	Yes
$12	1:0.5 1:1	33% 50%	Yes

Table 6: Allocation scenarios in Davis, Millner, and Reilly Control Treatment (2003)

Table 7 contains the results of the control experiment. The mean pass ratio is insignificantly different from unity, except for one instance where the mean pass ratio was 0.89.

It is evident from Table 7 that charitable receipts were higher under matching subsidies than under the functionally equivalent rebate subsidies.

Endowment	Subsidy Rate	Subsidy Type	Pass Rate (%)	Pass Ratio	Charitable Receipts
$8.00	1:0.5	Match	42.15		$5.06
	33%	Rebate	41.42	1.018	$3.31
	1:1	Match	45.64		$7.30
	50%	Rebate	42.15	1.076	$3.37
$12.00	1:0.5	Match	35.17		$6.26
	33%	Rebate	39.39	0.893	$4.70
	1:1	Match	40.89		$9.81
	50%	Rebate	43.60	1.066	$5.23

Table 7: Results from Davis, Millner, and Reilly Control Experiment

The results of the control experiment led DMR to conduct an additional experiment where they investigated the possibility that individuals may be unwilling to expend the extra time to compare different subsidies. For instance, participants may not have been able to recognize that subsidies such as "for every dollar you contribute, the experimenter will refund $0.50 to you" and "for every dollar you contribute, the experimenter will contribute $1.00" are functionally equivalent.

In an experiment using forty-two undergraduate students[7], subjects made similar allocation decisions as in the previous experiment. Individuals were given a table showing the total dollars they would retain and the total dollars the charity would receive as a result of their donation. It was hypothesized that providing subjects with this information would shift the pass ratios to the optimal predictions. Results of the experiment support DMR's hypothesis. Nevertheless, deviations persist, with participants erring in the direction of excess relative contributions with a matching subsidy.

[7] None of the students in this experiment were used in any other experiment conducted by DMR.

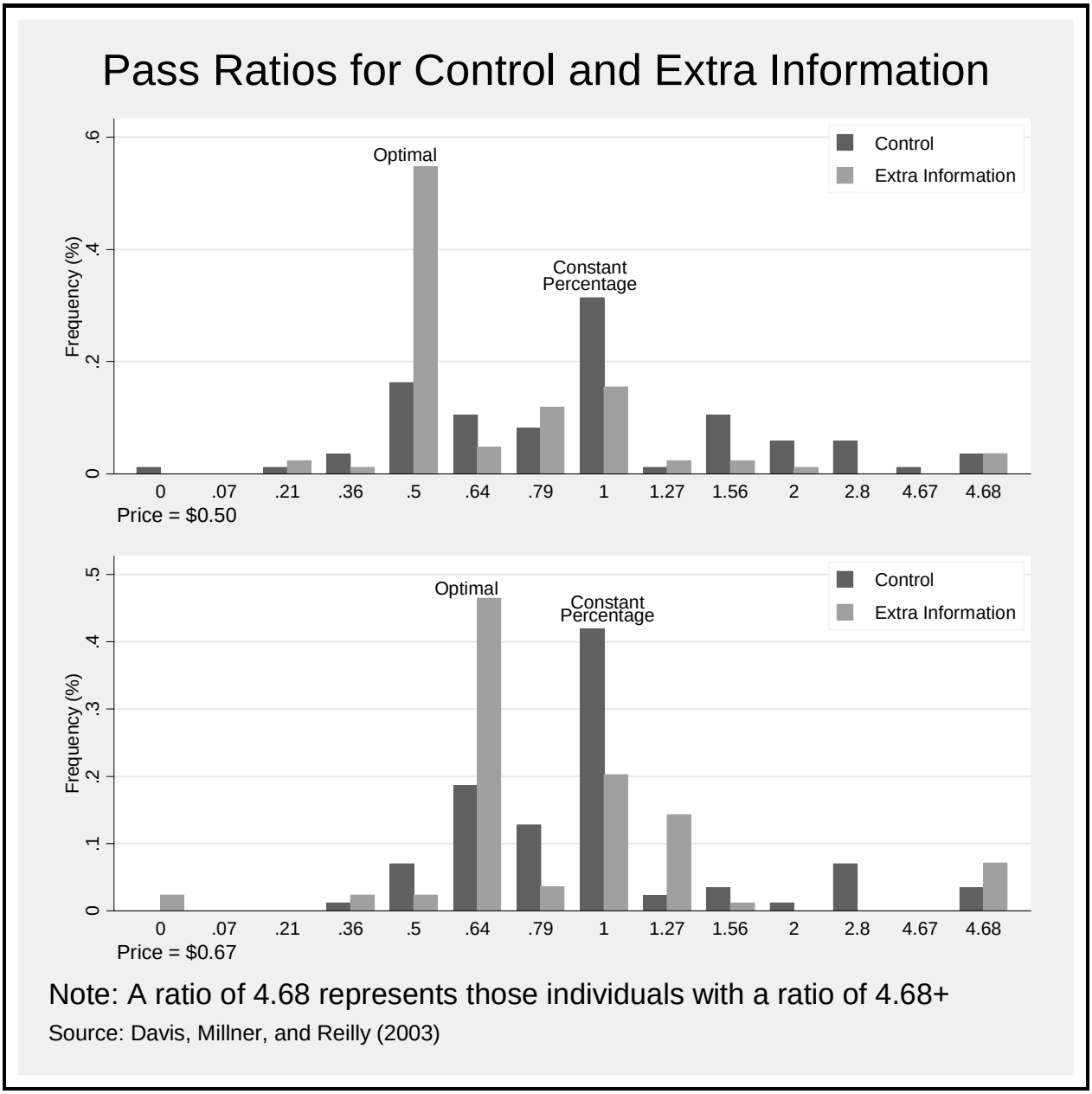

Figure 5: Pass Ratio Comparison in Davis, Millner and Reilly (2003)

Figure 5 shows the pass ratio distribution associated with the control and extra information treatments. A pass ratio of unity represents "constant percentage" behavior and a pass ratio of 0.5 and 0.64 are the optimal predictions. In the control treatment, it is clear that the most common strategy was contributions based on "constant percentage" behavior. In the treatment where additional information is provided to the participant, the subject's behavior was

closer to optimality. After optimal pass ratios, 'constant percentage' behavior represents the alternative strategy selected with the most frequency in the extra information treatment.

DMR conducted a neutral frame treatment to determine if the charitable context was influential in the observed differences in charitable receipts. They conducted an experiment where forty-nine undergraduate students allocated their budget between cash and a riskless "investment account" that generated a private return. Table 8 contains the various conditions the subjects encountered.

Budget	Match	Rebate	No Promotion
$8	1:0.5	33%	Yes
	1:1	50%	
$12	1:0.5	33%	Yes
	1:1	50%	

Table 8: Allocation scenarios in Davis, Millner, and Reilly Neutral Treatment (2004)

DMR found the amount passed to the "investment account" was still higher under a matching scheme than under a rebate scheme. However, the results of the neutral frame treatment seemed to weaken the constant percentage hypothesis. Under the constant percentage hypothesis, the pass ratio should have been unity. However, the pass ratio with the highest concentration was at 0.5 for the neutral frame treatment when the price was equal to $0.50. Figure 6 illustrates the pass ratio distribution of the control and neutral treatments.

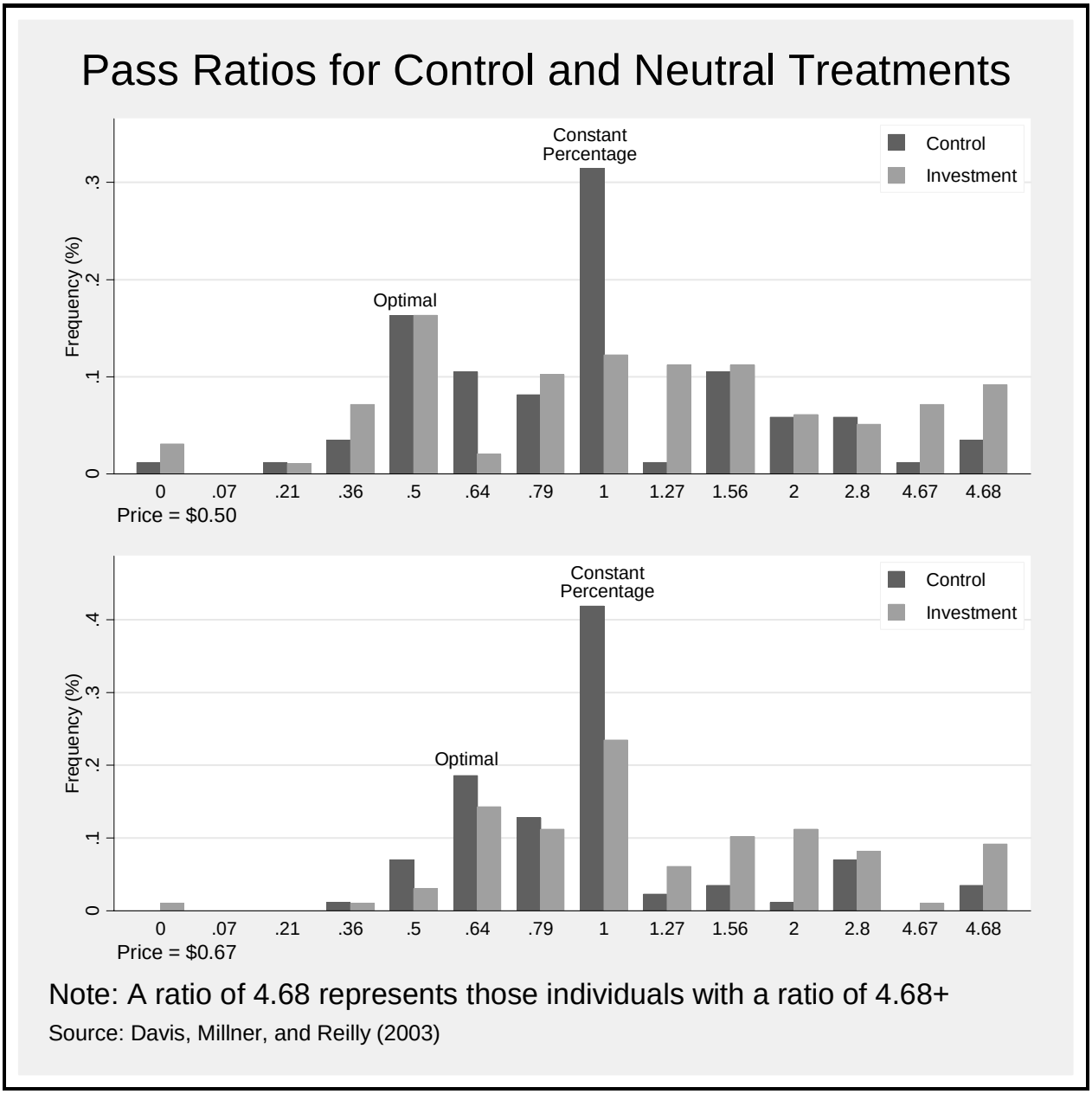

Figure 6: Pass Ratio Comparison in Davis, Millner and Reilly (2003)

Based on the hypothesis of "constant behavior", it was expected the subjects would continue to contribute a constant percentage of their endowment, regardless of the scenario. For the neutral frame treatment, participants erred in the direction of excess relative contributions with a matching subsidy. This is evident by the increase in the frequency of pass ratios higher than unity in the neutral frame treatment than in the control treatment.

Subsidy Effects and Purchases of Consumer Goods

Davis and Millner (2004) extend the focus of Eckel and Grossman (2003) and DMR (2003) by investigating the effects of promotional types on purchases of consumer goods, a context that is less abstract than charitable contributions and is more relevant to sample populations (college undergraduates and graduates).

Davis and Millner conducted an experiment where 103 undergraduate students[8] made a series of decisions regarding an offer to buy chocolate bars under differing promotional schemes. To ensure participants had the necessary disposable income, participants were presented the opportunity to purchase candy bars after they had been paid for their participation in an unrelated experiment. Table 9 contains a summary of the various conditions the subjects faced. An example of the allocation decision sheet is included in Appendix B on page B-3.

Budget	Price	Match	Rebate	No Condition
$5.00	$0.50	1:1 1:0.5	50% 33%	Yes
	$0.33	------	------	Yes
	$0.25	------	------	Yes

Table 9: Purchase Conditions in Davis and Millner (2004)

After the subjects completed their seven decisions, one decision was chosen at random and the subjects were paid accordingly. Davis and Millner found that net purchases were higher for a matching promotion than for a comparable rebate promotion. Unlike the public good focus of Eckel and Grossman (2003) and DMR (2003), the observed behavior in Davis and Millner (2004) is not attributable to "contributions" or "reward" framing effects. In fact, the presence of a third party is extraneous if individuals purchase chocolate bars for their own consumption. Figure 7 illustrates the pass ratios observed by Davis and Millner (2004). These results clearly

[8] Fourteen of the 103 subjects never purchased any chocolate bars under any condition.

indicate that constant percentage behavior was the most common strategy. Therefore, it is reasonable to conclude that constant percentage behavior extends to purchase decisions for private goods.

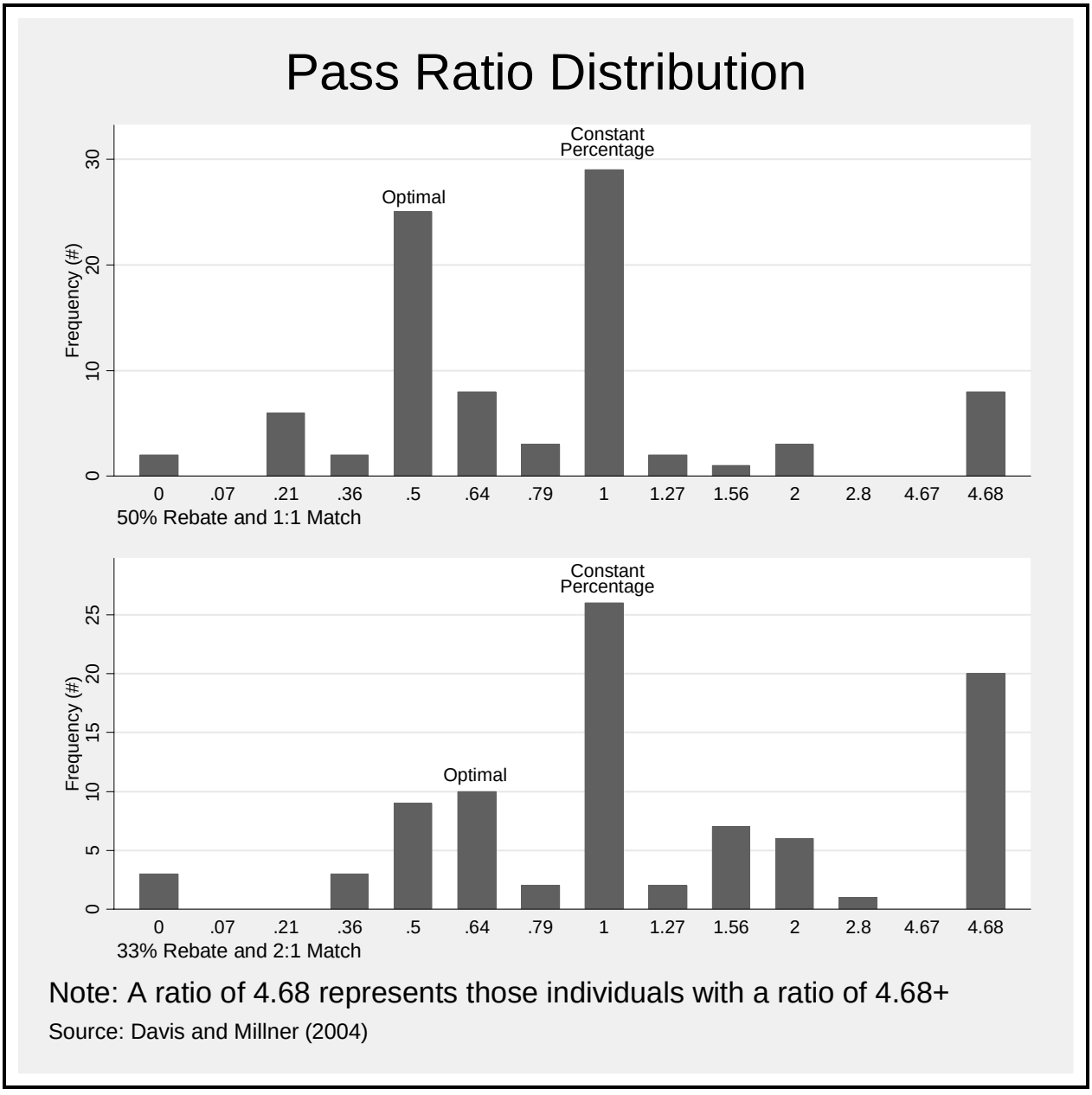

Figure 7: Pass Ratio Distribution from Davis and Millner (2004)

To gain some additional insight into subject's perceptions of matching and rebate promotions, Davis and Millner solicited responses to a pair of hypothetical scenarios, which

were included in the instructions. Each scenario paired a 1:1 matching condition and a 50% rebate condition. The first scenario is described as follows:

> *The lease on your apartment is ending and the landlord is about to make a final inspection before giving your security deposit back to you. You notice that a 150-Watt light bulb in the kitchen is burned out and go to the store to purchase a replacement. The store sells two brands of 150-Watt bulbs, "BrightLite" and "EverGlow". "BrightLite" is offering a rebate of half-off the purchase price to be redeemed at the register. "EverGlow" is offering a two for one special. Assuming that the products are perfect substitutes, which one would you purchase? Why?*

Since the individual only needs one light bulb, subjects were expected to prefer the rebate condition. In this scenario, 71% indicated a preference for a rebate condition and 28% indicated a preference for a matching condition (1% were indifferent). When asked to explain their preference, 59% of those that provided justification indicated the effective prices were equivalent and 36% indicated they were averse to rebates.

The second scenario is described as follows:

> *You and your friends are having a graduation party and you have been assigned the duty of buying potato chips. A large number of guests are expected so you need to purchase 20 bags. You go shopping at the local grocery store for chips. First, you see that "Idaho's Best" is having a 2 for 1 special. The comparable brand, "Idaho's Finest," has attached to it a coupon redeemable at the checkout for half off the regular price. Which one do you choose? Why?*

In this case, subjects were expected to be indifferent between the two conditions. However, 63% expressed a preference for the matching condition and 16% preferred the rebate condition (22% were indifferent). Of the subjects that provided justification, 38% stated they were averse to rebates. For those subjects who claimed they were indifferent, the justification was the effective prices were equivalent.

The responses to the two hypothetical situations suggest an aversion to rebates in a naturally occurring environment. This parallelism aids in explaining the observed behavior in a controlled environment.

Conclusion

This chapter reviewed some of the recent literature regarding individual behavior and the use of promotional activities. The literature reveals an observed preference toward matching promotions over rebate promotions in a controlled laboratory environment. Eckel and Grossman (2003) attributed the observed behavior to framing effects. Davis, Millner and Reilly (2003) concluded the observed behavior is the result of computational errors made by sample populations. Davis and Millner (2004) discovered that individuals have a tendency towards "rebate aversion" and this explains why matching promotions are preferred over rebate promotions.

A weakness in Eckel and Grossman (2003), DMR (2003), and Davis and Millner (2004) papers is the authors are unable to evaluate the subject's decisions based on theoretic predictions. Therefore, the authors were unable to determine if the observed behavior is the result of the subject's preference for a particular subsidy or if the results are due to the utility the subject receives from either donating to charity or consuming chocolate bars.

Chapter 3: Literature Review on Promotion Perception and Evaluation

Recent literature on promotion perception and evaluation reveals that framing effects significantly influence individual behavior. There is also evidence of considerable differences in how consumers evaluate different promotion types. This chapter will investigate how consumers process information pertinent to promotion evaluation.

Integration of Potential Savings

An important aspect of promotion evaluation is the integration of potential savings. A study by Campbell and Diamond (1990) suggests that framing effects[9] significantly influences how an individual evaluates a particular promotion[10]. They hypothesize that a consumer's purchase decision is not solely dependent on the effective price of the product.

In a survey using sixty-four students, subjects evaluated a local restaurant promotion. Specifically, a portion of the students were given a rebate promotion and the remainder was given a matching promotion. Subjects were asked to quantify the smallest dollar value discount they would consider to be a "good deal". Results of the survey revealed that the average dollar value under the matching promotion was 38% higher than under the rebate promotion. This implies the value of a matching promotion must be higher than that of a rebate promotion in order for them to consider it a "good deal"

A potential explanation of this observed behavior is how consumers may perceive the savings gained from a particular promotion. Campbell and Diamond hypothesize that when promotions are rebates, savings are easily taken into consideration when evaluating

[9] Framing effects refer to the fact it is possible to present information in a fashion that would lead to different conclusions.

[10] Campbell and Diamond (2003) used the terms "monetary" promotions to refer to rebate-type discounts and "non-monetary" promotions to refer to matching offers.

a promotion because the savings are denominated in the same units as the product's price. However, when promotions are in matching terms, the savings are not easily accounted for since matching schemes are denominated in units other than price and require more effort for consumers to evaluate. This perception leads to the possibility that individuals underestimate the value of matching promotions. This underestimation implies individuals prefer rebate promotions over matching promotions, which is contradictory to observed behavior in the experimental literature in chapter 2.

Framing Effects

How a consumer integrates potential savings is only one aspect of promotion evaluation. Chen, Monroe and Lou (1998) investigate how consumer perceptions are influenced by how a promotion is framed. They hypothesized that the attractiveness of a price promotion depends not only on the absolute savings from the promotion but also on the relative savings. Consumers tend to evaluate promotions in relative terms rather than in absolute terms.

In two experiments using 119 and 129 undergraduate business students, subjects considered purchasing a computer and floppy disks. Subjects were told they received a direct mail advertisement informing them of a 10% price reduction on a more advanced computer and floppy disks before they made their purchase decisions. Subjects were given either a straight price reduction or a coupon, which was framed in either dollar or percentage terms. The subjects were told the more advanced options would cost them 25% more without the discount. Chen, Monroe, and Lou were interested in determining if the promotion influenced the subject's purchase decision by subjects switching from their original purchase intentions to the more advanced option.

Results of the experiments concluded that subjects preferred the price reduction framed in dollar terms rather than in percentage terms for the computer. However, subjects preferred the price reduction framed in percentage terms than in dollar terms for the floppy disks. These results clearly indicate there were significant framing effects in terms of the proportionality of the discount relative to the list price of the promoted product. The results of Chen, Monroe, and Lou support the way we framed our promotions in our experiment.

Impact of Unexpected Savings on Consumer Purchase Decisions

Results from Chen, Monroe and Lou lead to the conclusion that unexpected savings from a promotion have a significant influence on individual purchase decisions. Heilman, Nakamoto and Rao (2003) explore an extension to Chen, Monroe, and Lou. They investigated the effects of unexpected in-store coupons to determine if these promotional activities increase market basket sales and lead to unplanned purchases, specifically complements of the promoted product. They surveyed grocery store shoppers by comparing the consumer's grocery list, which was prepared prior to entry into the grocery store, and their cash register receipt in order to determine if unexpected savings resulted in more unplanned purchases. Surprise coupons, specifically electronic coupons, are redeemed up to ten times more frequently than free standing inserts (FSI). These types of promotional methods have resulted in, on average, an increase in sales of 35% and a rise in total basket purchases of 14% (Thompson, 1997).

Results of their study conclude consumers who received an unexpected in-store coupon made more unplanned purchases and the dollar value of the market basket was significantly higher than those consumers that did not receive an in-store coupon. They

also verified there is a complement effect because they found that consumers who received an unexpected in-store coupon also made more unexpected purchases of items that are complements of the promoted product. These results lead to the question does promotions encourage the purchase of multiple units.

Promotion Evaluation

An important aspect of promotion evaluation is how individuals process information in order to determine if a promotion results in consumer surplus. Hardesty and Bearden (2003) developed a test of the inverted U information processing perspective, which states that extreme discounts may not be considered comprehensively. To illustrate the inverted U information processing perspective, consider a consumer who is shopping for a new stereo system. The consumer compiles product information in order to form a range of expected prices, which act as decision points when the consumer evaluates various offers. This range of prices is referred to as the consumer's "latitude of acceptance". Assume the consumer finds a stereo system on promotion at a local electronics store. In this case, the effective price of the stereo is higher than the upper bound of the consumer's latitude of acceptance. The consumer may perceive this promotion as "not being a good deal" and does not consider purchasing the stereo. Assume the consumer finds another stereo at a different local electronics store. However, in this case, the effective price of the stereo is below the lower bounds of the consumer's latitude of acceptance. The consumer may perceive the quality of the stereo is deficient and does not consider purchasing the stereo. This implies the consumer would only consider purchasing a stereo if the product's price is within the consumer's latitude of acceptance.

Hardesty and Bearden hypothesized that the increased difficulty associated with processing matching promotions compared to rebate promotions might result in greater skepticism of offers and frequent computational errors associated with promotion evaluation. In a survey, using 261 undergraduate marketing students, subjects responded to a promotion under various levels of price discounts and matching[11] offers. The various discounts were functionally equivalent to 10%, 25%, and 50%. The price discounts were presented in dollar terms and the matching promotions were presented using "% MORE FREE".

Results of the survey found that when promotion levels were high (50%), subjects preferred the price discounts over matching promotions. This observed preference may by explained by the fact that consumers can spend the savings on other things. Another explanation draws on the law of diminishing marginal rates of substitution. As matching promotions get larger, consumers may believe they are not able to consume the entire quantity and therefore the additional quantities are valued significantly less. When promotion levels were moderate (25%), subjects did not display a preference in regards to the promotion type. The results of the survey are not consistent with the observed behavior in the experimental literature in chapter 2.

Price Perceptions

This chapter has investigated how consumers perceive particular promotions. We have also investigated how consumers process explicit and implicit information from a specific promotion type. However, we have not discussed how a particular promotion

[11] The matching promotions in this literature are different from the matching promotions we utilize. The authors utilize bonus packs where free quantities are infinitely divisible.

type affects consumer's perception of price and future price expectations and how these perceptions affect a consumer's purchase intentions.

Folkes and Wheat (1995) examine how three types of consumer promotions (rebates[12], coupons, and straight price reductions) influence perceptions of price. They hypothesize a consumer's expectations of future prices should be higher for products offered with a rebate than for the same products offered whether a coupon or a straight price reduction promotion is used.

In an experiment using thirty-four undergraduate business students, subjects completed a questionnaire regarding the purchase of a specific household product. The questionnaire described the product, the regular and promoted price of the product and the promotion type being used. The value of the discount was similar across promotion types. Subjects were asked questions such as what is the maximum amount they would be willing to spend on this product, what they would consider is a fair price for the product, and what would they expect to pay for this product. The effective price of the product was not explicitly provided to the subjects. Results of the experiment indicate that the use of straight price reductions and coupons lower price perceptions relative to those in the rebate condition.

There are instances when consumers use the savings from a rebate promotion to infer a product's normal price. When consumers use the face-value of a coupon in order to infer a regular price, this is known as the "coupon effect". Raghubir (1998) investigated how the face-value of coupons can be used to define price perceptions of promoted products. Raghubir hypothesized that a coupon's value may signal the price of the product—the higher the coupon value, the higher the perception of price—and this

[12] Folkes and Wheat refer to rebate as savings received at a later date rather than at the time of purchase.

indirect informational effect can undercut the positive economic benefit of providing the discount. Assuming this hypothesis is correct, then trial usage of the promoted product may occur but when the product is not being promoted, consumers may be less likely to purchase the item if a higher price is perceived as a result of the higher discount.

Raghubir conducted an experiment using 173 undergraduate marketing students where the subjects were asked to evaluate a coupon for a tourist attraction while on a hypothetical trip. Subjects were asked to estimate the regular ticket price, given the coupon was for either 10% or 20% off the regular price of admission. A control group was used in this case and these subjects were not given a promotional discount. The results of the experiment indicate that price estimates were higher when the coupon discount was 20% verses 10% and both estimates were higher than the actual price of admission. These results imply that consumers use coupon value as a source of information to estimate price.

There is also some evidence consumers have some expectations about the range of percentage discounts based on prior experience with a particular brand. This implies higher coupon values should carry less weight when the consumer has prior experience with a particular product and brand. Therefore, the higher coupon value should only serve as an economic incentive to purchase the product. Since prior experience carries more weight than the face-value of a coupon in forming price expectations, then prior experience should moderate the coupon effect. Raghubir (1998) hypothesized that prior price information, whether contextually provided or internally available, moderates the coupon effect, thereby coupons with higher face-values are more effective when consumers know historical price levels.

Raghubir conducted an experiment using 158 undergraduate marketing students where the subjects were asked to hypothetically purchase a t-shirt from their campus bookstore. Subjects were given promotions in dollar and percentage terms. Some of the students were told the original price and the new sales price. The results of the experiment conclude the presence of contextual past price information moderates the coupon effect. The coupon effect was present only when alternative price information was unavailable to the subjects. When alternative price information was available, then higher discounts led to improved promotion evaluations. These results imply that high coupon values should include reference price information so that promotion evaluations may be improved.

Rational Expectations and Promotion Frequency

There is evidence to suggest that promotion frequency may have a significant effect on consumer price perceptions. There is a concern that repeated discount offerings may lower price expectations and this could affect repeat purchases and reduce the effectiveness of future promotions. If a product is regularly discounted, the consumer may have a tendency to perceive that the regular price of the product is too high and will only purchase the product when a promotion is involved. Several factors influence consumer expectations for future promotions, which affect consumer purchase intentions. The intensity, duration and frequency of promotions allow the rational[13] consumer to determine the probability of future promotions and the level of potential savings.

[13] An assumption in economic theory that individuals act logically in specifying their objectives and then make decisions which are consistent with those objectives. The consumer is assumed to maximize utility or satisfaction and will determine which purchases, in the light of individual taste for products and the relative prices of those products, to consume.

According to Gonul and Srinivasan (1996), if a consumer believes a good will be on sale in the near future, they may be inclined to postpone their purchase today in order to get a lower price in the future. The decision to hold off on certain purchases based on expectations of future promotions is a function of the consumer's individual inventory. Stockout costs are costs to the consumer if their personal inventory is depleted. This implies if stockout costs are high enough, the slightest probability of stockout encourages the consumer to purchase now rather than in the future, regardless of future promotion expectations. If consumers anticipate coupons and adjust their purchase behavior accordingly, then coupons may be a costly promotional activity.

The authors developed a model using panel[14] household scanner data from the A.C Neilsen Company. They used purchases of disposable diapers between mid-1986 and mid-1987 and focused on the three leading brands, which comprise more than 90% of the market and whose prices are comparable. There were a total of 138 households in the sample.

Results indicate consumers have higher expectations of future promotions when there is no coupon present in the current time period. This implies consumers are willing to postpone current purchases in order to utilize expected savings in the future. This effect is moderated when the consumer fears there is a possibility of stockout.

Conclusions

This chapter reviewed some of the marketing literature pertaining to promotional activities and individual behavior. The literature reveals there are significant differences in perceptions of functionally equivalent promotions. Campbell and Diamond (1990) and

[14] Panel data is a data set constructed from repeated samples from the population at a given point in time. The observations in a panel data set are individual-specific. Therefore, the population contains the same individuals and the only dynamic factor is the specific point in time when the data is collected.

Hardesty and Bearden (2003) investigated how individuals process information contained within a promotion and found that how an individual processes information is unique to the type of subsidy in effect.

Hardesty and Bearden (2003) and Chen, Monroe and Lou (1998) explored the impact of framing effects on promotion evaluation. Results indicated the presentation of potential savings has a significant effect on individual purchase intentions and promotion evaluation.

Folkes and Wheat (1995) and Raghubir (1998) examined how price perceptions are influenced by the coupon effect. Results imply that consumers use coupon value as a source of information to estimate price. However, the coupon effect is moderated when a reference price is provided to the consumer.

Gonul and Srinivasan (1996) considered the possibility that expectations of future promotions have a significant effect on an individual's immediate purchase intentions. They found that consumers are willing to postpone current purchases in order to utilize expected savings in the future.

Chapter 4: A Review of Experimental Methods

The Purpose of Experimental Methods in Economics

Experiments are a planned intervention in the natural order of events. Substantial knowledge in all sciences has come from actively manipulating or interfering with the stream of events. The use of experimental methods in economics to evaluate theory has been increasingly popular and has provided an avenue for bridging the gap between theory and observation. The economist uses relevant existing theories to design and implement a series of experiments for the purpose of testing the consistency of economic theory. This paper reports the results of a set of experiments that test the persistence of the observed anomaly through the elicitation of choices in a controlled environment. Specifically, we use an induced demand function to control for the value a subject places on a hypothetical private good. The methodology provides insight into the persistence of the observed anomaly and its causes.

Many experimentalists describe the purpose of an experiment as a test of the validity of a theory's underlying assumptions. According to Friedman and Sunder (1994):

> From a formal point of view, a theory consists of a set of axioms or assumptions and definitions, together with the conclusions that logically follow from them. A theory is formally valid if it is internally consistent—that is, it does not lead to statements that contradict each other—and if the conclusions are indeed provable from the assumptions. Some experimentalists think of experimental methods as a means to testing the descriptive validity of the assumptions about human behavior on which theory is based.

The statement by Friedman and Sunder (1994) implies much of economic theory is accepted (or rejected) based on the consistency of the underlying assumptions, rather than on the basis of having survived a thorough falsification process that can be

replicated. For instance, a cornerstone of economic theory regarding individual behavior is that individuals are assumed to be utility-maximizers. The important question is not whether individuals are utility maximizers but does a model based on utility maximization predict behavior accurately. A controlled environment provides a venue for observing the descriptive validity of theory along with providing a way to explore potential causes of observed contradiction.

Economic theory is assumed to be universal. In other words, economic theory is not environment-specific. This implies that if theory holds in natural markets, then it is also assumed to hold in a laboratory setting. If theory does not hold in the laboratory, then it is up to the advocates of the theory to explain exactly why the theory should still be considered reliable. However, there are limits to extrapolating behavior observed in the laboratory in order to predict behavior in a naturally-occurring environment.

Experimental Methods and Empirical Analysis

Economists have developed an assortment of technically sophisticated models designed to explain or predict behavior in a "natural market". Traditionally theories are tested through direct observation from naturally occurring phenomena and predictions from such models are often based on very subtle behavioral assumptions. Data collected from a continuous uncontrolled process in a naturally occurring environment is referred to as field data. Experimental data, also known as laboratory data, is deliberately created under controlled conditions in an artificial environment for scientific purposes. Sometimes, the use of field data is a significant hurdle when it comes to distinguishing alternative theories.

Government and/or private agencies typically collect specific data for non-scientific purposes and this data is typically used by economists. Data, in this context, may not be of sufficient detail or accuracy in order to match naturally occurring data with specific circumstances assumed by economic theory. In the past, if data relevant to an economic hypothesis could not be obtained from "natural" markets, then the hypothesis went without the benefit of empirical analysis. This implies the use of experimental methods in economics allows experimentalists to obtain data at the necessary level of detail and accuracy.

The difficulty collecting accurate data in naturally occurring environments can be illustrated by analyzing the efficiency of competitive equilibrium, also known as Adam Smith's Invisible Hand Theorem. Since supply and demand curves are not directly observable in natural markets, economists can use experimental methods, for example, Double-Auction Markets, to provide direct evidence regarding specific propositions of price theory. A Double-Auction Market provides experimentalists the ability to directly observe the interactions between buyers and sellers and these interactions allow economists to plot supply and demand functions and test the efficiency of various aspects of price theory.

Advantages of Experiments

Experimental methods have two significant advantages in the context of economic theory. The first advantage is replicability, which refers to the ability of other researchers to reproduce the experiment and either verify or nullify findings independently. The paper by Davis, Millner and Reilly (2003) is an example of replicability. They replicated

the findings of Eckel and Grossman (2003) and then expanded the experiment, which provided Davis, Millner and Reilly the ability to test their hypotheses.

The second advantage to using experiments is control, which is the ability to manipulate laboratory conditions so observed behavior can be used to evaluate economic theory. The assumption of ceteris paribus is important because it allows economists to segregate the effects of independent variables on the dependent variable. In a natural market, the assumption of ceteris paribus does not always hold because there are many factors changing at the same time. Therefore, the lack of control in naturally occurring environments allows many relevant factors to change, thereby making the identification of the relationship between one particular factor and the dependent variable difficult. For instance, a change in demand for a particular good can be brought about by changes in factors such as income, availability of complements and substitutes, the number of buyers and expectations all can change simultaneously. It is nearly impossible to allocate the marginal effect on price and quantity if two or more factors change at the same time. This implies a laboratory environment allows the economist to measure the effect of changing one determinant while keeping all other determinants constant.

Criticisms of Relying on Experiments

Experimental methods have several criticisms as a tool for testing economic theory. A primary criticism is the sample population typically used in an experimental setting are not as "sophisticated" as the relevant decision makers in the economy. The typical sample population used in experiments is undergraduate or graduate students. However, this is not a concern in regards to our experiment because every individual makes decisions, regardless of sophistication.

Economic relationships do not occur in isolation. Therefore, it is important to be careful when extrapolating behavior from a laboratory environment to a more complex natural market environment. However, this is not a criticism about experimental methods in general. This criticism is support for a particular experimental design; one where the complexity of the laboratory environment is increased gradually in order to make the characteristics between the laboratory market and the natural market more comparable.

The criticism of simplicity in the laboratory is also relevant in "real world" markets as well. The very nature of econometric models, which is a simplification of a more complex phenomenon, makes all economic analysis susceptible to this criticism. It seems reasonable that parallelism between a laboratory and a naturally occurring environment may be weak. On the other hand, if the experiment is designed to be consistent with economic theory, then maybe the theory is missing some crucial factor that is present in the natural economy. Experimental methods allow researchers to investigate such hypotheses.

The cost associated with data generation/collection is a significant obstacle in empirical analysis. A laboratory environment is usually expensive to build, maintain, and operate. Each experiment has fixed costs such as appearance fees paid to experiment participants, maintenance of facilities and computing hardware/software. Therefore, both fixed costs and marginal costs may be significant for laboratory experiments, but these costs are typically even higher for field experiments.

Why Experimental Design is Important

The importance of experimental design comes from the desire to make inferences from a laboratory environment to a naturally-occurring environment. Researchers are

rarely satisfied to simply describe the events they observe. They want to make inferences about causation. To gain such information without vagueness, some form of experimental design is usually required. Using the appropriate experimental design allows the experimentalist to rule out possible alternative causes of observed behavior, leaving direct causality apparent.

When the observed results of an experiment do not coincide with theoretic predictions, the first thing to do is to check the experimental design. This will ensure the observed ambiguity is the result of short-comings in theory and not the result of the experimental methods used. During the course of testing, if the experimental design still appears to be appropriate and the observed results do not coincide with theory then the experimentalist must specify an experimental design that will investigate the cause of the inconsistency.

Considerations in Design Selection

The selection of a specific type of design depends on the information needed to answer a specific question. Complex designs, involving a number of "control groups," offer more information than using a simple group design. However, not all of the relevant information needed can be achieved from any given design. Some information will be obtained from the assumptions, some of which are explicit. Other information comes from theories, accepted concepts and empirical evidence from related studies.

The first instinct in designing an experiment is the pursuit of realism where the design is intended to replicate, as close as possible, a natural environment. On the other hand, the desire to replicate the assumptions of a formal model may be a significant driver in the drafting of an experimental design. The question is which approach is right?

The correct answer is neither because the goal should be to find a design that offers the best opportunity to learn something useful and to answer the questions that inspired the research.

There are several questions that must be considered when determining the most appropriate experimental design.

1. **What are the main questions that need to be answered?** The experimentalist must know the questions a specific design will not answer. Some simple and useful designs have been labeled as "poor" because they are relatively simple and do not answer some questions. Yet, these simple designs may provide clear answers to the major questions of interest.
2. **Is the information worth the cost?** Collecting information is costly because labor, financial resources, participants, and time are all limited resources. The information gathered in the experiment has to be weighed against the cost of collecting the information. Being able to determine this will aid in selecting the most appropriate design.

The Use of Financial Incentives

Vernon Smith's induced value theory states that properly motivated individuals/groups, in a laboratory environment, have an important and significant influence in the verification of economic theories. The fundamental concept of induced-value theory is that proper use of a reward medium, normally some form of financial incentive, allows an experimenter to influence behavior from environmental subjects. According to Kagel and Roth (1995), the effect of paying subjects depends on the task they are being asked to perform. In many cases, subjects who are compensated are more

likely to exert more effort in order to maximize potential earnings, which improves performance. The main effect of paying subjects is a reduction in variance of their responses, which tends to increase the statistical significance of test statistics.

According to induced value theory, three conditions are sufficient to influence a subject's behavior. The first condition is monotonicity, which states that successive members of a sequence either consistently increase or decrease but do not fluctuate in relative value. This implies subjects must prefer more of the reward to less, and not become satiated. This condition is easier to satisfy by using monetary compensation as the reward medium. When the reward medium is extra points towards a student's final grade, monotonicity may not be achieved for those students who are earning high grades in the class in which the experiment is being conducted.

The second condition is salience where the majority of the payment the subject receives should be linked to subject's actions in the experiment. Subjects must perceive there is a relationship between the decisions they make and the level of rewards they receive. The subject must be convinced that the rewards they receive have economic value in the sense that the benefits outweigh the costs of making decisions. Therefore, salience is achieved by finding subjects whose opportunity costs are low and whose learning curves are steep. A simple laboratory environment promotes saliency.

The third condition is dominance where changes in subjects' utility from the experiment come mainly from financial incentives and other influences are insignificant. For instance, according to Kagel and Roth (1995), there is evidence that financial incentives may in fact not control a subject's preference because subjects may be more concerned about relative compensation rather than absolute payment. If the experimental

procedures make it impossible to know or estimate others' rewards, then dominance is achieved.

Conclusion

In this chapter, the role of experiments in economics was discussed. The purpose of experiments in economics is to test theories in carefully controlled environments. The advantages of using experimental methods are control, replicability, and the ability to measure, accurately, variables that may be difficult to measure or unobservable in naturally occurring environments. Relevant existing theories provide experimentalists a blueprint, which can be used to design and implement experiments.

The use of experimental methods is not a solution to all economic inquiries. Factors such as experimental design, administration, and interpretation are sources of continued scrutiny. Experimental methods are a complement to other empirical techniques and should not be construed as the only way to approach economic analysis.

Chapter 5: Experimental Design and Procedures

Purpose of the Experiment

The purpose of this experiment was to determine if the observed anomaly in Eckel and Grossman (2003); Davis, Millner, and Reilly (2003); and Davis and Millner (2004) would persist when subjects faced repeated trials, allowing for the possibility of learning. It is hypothesized that as subjects gain more experience, the number of units a participant obtains should tend to optimal levels. Since subjects were forced to review their purchase decisions, it was assumed the subjects would use the information they gained, thereby driving their choices closer to optimal levels and maximizing potential earnings.

Experimental Design

Our experiment uses an individual decision-making game structure used in Eckel and Grossman (2003); Davis, Millner and Reilly (2004); and Davis and Millner (2004). Subjects made numerous purchase decisions under various rebate, matching, and price reduction settings using a fixed budget. Subjects could expend their entire budget on multiple units of a hypothetical private good, make no purchases and retain the entire budget, or some combination of the two.

Participants were presented with six decisions sets and each set contained seven decisions under various rebate, matching, and price reduction conditions. This differs from Davis and Millner (2004) where only one set of decisions, not six, was used. Subjects were constrained by a budget of thirty-six lab dollars, which had a conversion rate of four lab dollars to one U.S dollar. Table 10 is a summary of the various purchase

conditions. The purchase conditions used were equivalent to the purchase conditions used in Davis and Millner (2004).

Price (Lab Dollars)	**Purchase Condition**
$6.00	No Match or Rebate
$6.00	You will receive a 50% rebate for every dollar you spend.
$6.00	For every unit you purchase, you will receive an additional unit for free.
$3.00	No Match or Rebate
$6.00	You will receive a 33% rebate for every dollar you spend.
$6.00	For every two units you purchase, you will receive an additional unit for free.
$4.00	No Match or Rebate.

Table 10: Summary of Purchase Conditions

The seven purchase conditions listed in Table 10 made up one decision set. The arrangement of the purchase conditions, in each decision set, was randomly ordered to control for sequencing effects.

Each subject was presented with an induced demand function, shown in Table 11.

Unit	Marginal Value
1	10.00
2	9.00
3	8.00
4	7.00
5	5.50
6	5.00
7	3.60
8	3.40
9	2.00
10	1.00

Table 11: Induced Demand Function

Given the budget of 36 lab dollars, the induced demand function was constructed so that participants were able to deviate from theoretic predictions. For instance, the marginal values were constructed so subjects could obtain less than the number of units predicted and the budget was large enough so that subjects could obtain more than the number of

units predicted, except under the 50% rebate condition. The marginal values were also selected so that subjects could easily calculate effective prices. Table 12 illustrates the predictions for the optimal number of units obtained.

Unit	Marginal Value	No Condition Price = $6	50% Rebate Price = $6	1:1 Match Price = $6	No Condition Price = $3	33%Rebate Price = $6	2:1 Match Price = $6	No Condition Price = $4
1	10.00	✓	✓	✓	✓	✓	✓	✓
2	9.00	✓	✓	✓	✓	✓	✓	✓
3	8.00	✓	✓	✓	✓	✓	✓	✓
4	7.00	✓	✓	✓	✓	✓	✓	✓
5	5.50		✓	✓	✓	✓	✓	✓
6	5.00		✓	✓	✓	✓	✓	✓
7	3.60			✓	✓			
8	3.40			✓	✓			
9	2.00							
10	1.00							

Table 12: Optimal Purchase Predictions

Table 12 implies that the optimal quantities are negatively correlated with price $(Q_{\$3} > Q_{\$4} > Q_{\$6})$ and generally invariant with respect to the subsidy condition ($Q_{Match1:1} = Q_{\$3}$ and $Q_{Match2:1} = Q_{Rebate33\%} = Q_{\$4}$.) The optimal number of units under a 50% rebate differs from the number or units under a 1:1 match because of a budget constraint and the fact that participants were not able to use the rebates they received to purchase additional units of the good. If the anomaly observed in Eckel and Grossman (2003); Davis, Millner, and Reilly (2003); and Davis and Millner (2004) persists, then we expect to see $Q_{Match1:1} > Q_{Rebate50\%}$ and $Q_{Match2:1} > Q_{Rebate33\%}$.

Experimental Procedures

We recruited forty subjects from undergraduate courses in economics at Virginia Commonwealth University. Subjects participated in four sessions outside of class. Participants were told they could earn money, paid in cash at the end of the experiment, with the amount to be determined by his/her decisions. Each participant was seated at a visually isolated computer terminal with a packet of information which contained

instructions, the Potential Decision Set Earnings Sheet, and a participant survey. The participant survey elicited responses to various socio-demographic questions as well as questions regarding the clarity of the instructions and procedures. The survey used is included in Appendix C starting page C-1.

The directions were read aloud by the session monitor. Participants were told they were going to make a series of purchase decisions under one of three possible purchase conditions: no rebate or match, a matching condition, or a rebate condition, given a per unit price.

Subjects were also told that each decision they made would result in potential earnings and their earnings for the experiment would be the potential earnings from one, randomly selected decision. The purpose for paying a subject based on the results from one randomly selected decision is the control of wealth effects. The potential earnings for a decision were equal to the sum of the budget remaining after purchases were finalized and the values of the units the subject obtained.

The instructions included several interactive examples where participants had an opportunity to make trial decisions in order to become familiar with the software. Subjects were told to begin making their decisions after any questions were answered by the session monitor.

After the completion of each set, the subjects were forced to review their decisions before they could move onto the next Decision Set. The subjects were also asked to record their potential earnings for each Decision Set on their Potential Decision Set Earning Sheet. At the completion of the session, each participant had six potential earnings, numbered from one to six. Six small pieces of paper, which were folded in

half, were numbered from one to six and each participant was asked to draw from the six pieces of paper. The number on the piece of paper chosen by the participant represented which of the six potential earnings would be the subject's earnings for the session. Participants were paid privately and exited the laboratory.

The results from the participant survey can be found in Appendix C starting on page C-4. Six of the forty recruited subjects were excluded from the sample because technical difficulties hindered the collection of complete sets of decisions for each price and promotion condition. We conducted a total of four sessions over a span of three days. The mean response to the question "The instructions for the experiment were clear and easy to follow" was 3.94 on a 5-point Likert scale (standard deviation of 1.01). This ranking is consistent with the mean response to the same question in two of the three treatments reported by Davis, Millner, and Reilly (2003) and is slightly less than the mean response to the same question in Davis and Millner (2004) and Eckel and Grossman (2003).

Chapter 6: Results

The analysis in this chapter will answer two questions:

1. Does the use of an induced demand function have an impact on the observed anomaly investigated by Eckel and Grossman (2003); DMR (2003); Davis and Millner (2004)?
2. If the anomaly is present, does the anomaly persist over time?

The first question involved replicating the analysis in Eckel and Grossman (2003); DMR (2003); Davis and Millner (2004), but with one difference. The dependent variable, D_{ics}, in our models measures the difference between the number of units each participant obtained and the theoretic prediction for each purchase condition and set. Therefore, if the dependent variable equals zero, then participants behave consistent with theoretic predictions. The models estimated in this chapter used panel analysis for thirty-four individuals. Panel analysis was used in order to control for individual effects. Descriptions for the variables used are located in Appendix D on page D-1.

To address the first question, we used only decisions from the first set in order to be consistent with recent experimental literature. We began by looking at the mean of D_{ic1} within the first set and controlled for individual effects. The results are summarized in Table 13.

D_{ic1}	Coeff.	Std. Err.	T-Statistic	P-Value	95% Confid. Interval	
Constant	-0.996	0.086	-11.590	0.000	-1.165	-0.826

Table 13: Mean of Deviations of Units Obtained from Theoretical Predictions for Set 1

It is evident from Table 13 that the average deviation is significantly different from zero, which means that participants did not behave consistently with theoretic

predictions. Specifically, individuals obtained nearly one less unit than predicted and this estimate is significantly different from zero at any conventional level of significance.

In order to get a preliminary assessment of whether there are significant differences in behavior across promotions, we looked at the pass ratios associated with decisions in the first set. Figure 8 illustrates the pass ratios for the first set. According to the pass ratios, when the effective price is equal to $4.00, nearly 21% of the decisions made were consistent with theoretic predictions. However, nearly 30% of the decisions made in the first set were consistent with theoretic predictions when the effective price was equal to $3.00. The distributions of the pass ratios are consistent with findings of Davis and Millner (2004). With the effective price of $4, there is evidence in support of constant percentage behavior.

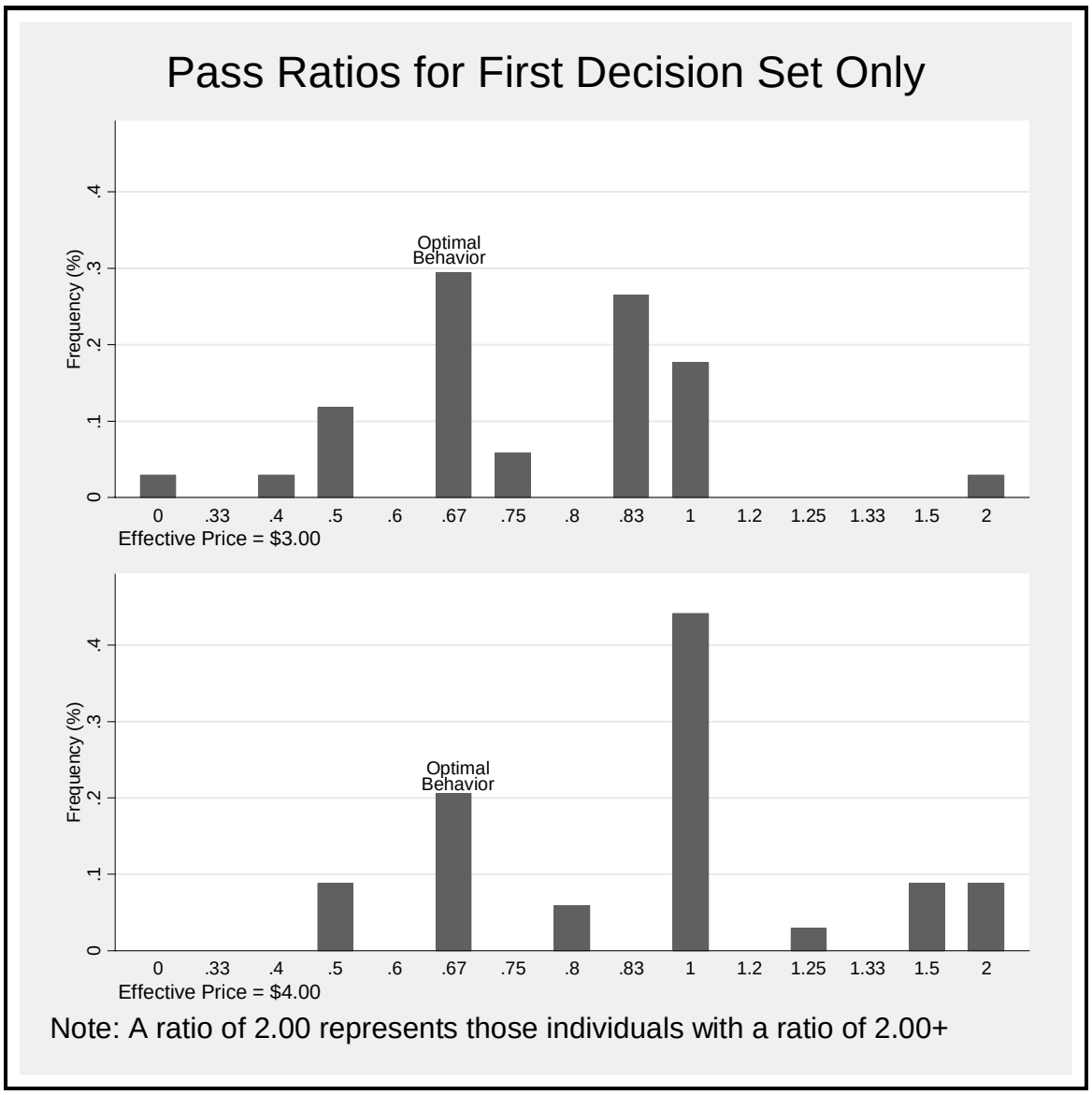

Figure 8: Pass Ratios for the First Decision Set

Equation 1 allows us to take a closer look at the potential differences in behavior based on the promotion type. Table 14 contains the results from Equation 1.

$$D_{ic1} = \alpha_i + \beta_1 \text{Discount} + \beta_2 \text{Rebate} + \beta_3 \text{Match} + \mu_i$$

Equation 1

Number of Obs	238
F(3, 201)	8.24
Prob > F	0.000
R-Squared	0.697
Adj R-squared	0.643
Root MSE	1.269

Equation 1

D_{ic1}	Coeff.	Std. Err.	T-Statistic	P-Value	95% Confid. Interval	
Discount	-0.676	0.256	-2.640	0.009	-1.182	-0.171
Rebate	-0.794	0.217	-3.660	0.000	-1.222	-0.366
Match	0.044	0.273	0.160	0.872	-0.494	0.582
Constant	-0.588	0.195	-3.020	0.003	-0.972	-0.204

Table 14: Results from Equation 1

All of the estimated coefficients are significantly different from zero, with the exception of the matching promotion variable. In fact, the estimated constant indicates that individuals obtained fewer units than predicted under the baseline condition, which is price equal to $6.00 and no promotion. When the promotion is a straight price reduction or a rebate, the individual obtains even fewer units than under the baseline condition and these results are statistically significant. However, when the promotion is a match, individuals did slightly better than under the baseline condition, but this result is not statistically significant.

We conducted a series of Wald tests to check for equivalence across promotion types. Table 15 contains the results of the tests. We first tested the joint hypothesis that the estimated coefficients associated with each promotion type are equal to zero, $\beta_1 = \beta_2 = \beta_3 = 0$. We reject this null hypothesis at any conventional level of confidence. We then tested a less restrictive hypothesis that the estimated coefficients are equal to each other, $\beta_1 = \beta_2 = \beta_3$. Results of the test lead to the conclusion that the estimated coefficients for rebates, discounts, and matches are not equivalent at any conventional level of confidence.

Test	F-Statistic	P-Value
$\beta_1 = \beta_2 = \beta_3 = 0$	8.24	0.000
$\beta_1 = \beta_2 = \beta_3$	7.73	0.001

Table 15: Results from Wald Tests for Equation 1

Results from Equation 1 lend some support to the findings of Eckel and Grossman (2003); Davis, Millner, and Reilly (2003); and Davis and Millner (2004). The estimated coefficient for matching promotions is positive but insignificantly different from zero. However, the estimated coefficients for discounts and rebate promotions are negative and significantly different from zero. Therefore subjects obtained fewer units than predicted under these two conditions, relative to the baseline condition. Thus, subjects tend to obtain more units under a matching promotion than a rebate or straight price reduction promotion. We tested the statistical significance of this conclusion by testing the null hypothesis that $\beta_3 \leq \beta_2$ [15] and found that we reject this null hypothesis at any conventional level of confidence. Therefore, there is support for our initial conclusion.

We extended Equation 1 to determine if there are differences across and within promotions. This means we allow for the possibilities that not only are there differences across promotion types but also differences within the different levels[16] of promotions. The Equation 2 specification allows us to test for such differences, again only using decisions from the first set. Table 16 contains the results from Equation 2.

$$D_{ic1} = \alpha_i + \beta_1 \text{Price}_{\$3} + \beta_2 \text{Price}_{\$4} + \beta_3 \text{Rebate}_{50\%} + \beta_4 \text{Rebate}_{33\%} + \beta_5 \text{Match}_{1:1} + \beta_6 \text{Match}_{2:1} + \mu_i$$

Equation 2

[15] This test was conducted by specifying a model that allowed us to use a one-sided T-test for the difference between the estimated coefficients of the rebate and matching variables. The test resulted in a p-value equal to 2.9e-05.

[16] The different levels of promotions were 50% rebate and 33% rebate, 1:1 match and 2:1 match, and price of $3 and $4.

Number of Obs	238
F(6, 198)	8.76
Prob > F	0.000
R-Squared	0.706
Adj R-squared	0.6486
Root MSE	1.259

Equation 2

D_{ic1}	Coeff.	Std. Err.	T-Statistic	P-Value	95% Confid. Interval	
$Price_{\$3}$	-0.79	0.30	-2.64	0.01	-1.39	-0.20
$Price_{\$4}$	-0.56	0.31	-1.79	0.08	-1.18	0.06
$Rebate_{50\%}$	-0.47	0.24	-1.94	0.05	-0.95	0.01
$Rebate_{33\%}$	-1.12	0.22	-5.11	0.00	-1.55	-0.69
$Match_{1:1}$	-0.12	0.36	-0.33	0.74	-0.82	0.59
$Match_{2:1}$	0.21	0.31	0.67	0.51	-0.40	0.81
Constant	-0.59	0.20	-3.00	0.00	-0.98	-0.20

Table 16: Results from Equation 2

Individuals still obtain fewer units than predicted under the baseline condition. When the promotion is a rebate or a straight price reduction, individuals continue to obtain even fewer units compared to the baseline condition. Also, individuals marginally improved when the promotion is a match, but the improvement is statistically insignificant.

We conducted a series of Wald tests to test for equivalence across and within promotion types. Table 17a contains a summary of the test results. The results of the Wald tests lead to several important findings. First, when the promotion is a straight price reduction, the estimated coefficients are statistically different from zero (p-value = 0.025), but not from each other (p-value = 0.482). Second, the differences within rebate promotions are both different from zero (p-value <0.001) and different from each other (p-value<0.001). Third, the differences within matching promotions are statistically insignificant (p-value = 0.670).

Test	F-Statistic	P-Value
$\beta_1 = \beta_2 = 0$	3.77	0.025
$\beta_1 = \beta_2$	0.50	0.482
$\beta_3 = \beta_4 = 0$	16.36	0.000
$\beta_3 = \beta_4$	14.06	0.000
$\beta_5 = \beta_6 = 0$	0.40	0.670
$\beta_5 = \beta_6$	0.72	0.399

Table 17a: Results from Wald Tests for Equation 2

We conducted a second round of Wald tests to test the equivalence between functionally equivalent promotions. Table 17b contains the results of the tests. We found that when the promotion is functionally equivalent to "50% off", the estimated coefficients are significantly different from zero (p-value = 0.045), but the coefficients are not statistically different from each other (p-value = 0.192). This means subjects did not behave consistently with theoretic predictions; however they behaved consistently within the various "50% off" functionally equivalent promotions. We again tested the null hypothesis that $\beta_5 \leq \beta_3$ and found that we fail to reject this null hypothesis at any conventional level of significance (p-value = 0.07).

We also found when the promotions are functionally equivalent to "33% off", the estimated coefficients are significantly different from zero and they are also significantly different from each other. This means that not only did participants not obtain the predicted number of units but they also did not behave consistently within the various "33% off" functionally equivalent promotions. Again, we tested the null hypothesis that $\beta_6 \leq \beta_4$ and found that we can reject the null hypothesis (p-value = 1.4e-07). This means that the number of units individuals obtained were closer to theoretic predictions under the matching promotion than under the functionally equivalent rebate promotion.

Test	F-Statistic	P-Value
$\beta_1 = \beta_3 = \beta_5 = 0$	2.73	0.045
$\beta_1 = \beta_3 = \beta_5$	1.66	0.192
$\beta_2 = \beta_4 = \beta_6 = 0$	15.28	0.000
$\beta_2 = \beta_4 = \beta_6$	14.28	0.000

Table 17b: Results from Wald Tests for Equation 2

Finding 1: We found the presence of an induced demand function had limited impact on influencing individual decisions. Individuals do not behave consistently within functionally equivalent promotions and the number of units obtained under a matching promotion tends to be higher than the number of units obtained under a rebate or discount promotion.

Question 2 is an extension of Eckel and Grossman (2003), DMR (2003), and Davis and Millner (2004). We investigated the possibility that participants behavior converged toward theoretic predictions as subjects gained experience through repeated decisions. To answer Question 2, we began by looking at the mean deviations of units obtained from the theoretical predictions, by set. Looking at the mean deviations allowed us to have a basic understanding of how individuals behaved by promotion across time. Table 18 contains the summary statistics.

Rebate: 50%					
Set	Mean	Std. Error	T-Stat.	95% Conf.	Interval
1	-1.06	0.26	-4.02	-1.59	-0.52
2	-1.18	0.28	-4.28	-1.74	-0.62
3	-1.09	0.28	-3.87	-1.66	-0.52
4	-0.82	0.25	-3.28	-1.34	-0.31
5	-1.00	0.27	-3.70	-1.55	-0.45
6	-0.88	0.22	-4.04	-1.33	-0.44
Match: 2:1					
Set	Mean	Std. Error	T-Stat.	95% Conf.	Interval
1	-0.38	0.42	-0.91	-1.24	0.47
2	-0.18	0.42	-0.42	-1.03	0.68
3	0.38	0.33	1.16	-0.29	1.05
4	0.12	0.36	0.32	-0.62	0.86
5	0.03	0.36	0.08	-0.70	0.76
6	0.68	0.30	2.23	0.06	1.29
Match: 1:1					
Set	Mean	Std. Error	T-Stat.	95% Conf.	Interval
1	-0.71	0.43	-1.64	-1.58	0.17
2	-0.06	0.35	-0.17	-0.78	0.66
3	0.00	0.40	0.00	-0.82	0.82
4	0.35	0.37	0.95	-0.41	1.11
5	0.24	0.38	0.63	-0.53	1.00
6	-0.06	0.38	-0.15	-0.84	0.72
Rebate: 33%					
Set	Mean	Std. Error	T-Stat.	95% Conf.	Interval
1	-1.71	0.32	-5.28	-2.36	-1.05
2	-1.38	0.31	-4.41	-2.02	-0.75
3	-1.38	0.29	-4.83	-1.97	-0.80
4	-1.15	0.26	-4.46	-1.67	-0.62
5	-1.21	0.26	-4.71	-1.73	-0.68
6	-1.24	0.25	-4.87	-1.75	-0.72
Price = $3.00					
Set	Mean	Std. Error	T-Stat.	95% Conf.	Interval
1	-1.38	0.45	-3.07	-2.30	-0.47
2	-1.59	0.47	-3.39	-2.54	-0.64
3	-1.53	0.43	-3.58	-2.40	-0.66
4	-1.44	0.42	-3.43	-2.30	-0.59
5	-1.24	0.43	-2.85	-2.12	-0.35
6	-1.65	0.44	-3.72	-2.55	-0.75
Price = $4.00					
Set	Mean	Std. Error	T-Stat.	95% Conf.	Interval
1	-1.15	0.37	-3.13	-1.89	-0.40
2	-1.03	0.34	-3.01	-1.72	-0.33
3	-0.97	0.33	-2.96	-1.64	-0.30
4	-1.09	0.31	-3.50	-1.72	-0.45
5	-1.00	0.35	-2.89	-1.70	-0.30
6	-1.32	0.32	-4.13	-1.98	-0.67
Price = $6.00					
Set	Mean	Std. Error	T-Stat.	95% Conf.	Interval
1	-0.59	0.20	-2.90	-1.00	-0.18
2	-0.53	0.22	-2.45	-0.97	-0.09
3	-0.35	0.22	-1.61	-0.80	0.09
4	-0.35	0.21	-1.64	-0.79	0.08
5	-0.41	0.21	-1.99	-0.83	0.01
6	-0.53	0.19	-2.72	-0.93	-0.13

Table 18: Deviation from Predictions by Purchase Condition and Set

If participants were to display learning effects, the mean deviations from predictions would tend to zero as the number of sets increase. Based on the results in Table 18, it is clear this is not the case, except for the 1:1 matching promotion, since the mean deviation from predictions does not tend to zero as subjects gain additional experience.

To investigate these findings further, we extended Equation 2 by incorporating all six sets of decisions. The model included dummy variables indicating the set along with a group of interaction variables indicating the set and promotion. The interaction variables were included in order to determine if there are promotion-specific learning effects present. The model specification is represented by Equation 3.

$$D_{ics} = \alpha_i + \beta_1 \text{Price}_{\$3} + \beta_2 \text{Price}_{\$4} + \beta_3 \text{Rebate}_{50\%} + \beta_4 \text{Rebate}_{33\%} + \beta_5 \text{Match}_{1:1} + \beta_6 \text{Match}_{2:1} + \beta_T Set_T + \theta_T^{P=\$3} + \theta_T^{P=\$4} + \theta_T^{Rebate50\%} + \theta_T^{Rebate33\%} + \theta_T^{Match1:1} + \theta_T^{Match2:1} + \mu_i$$

Equation 3

We were interested in determining if there are different "degrees" of learning across the various promotions. Table 19 contains a summary if the test results.

Test	F-Statistic	P-Value
$\theta_T^{P=\$3} = 0$	0.24	0.943
$\theta_T^{P=\$4} = 0$	0.19	0.968
$\theta_T^{\mathrm{Re}bate50\%} = 0$	0.36	0.876
$\theta_T^{\mathrm{Re}bate33\%} = 0$	0.43	0.827
$\theta_T^{Match1:1} = 0$	0.75	0.588
$\theta_T^{Match1:1} = 0$	1.31	0.258

Table 19: Promotion-Specific Learning Effects Test Results

The results in Table 19 provide strong evidence that individuals do not display different learning effects across the different promotions. This finding justifies the use of a model that has a learning effect common to all promotions.

Based on the findings in Table 19, we modified Equation 3 to only include dummy variables indicating the specific promotion and decision set. The model specification is represented by Equation 4. The results from Equation 4 are contained in Table 20.

$$D_{ics} = \alpha_i + \beta_1 \mathrm{Price}_{\$3} + \beta_2 \mathrm{Price}_{\$4} + \beta_3 \mathrm{Rebate}_{50\%} + \beta_4 \mathrm{Rebate}_{33\%} + \beta_5 \mathrm{Match}_{1:1} + \beta_6 \mathrm{Match}_{2:1} + \theta_T Set_T + \mu_i$$

Equation 4

Number of Obs	1428
F(41, 1353)	25.22
Prob > F	0.000
R-Squared	0.595
Adj R-squared	0.583
Root MSE	1.3062

Equation 4

D_{ics}	Coeff.	Std. Err.	T-Statistic	P-Value	95% Confid. Interval	
$Price_{\$3}$	-1.01	0.13	-7.62	0.00	-1.27	-0.75
$Price_{\$4}$	-0.63	0.11	-5.75	0.00	-0.85	-0.42
$Rebate_{50\%}$	-0.54	0.09	-5.83	0.00	-0.73	-0.36
$Rebate_{33\%}$	-0.88	0.09	-9.40	0.00	-1.07	-0.70
$Match_{1:1}$	0.42	0.14	3.07	0.00	0.15	0.69
$Match_{2:1}$	0.57	0.13	4.52	0.00	0.32	0.82
Set 2	0.15	0.12	1.21	0.23	-0.09	0.39
Set 3	0.29	0.12	2.34	0.02	0.05	0.53
Set 4	0.37	0.12	3.01	0.00	0.13	0.61
Set 5	0.34	0.12	2.78	0.01	0.10	0.58
Set 6	0.28	0.13	2.24	0.03	0.03	0.53
Constant	-0.70	0.11	-6.46	0.00	-0.91	-0.49

Table 20: Results from Equation 4

The estimated coefficient of the constant in Equation 4 represents the deviation from predictions for the control scenario (price of $6 with no rebate or matching promotion) in the first set. Results indicate that individuals obtained 0.70 units less than predicted under the control scenario. The estimated coefficients associated with the promotions represent how that specific promotion compares to the control scenario. For instance, under a 50% rebate promotion, the individual obtained 0.54 fewer units under the promotion than under the control scenario for the first set. We can also see from Table 20 that individuals obtained more units under a matching promotion than under the base scenario.

Based on the results from Table 20, individual behavior does, to a certain extent, converge towards theoretic predictions. This conclusion is based on the estimated coefficients associated with Set dummy variables. Since the magnitude of the estimated

coefficients gets larger and keeping in mind the estimated coefficient for the base scenario is negative, we can conclude that individuals do seem to display minimal learning effects. However, an examination of the estimated coefficients for each set suggests that the marginal convergence is minimal after the third set.

We compared the pass ratios in the first and sixth sets to see if the anomalous behavior persisted over time. Figures 9 illustrate the comparison of the pass ratios. The pass ratios illustrate that the most common strategy was purchases based on constant percentage behavior. This is especially evident when the effective price is equal to $4.00. There is not much difference between the pass ratios associated with the first and sixth set. Therefore, we can conclude that the observed anomaly persists over time. Since the learning effects are common across promotion types, we can conclude that individuals can approach theoretic predictions without affecting the persistence of the anomaly.

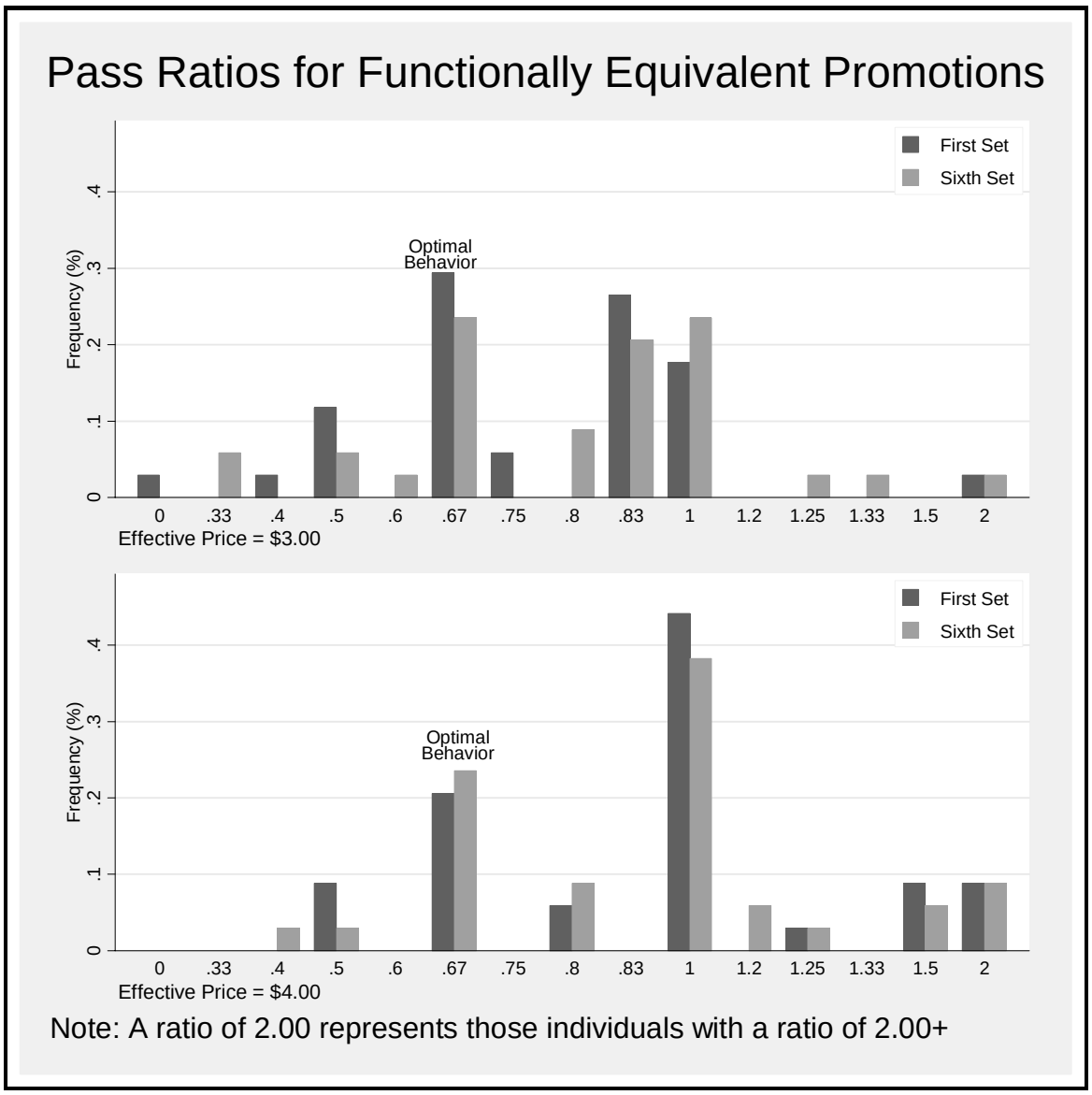

Figure 9: Pass Ratios for Set 1 and 6 for Functionally Equivalent Promotions

To assess the absolute performance of the typical subject, one must take into consideration the baseline condition. This led us to test the statistical significance of the linear combinations of estimated coefficients from Equation 4. If the linear combination of estimated coefficients is insignificantly different from zero, then the individual's behavior is consistent with theoretical predictions. For instance, $\alpha + \beta_3 + \theta_2 = 0$ indicates that a subject's decision under a 50% rebate condition in the second set is

consistent with theoretic predictions. We tested the significance of the decisions associated with the first and sixth set. Table 21 contains a summary of the test results.

Set = 1						
D_{ic1}	Coeff.	Std. Err.	T-Statistic	P-Value	95% Confid. Interval	
α	-0.70	0.11	-6.46	0.00	-0.91	-0.49
$\alpha+\beta_1$	-1.71	0.14	-12.16	0.00	-1.98	-1.43
$\alpha+\beta_2$	-1.33	0.12	-10.70	0.00	-1.58	-1.09
$\alpha+\beta_3$	-1.24	0.10	-11.98	0.00	-1.45	-1.04
$\alpha+\beta_4$	-1.58	0.10	-15.07	0.00	-1.79	-1.38
$\alpha+\beta_5$	-0.28	0.14	-1.91	0.06	-0.56	0.01
$\alpha+\beta_6$	-0.13	0.14	-0.96	0.34	-0.40	0.13
Set = 6						
D_{ic6}	Coeff.	Std. Err.	T-Statistic	P-Value	95% Confid. Interval	
$\alpha+\theta_6$	-0.42	0.10	-3.99	0.00	-0.62	-0.21
$\alpha+\beta_1+\theta_6$	-1.43	0.14	-10.20	0.00	-1.70	-1.15
$\alpha+\beta_2+\theta_6$	-1.05	0.11	-9.13	0.00	-1.28	-0.82
$\alpha+\beta_3+\theta_6$	-0.96	0.10	-9.50	0.00	-1.16	-0.76
$\alpha+\beta_4+\theta_6$	-1.30	0.10	-12.73	0.00	-1.50	-1.10
$\alpha+\beta_5+\theta_6$	0.00	0.15	0.03	0.98	-0.28	0.29
$\alpha+\beta_6+\theta_6$	0.15	0.13	1.14	0.26	-0.11	0.41

Table 21: Point Estimate Test Results from Equation 4

Results in Table 21 lead to the conclusion that behavior converged to theoretic predictions under matching promotions as individuals gained experience. Also, the point estimates associated with the first set indicate that individuals obtained fewer units than predicted under rebate and discount promotions. As they gained more experience throughout the experiment, individuals still obtained fewer units than predicted but the deviations from predictions are smaller in the sixth set than in the first set. Under other conditions, however, individuals obtained significantly fewer units than predicted even after five rounds of experience.

Finding 2: The additional experience the subject gained from making repeated decisions, under identical purchase conditions, did have a limited effect in driving decisions toward theoretic predictions. Even though deviations from theoretic predictions persisted, they lessened as individuals gained more experience. These results also lead to the conclusion that the observed anomaly persists over time.

Conclusion

This chapter contained the results of an experiment aimed at determining if the anomaly observed by Eckel and Grossman (2003); DMR (2003); and Davis and Millner (2004) persist over time. To answer this question, we generated a panel data set containing decisions made by thirty-four undergraduate students. In order to replicate the findings of Eckel and Grossman (2003); Davis, Millner, and Reilly (2003); and Davis, and Millner (2004), we analyzed the first set of decisions and found that presenting subjects with an induced demand function had limited impact on influencing decisions. Individuals continued to obtain more units under a matching promotion than under a functionally equivalent rebate or discount promotions.

In order to determine if the anomaly persists over time, we analyzed all six sets of decisions and found that the number of units obtained under a rebate promotion significantly deviates from theoretical predictions. We found that subjects did display minimal learning effects as they gained additional experience. However, results indicate that the observed anomaly has not been affected by the presence of learning effects.

Conclusion

This paper has established there are conditions where functional equivalence does not lead to strict equivalence. Specifically, when the potential savings from a rebate promotion cannot be immediately spent and when a good is finitely divisible, an individual's purchase decision is not consistent across functionally equivalent promotions. The main reason for the inconsistent behavior is because the presence of a specific promotion type significantly affects an individual's budget curve. For instance, rebate promotions can limit the individual's ability to maximize the benefits of a lower effective price if potential savings cannot be spent immediately. Also, matching promotions are not as "flexible" as rebates or straight price reductions because the individual effectively purchases a bundle rather than individual units. These differences between promotion types have a significant impact on the ability to compare consumer purchases across promotion types.

Recent experimental literature has observed this seemingly anomalous behavior in both a private and public good context. Eckel and Grossman (2003), DMR (2003), and Davis and Millner (2004) have attributed this observed behavior to framing effects, computational error, and a tendency towards "rebate aversion". It has also been suggested there are significant differences in how individuals evaluate various promotion formats. All of these reasons have merit. However, these reasons do not allude to the persistency of this anomalous behavior.

Our experiment used a variation of a modified dictator game where individuals made repeated decisions under various rebate, matching, and price reduction settings. Our findings were consistent with the results of Eckel and Grossman (2003), DMR

(2003), and Davis and Millner when we analyzed only the first set of decisions. By incorporating all six sets of decisions, we found that individuals did display minimal learning effects. Nevertheless, deviations from theoretic predictions persisted.

Future research in this area remains. The next logical step is to change the way rebate promotions are framed. An individual's perception of rebate promotions may be influenced by how information is presented.

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Appendix A

Constrained Utility Maximization

Let's assume a realistic utility specification; one where the individual's utility maximization is constrained by a budget. Again, let's assume that the individual's utility function is a Cobb-Douglas function and the individual's income is defined as

$$I = P_X X + P_Y Y .$$

The income constraint can be incorporated into the utility function by setting up a Lagrangian expression:

$$L = X^{\alpha} Y^{\beta} + \lambda(I - P_X X - P_Y Y)$$

The first-order conditions are:

$$\frac{\partial L}{\partial X} = \alpha X^{\alpha-1} Y^{\beta} - \lambda P_X = 0 \quad \rightarrow \quad \lambda = \frac{\alpha X^{\alpha-1} Y^{\beta}}{P_X}$$

$$\frac{\partial L}{\partial Y} = \beta X^{\alpha} Y^{\beta-1} - \lambda P_Y = 0 \quad \rightarrow \quad \lambda = \frac{\beta X^{\alpha} Y^{\beta-1}}{P_Y}$$

$$\frac{\partial L}{\partial \lambda} = I - P_X X - P_Y Y = 0$$

$$\frac{\beta X^{\alpha} Y^{\beta-1}}{P_Y} = \frac{\alpha X^{\alpha-1} Y^{\beta}}{P_X}$$

$$\frac{P_X}{P_Y} = \frac{\alpha Y}{\beta X} \quad \rightarrow \quad P_Y Y = \frac{\beta}{\alpha} P_X X = \frac{1-\alpha}{\alpha} P_X X$$

The optimal combination of X and Y can be determined by substituting back into the budget constraint.

$$I = P_X X + P_Y Y$$

$$I = P_X X + \left(\frac{1-\alpha}{\alpha} P_X X\right) \qquad I = \left(\frac{1-\beta}{\beta} P_Y Y\right) + P_Y Y$$

$$= P_X X\left(1 + \frac{1-\alpha}{\alpha}\right) \qquad = P_Y Y\left(1 + \frac{1-\beta}{\beta}\right)$$

$$\rightarrow$$

$$= \frac{1}{\alpha} P_X X \qquad = \frac{1}{\beta} P_Y Y$$

$$X^* = \frac{\alpha I}{P_X} \qquad Y^* = \frac{\beta I}{P_Y}$$

This implies that an individual whose utility function is a Cobb-Douglas function will always choose to spend α percent of their income on Good X and β percent of their income on Good Y.

Appendix B

Eckel and Grossman (2003) Allocation Decision Sheet

Problem	Endowment		Hold	Pass
1	100	For every token you pass to the charity, the charity will receive one token.		
2	75	For every token you pass to the charity, the experimenter will refund to you one-half token.		
3	40	For every token you pass to the charity, the experimenter will match it with one additional token.		
4	75	For every token you pass to the charity, the experimenter will refund to you one-quarter token.		
5	60	For every token you pass to the charity, the experimenter will refund to you one-quarter token.		
6	60	For every token you pass to the charity, the experimenter will match it with one-third additional token.		
7	40	For every token you pass to the charity, the experimenter will match it with one-fourth additional token.		
8	60	For every token you pass to the charity, the charity will receive one token.		
9	75	For every token you pass to the charity, the experimenter will match it with one additional token.		
10	40	For every token you pass to the charity, the experimenter will refund to you one-half token.		
11	40	For every token you pass to the charity, the experimenter will refund to you one-fifth token.		
12	75	For every token you pass to the charity, the experimenter will match it with one-third additional token.		

Davis, Millner and Reilly (2003) Allocation Decision Sheet for Control Treatment

Prob	Endowment	Condition	Hold (for myself)	Pass (to charity)
1	$8	For every $1 you pass, the Charity will receive $1.50; your $1 and a matching $.50 provided by the experimenter.		
2	$12	For every $1 you pass, the Charity will receive $1, and, and experimenter will refund to you $.50.		
3	$8	For every $1 you pass, the Charity will receive $2; your $1 and a matching $1 provided by the experimenter.		
4	$12	For every dollar you pass, the Charity will receive $1, and the experimenter will refund to you $.33.		
5	$8	For every $1 you pass, the Charity will receive $1.		
6	$12	For every $1 you pass, the Charity will receive $1.50; your $1 and a matching $.50 provided by the experimenter.		
7	$8	For every $1 you pass, the Charity will receive $1, and, and experimenter will refund to you $.50.		
8	$12	For every $1 you pass, the Charity will receive $2; your $1 and a matching $1 provided by the experimenter.		
9	$8	For every dollar you pass, the Charity will receive $1, and the experimenter will refund to you $.33.		
10	$12	For every $1 you pass, the Charity will receive $1.		

Davis and Millner (2004) Allocation Decision Sheet

Problem	Condition	Spend (on choc. bars)	Hold (for yourself) = $5.00 – (c)
S	Each chocolate bar costs $0.33		
E	Each chocolate bar purchased costs $0.50. For every bar purchased, you will receive an additional bar free		
M	Each chocolate bar purchased costs $0.50. For every 2 bars purchased, you will receive an additional bar free		
D	Each chocolate bar costs $0.50		
F	Each chocolate bar purchased costs $0.50. You will receive a 50% refund for every dollar you spend on chocolate bars		
T	Each chocolate bar purchased costs $0.50. You will receive a 33% refund for every dollar you spend on chocolate bars		
H	Each chocolate bar costs $0.25		

Appendix C

Participant Survey

1. Age?_____

2. What is your sex? (Circle one.) Male Female

3. Married? (Circle one.) YES NO

4. Children? (Circle one.) YES NO

5. Which of the following categories best describes you? (Circle one)
   Asian-American/Oriental
   African-American/Black
   Caucasian/White
   Hispanic-Black/Spanish-speaking Black
   Hispanic-White/Spanish-speaking White
   Native-American/American Indian
   Other (Please specify:_____)

6. Class (Circle one)
   Freshman
   Sophomore
   Junior
   Senior
   Graduate

7. Major (Circle one)
   Economics
   Other Business
   Psychology
   Sciences
   Liberal Arts
   Other

8. How many Economics classes have you taken at the university level? (Circle one)
   None
   One
   Two
   Three
   Four
   Five
   Six
   More than six

9. Have you ever participated in a behavior experiment?(Circle one) YES NO

10. Do you feel that the feedback you received after each set of decisions helped you understand the game? (Circle one) YES NO

11. Employment Status? (Circle one)
    Not Employed
    Part-time Employment
    Full-time Employment

12. Enrollment Status? (Circle one)
    Part-time Student
    Full-time Student
    Special Student (Non Degree-Seeking)

Procedures Questionnaire

Please respond to the following items by circling the number on the rating scale that best represents your opinion about that item. For item 5, record your answer in the space provided. Your responses are completely anonymous.

	Strongly Disagree				Strongly Agree
1. The procedures followed in this experiment preserved your anonymity.	1	2	3	4	5
2. The instructions for the experiment were clear and easy to follow.	1	2	3	4	5

Survey Results

	All Sessions (%) *(n = 34)*	Session 1 (%) *(n = 8)*	Session 2 (%) *(n = 10)*	Session 3 (%) *(n = 9)*	Session 4 (%) *(n = 7)*
Age	21.12	22.13	21.40	20.56	20.29
Std. Dev.	*1.59*	*1.81*	*1.07*	*0.53*	*2.29*
Male	22	6	6	5	5
	64.7%	*75.0%*	*60.0%*	*55.6%*	*71.4%*
Single	32	8	9	9	6
	94.1%	*100.0%*	*90.0%*	*100.0%*	*85.7%*
Race					
Asian	4	1	1	0	2
	11.8%	*12.5%*	*10.0%*	*0.0%*	*28.6%*
Black	6	0	1	3	2
	17.7%	*0.0%*	*10.0%*	*33.3%*	*28.6%*
White	23	6	8	6	3
	67.7%	*75.0%*	*80.0%*	*66.7%*	*42.9%*
Hispanic	1	1	0	0	0
	2.9%	*12.5%*	*0.0%*	*0.0%*	*0.0%*
Employment					
Not Employed	11	1	5	2	3
	32.4%	*12.5%*	*50.0%*	*22.2%*	*42.9%*
Part-Time	21	7	4	7	3
	61.8%	*87.5%*	*40.0%*	*77.8%*	*42.9%*
Full-Time	2	0	1	0	1
	5.9%	*0.0%*	*10.0%*	*0.0%*	*14.3%*
Enrollment*					
Part-Time	1	0	0	0	1
	2.9%	*0.0%*	*0.0%*	*0.0%*	*14.3%*
Full-Time	32	8	10	9	5
	94.1%	*100.0%*	*100.0%*	*100.0%*	*71.4%*
Class					
Freshman	3	0	0	1	2
	8.8%	*0.0%*	*0.0%*	*11.1%*	*28.6%*
Sophomore	2	0	0	0	2
	5.9%	*0.0%*	*0.0%*	*0.0%*	*28.6%*
Junior	18	5	4	7	2
	52.9%	*62.5%*	*40.0%*	*77.8%*	*28.6%*
Senior	11	3	6	1	1
	32.4%	*37.5%*	*60.0%*	*11.1%*	*14.3%*

	All Sessions (%) *(n = 34)*	Session 1 (%) *(n = 8)*	Session 2 (%) *(n = 10)*	Session 3 (%) *(n = 9)*	Session 4 (%) *(n = 7)*
Major					
Business	25	6	9	5	5
	73.5%	*75.0%*	*90.0%*	*55.6%*	*71.4%*
Economics	2	0	0	2	0
	5.9%	*0.0%*	*0.0%*	*22.2%*	*0.0%*
Sciences	2	0	1	0	1
	5.9%	*0.0%*	*10.0%*	*0.0%*	*14.3%*
Other	5	2	0	2	1
	14.7%	*25.0%*	*0.0%*	*22.2%*	*14.3%*
Economics Classes Taken					
0-1	6	0	0	2	4
	17.7%	*0.0%*	*0.0%*	*22.2%*	*57.1%*
2-3	24	7	9	5	3
	70.6%	*87.5%*	*90.0%*	*55.6%*	*42.9%*
4-5	1	1	0	0	0
	2.9%	*12.5%*	*0.0%*	*0.0%*	*0.0%*
6+	3	0	1	2	0
	8.8%	*0.0%*	*10.0%*	*22.2%*	*0.0%*
Prior Experience					
No	22	6	3	7	6
	64.7%	*75.0%*	*30.0%*	*77.8%*	*85.7%*
Feedback					
Yes	26	3	10	8	5
	76.5%	*37.5%*	*100.0%*	*88.9%*	*71.4%*
Anonymity	4.29	4.63	4.30	4.00	4.29
Std. Dev.	*1.06*	*0.52*	*1.34*	*1.22*	*0.95*
Instructions	3.94	4.00	3.90	3.78	4.14
Std. Dev.	*1.01*	*1.31*	*1.10*	*0.67*	*1.07*

* One male subject from session four did not complete this question.

Appendix D

Variable Dictionary

Variable	Description
D_{ics}	# of units obtained – Theoretic Predictions. i = individual, c = condition, and s = set
Discount	= 1 if promotion condition is a price discount = 0 if otherwise.
Rebate	= 1 if promotion condition is a rebate = 0 if otherwise.
Match	= 1 if promotion condition is a match = 0 if otherwise
$Price_{\$3}$	= 1 if price is equal to $3 = 0 if otherwise
$Price_{\$4}$	= 1 if price is equal to $4 = 0 if otherwise
$Rebate_{50\%}$	= 1 if promotion condition is a 50% rebate. = 0 if otherwise
$Rebate_{33\%}$	= 1 if promotion condition is a 33% rebate. = 0 if otherwise
$Match_{1:1}$	= 1 if promotion condition is a 1:1 match. = 0 if otherwise
$Match_{2:1}$	= 1 if promotion condition is a 2:1 match = 0 if otherwise
Set_T	= 1 if Set is equal 2, 3, 4, 5, or 6 = 0 if Set is equal to 1
θ_T^X	Interaction variables indicating a specific promotion condition (X) in a particular set (T).