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Evidence on the profitability of credit card arbitrage

Terrance Jalbert,[a,*] Jonathan Stewart,[b] Mercedes Jalbert[c]

[a]*College of Business and Economics, University of Hawaii at Hilo, Hilo, HI 96720, USA*
[b]*Abilene Christian University, Abilene, TX 79699, USA*
[c]*The Institute for Business and Finance Research, Hilo, HI 96720, USA*

Abstract

Financial institutions frequently offer low introductory interest rates to entice individuals to open and use credit accounts with their firm. This paper examines the possibility of earning arbitrage profits by taking advantage of these special offers. We develop a formula to measure the profit potential from undertaking credit card arbitrage and identify conditions conducive to profitable and unprofitable arbitrage. In addition, we examine the sensitivity of the arbitrage transaction to changes in interest rates, interest rate levels, and fees. Finally, we examine the impact of credit card arbitrage on the credit rating of the arbitrageur. © 2008 Academy of Financial Services. All rights reserved.

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1. Introduction

Many banks offer credit card balance transactions with low, or no interest rates. The balances can generally be transferred to pay off another card or transferred directly into a checking account. These introductory low interest rate offers are intended as an enticement for individuals to open an account with the financial institution or to transfer their balance to a lower interest rate credit card. The low interest rate offers generally apply to an introductory period and have an up-front fee. The introductory time period is typically anywhere from three months to eighteen months. Other promotions offer the introductory rate until the balance is paid off. Still other promotions offer perquisites, such as frequent

* Corresponding author. Tel.: +1-808-974-7456; fax: +1-808-974-7685.
E-mail address: jalbert@hawaii.edu (T. Jalbert).

flier miles, for each dollar transferred to their affiliated credit card. Some promotions require the cardholder to make a purchase to receive the special rate.

Although the credit card offers are intended to attract more credit card business for the bank, they may also provide the customer with the potential to earn an arbitrage profit. To earn an arbitrage profit, an individual takes a cash advance against the credit card and deposits the funds received into an FDIC insured money market account. An arbitrage profit is earned if the interest earned on the money market account exceeds the cost of funds related to the credit card cash transfer.

Low introductory rates serve as a loss leader for the financial institution. Banks profit from these offers in several ways. Some of the offers are made on accounts with an annual fee. In these instances, the annual fee offsets the cost of offering the introductory rate. In other instances, there are penalties for not paying the card off according to the terms of the introductory offer. In the event of a missed or late payment, the interest rate on the card reverts to the regular, much higher rate allowing the bank to earn a profit. The offers are typically subject to a cross-default feature, whereby a default by the borrower on any of their financial obligations causes the credit card to revert to the higher, regular rate. Banks may also earn a profit if the cardholder uses the card for purchases in addition to the cash advance. The bank earns a transaction fee in these instances. These transaction fees offset the cost of providing the low introductory rate. Finally, some introductory offers, despite having an enticing appearance, are designed in such a way that arbitrage attempts will be unprofitable.

In this paper, we examine credit card arbitrage and the extent to which profits can be earned from credit card arbitrage. In addition, we consider the role of items that may potentially frustrate the arbitrage or reduce the profitability of the transaction. The remainder of the paper is organized as follows. Section 2 reviews some of the relevant literature regarding credit card operations and transactions. Section 3 provides a detailed example of a credit card arbitrage transaction. Section 4 considers the sensitivity of the profits to changes in the underlying variables of the arbitrage. Section 5 examines the impact of credit card arbitrage on credit scores. Finally, Section 6 provides concluding comments on the transaction.

2. Prior literature

To our knowledge, no known paper has directly analyzed arbitrage opportunities available through the use of credit cards. The presence of active credit card arbitrageurs could impact the findings of a variety of studies and lines of literature. As such, we relate this paper to the general literature on credit card use, profitability, and the determination of credit card interest rates. One series of articles examines the profitability of credit card operations for the banking industry. Ausubel (1991) finds that credit card operations earn three to five times the rate of return earned in the overall banking industry. He finds that about 25% of credit card customers pay off their accounts in full each month and 75% carry some balance from month-to-month. Others that examine the structure and performance of the bankcard industry include Calem (1992) and DeMuth (1986). The research conducted here will extend the profitability literature by providing evidence on opportunities where arbitrage can be under-

taken against the financial institution, thereby decreasing the profits of the credit card operations.

A second line of literature examines the persistence or stickiness of credit card interest rates. Most of the work in this area indicates that interest rates on noncredit card products tend to decline more rapidly with the general level of interest rates whereas credit card rates are slow to adjust downward. A number of explanations have been proposed in the literature for this stickiness. Ausubel (1991) proposes three possible reasons for the stickiness of rates. First, cardholders incur search costs if forced to find another credit card. Second, cardholders incur switching costs if they are forced to change credit cards. Third, firms face an adverse selection problem if they unilaterally reduce credit card rates. Calem and Mester (1995) empirically test these hypotheses finding elements of support for each. This paper will provide additional evidence on the adverse selection problem. To the extent that arbitrage opportunities are present, adverse selection problems may be magnified.

Another line of literature examines credit card networks. Chakravorti and To (2002) propose a model that explains interactions between consumers, merchants and card issuers. In their model, the issuer's ability to charge higher merchant discount fees depends on the number of customers gained when the credit cards are accepted. Each merchant faces a prisoner's dilemma where each independently chooses to accept credit cards, however all merchants' profits are reduced because of intertemporal business stealing across industries.

In a later paper, Ausubel (1999) examines preapproved credit card solicitations. He finds evidence of adverse selection whereby the least creditworthy individuals receiving the offer are more likely to respond. Moreover, he finds that recipients of credit card solicitations over respond to the introductory interest rate, relative to the duration of the introductory offer and to the interest rate that applies after the introductory period. Specifically, he finds that consumers are at least three times as sensitive to changes in introductory interest rates as compared to dollar-equivalent changes in the postintroductory interest rate. He also finds that consumers are two to three times as responsive to changes in the introductory interest rate as compared to dollar-equivalent changes in the duration of the introductory offer. Our research will extend this line of literature by precisely measuring arbitrage profits at different interest rate combinations. This measurement provides additional evidence on the motivations of individuals to respond to interest rate changes.

Brito and Hartley (1995) demonstrate that borrowing on credit cards at high interest rates may be rational. They argue that low transaction costs can make credit card loans attractive relative to bank loans. That is in many instances, consumers are better off paying interest on an outstanding credit card balance than paying the transaction cost of arranging a loan from a financial institution. Gross and Souleles (2002), examine how people respond to credit supply. They find that increases in credit limits generate a significant increase in debt levels. They find that many credit card borrowers simultaneously hold low yielding assets. They indicate that the average long-run elasticity of debt to the interest rate is approximately -1.3. Less than half of this elasticity can be explained by balance shifting across cards. Most of the elasticity is found to reflect a change in total borrowing. This paper extends the analysis of Brito and Hartley (1995) by providing additional evidence that borrowing on credit cards may be rational.

Some people surmise that credit card companies have taken steps to target individuals who

are least likely to incur and manage additional credit card debt well. Several studies, including Black and Morgan (1999) and Bird, Hagstrom and Wild (1999) argue that credit card debt has become more readily available to lower income households on an absolute basis and has increased at a faster rate than for middle- and high-income households. Stavins (2000) finds evidence that bank credit card companies which extend credit to higher risk borrowers, charge higher interest rates and fees, earning higher net revenues. Kidane and Mukherji (2004) analyze the characteristics of consumers who are targeted and those who are neglected by credit card companies. Contrary to the spirit of the previous work in this area, they provide evidence that credit card companies target consumers who have greater financial resources, a clean credit history, and a track record of responsible credit use. They also find evidence that individuals with fewer financial resources, recent payment problems, or limited credit history are neglected by credit card companies. These results have important implications for our study of credit card arbitrage. They imply that individuals with better credit history and financial resources are more likely to receive credit card offers that position them to execute credit card arbitrage transactions.

Changing characteristics of credit card holders, as noted above, might be indicative of various demographic groups being more inclined to engage in credit card arbitrage. Indeed, a series of articles have examined how household debt changes over the life cycle (see Crook, 2001; Cox & Jappelli, 1993; Yilmazer & DeVaney, 2005). The presence of credit card arbitrage could impact these studies if individuals of certain age are more or less likely to engage in credit card arbitrage. Such studies should be careful to examine the amount of debt net of money market and other highly liquid cash balances. A variety of other works have examined credit card ownership and usage (see Kim & DeVaney, 2001; Castonova & Hagstrom, 2004). Kim and DeVaney specifically find demographic difference in the likelihood of having an outstanding credit card balance and in the amount of the outstanding balance.

Sullivan and Worden (1995) consider credit card defaults and bankruptcy. They find evidence of a moral hazard where consumers who are paying high interest rates on credit cards, tend toward the aggressive use of credit in an apparent attempt to maximize the value of their option to default. They argue that these findings provide a plausible explanation for consumers' seeming insensitivity to interest rates charged on credit cards.

Bi and Montalto (2004) argue that the level of emergency funds of individuals should be related to the availability of credit and other factors. They find that about 65% of households rely to some degree on credit card borrowing with 33% of their sample borrowing in excess of $8,000 on their credit cards. To the extent that banks charge annual fees on credit cards and individuals must spend time managing the accounts, these sources of emergency funds are costly beyond the direct interest charged on outstanding balances. The research in this paper shows how individuals might use credit card arbitrage to reduce the cost of maintaining this source of emergency funds.

A critical issue related to credit card arbitrage is the impact that it might have on a consumer's credit score. While the precise computation of credit scores is not publicly available, many popular press articles propose actions that will improve individual credit scores. Some factors that are commonly referenced include the number of credit cards, the length of credit history, and the incidence of late or missed payments. *Cardline* (2006)

reports that from 2001 to 2006 the average consumer credit score fell seven points to 675 whereas the average consumer balance on credit card debt increased from $7,270 to $12,300. Two other factors potentially contributing to these lower credit scores are an increase in late payments and delinquencies and an increase in the credit balance to credit limit ratio. Spencer (2006) describes situations where consumer credit scores have been damaged by fees and fines owed for items like overdue library books and unpaid parking tickets. In some cases, the impact led to higher mortgage rates and down payments. King and King (2005) provide a compelling argument for consumers to prefer the use of credit cards over debit cards under the assumption that the credit card balance is paid on time each payment period. Their work considers the use of credit cards as a substitute for cash, checks, and debit cards. This approach assumes that individuals pay off the balance of their credit cards each month. Because the credit function of the cards is not the focus of their work, they do not address the issue of credit scores.

3. Credit card arbitrage

This section provides a detailed example of a credit card arbitrage transaction. The temptation for a novice is to compute the profit from a credit card arbitrage as the product of the periodic spread between the money market and credit card interest rates multiplied by the cash advance amount. For example, consider a six-month credit card offer for 1% interest, and a $75 fixed fee. The card has a $10,000 credit line. Funds from the credit line are deposited in a money market account that pays 5% interest. The novice approach to computing the profit is as follows:

$$(0.05–0.01)*(1/2)*(10{,}000) - \$75 = \$125.$$

Although the novice approach represents a rough and ready approximation, it lacks accuracy. The lack of accuracy stems from three sources. First, the novice approach ignores the difference in balances between the money market and credit card accounts over the life of the transaction. This difference stems from the fixed fee, which is added to the credit card balance, but is not available to be deposited in the money market account. The second source of inaccuracy stems from ignoring the periodic minimum payments that must be made on the credit card balance. These payments reduce the amount of funds in the interest bearing account on a monthly basis. Third, the novice approach ignores any annual fees that might be charged on the credit card.

To demonstrate the precise computation of profit from a credit card arbitrage, consider a credit card that has no annual fee. The card offers a zero percentage interest rate for six months on balance transfers. The offer has an initial fee of 3% of the balance transferred with a minimum fee of $10 and a maximum fee of $75. The cardholder is required to make a minimum payment of 2% of the outstanding balance each month. Assume that an FDIC insured money market account that pays 4% annual interest is available to the investor. A person with a $10,100 available credit balance can execute a credit card arbitrage by taking the following actions. The investor initiates a $10,000 balance transfer. The $75 transfer fee is added to the credit card balance bringing the total to $10,075. The individual invests the

Table 1 Profit from Credit Card Arbitrage

Month	Credit card balance beginning of month	Credit card payment	Credit card balance end of month	Money market balance beginning of month	Interest earned on money market	Money market balance at the end of month	Profit
1	$10,075.00	$201.50	$9,873.50	$10,000.00	$33.33	$9,831.83	−$41.67
2	$9,873.50	$197.47	$9,676.03	$9,831.83	$32.77	$9,667.14	−$8.94
3	$9,676.03	$193.52	$9,482.51	$9,667.14	$32.22	$9,505.84	$23.33
4	$9,482.51	$189.65	$9,292.86	$9,505.84	$31.69	$9,347.88	$55.02
5	$9,292.86	$185.86	$9,107.00	$9,347.88	$31.16	$9,193.18	$86.18
6	$9,107.00	$182.14	$8,924.86	$9,193.18	$30.64	$9,041.68	$116.82

The table assumes that a $10,000 cash advance is taken against a credit card. The card charges a $75 cash advance fee but offers a 0% 6-month interest rate. Funds placed in an FDIC-insured money market account earn 4% nominal interest.

$10,000 received from the transfer into the FDIC insured money market account. During each of the following six months, the investor makes the 2% minimum payment on the credit card using funds withdrawn from the money market account. At the end of the six-month period the individual withdraws funds from the money market account to pay off the credit card balance. The payments and outstanding balances over the following six months are as indicated in Table 1. The $116.82 remaining in the account at the end of the six-month period represents the arbitrage profit.

In the analysis above, we assume a zero percentage interest rate on the credit card. However, the arbitrage can also be effective on credit card offers with a positive interest rate as long as the spread between the money market rate and credit card rate is sufficiently large to offset the fixed costs. Consider the same situation as described in Table 1 with one exception. In this example, the financial institution charges a one percentage nominal interest rate on outstanding credit card balances for the first six months. The results of this analysis are presented in Table 2. The arbitrage profit in Table 2 is $68.79. Thus, although a positive

Table 2 Profit from Credit Card Arbitrage with credit card interest

Month	Credit card balance beginning of month	Credit card payment	Interest on credit card	Credit card balance end of month	Money market balance beginning of month	Interest earned on money market	Money market balance at the end of month	Profit
1	$10,075.00	$201.50	$8.40	$9,881.90	$10,000.00	$33.33	$9,831.83	−$50.06
2	$9,881.90	$197.64	$8.23	$9,692.49	$9,831.83	$32.77	$9,666.97	−$25.52
3	$9,692.49	$193.85	$8.08	$9,506.72	$9,666.97	$32.22	$9,505.34	−$1.38
4	$9,506.72	$190.13	$7.92	$9,324.51	$9,505.34	$31.68	$9,346.89	$22.38
5	$9,324.51	$186.49	$7.77	$9,145.79	$9,346.89	$31.16	$9,191.56	$45.77
6	$9,145.79	$182.92	$7.62	$8,970.49	$9,191.56	$30.64	$9,039.28	$68.79

The table assumes that a $10,000 cash advance is taken against a credit card. The card charges a $75 cash advance fee and charges a 1% nominal interest rate for the first 6 months. Funds placed in an FDIC-insured money market account earn 4% nominal interest.

interest rate on the credit card reduces the magnitude of the offer, under many interest rate combinations, the arbitrage may still be effective.

The credit card arbitrage can be frustrated in several ways. First, introductory offers are generally voided if the individual is late on either a payment on the credit card in question, or a payment on any other loan obligation. In the event of a missed payment, the interest rate increases to the regular, much higher rate. The arbitrage can also be frustrated if the individual does not pay off the entire balance at the end of the introductory period. The entire arbitrage profit can be offset by paying the regular interest rate, even for a short period of time. The arbitrage can also be frustrated by taxes. To the extent that interest earned is taxable, whereas interest paid on credit card debt is not tax deductible, the taxes involved could exceed the profit.[1] In addition, the increase in debt obligations will most likely reduce the credit rating of the investor. This might lead to a situation where the arbitrage profits are offset by higher interest rates on the individual's other debts. The issue of credit ratings is explored in additional detail in Section V. Finally, the arbitrage might be frustrated if the individual does not have a sufficiently large credit line. In such instances, the profits earned might not offset the up-front costs of setting up the transaction.

3.1. Measuring the arbitrage profit

In this section, we develop a formula that allows investors to compute the profit from a credit card arbitrage under any combination of money market interest rates, credit card interest rates, introductory offer time period, and fixed balance transfer fee. By using the formula here, investors will quickly determine the profitability from a particular arbitrage arrangement. Investment advisors will be able to demonstrate quickly and efficiently to their clients how to most effectively manage their credit card debts. Moreover, banks can use the formula developed here to design the most effective introductory offers.

The arbitrage profit, *$Profit*, can be computed as the difference between the amount of funds accumulated in the money market account at any time, MMB_N, and the amount of money owed on the credit card account at the same time point, CCB_N, as follows:

$$\$\text{Profit} = \text{MMB}_\text{N} - \text{CCB}_\text{N} \tag{1}$$

Defining the dollar amount of funds borrowed as B, the percentage minimum monthly payment as P, the periodic interest rate earned on the money market account, IM, the periodic interest rate charged on the credit card IC, a time indicator N, the number of periods in the analysis, K, and the fixed charge associated with taking the balance transfer as F, then the money market balance at any time point, N, can be computed as:

$$\text{MMB}_\text{N} = \text{B}(1 + \text{IM})^\text{N} - (\text{B} + \text{F})(\text{P})\sum_{\text{i}=1}^{\text{N}}(1 + \text{IC} - \text{P})_\text{i}^{\text{N}-1}(1 + \text{IM})^{\text{K}-\text{i}} \tag{2}$$

Using the same notation, the credit card balance at any time N can be stated as:

$$\text{CCB}_\text{N} = (\text{B} + \text{F})(1 + \text{IC} - \text{P})^\text{N} \tag{3}$$

Table 3 Arbitrage profits at different interest rate levels

		Credit card interest rate										
		0.0%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
Money market rate	0.0%	−75.00	−123.02	−171.24	−219.67	−268.29	−317.11	−366.14	−415.37	−465.80	−514.44	−564.28
	1%	−27.35	−75.38	−123.60	−172.03	−220.65	−269.48	−318.51	−367.74	−417.18	−466.82	−516.66
	2%	20.50	−27.53	−75.75	−124.18	−172.81	−221.64	−270.67	−319.91	−369.35	−418.99	−468.84
	3%	68.56	20.53	−27.70	−76.13	−124.76	−173.60	−222.63	−271.87	−321.31	−370.96	−420.81
	4%	116.82	68.79	20.55	−27.88	−76.51	−125.35	−174.39	−223.63	−273.07	−322.72	−372.57
	5%	165.29	117.25	69.02	20.58	−28.06	−76.89	−125.94	−175.18	−224.63	−274.28	−324.12
	6%	213.96	165.92	117.68	69.25	20.61	−28.24	−77.28	−126.53	−175.97	−225.63	−275.49
	7%	262.84	214.80	166.56	118.12	69.48	20.63	−28.41	−77.66	−127.12	−176.77	−226.64
	8%	311.93	263.88	215.64	167.19	118.55	69.71	20.66	−28.55	−78.05	−127.71	−177.58
	9%	361.22	313.18	264.93	216.49	167.84	118.99	69.94	20.68	−28.78	−78.44	−128.31
	10%	410.73	362.68	314.43	265.98	217.33	168.48	119.43	70.17	20.71	−28.96	−78.83

The table assumes a $10,000 cash advance on a credit card with a $75 fixed charge and a 6-month introductory offer. The figure in each cell is the dollar amount of the arbitrage profit.

By substituting Eqs. (2) and (3) into Eq. (1), the arbitrage profit can be restated as[2]:

$$\$\text{Profit} = B(1 + IM)^N - (B + F)(P)\sum_{i=1}^{N}(1 + IC - P)_i^{N-1}(1 + IM)^{K-i} - (B + F)(1 + IC - P)^N \quad (4)$$

To demonstrate the use of Eq. (4), consider again the example from Table 2. The arbitrage profit can be computed using Eq. (4) as:

$$\begin{aligned}\$\text{Profit} &= 10000(1 + .04/12)^6 - (10000 + 75)(.02)[(1 + .01/12 - 0.02)^0(1 + .04/12)^5 \\ &- (1 + .01/12 - .02)^1(1 + .04/12)^4 - (1 + .01/12 - .02)^2(1 + .04/12)^3 \\ &- (1 + .01/12 - .02)^3(1 + .04/12)^2 - (1 + .01/12 - .02)^4(1 + .04/12)^1 \\ &- (1 + .01/12 - .02)^5(1 + .04/12)^0] - (10{,}000 + 75)(1 + .01/12 - .02)^6 \quad (5)\end{aligned}$$

$$\begin{aligned}\$\text{Profit} &= 10{,}201.67 - 204.88 - 200.29 - 195.79 - 191.40 - 187.11 - 182.92 \\ &- 8970.49 = 68.79 \quad (6)\end{aligned}$$

4. Sensitivity analysis

The analysis continues by examining the sensitivity of arbitrage profits to changes in the four underlying variables of the arbitrage transaction. The variables are examined in the following order: interest rate levels, fixed fee structure, credit availability, and annual fees.

4.1. Interest rate levels

Table 3 demonstrates the use of Eq. (4) by calculating the profit for a $10,000 cash

advance on a credit card with a $75 fixed charge and a six-month introductory offer. The equation is solved for different interest rates on the money market account and rates on the credit card. In this example, a profit occurs any time the money market rate is two percentage points or more above the credit card rate. The careful reader of Table 3 will notice different profits for the same interest rate spread at different interest rate levels. For example, the profit from a 4%/1% MM/CC spread is $68.79, however the profit from a 8%/5% MM/CC spread is $69.71. This is not an error. The first example is lower, reflecting the relative difficulty of offsetting the $75 fixed cost when reinvesting at lower interest rate levels.

4.2. Fee structure

Next, we examine how different fixed fee structures affect the arbitrage profit. Table 3 solved for the arbitrage profit with unrestricted interest rate combinations. In Table 4, the credit card rate is restricted to one percentage. However, the money market rate is allowed to vary. Thus, the interest rate differential represents the money market rate of interest minus the one percentage rate charged on the credit card. This restriction allows us to demonstrate how different fixed fee structures affect the arbitrage profits available. Table 4 shows the arbitrage profit computations at varying fixed fee structures that are commonly offered by credit cards. Panel A examines an offer that provides an introductory rate that is good until the offer is paid off. For convenience purposes, we assume that the borrower terminates the loan after 10 years by paying off any remaining balances due. Panels B, C, D, and E examine an introductory offer that expires after 18, 12, 6, and 3 months, respectively.

4.3. Credit availability

Next, we examine the profit at varying levels of available credit. The profits in Table 4 are not linear in the amount of the cash advance because the fixed charge reaches a maximum, typically $75. Thus, it is important to examine the amount of the profit at varying available credit levels. Table 5 presents the profitability of credit card arbitrage on $1,000, $5,000, $10,000, $20,000, $30,000, and $100,000 credit lines. To facilitate these computations, we hold the fixed charge for the cash advance to be 3%, with a $75 maximum, a common combination at the time of this writing. The solutions are computed for the following terms: until paid off, 18-, 12-, 6-, and 3-month offers in Panels A through E of Table 5, respectively.

The results presented in Table 5 show that a $10,000, 6-month, offer with a 3% interest differential and $75 maximum fixed charge will produce a $68.79 arbitrage profit, the same results noted earlier in the paper. However, if the credit balance were $20,000, the arbitrage profit would be $213.00 and $1,366.75 for a $100,000 credit balance. This arbitrage is not profitable for credit levels of $5,000 or $1,000. Clearly, the greater the magnitude of the transaction, the more likely that it will be profitable. This is because the fixed charge is more easily overcome using larger lines of credit.

Table 4 Profit on a $10,000 cash advance

Interest differential	None	2% max $50	3% max $75	3% no max	4% max $100	4% no max
Panel A: Until the loan is paid off (10 years), fixed cost						
0.5%	217.08	160.07	131.58	−124.93	103.08	−238.93
1%	449.26	390.45	361.04	96.38	331.63	−21.25
1.5%	697.44	636.74	606.39	333.25	576.04	211.86
2%	962.54	899.89	868.56	586.62	837.23	461.31
2.5%	1,245.57	1,180.88	1,148.53	857.43	1,116.19	728.05
3%	1,547.54	1,480.74	1,447.34	1,146.72	1,413.93	1,013.11
3.5%	1,869.57	1,800.57	1,776.07	1,455.56	1,731.57	1,317.56
4.0%	2,212.81	2,141.52	2,105.88	1,785.09	2,070.23	1,612.52
4.5%	2,578.47	2,504.81	2,467.98	2,136.50	2,431.15	1,989.18
5%	2,967.85	2,891.72	2,853.65	2,511.06	2,815.58	2,358.80
Panel B: 18-month interest rate time period, fixed cost						
0.5%	64.67	13.86	−11.55	−240.21	−36.96	−341.84
1%	129.83	78.96	53.52	−175.40	28.09	−277.15
1.5%	195.48	144.55	119.09	−110.10	93.62	−211.97
2%	261.63	210.64	185.14	−44.31	159.65	−146.29
2.5%	328.27	277.22	251.70	21.97	226.17	−80.12
3%	395.42	344.31	318.76	88.76	293.20	−13.46
3.5%	463.07	411.90	386.32	156.06	360.74	53.72
4.0%	531.23	480.00	454.39	223.86	428.77	121.40
4.5%	599.91	548.62	522.97	292.17	497.33	189.59
5%	669.10	617.75	592.07	360.99	566.40	258.29
Panel C: 12-month interest rate time period, fixed cost						
0.5%	45.38	−5.15	−30.42	−257.79	−55.68	−359.85
1%	90.97	40.41	15.14	−212.36	−10.14	−313.47
1.5%	136.78	86.20	60.91	−166.70	35.62	−267.86
2%	182.81	132.20	106.90	−120.83	81.60	−222.04
2.5%	229.06	178.43	153.11	−74.74	127.80	−176.00
3%	275.53	224.87	199.54	−28.42	174.21	−129.74
3.5%	322.23	271.54	246.20	18.11	220.86	−83.26
4.0%	369.14	318.43	293.07	64.87	267.72	−36.56
4.5%	416.28	365.54	340.18	111.85	314.81	10.37
5%	463.65	412.88	387.50	159.05	362.12	57.52
Panel D: 6-month interest rate time period, fixed cost						
0.5%	23.91	−26.35	−51.48	−277.63	−76.60	−378.14
1%	47.87	−2.39	−27.53	−253.71	−52.66	−354.23
1.5%	71.88	21.61	−3.52	−229.73	−28.66	−330.27
2%	95.94	45.67	20.53	−205.71	−4.61	−306.26
2.5%	120.05	69.77	44.63	−181.63	19.49	−282.20
3%	144.22	93.93	68.79	−157.51	43.64	−258.08
3.5%	168.43	118.14	92.99	−133.33	67.85	−233.91
4.0%	192.70	142.40	117.25	−109.10	92.10	−209.70
4.5%	217.02	166.71	141.56	−84.82	116.41	−185.43
5%	241.39	191.08	165.92	−60.48	140.77	−161.11
Panel E: 3-month interest rate time period, fixed cost						
0.5%	12.28	−37.85	−62.91	−288.48	−87.98	−388.73
1%	24.57	−25.56	−50.63	−276.20	−75.69	−376.46
1.5%	36.86	−13.27	−38.33	−263.91	−63.39	−364.17
2%	49.17	−0.96	−26.02	−251.61	−51.09	−351.87
2.5%	61.49	11.36	−13.71	−239.30	−38.77	−339.56
3%	73.82	23.69	−1.38	−226.98	−26.44	−327.24
3.5%	86.16	36.03	10.96	−214.64	−14.11	−314.91
4.0%	98.51	48.38	23.31	−202.30	−1.76	−302.57
4.5%	110.87	60.73	35.67	−189.95	10.60	−290.22
5%	123.24	73.10	48.03	−177.58	22.97	−277.86

This table indicates the amount of the arbitrage profits on a $10,000 cash advance at varying fixed cost and interest rate combinations. Panel A assumes a payoff of 10 years. The credit card interest rate is 1% in all cases. The money market interest rate varies as indicated by the interest differential value. For example, an interest differential of 1% represents a money market interest rate of 2%.

Table 5 Profitability at differing credit lines

Interest differential	$1,000	$5,000	$10,000	$20,000	$30,000	$100,000
Panel A: Until paid off, with 10 year balloon payment						
0.5%	−12.49	23.04	131.58	348.65	565.73	2,085.28
1%	9.64	136.41	361.04	810.30	1,259.57	4,404.40
1.5%	33.33	257.67	606.39	1,303.83	2,001.27	6,883.35
2%	58.66	387.29	868.56	1,831.11	2,793.65	9,531.47
2.5%	85.74	525.75	1,148.53	2,394.10	3,639.66	12,358.62
3%	114.67	673.57	1,447.34	2,994.88	4,542.42	15,375.21
3.5%	145.56	831.28	1,766.07	3,635.64	5,505.21	18,592.19
4.0%	178.51	999.47	2,105.88	4,318.68	6,531.49	22,021.13
4.5%	213.65	1,178.74	2,467.98	5,046.45	7,624.92	25,674.21
5%	251.11	1,369.73	2,853.65	5,821.50	8,789.35	29,564.28
Panel B: 18-month interest rate time period						
0.5%	−24.02	−43.89	−11.55	53.12	117.79	570.49
1%	−17.54	−11.39	53.52	183.35	313.18	1,222.00
1.5%	−11.01	21.34	119.08	314.57	510.15	1,878.42
2%	−4.43	54.32	185.14	446.77	708.40	2,539.80
2.5%	2.20	87.56	251.70	579.97	908.25	3,206.16
3%	8.88	121.05	318.76	714.18	1,109.60	3,877.54
3.5%	15.61	154.78	386.32	849.39	1,312.46	4,553.97
4.0%	22.39	188.77	454.39	985.62	1,516.86	5,235.50
4.5%	29.22	223.02	522.97	1,122.88	1,722.79	5,922.14
5%	36.10	257.52	592.07	1,261.17	1,930.27	6,613.95
Panel C: 12-month interest rate time period						
0.5%	−25.78	−53.10	−30.42	14.96	60.34	377.97
1%	−21.24	−30.35	15.14	106.11	197.08	833.86
1.5%	−16.67	−7.48	60.91	197.69	334.47	1,291.93
2%	−12.08	15.50	106.90	289.71	472.52	1,752.20
2.5%	−7.47	38.58	153.11	382.17	611.24	2,214.67
3%	−2.84	61.78	199.54	475.08	750.61	2,679.34
3.5%	1.81	85.08	246.20	568.42	890.65	3,146.24
4.0%	6.49	108.50	293.07	662.22	1,031.36	3,615.36
4.5%	11.18	132.03	340.18	756.46	1,172.74	4,086.73
5%	15.91	155.68	387.50	851.15	1,314.80	4,560.34
Panel D: 6-month interest rate time period						
0.5%	−27.76	−63.43	−51.48	−27.57	−3.66	163.70
1%	−25.37	−51.46	−27.53	20.34	68.21	403.29
1.5%	−22.97	−39.46	−3.52	68.35	140.23	643.38
2%	−20.57	−27.44	20.53	116.47	212.41	883.99
2.5%	−18.16	−15.40	44.63	164.68	284.74	1,125.11
3%	−15.75	−3.32	68.79	213.00	357.22	1,366.75
3.5%	−13.33	8.78	92.99	261.43	429.86	1,608.89
4.0%	−10.91	20.90	117.25	309.95	502.65	1,851.55
4.5%	−8.48	33.05	141.56	358.58	575.60	2,094.73
5%	−6.04	45.23	165.92	407.31	648.70	2,338.43
Panel E: 3-month interest rate time period						
0.5%	−28.85	−69.05	−62.91	−50.63	−38.36	47.59
1%	−27.62	−62.91	−50.63	−26.06	−1.50	170.46
1.5%	−26.39	−56.76	−38.33	−1.47	35.40	293.44
2%	−25.16	−50.61	−26.02	23.15	72.32	416.53
2.5%	−23.93	−44.45	−13.71	47.79	109.28	539.71
3%	−22.70	−38.29	−1.38	72.44	146.26	663.01
3.5%	−21.46	−32.12	10.96	97.12	183.28	786.4
4.0%	−20.23	−25.95	23.31	121.82	220.33	909.90
4.5%	−18.99	−19.77	35.67	146.54	257.41	1,033.50
5%	−17.76	−13.59	48.04	171.28	294.52	1,157.21

This table shows the profit from credit card arbitrage at different interest rate spreads and available credit balances. The fixed charge on the cash advance in each computation is 3%, with a $75 maximum. The credit card interest rate is 1% in all cases. The money market interest rate varies as indicated by the interest differential value. For example, an interest differential of 1% represents a money market interest rate of 2%.

4.4. Annual fees

Thus far, we have analyzed arbitrage opportunities for credit cards that do not charge an annual fee. In this section, we consider how annual fees on the credit card affect the analysis. Cards that offer an annual fee commonly also offer side benefits, such as frequent flier miles. For example, United Airlines charges an $85 annual fee on its branded Visa credit card. In return, United gives the cardholder 2,500 frequent flier miles each year when the holder pays the annual fee. In addition, the United Airlines Visa allows cardholders to earn additional miles in two ways. First, cardholders earn one frequent flier mile for each dollar charged on the card. Second, the card allows the individual to earn frequent flier miles for cash advances. Specifically, holders are earning 1 frequent flier mile for each $2.00 of balance transfers taken on the card up to a limit of 10,000 frequent flier miles. This second method of earning additional miles is relevant for the credit card arbitrage discussed here. However, computing the value of the side benefits received is complex and is beyond the scope of this paper. Thus, we limit our discussion to the general effect of annual fees, without incorporating any side benefits the card might offer.

In general, annual fees reduce the potential arbitrage profit. Often the term of the offer and the corresponding fee are identical at one year. In this case, the annual fee can be viewed as a direct component of the fixed fee associated with the offer. Consider a 1-year credit card offer with a $10,000 cash advance limit, a $75 cash advance fee, a credit card rate of 1% and a money market rate of 4%. The card has an annual fee of $85. In this scenario, the profit from the arbitrage is $113.42, as compared to $199.54 without the annual fee.

The situation becomes more complex when the maturity of the offer is longer or shorter than one year. In this case, it is necessary to allocate the annual fee. Consider a six-month offer that is otherwise identical to the example in the previous paragraph. The cost of the annual fee must be paid at the outset of the agreement. This combination would result in a loss of $16.70. However, if the investor is able to replicate the arbitrage opportunity a second time during the same year, a profit can be earned. The annual fee is paid with the first arbitrage transaction, so the second transaction yields a return of $68.78. The total profit for the year on this card is: $52.08 = $68.78 − $16.70.

Further complicating the situation is when the card offer extends over a period of longer than one year. In this case, it is necessary to incorporate more than one annual fee payment into the analysis. This can be particularly problematic for offers that are good until the balance of the loan is paid off. Perhaps the easiest way to address this issue is to find the least common denominator for replicating the offers. In the case of an 18-month offer, two annual fees must be paid. However, the second annual fee period is only half expired when the introductory offer expires. If the credit card offer were undertaken a second time, the combination of the offers would span three years and would match the annual fee period.

5. Credit card arbitrage and credit scores

It is critical to consider the impact of credit card arbitrage on the credit score of the arbitrager. If the additional credit balances associated with undertaking credit card arbitrage

have a negative impact on an individual's credit score, the profitability of the arbitrage might be frustrated. At least three issues must be examined to evaluate the effects of credit card arbitrage on the credit score of the arbitrager. The first issue is how increasing credit balances affect the credit rating. To undertake credit card arbitrage, some investors might seek more credit than would otherwise be optimal. The effect of these additional balances must be determined. The second factor is the extent to which carrying balances on these credit cards affects an individual's credit rating. Third, is how increased numbers of timely payments affect the credit rating.

Optimally, one would use a precise formula to determine the impact of arbitrage transactions on credit scores. Unfortunately, the exact formulas used to compute credit scores are proprietary information of the rating agencies and are not available to the authors. Because of this limitation, the precise effect of undertaking credit card arbitrage cannot be determined. Nevertheless, some general information can be gleaned about the credit score computation algorithm. We use this information to estimate the impact of credit card arbitrage on credit scores. DeVaney and Lytton (1995), provide a listing of some 42 factors that affect credit scores. Such lists are commonly categorized into five categories, family status/living arrangements, employment, personal information, financial history, and credit bureau information (Friedland, 1993). Although a complete examination of credit scoring methods and statistical procedures is beyond the scope of this paper, the interested reader is referred to Rosenberg and Gleit (1994).

While the precise formulas used to compute credit scores are not available to the general public, credit score simulators are made available by various credit agencies. In this section, we utilize one of these simulators to demonstrate the approximate impact of increasing credit balances associated with undertaking credit card arbitrage.

We estimate credit scores using a free credit score simulator available from www.bankrate.com. The bankrate simulator allows one to estimate how changes in various factors affect their credit score. We are interested in two elements of the estimation. The first is how total credit card balances and loans affect the credit score. Second, is the portion of available credit that an individual utilizes. To determine the impact of credit card arbitrage on investor credit scores, we consider an individual with a perfect credit history. We simulate the impact of credit card arbitrage on standard credit scores by changing the two variables of interest noted above.

The resulting computations are noted in Table 6. The individual that does not undertake credit card arbitrage is expected to have a balance outstanding on his credit cards of $1,000 to $5,000 and utilizes 9% or less of his available credit as noted in Column 1. This individual will have a credit score that ranges from 770 to 820. If the individual engages in credit card arbitrage, two factors in the simulation change. The balance owed on credit cards will increase and the percentage of total credit utilized will increase. In Columns 2 through 5 of Table 6, the credit balance is increased to more than $20,000. In each column, the percentage of available credit utilized varies. Engaging in the maximum amount of credit card arbitrage possible results in a credit score reduction to a range of 675 to 725 (see Column 5). Thus, this simulation suggests a reduction in FICO[3] score of up to 100 points when engaging in credit card arbitrage.

A decline in credit score associated with credit card arbitrage is not particularly prob-

Table 6 The effect of large credit card balances on credit ratings

Panel 1

Question	Value 1	Value 2	Value 3	Value 4	Value 5
Number of credit cards	5+	5+	5+	5+	5+
How long since your first credit card?	20+ yrs	20+ yrs	20+ yrs	20+ yrs	20+ yrs
Number of loans or credit cards applied for in the past year?	1	1	1	1	1
How recently have you opened a new credit card or loan?	+6 mos	+6 mos	+6 mos	+6 mos	+6 mos
How many of your loans or credit cards currently have a balance?	0–4	0–4	0–4	0–4	0–4
Excluding your mortgage, what is the balance on all loans and credit cards?	1,000–5,000	$20,000+	$20,000+	$20,000+	$20,000+
When did you last miss a credit card or loan payment?	Never	Never	Never	Never	Never
What is the most delinquent you have ever been?	N/A	N/A	N/A	N/A	N/A
How many of your loans/or credit cards are currently past due?	0	0	0	0	0
What percentage of your total credit card limits do your credit card balances represent?	0–9%	40–49%	50–69%	70–89%	90–99%
Please indicate if you have ever gone through any of the following negative financial events in the last 10 years: bankruptcy, tax lien, foreclosure, repossession, or account referred to collection agency?	No	No	No	No	No
Resulting estimated FICO Score	770–820	725–775	700–750	690–740	675–725

Panel 2

Question	Value 6	Value 7	Value 8	Value 9	Value 10
Number of credit cards	5+	5+	5+	5+	5+
How long since your first credit card?	20+ yrs	20+ yrs	20+ yrs	20+ yrs	20+ yrs
Number of loans or credit cards applied for in the past year?	1	1	6+	6+	0
How recently have you opened a new credit card or loan?	+6 mos	+6 mos	−3 mos	−3 mos	+6 mos
How many of your loans or credit cards currently have a balance?	9+	0–4	9+	9+	0–4
Excluding your mortgage, what is the balance on all loans and credit cards?	$20,000+	1,000–5,000	20,000+	20,000+	0
When did you last miss a credit card or loan payment?	Never	Never	Never	Never	Never
What is the most delinquent you have ever been?	N/A	N/A	N/A	N/A	N/A
How many of your loans/or credit cards are currently past due?	0	0	0	0	0
What percentage of your total credit card limits do your credit card balances represent?	90–99%	0–9%	0–9%	40–49%	0–9%
Please indicate if you have ever gone through and of the following negative financial events in the last 10 years: bankruptcy, tax lien, foreclosure, repossession, or account referred to collection agency?	No	No	No	No	No
Resulting estimated FICO Score	650–700	770–820	715–765	680–730	765–815

This table shows credit score estimations using the credit score simulator at www.bankrate.com. The estimations are computed by varying the values of the input variables.

lematic if the FICO score recovers quickly when the credit card arbitrage arrangement is terminated. If FICO scores recover quickly, the individual can restore his or her FICO score

simply by terminating the arbitrage arrangement at any time point. To simulate the effects of terminating the arbitrage arrangement, we compute the FICO score under two scenarios that might be associated with conducting the arbitrage. In Panel 2 of Table 6, we simulate the elimination of credit card arbitrage. In the first column, we consider an individual that engages in credit card arbitrage. If the individual ceases engaging in Credit Card Arbitrage, we witness three effects. The first two effects are that both the card balances and percentage of credit used will decline. Each of these effects will lead to an improvement in an individual's credit score. The third effect is that the length of time since the last credit card loan was opened will likely be shorter. This will tend to erode an individual's credit score. The results of these changes are demonstrated in Columns 2 through 5 of Panel 2. In general, the results suggest that the credit score will increase soon after the arbitrage is terminated, increasing back nearly to the original prearbitrage levels reported in Panel 1, Column 1.

6. Conclusions

This paper examines the profitability of credit card arbitrage. The credit card arbitrage discussed here involves taking cash advances against credit cards with low introductory rates and depositing the funds into FDIC insured money market accounts. We develop formulas to compute the amount of potential arbitrage under various circumstances. The amount of the arbitrage profit is calculated under varying credit limits and combination of interest rates on the credit card and money market accounts.

Our findings indicate that credit card arbitrage opportunities do indeed exist. We find that the magnitude of the arbitrage is sensitive to the spread between the card rate and the money market rate, the minimum payment amount required on the card, the length of time for the introductory offer and the amount of the credit available. These opportunities are most lucrative for those individuals with large available credit limits.

The findings here extend several previous lines of literature. First, by demonstrating the presence of arbitrage opportunities as financed by credit card issuing firms, we show that bank profitability can be adversely affected by individuals who take advantage of these opportunities. We extend the literature related to responses to credit card offers by demonstrating the profit opportunities that can be earned by offers with various interest rate, cash advance fees and other features of the offer. Finally, we demonstrate that borrowing on credit cards can be rational, even when interest rates are high, as long as interest rates on investment opportunities provide a positive return opportunity. Future research might extend the work here by examining the extent to which business owners utilize introductory credit card offers to finance their operations.

Notes

1. Tax deductibility of interest is only an issue in the event that the introductory offer is at a positive interest rate. In addition, if the credit card arbitrage arrangement is executed within a business entity, the credit card interest would likely be a tax-deductible expense against the business income.

2. One might also be interested in defining other variables. For example, the credit card payment at any time point, N, can be computed as

$$\$CCP = (B + F)(P)(1 + IC - P)^{N-1} = (10{,}075)(0.02)(1 + .01/12 - .02)^2 = \$193.85 \quad (7)$$

and the total Credit Card Payments to date can be computed as

$$\$CCPtotal = (B+F)(P)\sum_{i=1}^{N}(1 + IC - P)^{N-1}. \quad (8)$$

$$\$CCPtotal = (10{,}075)(0.02)$$

$$[(1 + .01/12 - .02)^2 + (1 + .01/12 - .02)^1 + (1 + .01/12 - .02)^0 = \$592.99. \quad (9)$$

The interest due on the credit card in any time period, N, can be computed as

$$\$IC_N = (B + F)(1 + IC - P)^{N-1}(IC) = (\$10{,}075)(1 + .01/12 - .02)^2(.01/12) = \$8.08 \quad (10)$$

The total amount of interest paid to date at any time point can be computed as

$$\$ICtotal_N = (B + F)(IC)\sum_{i=0}^{N-1}(1 + IC - P)^{N-1} \quad (11)$$

$$\$ICtotal_N = (\$10{,}075)(.01/12)$$

$$[(1 + .01/12 - .02)^2 + (1 + .01/12 - .02)^1 + (1 + .01/12 - .02)^0 = \$24.71 \quad (12)$$

3. FICO is an acronym for Fair Isaac Credit Organization.

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References

Ausubel, L. (1991). The failure of completion in the credit card market. *American Economic Review, 81*, 50–81.

Ausubel, L. (1999). Adverse selection in the credit card market. University of Maryland, Working paper, 1–52.

Bi, L., & Montalto, C. P. (2004). Emergency funds and alternative forms of saving. *Financial Services Review, 13*, 93–109.

Bird, E. J., Hagstrom, P. A., & Wild, R. (1999). Credit card debts of the poor: high and rising. *Journal of Policy Analysis and Management, 18*, 125–33.

Black, S. E., & Morgan, D. P. (1999). Meet the new borrowers. *Current issues in economics and finance.* Federal Reserve Bank of New York, February.

Brito, D. L., & Hartley, P. R. (1995). Consumer rationality and credit cards. *Journal of Political Economy, 103,* 400–433.

Calem, P. (1992). The strange behavior of the credit card market. *Business review.* Federal Reserve Bank of Philadelphia, January/February, p. 3–14.

Calem, P., & Mester, L. (1995). Consumer behavior and the stickiness of credit card interest rates. *The American Economic Review, 85,* 1327–1336.

Castronova, E., & Hagstrom, P. (2004). The demand for credit cards: evidence from the survey of consumer finances. *Economic Inquiry, 42,* 304–318.

Chakravorti, S., & To, T. (2002). A theory of credit cards. Federal Reserve Bank of Chicago, Working paper, p. 1–18.

Consumers' debt rises, credit scores fall. *Cardline, 6, November 24, 2006.*

Cox, D., & Jappelli, J. (1993). The effect of borrowing constraints on consumer liabilities. *The Journal of Money Credit and Banking, 25,* 197–213.

Crook, J. (2001). The demand for household debt in the USA: evidence from the 1995 Survey of Consumer Finance. *Applied Financial Economics, 11,* 83–91.

DeMuth, C. C. (1986). The case against credit card interest rate regulation. *Yale Journal of Regulation, 3,* 201–242.

DeVaney, S. A., & Lytton, R. H. (1995). Household insolvency: a review of household debt repayment, delinquency, and bankruptcy. *Financial Services Review, 4,* 137–156.

Friedland, M. (1993). In any language, credit grantors say "yes!" to scoring. *Credit World, 82,* 13–16.

Gross, D. B., & Souleles, N. (2002). Do Liquidity constraints and interest rates matter for consumer behavior? Evidence from credit card data. *Quarterly Journal of Economics, 117,* 149–185.

Kidane, A., & Mukherji, S. (2004). Characteristics of consumers targeted and neglected by credit card companies. *Financial Services Review, 13,* 185–198.

Kim, H., & DeVaney, S.A. (2001). The determinants of outstanding balances among credit card revolvers. *Financial Counseling and Planning, 12,* 66–77.

King, A. S., & King, J. T. (2005). The decision between debit and credit: finance charges, float, and fear. *Financial Services Review, 14,* 21–36.

Rosenberg, E., & Gleit, A. (1994). Quantitative methods in credit management: a survey. *Operations Research, 42,* 589–613.

Spencer, J. (2006). A new threat to your credit rating: unpaid parking tickets, library fees start to hurt consumer credit as strapped cities seek payment. *The Wall Street Journal, 3,* D1.

Stavins, J. (2000). Credit card borrowing delinquency, and personal bankruptcy. *New England Economic Review, July/August,* 15–30.

Sullivan, A. C., & Worden, D. (1995). Credit cards and the option to default. *Financial Services Review, 4,* 123–136.

Yilmazer, T., & DeVaney, S. A. (2005). Household debt over the life cycle. *Financial Services Review, 14,* 285–304.