Consumer Preference for Convenience, Adoption of Card Reader Technology, and Effect on Sales

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Abstract

Utilizing data from Los Angeles gasoline retailers, we consider the potential role of consumers' preference for credit on sales and provide estimates quantifying the effect on sales of installing credit card acceptors at gasoline pumps. We also consider how retailers' timing of adoption affects this return.

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1. Introduction

During the past 15 years, there has been a rapid adoption of a new payment technology by an important commercial segment of the economy, namely the growing use of card-readers at gasoline service stations. The purpose of this paper is to examine the effect of adoption on individual stations' gasoline sales, thus providing evidence of the gains to adopting this new technology that helps explain its rapid implementation.

The framework for our analysis is the classic differentiated product markets introduced by Perloff and Salop (1985), but with an important addition. Namely, we assume that sellers can obtain an advantage over competitors by adopting a new technology, which we formally introduce into the model by assuming that when some consumers draw from a distribution of values to determine the gross surplus to buying from different sellers, the distribution they draw from is "better" in the first-order stochastic dominance sense for sellers offering the new payment technology.[2] Simulations of the model illustrate the gains to adopting this technology, which are greatest for the sellers who adopt first. Of course, if the cost of adoption is sufficiently small, then all sellers would simultaneously adopt. However, our empirical findings show that not all sellers adopt at once. This suggests heterogeneity across sellers that may affect the timing of adoption. We identify two factors below that our data indicate have important predictive power in determining whether and when a seller adopts this technology.[3]

First, consider differences in the proportion of customers drawing from the preferred distribution with stations that offer card-reader technology. Brands of gasoline that encourage

[2] The value to card-readers at the pump is several fold. First, it reduces the time spent fueling, without waiting in line to pay. The faster refueling also provides benefits to other customers by reducing congestion at the station. Second, a card acceptor allows customers to stay with their vehicle, eliminating the need to unfasten small children or lock the car.

[3] A complete characterization of our model, along with its implications for price, appears in Barron, Offenberg, and Umbeck (2004).

credit-card payments will have a larger proportion of their customers who value technology that allows card payment at the pump. For these stations, the value of adopting the new technology first will be greater. We thus find earlier adopters of new payment technology to be sellers with a higher proportion of customers who already pay using credit or debit cards. Such sellers are often major brand gasoline stations, so it is not surprising that we find sellers of major brands to be more likely to adopt first.

Second, in locations with high fixed costs, equilibrium implies a smaller number of stations per customer, with higher volume per fueling station. Other things equal, it can be shown that higher-volume stations have a greater value to adopting the new technology. Given a fixed cost of adopting, it is not surprising then that a second determinant of an early adopter is the size of the station. Specifically, we find that higher-volume stations are more likely to adopt card reader technology early.

In sum, we have found that the early adoption of card reader technology on gasoline pumps is more likely for branded versus unbranded stations and more likely for higher-volume stations. We now turn to evidence from the Los Angeles area that quantifies the effect on sales of installing credit card acceptors. In doing so, we also provide measurable evidence of consumers' preference for credit as a payment mechanism.

2. Empirical Evidence on Effects of Card Acceptors

By providing the benefits of card acceptors to customers, a retail gasoline seller can differentiate its station from competitors in a market. However, it is unclear whether this differentiation would produce any substantial changes in their volume of sales. The results reported below demonstrate that it does. Our analysis relies on Whitney-Leigh annual census

data drawn from the Los Angeles area from 1992 to 1998.[4] Table 1 indicates the average monthly volume, number of stations in the census, and the percent of stations with a card reader. The proportion of stations with a card reader is increasing over time during this period.

Table 2 provides descriptive statistics for the variables used in the regression model of station volume determination. Table 3 reports the result of ordinary least-squares (OLS) and fixed-effects estimations of the determinants of monthly gasoline sales. The variables included are the number of hours open per week, year dummy variables (the excluded year is 1998), dummy variables indicating various attributes of the station (car wash, repair bay, ATM), dummy variables indicating an independent or ARCO brand station (excluded brands are major brands), a dummy variable indicating if the station is a jobber, and a dummy indicating the key variable of interest, if there is a "multi-product dispenser" with a credit card acceptor.

Among the expected findings are that stations that are open longer, have no repair bays, or have a car wash have larger volumes. Interestingly, a station with a credit-card acceptor has an expected volume around 46,500 gallons higher per month than stations that do not. Note that the average monthly volume across all stations is 125,021 gallons. The addition of a credit card reader at the pump may increase a station's volume of sales by as much as 37%.

The second column in Table 3 reports the estimation results for a fixed-effect model that looks at differences across time for each station depending on a change in the station's characteristics. Thus, since location never changes for a particular station, location variables have no variation and are dropped from the estimation. Not surprisingly, we find a much lower effect for card acceptors, with volume increasing by 20,183 gallons, other things equal. However, the 16% increase in volume from installing a credit card reader is still significant.

[4] Whitney-Leigh is now Burnett and Associates.

The third column in Table 3 incorporates separate coefficients depending on the year of conversion to card reader technology, corresponding to the order in which stations adopt. We find that order affects the impact on average volume of sales, which demonstrates how the timing of card reader adoption plays a large role in determining the return to retailers. For instance, a firm installing a card acceptor in 1992 receives an additional 12,000 in volume, while a firm adopting in 1995 sees a larger difference, at around 21,000.

Our analysis indicates that, if all stations were identical except for card payment technology, then the stations that adopt first would experience the greatest return. Yet we find larger increases in volume for later adopters. One reason for this might be that, over time, the proportion of consumers who value the new technology increases as individuals became aware of the advantages of the new technology. According to credit bureau data assembled by Trans Union, LLC, over this time period there was substantial growth in the acquisition of credit cards in the Los Angeles area, as seen in Figure 1.[5] This occurrence likely contributed to an increase in the proportion of customers who value the new technology, and thus the continued adoption of the technology over time.

5. Conclusion

Greenspan once noted the important of the rapid rate of installation of "multifunctional electronic terminals in the retailing sector, particularly at gasoline service stations…" (1996, p. 692). Our paper is able to provide evidence why this rapid increase may have occurred, as we demonstrate that adoption led to substantial increases in sales. With this result, we are also able

[5] These data reflect quarterly samples of credit reports. Each quarterly sample contains approximately 30 million depersonalized credit reports, aggregated at the county level. The Los Angeles area is defined as Los Angeles, Orange, Riverside, San Bernardino, and Ventura County.

to provide empirical evidence of consumers' preferences for using credit as a mechanism of payment, consistent with research on competition between credit and fiat money.[6]

Further, we show that not all stations adopt simultaneously, as branded stations and stations with larger volume tend to convert to the new payment technology earlier. However, the return to adoption still clearly exists in later periods, which may be due in part to an increasing proportion of consumers who value the new payment technology.

[6] See, for example, Shi (1996), who shows that, "credit dominates money in the rate of return when they coexist" (p. 629), and that, "Although money is [an attractive medium of exchange], not everyone has it" (p. 639). We lend an additional element to this argument by claiming that conveniences, such as credit card acceptors on gasoline pumps, may help contribute to consumer preference for credit.

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Table 1
Characteristics of Stations in Los Angeles (Whitney-Leigh)

	Characteristic		
Year	*Average Monthly Volume*	*Number of Stations*	*Percent with Card Reader*
1992	108,170	4,378	19.4%
1993	115,449	4,313	28.5%
1994	119,554	4,257	37.8%
1995	119,473	4,183	45.3%
1996	133,781	4,120	55.0%
1997	136,275	4,076	61.2%
1998	145,107	3,962	67.7%
Overall	125,021	29,289	44.5%

Table 2

Descriptive Statistics for Variables Used in Regression Model of Monthly Gasoline Sales

Variable	***Mean***	***Standard Deviation***	***Minimum Value***	***Maimum Value***
Monthly gasoline volume	125,021	76,027	300	696,100
Dummy variable for ARCO brand station	0.153	0.360	0	1
Dummy variable for Independent brand station	0.148	0.355	0	1
Dummy variable is station a jobber	0.187	0.390	0	1
Dummy if ATM present at station	0.328	0.470	0	1
Dummy if card reader at station	0.445	0.497	0	1
Dummy if station has repair services	0.443	0.497	0	1
Number of weekly hours station open	146.627	32.408	40	168
Dummy variable if station has car wash	0.072	0.258	0	1
Dummy variable if station offers full-serve	0.237	0.426	0	1
Dummy variable if year equals 1992	0.149	0.357	0	1
Dummy variable if year equals 1993	0.147	0.354	0	1
Dummy variable if year equals 1994	0.145	0.352	0	1
Dummy variable if year equals 1995	0.143	0.350	0	1
Dummy variable if year equals 1996	0.141	0.348	0	1
Dummy variable if year equals 1997	0.139	0.346	0	1

Table 3
OLS and Fixed-Effects Estimations of Monthly Gasoline Sales for Los Angeles

Variable	*OLS Estimation*	*Fixed-Effects Estimation*	*Fixed-Effects Estimation*
Dummy variable for ARCO brand station	71,977.32	29,959.01	30,561.88
	(75.46)***	(14.04)***	(14.29)***
Dummy variable for Independent brand station	-13,601.70	-3,167.00	-2,731.16
	(11.31)***	(2.41)**	(2.06)**
Dummy variable is station a jobber	-4,176.92	-5,224.71	-4,472.44
	(3.75)***	(3.08)***	(2.63)***
Dummy if ATM present at station	2,076.63	2,154.37	1,841.38
	(2.60)***	(2.90)***	(2.47)**
Dummy if card reader at station	46,489.37	20,183.78	
	(60.73)***	(24.46)***	
Dummy if card reader at station and year equals 1992			11,951.51
			(7.32)***
Dummy if card reader at station and year equals 1993			16,032.81
			(11.07)***
Dummy if card reader at station and year equals 1994			22,031.31
			(16.02)***
Dummy if card reader at station and year equals 1995			20,956.24
			(15.49)***
Dummy if card reader at station and year equals 1996			24,776.12
			(18.15)***
Dummy if card reader at station and year equals 1997			21,775.25
			(15.53)***
Dummy if card reader at station and year equals 1998			21,591.03
			(14.53)***
Dummy if station has repair services	-8,311.52	-9,083.78	-8,850.13
	(11.49)***	(6.25)***	(6.09)***
Number of weekly hours station open	750.71	350.40	353.32
	(70.20)***	(17.49)***	(17.65)***
Dummy variable if station has car wash	20,154.50	10,245.40	9,760.45
	(16.50)***	(3.99)***	(3.80)***
Dummy variable if station offers full-serve	6,556.23	1,018.19	725.79
	(7.52)***	-0.93	-0.67
Dummy variable if year equals 1992	-7,160.33	-12,533.10	-9,881.92
	(5.73)***	(12.33)***	(7.03)***
Dummy variable if year equals 1993	-4,930.77	-9,548.79	-7,381.29
	(4.02)***	(9.84)***	(5.29)***
Dummy variable if year equals 1994	-5,792.18	-9,463.12	-9,210.17
	(4.89)***	(10.39)***	(6.62)***
Dummy variable if year equals 1995	-10,067.00	-12,252.10	-11,664.60
	(8.58)***	(13.75)***	(8.34)***
Dummy variable if year equals 1996	-2,403.52	-2,361.01	-3,942.31
	(2.07)**	(2.72)***	(2.76)***
Dummy variable if year equals 1997	-4,123.89	-3,456.90	-3,445.25
	(3.55)***	(4.01)***	(2.36)**
Constant	-8,980.48	71,079.35	69,482.57
	(4.85)***	(22.03)***	(20.86)***
Observations	29,289	29,289	29,289
R-squared	0.55	0.11	0.11
Number of groups		5,480	5,480

Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Figure 1
Proportion of LA Area Consumers With Positive Aggregate Debt Balance in Credit Bureau Files
That Have One or More Active Bank Revolving Accounts