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The Value of Payment Instruments: Estimating Willingness to Pay and Consumer Surplus

Tai Lam and Crystal Ossolinski

RDP 2015-03

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Abstract

This paper draws on a survey of consumers' willingness to pay surcharges to use debit cards and credit cards, rather than cash. Just as the price a consumer is willing to pay for a good or service is indicative of the value he/she places on that item, the willingness to pay a surcharge to use a payment method reflects that method's value to that consumer, relative to any alternatives.

We find a wide dispersion in the willingness to pay for the use of cards. Around 60 per cent of consumers are unwilling to pay a 0.1 per cent surcharge, which suggests that for these individuals, the net benefits of cards are very small or that cash is actually preferred. At the other end of the distribution, some individuals (around 5 per cent) are willing to pay more than a 4 per cent surcharge, indicating they place a substantial value on paying using cards. On average, consumers have a higher willingness to pay for the use of credit cards than debit cards. This difference can be viewed as the additional value placed on the non-payment functions – rewards and the interest-free period – of credit cards. We estimate that on average credit card holders place a value of 0.6 basis points on every 1 basis point of effective rewards rebate.

Based on the survey data and information on the costs to merchants of accepting payment methods, we can predict the mix of cash, debit card and credit card payments chosen by consumers under different levels of surcharging and explore the implications for the efficiency of the payments system. In particular, the consumer surplus in a scenario where merchants do not surcharge and the costs of all payment methods are built into retail prices can be compared with that where merchants surcharge based on payment costs and retail prices are correspondingly lower. Our findings suggest that cost-based surcharging leads to some consumers switching to less costly payment methods, resulting in greater efficiency of the payment system and an increase in consumer surplus of 13 basis points per transaction.

JEL Classification Numbers: C83, D12, D61, E42

Keywords: discrete choice experiment, consumer payment choice, consumer surplus, retail payment systems

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1. Introduction

Consumers have significant decision-making power in the choice of which payment method to use to pay for purchases. Standard economic models would suggest that an individual will chose the option that gives them the greatest net benefit (i.e. the greatest benefit once costs are taken into account). Consumers are likely to value different payment methods based on their features; for example, cash may offer greater privacy, while the use of debit or credit card payments may allow consumers to carry less cash. Measuring the value that consumers place on different payment instruments is a key step in understanding consumers' choice of payment instrument and how this choice may change if an explicit price (a surcharge) is charged on some payment instruments at the point of sale. Having a measure of the relative value also enables the calculation and comparison of changes in consumer surplus at different price levels.

Although previous research has looked extensively at how consumers' characteristics affect the choice of payment method, few studies have looked to measure the relative value that consumers place on using different payment methods. One reason is that data are scarce; explicit pricing of payment products at the point of sale is not common practice and so it is difficult to observe directly how consumers will behave when they do face a price.

To overcome the lack of data, we adopt an approach used widely in other areas of economics and apply it to measuring the value of payment methods. Using a modified form of a discrete choice experiment (DCE) as implemented in the Reserve Bank of Australia's 2013 Survey of Consumers' Use of Payment Methods, we obtained consumers' stated willingness to pay for debit card and credit card payments. Specifically, two DCE questions measured the maximum surcharges that 1 167 consumers were willing to pay to make a $50 purchase using a debit card and a credit card, respectively, instead of using cash. The results can be interpreted as the relative value that each consumer places on using debit cards and credit cards instead of cash.

Using this novel dataset, we first aim to quantify in monetary terms the value that consumers place on debit card and credit card payments relative to cash payments. We show that there is considerable heterogeneity in respondents' willingness to pay for debit card and credit card payments and that the proportion of consumers willing to pay to use a payment method decreases in a plausible way in response to an increase in the surcharge. Positing that the heterogeneity is likely to be related to the characteristics of the consumer and the features of the card that they hold, we attempt to measure the value that consumers place on two specific features of credit cards: interest rates and rewards programs.

Our second aim is to show how information on consumers' willingness to pay for different payment methods can be used to understand payment method choice, particularly in response to surcharging of payment methods. We examine how consumers' use of payment methods may change when the costs of each method are transparently passed on to consumers at the point of sale through a surcharge instead of being built into, and increasing, the baseline price across all consumers. We outline a model in which consumers choose the payment method that offers them the greatest benefit at the point of sale. We then explore how consumers switch between cash, debit card and credit card payments when a cost to consumers is introduced in the form of a surcharge, considering a range of hypothetical cost scenarios. The aggregate consumer surplus is calculated for each scenario, providing an objective criterion to rank the efficiency of each scenario. Measuring consumer surplus is a key advantage of obtaining willingness-to-pay data using DCE.

2. Literature

Our paper measures the consumers' benefit derived from the use of payment cards and examines how the mix of payments may change under direct pricing. To date, these two themes have been approached in two quite different ways.

There have been a number of attempts at quantifying consumer benefits from the use of different payment methods. These papers include a seminal paper by Garcia Swartz, Hahn and Layne-Farrar (2004) for the United States and a similar paper for Australia by Simes, Lancy and Harper (2006). The two papers hypothesise a range of features for card payments methods, which include, where appropriate, record-keeping, privacy, float (deferred payment), access to a line of credit, rewards and cash-out features. They then build up the aggregate consumer benefit from separate component estimates of the benefits of each feature. These components are valued using a variety of methods including: opportunity cost, explicit prices and inferred benefits.[1] However, since some of the benefits were quantified at cost or indirectly, it may not necessarily be the case that consumers would actually attach the estimated values to those benefits. Our methodology differs in that valuations are elicited directly from consumers and heterogeneity in valuations is permitted.

More recently, a number of papers have used cross-sectional databases to quantify the consumer response to transaction-based pricing.[2] Borzekowski, Kiser and Ahmed (2008) used survey data on debit card adoption and use to evaluate how US consumers reacted to per-transaction prices on card payments. They found that the likelihood of a consumer using a debit card was 12 percentage points lower if the consumer was charged a 1.8 per cent transaction fee by their issuing bank. Bolt, Jonker and van Renselaar (2010) is the closest to our own paper in that it evaluated consumers' responses to a surcharge at the point of sale. Using data from a survey of merchants on the share of sales made using a debit card and the merchant's surcharge on debit cards, they found that removing the average 2.3 per cent surcharge on small-value payments would increase the use of debit cards by around 8 percentage points. In contrast, Ching and Hayashi (2010) and Simon, Smith and West (2010) evaluated how the implicit price incentive provided by reward programs stimulates use of the payment method to which the rewards are attached. The same conclusions apply; consumers are prompted to increase their use of payment methods which have greater rewards and lower prices.

Our approach builds on these two streams of work, but is distinct in its methodology and use of stated preference data. First, we directly measure the value that consumers place on cards, and specific features of credit cards, by eliciting how willing individuals are to pay to use those cards through a DCE. The approach then enables us to evaluate how Australian consumers' payment choices might

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1 For example, privacy was valued at the discount forgone on not belonging to a store loyalty program, reward points were valued at the cost of purchasing rewards points and the float (deferred payment) was valued as the interest gained on the free funds.

2 An early paper was Humprey, Kim and Vale (2001), which used aggregate time series data to evaluate how pricing affected the use of payment products.

respond to different surcharge levels, using a different approach to that of Bolt *et al* (2010) for the Netherlands. Our data also allows us to calculate the changes in consumer surplus that occur as a result of consumers' payment choices.

To the best of our knowledge, this paper presents the first use of DCE and contingent valuation techniques in valuing card payments. DCEs involve a hypothetical question posed to respondents where they must choose between two or more outcomes that differ in their characteristics (e.g. price and features). They are an important and flexible tool in valuing goods or services where the prices are not observable or markets do not exist, including in environmental, health and transport economics. Hausman (1993), Carson, Flores and Meade (2001) and Kling, Phaneuf and Zhao (2012) provide reviews and critiques of this extensive area of literature. We are motivated to use a modified form of DCE to gather data because it allows us to observe the willingness to pay for all respondents. In contrast, the revealed preference data that we use only contain information about when a respondent both faces a surcharge (which is relatively rare) and chooses to pay it.

3. Data

We use data from the Reserve Bank of Australia's 2013 Survey of Consumers' Use of Payment Methods (the Survey). The dataset consists of 1 167 individuals representative of the Australian adult population and includes information on respondents' demographic characteristics, their ownership of debit and credit cards, their use of various payments methods as logged by a week-long diary, and information about their preferences as to payment attributes. The Survey was conducted by Colmar Brunton during November 2013. Full details of the survey methodology and results of the study are available in Ossolinski, Lam and Emery (2014).

In addition, we use data on the features of the credit card held by the respondents. As part of the Survey, each respondent identified their most commonly used credit card and debit card. The detailed features of the credit cards were obtained from information on card issuers' websites.

In the Australian market, institutions issuing credit cards typically offer a number of card product categories that involve different mixes of card features.[3] The main credit card features that we are interested in are the rewards program and the interest rate. We quantify the generosity of the rewards program on cards by the rewards rebate – which we calculate to be $100 divided by the spending required to obtain a $100 major store gift card (i.e. the effective rebate on a $1 of spending).[4] Around 40 per cent of respondents held cards without rewards programs (Table 1). Around 5 per cent of respondents belong to premium rewards programs that provide a rebate of over 100 basis points.

The interest rate charged on credit card purchases after the expiry of the interest-free period (typically 30–55 days) can vary from card to card. Posted interest rates on card products vary from 10 per cent per annum to over 22 per cent, although the majority of respondents held cards that have an interest rate of 18–22 per cent.[5] Charge cards require their users to pay the balance in full each month and thus do not charge interest on their balances. Credit card holders can be divided into those that pay their balance in full prior to the interest-free period expiring (transactors) and those who revolve their credit card balances (revolvers).

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3 Credit cards are often classified into standard, low-rate and premium cards, which all attract different annual fees. Standard cards provide a moderate level of rewards and attract a moderate annual fee. Low-rate cards specialise in offering comparatively low rates of interest, but may attract higher annual fees than standard cards, and typically offer no rewards. Lastly, a premium category of cards exist that have high rewards, provide extra services (e.g. travel insurance, price protection, or concierge services), but are offset by a high annual fee.

4 Basing our measure on gift cards from major store chains provides us with a comparable measure of generosity across different rewards programs. There may nevertheless be some imprecision with our measure; for example, some rewards programs are designed around the redemption of air travel benefits, the value of which is difficult to measure given the differing and fluctuating prices of air fares.

5 Most financial institutions offer zero interest balance transfers for individuals switching credit card providers. This may mean the posted interest rate is not reflective of the interest costs some credit card holders may actually face.

Table 1: Characteristics of Credit Cards Held by Respondents

	Number of respondents	Per cent of credit card holders
Debit card ownership	938	
Credit card ownership	605	100
Credit card features		
Rewards rebate (bps)[(a)]		
No rewards rebate	234	39
20–39	57	9
40–59	151	25
60–79	128	21
80–99	5	1
≥ 100	30	5
Interest rate (per cent)		
No interest (charge cards)	37	6
10–13.99	95	16
14–17.99	58	10
18–21.99	408	67
≥ 22	7	1
Premium services	218	36

Note: (a) The rewards rebate is calculated as $100 divided by the spending required to obtain a $100 major store gift card

Sources: Authors' calculations based on survey data; RBA

3.1 The Modified Discrete Choice Experiment

The modified DCE itself was contained in a questionnaire answered by respondents after they had completed the week-long payment diary. Responses were collected online from 1 069 participants and via a paper questionnaire from another 98 participants who did not have access to the internet. The modified DCE was shortened for the paper participants as there were concerns that participants would not follow the full sequence of questions in a paper format. This paper draws only on the responses of the online participants who faced the full sequence of modified DCE questions and, for credit card holders, provided the necessary details to identify their primary credit card. The sample of 938 participants is representative of the Australian population aged over 18 years (see Table A1).

The DCE asked respondents to consider a hypothetical situation in which they are making a $50 transaction at a store. Respondents were told that they had their typical amount of cash on them and their most commonly used debit card. They were required to choose whether to pay using a debit card and pay a 1 per cent surcharge, or to make the purchase using cash with no surcharge. Contingent on whether they chose to proceed with their debit card or proceed with cash, two follow-up questions were posed where the level of the card surcharge was increased or decreased to refine the respondent's range of willingness to pay (as per the logic described in Table 2).[6] From the series of questions, the willingness to pay of each respondent can be identified as falling within one of eight willingness-to-pay ranges listed in Table 2.

Table 2: DCE Questions and Resulting Respondent Willingness-to-pay Range

Decision to proceed with card payment; per cent of card surcharge on $50 transaction

1st question		2nd question		3rd question		Resulting willingness-to-pay range
1%	if Yes	3%	if Yes	4%	if Yes	≥ 4%
					if No	3–4%
			if No	2%	if Yes	2–3%
					if No	1–2%
	if No	0.5%	if Yes	0.75%	if Yes	0.75–1%
					if No	0.5–0.75%
			if No	0.1%	if Yes	0.1–0.5%
					if No	< 0.1%

Source: RBA

The sequence of three questions was repeated for credit card holders with the variation that the respondent had to choose between using their most commonly used credit card and paying the surcharge, or using cash (which did not attract a surcharge) to make the purchase. (All respondents held debit cards and thus

6 In more-typical implementations of DCE, price levels faced by respondents are randomised to create additional variation and mitigate the effects of anchoring (where respondents' answers are influenced by a value shown earlier in the question or by the answer structure of the DCE). Randomisation was not possible in the Survey.

answered the debit card questions.) The results of the two sequences of questions is that we observe each respondent's willingness-to-pay range for the use of credits cards (provided they own a credit card) and separately, their willingness-to-pay range for the use of debit cards, both relative to the cash alternative. The questions were designed to allow comparison, assuming transitivity, of the willingness to pay for the use of debit cards and credit cards against a common baseline (the use of cash).

The DCE was designed to limit certain biases that can be introduced when asking for stated preference data.[7] The scenario was designed to be realistic so that respondents could provide an answer that is representative of their actions in the real world. First, surcharging is a known practice in Australia and the range of surcharge values included in the hypothetical scenario was also realistic, which should have helped to reduce hypothetical bias. Further, the \$50 price point was specifically chosen to increase the likelihood of measuring the value of the payment function of the card. Debit cards and credit cards are both commonly used for \$50 transactions (Ossolinski *et al* 2014). At values of \$100 or higher, credit cards are more frequently used than debit cards, presumably because liquidity constraints factor increasingly in the consumer's decision of which payment method to use as the value of the payment increases. Finally, data from the Survey indicated that 55 per cent of respondents at the beginning of the Survey carried enough cash to make this payment without needing to go to an ATM.[8]

The realism and simplicity of the scenario may, however, have unintended effects. First, it is possible that some consumers may refuse – both in reality and in our scenario – to pay a surcharge due to strong negative feelings to additional charges applied at the point of sale rather than due to an objective evaluation of the benefits of different instruments; this behaviour is necessarily outside our model. Second, some consumer advocacy groups have advanced 1 per cent as a reasonable

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7 For a critique of the use of willingness-to-pay estimation techniques see Kling *et al* (2012).

8 The Survey data only provides information on the amount of cash respondents held at specific points in the Survey rather than their 'typical' amount. The DCE uses the 'typical' amount of cash as a way of framing the situation under realistic conditions, and the amount of cash is not intended to serve as a constraint for the respondents' answers. The DCE responses suggest this was not interpreted as a constraint, as respondents who held less than \$50 at the start of the Survey were distributed relatively evenly across each willingness-to-pay range and were not over-represented in the group of respondents willing to pay the 4 per cent surcharge.

surcharge on credit cards, which may have influenced respondents' own valuation of the benefit of cards. Third, all respondents faced the same surcharge level of 1 per cent in the first question of the DCE (randomisation was not possible), which may have anchored their responses to subsequent questions.

A final issue is that $50 is a whole number also equal to the value of one of the Australian banknotes; this is likely to lower the perceived cost of using cash and increases the probability of using cash relative to payments in the nearby price range.[9] Our results, therefore, are going to be most applicable to point-of-sale payments of around $50. Payments data from the same sample of consumers suggest that payments of $50 account for around 2 to 3 per cent of the number and value of all point-of-sale payments, whilst payments of between $40 and $60 make up around 13 per cent of the number and value of all point-of-sale payments. Despite the small shares, these are non-trivial amounts considering that over $300 billion is spent at the point of sale each year.

Importantly, however, any biases and caveats are likely to affect the willingness to pay for the use of debit cards and credit cards equally. This provides us with more confidence in comparing the value of the payment function of debit cards relative to credit cards, a key measurement of interest for this paper.

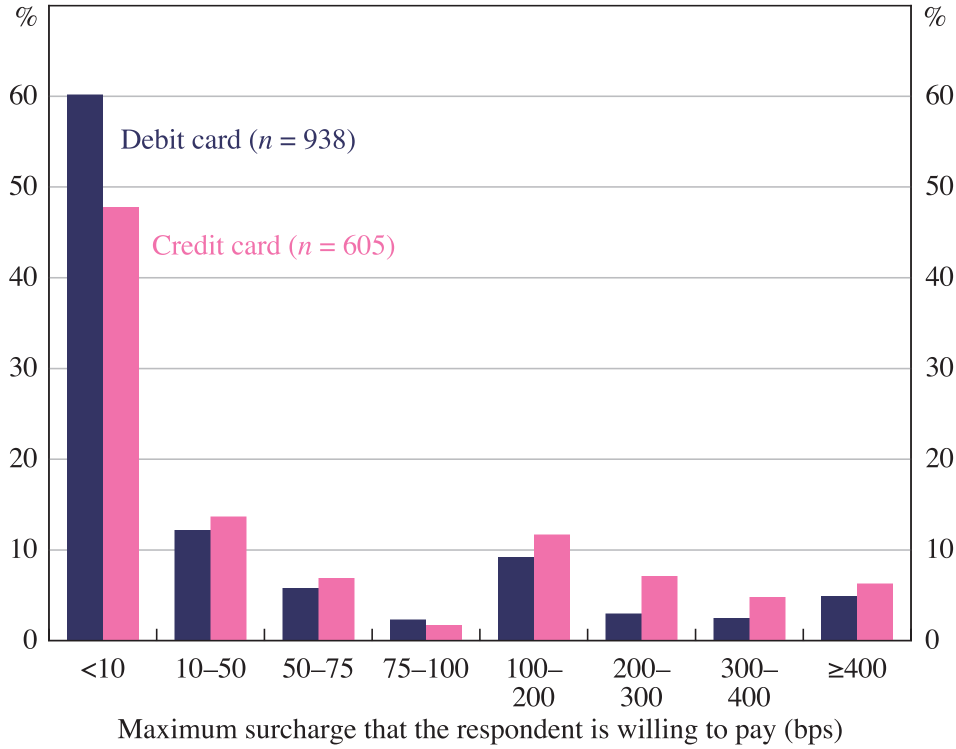
4. Distribution of Willingness to Pay for Card Payments

The share of respondents in each willingness-to-pay range is shown in Figure 1. There is noticeable heterogeneity in respondents' willingness to pay for card payments.

9 Payments data from the same sample of consumers indicate that the share of payments made using cash rises from around 35 per cent for all point-of-sale payments between $40 and $60 to around 50 per cent for payments of exactly $50. This may reflect that the speed of the transaction is lower when change is involved, or that individuals prefer not to receive change.

Figure 1: Maximum Willingness to Pay

Per cent of card holders with a maximum willingness to pay within that range



Note: Surcharge ranges are up to but not including the upper end of the range, such that there is no double counting

Sources: Authors' calculations based on survey data; RBA

Around 60 per cent of respondents indicated that their willingness to pay to use debit cards was less than 10 basis points when cash was an alternative. This proportion was lower for credit cards; around 47 per cent indicated a willingness to pay less than 10 basis points. For these consumers, cards appear to offer no additional value over cash at this price point ($50); cash may even be valued more highly as a payment method. At the other end of the distribution, around 5 per cent of respondents were willing to pay at least 400 basis points to use a debit or credit card, suggesting a small proportion of individuals value card payments quite highly.

The DCE data accords well with diary data on the surcharges that were paid during the week of the Survey. While respondents who were willing to pay 400 basis points or more to use credit cards made only 6 per cent of point-of-sale payments, these individuals paid 10 per cent of all point-of-sale surcharges recorded. Likewise, respondents who said they were unwilling to pay even a 10 basis point surcharge made 46 per cent of payments, but only paid 25 per cent of surcharges.[10] This correlation between the answers to the DCE and behaviour observed in the diary gives us confidence in the use of the DCE to estimate willingness to pay. A more detailed crosscheck of the two types of data is limited by the small sample of surcharges that were paid and recorded during the Survey and the incomplete information regarding surcharges recorded in the diary. In particular, the diary data does not distinguish between a transaction that did not attract a surcharge and a transaction that did attract a surcharge, but in which an alternative payment method was used or the transaction discontinued. An additional crosscheck is whether the respondents were observed to have paid surcharges of the value that is consistent with their stated willingness to pay. As expected, a high level of consistency exists for the small number of payments that are similar to the scenario posed in the DCE.

An alternative way to view the data is to plot the percentage of respondents who are willing to pay the surcharge at each level of surcharge (Figure 2). The resulting cumulative distributions are analogous to demand functions.[11] Across the range of surcharge values used in the DCE, these functions appear well-behaved; they are downward sloping and more elastic at lower price points than higher price points. At each level of surcharge, a higher portion of respondents are willing to pay for the use of a credit card than the use of a debit card, consistent with the additional benefits and features provided by credit cards.

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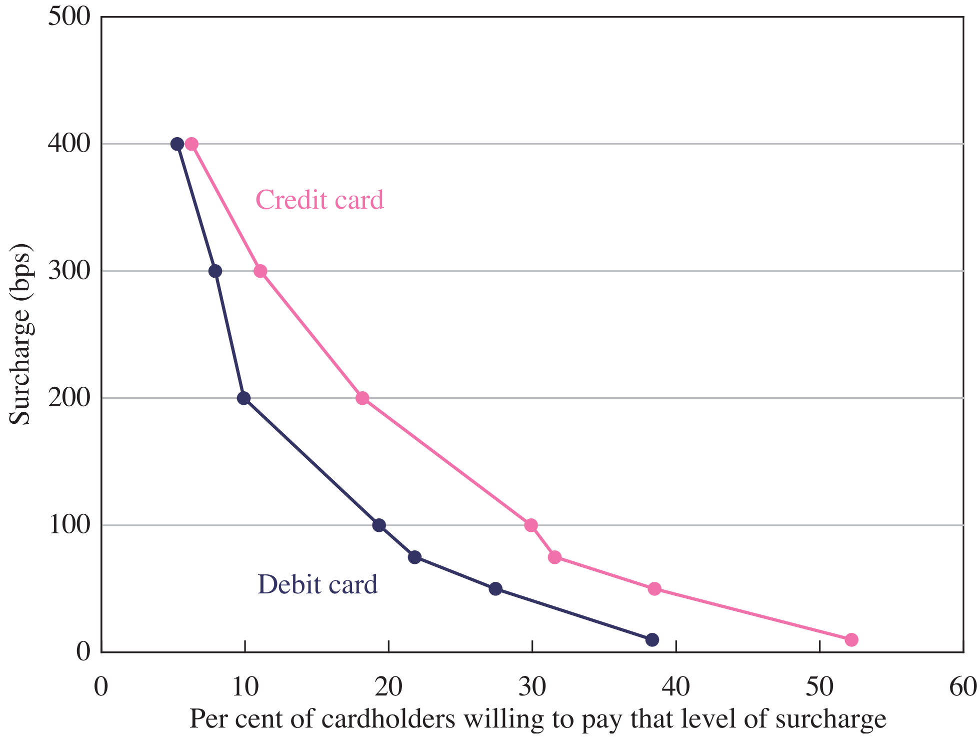
10 Under a simple probit model that regresses the probability that a surcharge is paid with independent variable dummies of the response to the DCE, point-of-sale payments made by individuals unwilling to pay a 0.1 per cent credit card surcharge are statistically significantly the least likely to have paid a surcharge. Individuals in each higher willingness-to-pay range were broadly more likely to have paid a surcharge than the preceding lower willingness-to-pay range, though the small sample means the effect is not necessarily statistically significant if comparing adjacent willingness-to-pay ranges.

11 Each distribution is built on the assumption that all individuals make one payment where they consider the use of debit cards or cash and another where they consider the use of credit cards or cash. This is a more restrictive assumption than underpins a standard demand curve. We do not scale the data by the number of payments made by each individual as the focus on a $50 transaction is already stylised.

Figure 2: Willingness to Pay for Debit Card and Credit Card Payments

Cumulative distribution



Sources: Authors' calculations based on survey data; RBA

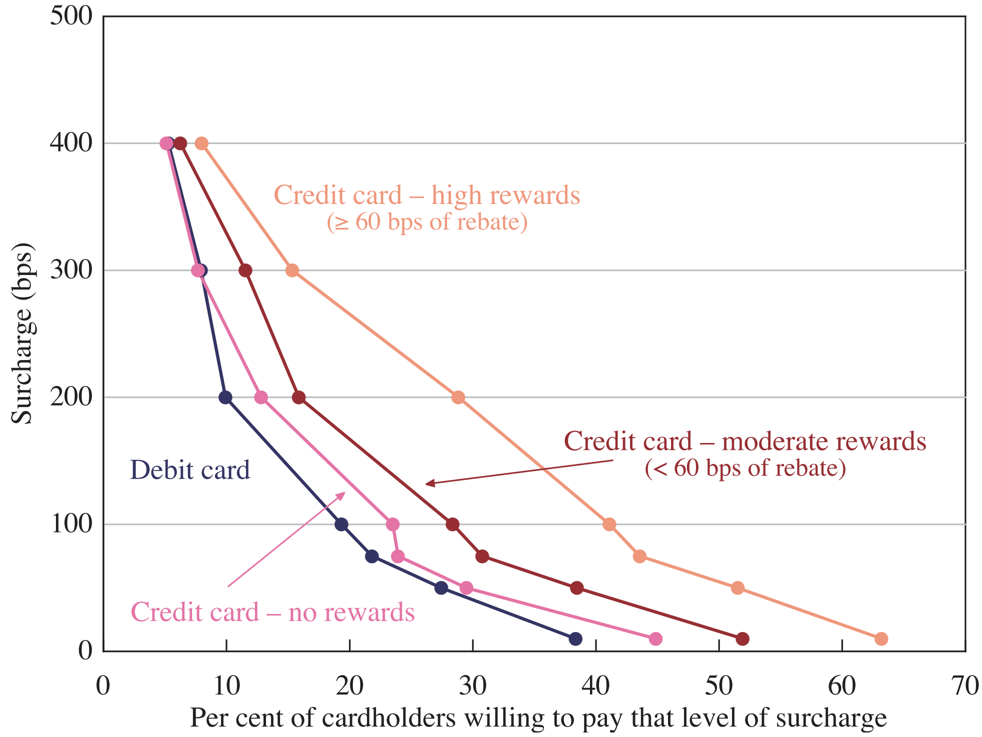
This distribution accords with intuition. In Australia, debit cards do not generally offer any features other than enabling electronic funds transfer at the point of sale. Therefore, the willingness to pay for a debit card is likely to be indicative of the benefits associated with making a payment electronically instead of using cash. These benefits could include: a reduction in cash held or a reduction in the frequency of cash withdrawals due to the ability to access funds electronically at the point of sale; no need to manage change; consideration of tender times (for example, contactless transactions can be faster); or the automatic record of transactions. It should be noted, however, that individuals will also attach value to the benefits of using cash, which could include: privacy, the ability to manage finances; near universal acceptance at merchants; a fast tender time; or to avoid the potential theft of card details. The fact that 60 per cent of respondents reported that they would not be willing to pay even a 10 basis point surcharge to use a debit card instead of cash indicates that many consumers value the use of debit cards and cash similarly, or may even prefer to use cash for the $50 transaction considered in the scenario.

The benefits of electronic payments are shared by credit cards, so that the difference in the willingness to pay for credit cards and debit cards provides an estimate of the value of the additional features of credit cards as a payment instrument for the sample of credit card holders. Given the scenario, the features that should influence our measure of willingness to pay are the benefits that would be realised through the use of each respondent's card for a $50 purchase in a store. These may include access to credit, interest-free periods and reward points based on the value of the purchase. Other features, such as concierge services and travel insurance, may also motivate the use of the card for related purchases of car hire, holiday travel or entertainment services, but these are unlikely to be relevant given the scenario presented in the modified DCE. Any features of the card that are attached purely to ownership (for example, the payment of an annual fee) should not affect the decision of rational consumers to use the card in the scenario.

The role that credit card features play in influencing the willingness to pay for credit cards is depicted in Figure 3. The fact that individuals holding cards with more substantial features are generally willing to pay a higher surcharge suggests that individuals attach some benefit to the features of credit cards. In particular, at all levels of surcharge, holders of cards with more generous rewards are more likely to be willing to pay to use their cards.

Figure 3: Willingness to Pay for the Use of Cards with Different Features

Cumulative distribution



Sources: Authors' calculations based on survey data; RBA

4.1 Average Willingness to Pay

Since our data only indicate a range of willingness to pay for each respondent, the calculation of the average level of willingness to pay requires mapping the data to a continuous distribution. This is also the first step in undertaking the regression analysis completed in Section 5.

We use a standard regression framework for double-bounded willingness-to-pay data developed by Hanemann, Loomis and Kanninen (1991). In this framework, willingness to pay is specified as a latent variable in a discrete choice model. From this model, a likelihood function for the data can be written. Maximum likelihood estimation is then used to estimate the specified parameters (see Appendix B for the details, although a brief outline is given here). We assume willingness to pay is normally distributed; our choice of distribution is discussed further below.

In this model, consumer *i*'s willingness to pay (our variable of interest) to use a card instead of cash is specified as a continuous latent (i.e. unobserved) random variable represented by:

$$WTP_i = \alpha + \varepsilon_i; \quad \varepsilon_i \sim N\left(0, \sigma^2\right)$$

Here, α is the unconditional mean willingness to pay and ε_i is the normally distributed random error term with σ^2 variance. In this section, our focus is on estimating the unconditional sample average and no covariates are included in the model. Sections 5 and 6 expand on this specification by including covariates.

Our observable data are the set of variables that tell us which of the eight ranges of willingness to pay presented in Table 2 the respondent falls into:

$$y_{i,p_l p_u} = \begin{cases} 1 \text{ if } p_l \leq WTP < p_u \\ 0 \quad \text{otherwise} \end{cases}$$

where $y_{i\,p_l,p_u}$ is an indicator variable taking the value 1 if consumer i's willingness to pay lies within the range and 0 otherwise. p_l is the lower bound price of the range and p_u is the upper bound price of the range. The eight ranges of willingness to pay in basis points are: $(-\infty,10)$, $[10,50)$, $[50,75)$, $[75,100)$, $[100,200)$, $[200,300)$, $[300,400)$, $[400,+\infty)$.

The probability that respondent i has a willingness to pay between p_l and p_u is given by:

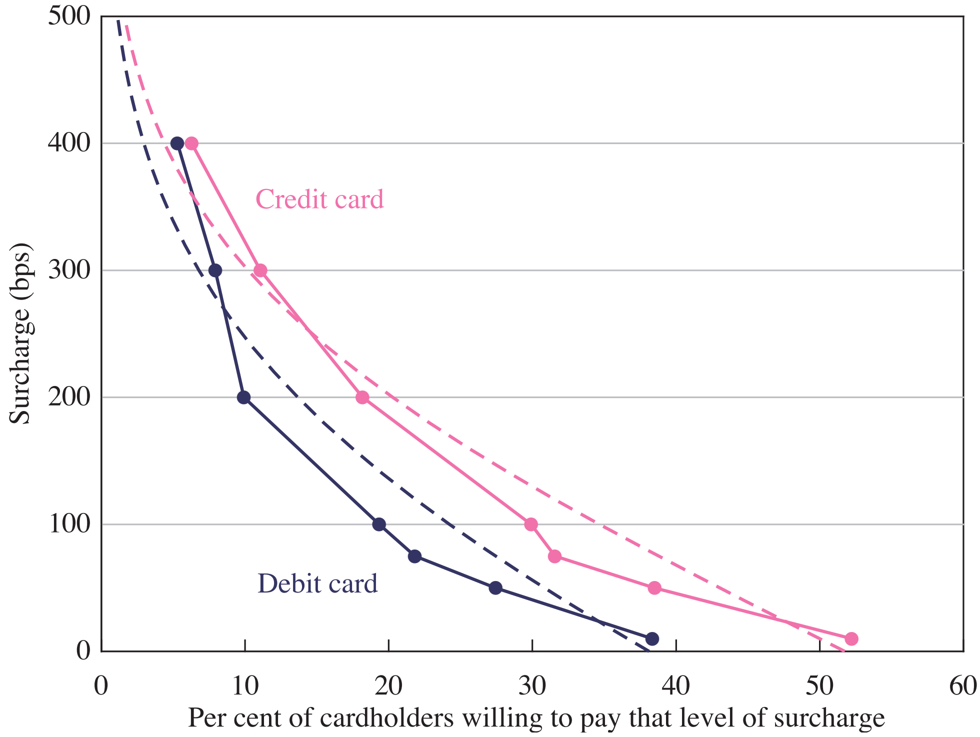
$$\begin{aligned}
\Pr\left(y_{i,p_l,p_u} = 1\right) &= \Pr\left(p_l \leq WTP_i < p_u\right) \\
&= \Pr\left(p_l \leq \alpha + \varepsilon_i < p_u\right) \\
&= \Pr\left(p_l - \alpha \leq \varepsilon_i < p_u - \alpha\right) \\
&= \Pr\left(p_u - \alpha > \varepsilon_i\right) - \Pr\left(p_l - \alpha \geq \varepsilon_i\right) \\
&= F\left(p_u - \alpha\right) - F\left(p_l - \alpha\right)
\end{aligned}$$

Here $F()$ is the normal cumulative distribution function of ε_i. The likelihood function is detailed in Appendix B.

As a first step, two constant-only regressions (i.e. not containing any independent variables) are estimated separately for debit cards and credit cards. The purpose is to provide the summary statistics of our data – the estimate of the mean and variance of the willingness to pay for debit cards and credit cards for our sample. Plotting the estimated cumulative distribution function from the fitted normal distribution against our observed data suggests that our assumption of normality provides an appropriate fit for the data for the positive range of willingness to pay shown in Figure 4.

Figure 4: Estimated Willingness to Pay for Debit Card and Credit Card Payments

Cumulative distribution



Note: Dashed lines are the fitted series

Sources: Authors' calculations based on survey data; RBA

The fact that the willingness to pay of a large proportion of consumers falls in the lowest unbounded range proves to be a problem for estimation. Under the specification of a normally-distributed error, around half of respondents are estimated to have a negative willingness to pay for the use of debit cards and credit cards (i.e. the merchant would need to offer a discount for the use of cards to entice these respondents to pay with a card rather than cash).[12] For these people, we must

12 Specifically, our model predicts that the willingness to pay for debit cards is distributed $N(-76.3, 252.2^2)$ and that willingness to pay for credit cards is distributed $N(10.0, 228.4^2)$.

make a judgement about how accurate this model prediction is and whether this affects the results of greatest interest.

A priori, based on our assessment of the relative benefits of cards and cash, we would expect that willingness to pay for the use of cards is positive, zero or only slightly negative. Data on payment use collected in the Survey shows that 88 per cent of respondents used a card at the point of sale at least once over the week of the Survey. Given that cash is universally accepted at the point of sale, this statistic suggests it is unlikely that our respondents strongly prefer cash (i.e. have large negative willingness to pay). Our preferred option is, therefore, to truncate the distribution at zero; i.e. the mean is calculated averaging willingness to pay if it is predicted to be positive and zero otherwise (see Appendix B). Alternative assumptions consistent with a small negative willingness to pay for card payments are considered for sensitivity analysis.

If we were to assume that willingness to pay was strictly positive, then an alternative assumption could be the log-normal distribution. However, we find that the ‘fat tail’ of the log-normal distribution results in an unrealistically high proportion of individuals being predicted to be willing to pay more than 400 basis points, which skews the average willingness to pay upwards significantly. Accordingly, we judge the truncated normal distribution to be a more representative distribution of the underlying data than a log-normal specification. The comparatively better fit for the portion of respondents with a positive willingness to pay gives us more confidence in this approach. We nevertheless test our results in Section 5 against a log-normal distribution and find similar results. Alternate non-negative distributions are left for future work as they are less commonly used in the willingness-to-pay literature and present greater difficulty for convergence in maximum likelihood estimation.

Table 3 provides the mean willingness to pay (post-truncation) for the use of debit cards and credit cards under a range of assumptions. Assuming that the minimum willingness to pay for a card payment is zero basis points, the median willingness to pay for using debit cards is zero while the mean is 67 basis points. For credit cards, willingness to pay is estimated to be higher on average; the median willingness to pay is 10 basis points and the mean is 96 basis points. We note that the mean willingness to pay for debit cards appears to be similar for both the sample of credit card holders and non-holders despite some differences in the demographic characteristics of these two groups. The average willingness to pay, however, is sensitive to the assumption of the minimum willingness to pay.

The difference in the willingness to pay for debit card payments and credit card payments is less sensitive to the assumption regarding the minimum willingness to pay. The difference suggests that the additional benefit of the payment-related features of credit cards for this group is around 30 basis points. These features include the monetary incentives given to consumers for the use of credit cards, namely the reward points that accrue and the interest-free period.

Table 3: Willingness to Pay for Card Payments

Sample of credit card holders; truncated mean (median); basis points

	Debit card	Credit card	Difference in means
Minimum willingness to pay assumed to be:			
0 bps	67 (0)	96 (10)	29
–10 bps	61 (–10)	91 (10)	31
–20 bps	55 (–20)	87 (10)	32
–50 bps	38 (–50)	74 (10)	36
Memo items (0 basis points minimum):			
Full sample	*67 (0)*		
Sample of people who only hold debit cards	*66 (0)*		

Note: 938 respondents held a debit card, of which 605 respondents also held a credit card

5. Willingness to Pay for the Use of Credit Card Features

5.1 Model

The value that consumers place on debit card and credit card payments appears to be related to the type of card held. To explore this further, we expand the model underlying the econometric analysis in Section 4.1 to include both the characteristics of the respondent and the key features of the credit card that they hold as determinants of a consumer's willingness to pay.

Specifically, the model used to explain a consumer's willingness to pay (WTP_i) is:

$$WTP_i = \alpha + \boldsymbol{x}_i'\boldsymbol{\beta} + \mathbf{z}_i'\boldsymbol{\gamma} + \varepsilon_i$$

where $\boldsymbol{x}_i$ are an individual's list of personal characteristics and preferences and $\mathbf{z}_i$ refers to the features of the card: the rewards rebate per dollar spent and the interest rate. Given the structure of the data, the willingness to pay is necessarily measured in relation to the use of a different payment method, in this case cash. Therefore, the constant term, α, captures the net benefit associated with paying with a card instead of using cash for the baseline individual. This reflects the net effect of the various costs and benefits of cash and cards discussed previously.

Given that an individual's characteristics and attitudes to payment methods may be correlated with their willingness to pay, we favour including a wide range of personal characteristics and preferences as controls in the regression ($\boldsymbol{x}_i$). These include household income, a person's employment status, education and characteristics of their household. Information about what factors – security, speed, privacy, the ability to use their own funds or the desire to avoid charges – the person considers when choosing a payment method at the point of sale was also included to help control for unobserved heterogeneity, following Ching and Hayashi (2010). Two additional card characteristics (whether the card is a premium card or charge card such as American Express or Diners Club) are also included as controls.

Again, the question as to a plausible minimum willingness to pay is relevant to understanding the results. In this analysis, the marginal effects are calculated assuming that the minimum willingness to pay is zero.

5.2 Sample Selection and Endogeneity

The model in this section is estimated for the sample of people who hold a credit card and thus the results in this section are limited to this group. We do not speak to how the value of a credit card payment may differ between credit card holders and non-credit card holders.

Another issue is whether there is a relationship between a person's choice of card and potentially unobserved characteristics that also influence a person's willingness to pay for the features of that card. Ching and Hayashi (2010) suggest such endogeneity may arise because: consumers may choose rewards programs because they use credit cards more often and so expect a higher net benefit from rewards after search costs or an annual fee are taken into account; or consumers with rewards programs may have better knowledge of credit card features, causing them to view credit cards more favourably.[13] However, these issues are not likely to cause meaningful endogeneity in our regression for similar reasons as those discussed in Simon *et al* (2010). First, the payment function of credit cards is very similar to that of debit cards (which are ubiquitous in Australia), and so it is highly unlikely that consumers will learn anything about the non-price features of credit cards from greater use of them. Second, once an individual chooses to hold a credit card, the primary reason to select a card with a rewards program is the monetary benefit of the reward points; which is exactly the feature we wish to value.

Although we conclude that any sample selection or endogeneity issues are minimal, for the interested reader we provide some information about the demographics of credit card and rewards program holders. We model the choice of holding a credit card or not using a probit model, where the latent variable is the utility of holding the card and is determined by demographic and preference characteristics. For the group of credit card holders, we model the choice of reward program membership in a similar fashion. The regression results are presented in Table C1 and some notable results are discussed here.

5.2.1 Credit card holding

Our results on the likelihood of holding a credit card and the likelihood of being a member of a rewards program (see Table C1) are consistent with other papers that link demographic characteristics with credit card holding and use, for example, Klee (2006) and Simon *et al* (2010). Respondents with high incomes and high levels of education are more likely to hold a credit card, whereas respondents aged

13 Ching and Hayashi (2010) also consider a third source of endogeneity; that consumers who use credit cards more frequently may receive pre-approved offers to join rewards programs. This is not relevant in the context of the scenario, which is based on the known qualities of the existing primary card.

under 30 years, as well as respondents who are unemployed or not in the labour force, are less likely to hold a credit card. One reason for this result is that credit card application criteria typically include income and employment status, and may include age. The positive income effect may also reflect the possibility that those who have greater expenditure have greater incentive to own a credit card, as they are more likely to regain the annual fee paid on the card through reward points. Those who are retired are just as likely as those who are employed to hold a credit card.

The results for preferences in Table C1 are intuitive and significant, indicating that these often unobserved personal characteristics are important for determining payment use.[14] Respondents who stated that they value rewards are significantly more likely to own a credit card. In contrast, those that prefer to draw from their own liquidity when making payments and those that value a higher level of privacy are significantly less likely to own credit cards.

5.2.2 Membership of rewards programs

Conditional on holding a credit card, respondents from low-income households are less likely to participate in a rewards program (Table C1). As discussed by Simon *et al* (2010), this is likely to reflect two factors. First, households with lower incomes may be uncertain of paying off their credit card each month, and so may choose to hold low-rate cards, which are much less likely to have rewards programs. Second, households with lower income may have lower expected expenditure and, therefore, might not expect to gain enough reward points through use of credit cards to offset the cost of holding such cards that are likely to have higher annual fees. It may also be more difficult for lower-income households to be approved for cards with more generous reward programs. Those who value spending from their own funds are also less likely to participate in a rewards program, even controlling for income effects and conditional on holding a credit card. This supports the need to control for these factors in our regressions of willingness to pay.

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14 Preferences to avoid charges did not appear to influence credit card ownership. This gives greater validity to the use of a surcharging scenario to gather the willingness to pay for the use of debit cards and credit cards, as respondents that hold credit cards do not appear to have a fundamentally different view of surcharges to those that only hold debit cards.

5.3 Results: Willingness to Pay for Credit Card Features

Table 4 provides the estimation results of the model specification set out in Section 5.1 and methodology detailed in Appendix B. The marginal effects can be interpreted as the average additional willingness to pay across respondents for a given change in the variable of interest, holding the respondents' other characteristics at their observed values. The change will either be a one unit increase for continuous variables or a change from the base case to the alternative for indicator variables. As a crosscheck of the results, we also present the equivalent regression on the willingness to pay for debit cards (where the card feature variables are the respondent's credit card features). We include the card features of the primary credit card of that individual with the expectation that the effect of a respondent's credit card features on the willingness to pay for the use of debit cards will be insignificantly different from zero. This expectation is supported and, further, we find that similar demographic factors affect the willingness to pay for credit cards and debit cards. This correspondence with expectations supports the validity of our interpretation of the results for credit card features.

In line with expectations, the level of rewards rebate for a respondent's credit card has a positive effect on an individual's willingness to pay for credit cards. The marginal effect is estimated to be around 0.6; that is, an increase in the rewards rebate rate of 1 basis point increases the price that individuals in our sample will pay to use their card by 0.6 basis points.

As expected, the rewards rebate does not influence an individual's willingness to pay for debit cards; the estimated marginal effect is zero. This crosscheck provides us with a degree of confidence that the rewards rebate variable is capturing effects specific to the gaining of reward points from the use of credit cards. Contrary to expectations, we find that the posted interest rate on the credit card is not a statistically significant predictor of the willingness to pay for the use of credit cards, although the estimated marginal effect is negative as expected. The effect is not significant even when interacting with the revolver status.

Table 4: Marginal Effect on Willingness to Pay

Sample of credit card holders (*continued next page*)

	Credit card		Debit card	
	Coefficient	Marginal effect[(a)]	Coefficient	Marginal effect[(a)]
		Basis points		Basis points
Card features				
Rewards rebate (basis points)	1.1***	0.6	0.2	0.0
Interest rate (per cent)	–5.2	–2.7	0.9	0.1
Financial status				
Revolver	40.0*	24.0	66.8**	12.4
Premium status	41.4*	24.8	55.7*	8.7
Charge card	–94.3	–31.6	–1.3	–0.2
Age (base = 30–39 years)				
18–29 years	55.0	36.7	81.3*	21.3
40–49 years	11.1	6.2	16.0	1.9
50–64 years	–10.7	–5.2	–10.4	–0.9
65+ years	–10.0	–4.9	–9.8	–0.9
Household income (base = 3rd quartile)				
1st quartile	–12.4	–4.7	1.4	0.1
2nd quartile	37.4	19.8	44.3	6.0
4th quartile	45.0*	24.9	40.7	5.2
Education (base = year 12)				
Year 11 or below	–13.4	–4.8	–13.8	–0.8
Trade certificate	59.7	32.5	65.2	9.2
Diploma	63.7*	35.4	49.6	5.9
Bachelor degree or higher	19.8	8.5	31.7	3.0
Labour force status (base = employed)				
Unemployed	–23.2	–11.2	3.6	0.6
Not in labour force	10.5	5.9	–2.0	–0.3
Retired	6.1	3.3	–47.9	–4.6
Gender (base = female)				
Male	–12.9	–7.0	–21.1	–2.8

Table 4: Marginal Effect on Willingness to Pay
Sample of credit card holders (*continued*)

	Credit card		Debit card	
	Coefficient	Marginal effect(a)	Coefficient	Marginal effect(a)
		Basis points		Basis points
Life stage (base = couple with children)				
Couple, no children	13.4	8.5	–4.0	–0.7
Couple, children left home	–28.3	–14.5	6.7	1.2
Single, no children	–40.4	–19.4	–69.6*	–6.2
Single, children	–41.3	–19.7	–18.6	–2.7
Single, children left home	78.1	61.1	76.7	25.4
Other	1.6	0.9	–9.6	–1.5
Location (base = capital city)				
Regional	–23.3	–11.9	–1.2	–0.2
Preferences				
Speed	–24.8	–13.8	–8.5	–1.3
To avoid charges	–5.1	–2.8	–19.8	–2.8
Greater security	13.0	7.0	–45.7	–5.9
Draw from own funds	–27.9	–15.0	–11.5	–1.7
Greater privacy	5.5	3.0	36.8	6.5
Constant	19.5		–138.9	
Sample size	605		605	

Notes: ***, ** and * denote significance at the 1, 5 and 10 per cent level, respectively
(a) Calculated as the average marginal effect on the sample from a one unit change in the continuous independent variables and a change from the base category to specified case for categorical independent variables; the average is calculated after truncation of willingness to pay at zero for any predictions less than zero (Appendix B); significance not shown

Two additional results are of interest. Premium card holders were found to be willing to pay more for the use of both debit cards and credit cards. While premium cards provide additional benefits like concierge services and travel insurance, the majority of such benefits would not be realised in the hypothetical $50 purchase in question. This result is also independent of the price features of the credit card, which were controlled for by including the interest rate and rewards rebate in the regression. One possible explanation of this result is that premium card holders value the 'prestige' that is a marketing feature of such cards, although this should only influence the result for credit cards.

Second, revolvers are willing to pay more to use both debit and credit cards.[15] Focusing first on the credit card result, it could be expected that revolvers would be willing to pay less than others to use a credit card, as they are likely to immediately incur interest costs for the purchase. However, if the revolver is liquidity constrained and must use credit, they could be more willing to pay, though we do not believe this would be applicable for the $50 purchase posed in the DCE. A possible explanation could be that the revolver variable is capturing a an unrelated effect not accounted for in our other demographic and preference variables. This is supported by the results on the willingness to pay for the use of debit cards, which should not otherwise be influenced by the credit features of the respondents' credit cards. Additionally, while revolvers have a higher willingness to pay for both credit and debit cards than do transactors, the additional benefit that revolvers place on using a credit card above using a debit card is larger than the same for transactors.

Broadly speaking, demographic and preference characteristics appear to play a limited role – after the inclusion of other variables – in explaining the variation in willingness to pay, with most coefficients being statistically insignificant in determining willingness to pay for either credit or debit cards. Similar factors appear to affect the willingness to pay for debit cards and credit cards. An income effect is suggested as respondents in the highest household income quartile are willing to pay more to use their credit cards relative to the other quartiles. Individuals aged 18–29 years are also willing to pay more than older individuals to use their debit or credit cards. While preferences were important factors for whether respondents held a credit card and joined rewards programs, most did not appear to influence how much respondents were willing to pay to use a credit card. Again, the similarity of the estimated coefficients across the debit card and credit card regressions supports the results of the credit card regression.

15 Revolvers are individuals who typically allow their credit card balance to roll over from month to month and, therefore, incur interest charges; transactors typically pay the balance before the end of the interest-free period.

Table 5 draws out the estimated willingness to pay for card features. Starting from a baseline where each credit card respondent has a rewards rebate of 40 basis points (but otherwise has their observed characteristics unchanged), a 40 basis point increase in the effective rewards rebate to 80 basis points results in an increased benefit of 31 basis points. While our measure of reward rebates is not sufficiently precise (since it is based on the assumed redemption of $100 gift cards) to conclude that this result is evidence of a one-for-one valuation, it is possible that cardholders do not value the rewards rebate at its full redemption value. Rewards rebate points are not as liquid as cash; cardholders typically need to accumulate enough reward points to be able to benefit from the rewards and the timing of pay-off is uncertain. However, this does not preclude some individuals from obtaining one-to-one or greater benefits from rewards.

Table 5: Marginal Willingness to Pay for Card Features

	Baseline[(a)]	Alternative	Marginal increase in willingness to pay
			Basis points
Credit card			
Rewards rebate[(b)](basis points)	40	80	31
Interest rates (per cent)	17	13	12

Notes: (a) The baseline respondent's willingness to pay is 98 basis points

(b) The coefficient for the rewards rebate is significant at the 1 per cent level; the rewards rebate is calculated as $100 divided by the spending required to obtain a $100 major store gift card

A 4 per cent decrease in the interest rate from the baseline of 17 per cent to 13 per cent, a level similar to a low-rate card, is associated with a 12 basis point benefit, although this coefficient was not significantly different from zero at even the 10 per cent level. This insignificant result is somewhat surprising given the potential interest savings. However, it may be due to the fact that 73 per cent of respondents reported that they typically pay off their balance before any interest is due.

Although we argue that rewards program membership is not endogenous as argued by Ching and Hayashi (2010), we may speculate on how the results may be affected if this behaviour were true. If true, rewards program holders are likely to have chosen a credit card with features they find desirable and, therefore, value more highly. Consequently, the estimated value of the rewards rebate in our model could be overestimated. Given the expected direction of the bias, the hypothesised bias does not weaken our finding that the incremental value placed on use of credit cards is relatively small.

We also repeat this exercise with the assumption of a log-normal distribution for the willingness to pay for the use of credit cards (see Appendix D for full details). The results are qualitatively similar in terms of the statistical significance and direction of the coefficients regardless of which distribution is assumed. Under a log-normal assumption, the marginal effect of a basis point increase in the rewards rebate is a 0.2 basis point increase in willingness to pay.[16]

6. Estimating Consumer Surplus under Various Surcharging Scenarios

The second part of this paper explores how the willingness-to-pay data can be combined with a decision model of consumers to understand payment method choice. We first predict each respondents' willingness to pay using a variant of the model outlined above. We then outline a simple economic decision-making model of the consumer that predicts the mix of payments used in a range of surcharging scenarios. Each respondent's willingness to pay for debit cards and credit cards is a measure of the benefit they receive from using that instrument relative to cash. An individual behaving rationally will choose to use the payment method that offers the greatest net benefit, i.e. the highest benefit once the cost (the price or the surcharge) is taken into account.

For each scenario, we also estimate the 'economic surplus' for consumers, which is the benefit received by consumers from the payment method chosen less the price to use that payment method. Estimation of consumer surplus is a considerable benefit of using the willingness-to-pay data. Comparing the surplus across different surcharging scenarios, we demonstrate the potential gains from aligning prices with costs. The following results should not be interpreted as a definitive outcome of surcharging but rather as an illustrative exercise of how the estimated consumer

16 In comparison to the normal distribution specification with truncation, the effect of the rewards rebate under the log-normal specification may be underestimated because of the skewness in the log-normal distribution.

benefit can be used in calibration, leaving future work to explore its use in more sophisticated models of the payments system.

Similar counterfactual exercises have been conducted in recent papers. Borzekowski and Kiser (2008) utilised counterfactuals to explore how consumers' choice of payment methods would be influenced by the removal/non-acceptance of certain payment methods by merchants. They found that the removal of debit cards increased use of paper methods, cash and cheques, more than credit cards and vice versa. Likewise, Ching and Hayashi (2010) focus on the effect of removing one of the payment options from the set; say due to merchants' decisions not to accept that method. Bolt *et al* (2010) consider how usage of debit cards may change under different surcharge levels. Given our dataset, it is feasible to consider the response to specific price (surcharge) levels on cash, debit cards and credit cards as well as the effect of non-acceptance of these methods. Our use of DCE is also unique in providing a measure of the change in consumer surplus.

6.1 Predicted Willingness to Pay

For each of the 938 respondents, we estimate the willingness to pay for credit cards (where applicable) and debit cards using a predictive model. The predictive model is an extended form of the model specified in the previous section that incorporates: more granular categories for employment status and education level; a wider range of demographic variables including personal income, the type of employment undertaken and the individual's main financial institution; and payment diary variables of the percentage of debit card and credit card use, value of spending on debit cards and credit cards, and number of surcharges paid (full list in Table E1). Extending the number of covariates in the model allows for greater variation and more precision in the predicted willingness to pay. However, the inclusion of potentially endogenous payment variables collected in the diary means that the coefficients cannot be interpreted as estimates of the causal effects of independent variables on willingness to pay (and the standard errors are also subject to bias). This is not a concern in this section of the paper as we are simply relying on the regression variables as correlates to provide an in-sample prediction of each respondent's willingness to pay; the current exercise should be distinguished from the investigation of causal relationships in Section 5.

6.2 Decision Framework

In our model, consumers make the decision of which payment method to use. Under the model, consumers will choose the payment method that gives them the greatest net benefit (or economic surplus), which is the difference between their willingness to pay for that method and the surcharge for using that method (i.e. the benefit they expect to receive in using that payment instrument at the cost directly attached to using that instrument). The net benefit to each individual i of using payment method j is given by:

$$NB_{i,j} = WTP_{i,j} - S_j$$

where j is an element of the set J, which contains the available payment methods (cash, debit card and credit card), $WTP_{i,j}$ is individual i's estimated willingness to pay for payment method j from our model and S_j is the surcharge (price) on payment instrument j. Since our estimates of the benefit of debit cards and credit cards are relative to the use of cash, the benefit of paying with cash is normalised to zero.

A respondent will choose to use payment method j (the choice is denoted as $M_{i,j} = 1$) if the net benefit of using payment method j is greater than the net benefit of using any other payment method:

$$NB_{i,j} > NB_{i,k} \forall k \neq j$$

Respondents who do not hold a credit card have their choice set limited to cash and debit cards.

6.3 Calculation of Economic Surplus

To evaluate the effect of the change in the mix of payment methods in response to the surcharging scenario, we calculate and compare the sum of the consumers' economic surplus under each scenario.[17] In our simple static model, each consumer makes one purchase of a \$50 item in a store. We assume that there are a large

17 We assume that the merchant, card issuing and card acquiring markets are all competitive.

number of identical merchants (i.e. no monopolistic pricing), which we call the representative merchant, all selling the same item worth \$50. We assume that this representative merchant incurs costs in accepting payments and that each payment method has a different cost (C_j). Each sale has the same benefit (the benefit of the sale is normalised to zero) for the merchant regardless of what payment method is used.[18] It is assumed that merchants are competitive and must recover their costs; costs can be recouped through surcharges on more costly payment methods or increases in the general prices of the items that are charged to all consumers, or some combination of the two.

Consumers' economic surplus per transaction is the sum of each individual's net benefit of using the payment method they choose (the first term below) less the merchant costs that are built into an increase in the base price of the item, to the extent these merchant costs are not recovered through surcharging (the second term):

$$Surplus = \frac{1}{N}\left(\sum_{i=1}^{N}\sum_{j\in J}\left(WTP_{i,j} - S_j \middle| M_{i,j} = 1\right) - \sum_{i=1}^{N}\sum_{j\in J}\left(C_j - S_j \middle| M_{i,j} = 1\right)\right)$$

The number of transactions is equal to the number of respondents (N). When merchants surcharge at their cost of acceptance ($C_j = S_j$), the second term is nil.[19]

Under this model, S_j affects consumers' combined surplus by changing the mix of payments in the economy. The surplus associated with each payment method is not itself changed by altering S_j. To aid in interpretation, we focus on the change in the total surplus from a baseline scenario to an alternative scenario in terms of the basis points per \$50 transaction.

18 In a dynamic analysis, the increase in the price of the items may affect total sales volumes. However, in our model, demand for items is static. Likewise, some argue that acceptance of credit cards increases sales by reducing liquidity constraints of consumers, thus benefiting merchants. Our model does not include such effects.

19 We note that this implies that the price of the item will in many scenarios be greater than \$50. We recognise that the DCE results are most applicable to items priced at \$50 exactly and that increasing the price of the item above \$50 to a non-whole value number may imply a greater value on card payments than is used in the scenarios.

6.4 Scenario Analysis

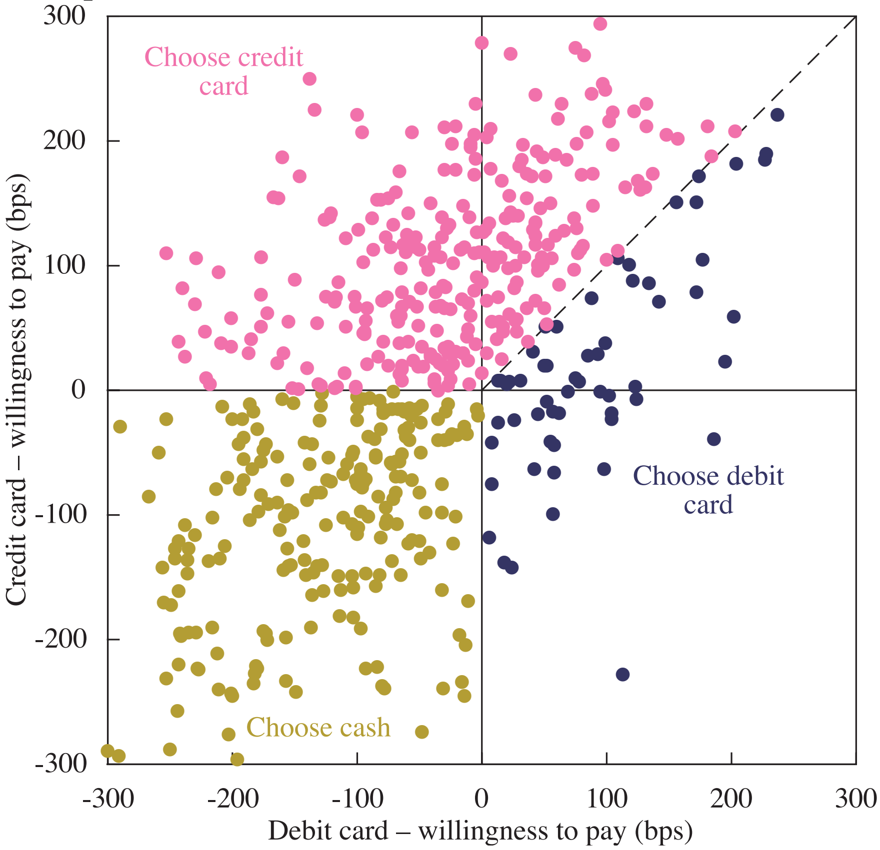
A number of scenarios are considered to examine how the imposition of surcharges may affect the mix of payment methods and the economic surplus of consumers. The baseline scenario is one where merchants accept cash, debit card and credit cards but there is no surcharging of any payment method. We compare the baseline outcomes to several alternative scenarios. In the first, the representative merchant applies a surcharge to the two higher-cost payment methods of three (cash, debit cards and credit cards), with the surcharges set to equal the incremental (to the lowest-cost method) costs of acceptance. In a second scenario, the representative merchant surcharges at the cost of acceptance of each payment method rounded to the nearest percentage point. We also compare these scenarios to others where the merchant surcharges at an arbitrary level or refuses to accept one of the payment methods.

Starting with the baseline scenario, where the surcharges on cash, debit cards and credit cards are all set to zero, respondents simply choose the payment method that provides them with the highest willingness to pay.[20] Figure 5 depicts the decision framework for credit card holders under the baseline scenario. Respondents who are predicted to receive no benefit from the use of debit cards and credit cards (bottom left quadrant) will choose to use cash. Those in the top left and bottom right quadrant only obtain a positive benefit from one type of card and thus will choose to use that card. For respondents that obtain benefit from both debit and credit cards, the card that provides the higher benefit will be chosen. For non-credit card holders (not shown), the choice is between whether to pay using a debit card or using cash; those who have a positive predicted willingness to pay with a debit card (around 33 per cent) are assumed to choose their debit card and the remainder are assumed to choose cash.

20 As the DCE did not include a scenario asking about willingness to pay with a card when there was no surcharge, the outcome of this scenario is dependent on our assumption of the normality of the underlying distribution of willingness to pay. However, because the minimum surcharge value considered in the DCE of 0.1 per cent was very close to zero we believe it is reasonable to consider the no-surcharge scenario as the baseline.

Figure 5: Willingness to Pay Under No-surcharging Scenario

Respondents that hold both credit cards and debit cards



Note: The dashed line is the line of indifference between the relevant payment methods

Under the baseline scenario, 51 per cent of respondents choose cash, 18 per cent choose debit card and 31 per cent choose credit card. These proportions can be compared to the mix of payments used for point-of-sale purchases of $50 recorded in the Survey (Table 6).[21] The comparison suggests that under the baseline scenario our model predicts the share of cash used well, although it underestimates the use of debit cards and overestimates the use of credit cards.[22] The lower share of credit card payments reported in the Survey relative to the outcome of the model

21 We can infer the mix of payments without the predictive model, but by simply using the DCE response data on which willingness-to-pay range a respondent falls in. We find the mix predicted by the ranges are consistent with the mix predicted by the predictive model and those recorded in the Survey (see Table E2). However, simply using the willingness-to-pay ranges does not allow the calculation of consumer surplus or provide sufficient precision in predicting the mix of payment under surcharging.

22 A comparison of how closely the model correctly predicts the in-sample data is provided in Table E3. Similar to the comparison to the Survey data in Table E2, we under-predict the willingness to pay for debit cards, whilst the credit card predictions display some dispersion.

is consistent with some use of surcharging in 2013, which would be expected to affect the relative shares of debit cards and credit cards to a degree. In contrast, our baseline assumes that no payment methods are surcharged.

Table 6: Use of Payment Methods Under Scenarios
All cardholders

	Consumer Use Survey data[(a)]	**No-surcharging scenario**	**Surcharging-at-cost scenario**	
	Per cent of payments	Per cent of payments	Surcharge price[(b)] Basis points	Per cent of payments
Cash	51	51	10	61
Debit card	29	18	0	29
Credit card	20	31	118	10
Change in surplus from no surcharging		*baseline*	*13 bps*	

Notes: (a) Reserve Bank of Australia's 2013 Survey of Consumers' Use of Payment Methods; $50 point-of-sale transactions
(b) Surcharge price is based on data on cost of payments in Stewart *et al* (2014); cost of lowest-cost instrument, debit card, is normalised to zero

Sources: Authors' calculations based on survey data; RBA

Due to the assumption of a normal distribution for the willingness to pay, the model predicts a large group of individuals with negative willingness to pay for the use of cards. We do not truncate the estimated willingness to pay at zero for the scenario analysis. Truncation at near zero would not change the mix of payment methods chosen (i.e. the ranking of payment instruments for each individual is preserved with or without truncation).[23] Similarly, the estimate of consumer surplus is unaffected by the large negative willingness to pay as those negative benefits are not realised by the respondents (e.g. a respondent in the top left quadrant will choose between cash and credit cards; any change in behaviour and associated increase in surplus would not be influenced by the highly negative willingness to pay predicted for debit cards).

23 Truncation at zero would likewise not change the results if it is also assumed that cash is preferred to debit cards and credit cards, when the net benefits of each relevant payment instrument is equal.

To conduct the first surcharging scenario, we assume the representative merchant sets the surcharges at its cost of accepting each payment method. We approximate these costs from a 2014 study on the costs of payments in Australia by Stewart *et al* (2014). The costs to the representative merchant in our scenario for a $50 payment is 108 basis points for a cash payment, 98 basis points for a debit card payment and 216 basis points for a credit card payment.[24]

The decision framework is only affected by the relative (rather than absolute) price of each payment method. Therefore, we normalise the surcharge of the least costly method (debit cards) to zero and the surcharge on cash and credit cards is equal to the difference in the cost of that method to debit cards. Under the surcharging scenario, the representative merchant applies a 10 basis point surcharge on cash, no surcharge on debit cards and a 118 basis point surcharge on credit cards.[25]

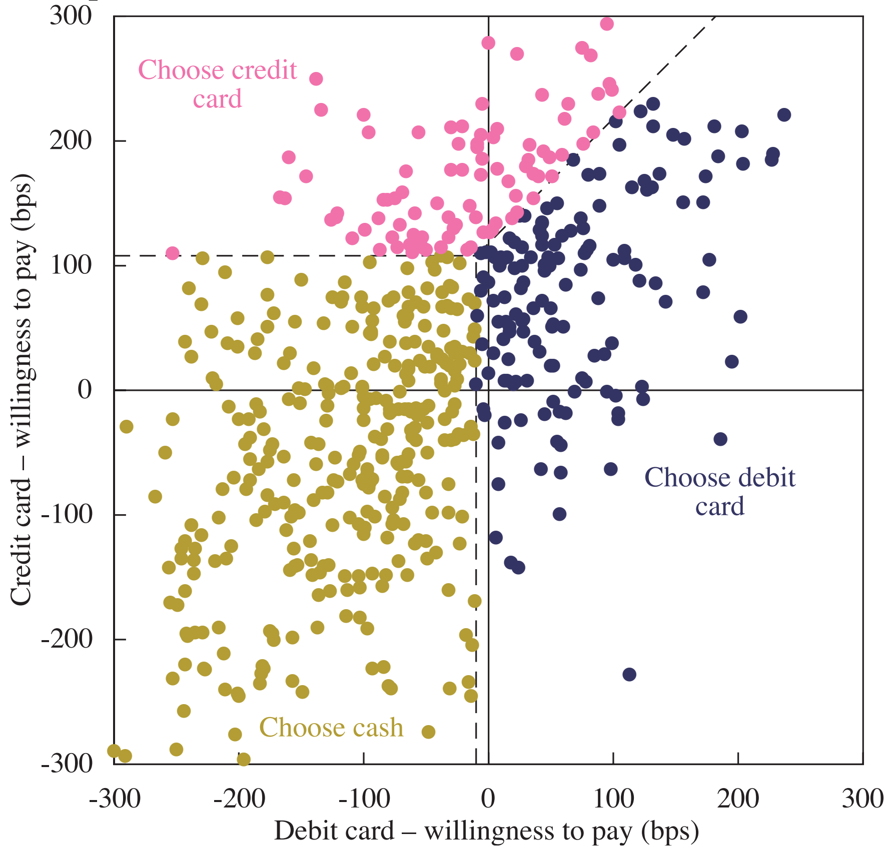
The change in relative prices compared to the no-surcharging scenario causes a shift in the mix of payments; consumers who may previously have received the greatest benefit from one payment method, may now receive the greatest benefit from using a different payment method. Figure 6 shows how the use of the three instruments by credit card holders is distributed under the surcharging scenario.

24 The costs for merchants are approximated by the resource costs of payments, which Stewart *et al* (2014) show are predominantly borne by merchants. These figures include the resource costs of financial institutions, which are passed onto merchants in the form of merchant service fees, and the merchants' own resource costs. It is worth noting that cost study uses data on a selected number of large retailers and that the range of costs for different merchants can be wide; for example, costs for smaller merchants are higher given the lack of economies of scale and higher fees. The level of cost may therefore not be applicable for all merchants. Further, the resource costs incurred vary by payment size; cash is cheaper than debit cards at payment values below $20, although credit cards are always the most expensive payment method.

25 A surcharge on cash is technically outside the scope of the DCE data. However, a very similar result is obtained when there is no surcharge on cash.

Figure 6: Willingness to Pay Under Surcharging-at-cost Scenario

Respondents that hold both credit cards and debit cards



Note: The dashed lines are the lines of indifference between the relevant payment methods

For the full sample (i.e. including those that do not hold credit cards), the results of the change in relative prices are that 12 per cent of individuals shift from using credit cards to using cash, 10 per cent of individuals switch to using debit cards instead of credit cards and around 1 per cent of individuals shift from cash to debit cards. Table 6 summarises the net effect on the shares of each payment method; the use of cash and debit cards increases to 61 per cent and 29 per cent respectively, and the use of credit cards decreases significantly to 10 per cent. The mix of payment methods has changed, but all payment methods are still being used.

The predicted shift toward cash from credit cards is very strong in the model. This result may be affected by the framing of the scenario around a $50 payment, for which the use of cash is higher than payments in the surrounding price range. If the payment function of cards has been slightly undervalued, the scenario may over-predict the shift toward cash relative to debit cards. However, the result is consistent with the findings of Borzekowski and Kiser (2008) in a similar counterfactual exercise for the United States.

The increase in the joint surplus of consumers and merchants amounts to 13 basis points per transaction under the surcharging scenario (Table 6). This increase in surplus is driven by the change in the mix of payments as individuals switch away from the payment methods for which their net benefit was small but which incurred relatively high costs for the merchant that had to be built into a higher base price.[26] As consumers switch to using payment methods with a lower net cost, the total price paid by consumers falls. The application of surcharging introduces market discipline into the consumer's choice of payment method and improves the overall economic outcome.

The finding that the mix of payments is more economically efficient and that consumer surplus is higher in the presence of surcharging holds for all instances where the merchant surcharges at the costs of acceptance. The magnitude of the increase in joint surplus, however, is sensitive to the relative costs of each payment method, increasing when the difference in costs is large and diminishing as the difference in payment costs gets smaller.

In contrast, where merchants do not surcharge at the cost of acceptance, surplus may not necessarily increase. Whether an efficiency gain is realised will depend on how closely the surcharges approximate the cost of acceptance. If the deviation is small, say due to rounding of surcharges, the system is still likely to experience an increase in efficiency; for example, in a scenario involving no surcharge on cash or debit cards and a 100 basis point surcharge applied to credit cards, the economic surplus nevertheless increases by 12 basis points (Table 7). That is, nearly all the potential efficiency gains from surcharging exactly at cost are obtained in this scenario.

However, in situations where the merchant arbitrarily surcharges with no regard to the respective costs of the payment methods, outcomes are uncertain. Our third

26 The increase in surplus is primarily driven by the group of individuals who changed their choice of payment method from credit cards to cash, and another group who switched from credit cards to debit cards. As discussed above, the change in surplus for individuals who changed their choice from credit cards to cash are not affected by their predicted negative willingness to pay, but rather their relative willingness to pay for credit cards.

scenario presents an example where merchants surcharge debit cards at 100 basis points and credit cards at 300 basis points. Under this scenario, the use of cards falls significantly and surplus falls by 4 basis points in comparison to no surcharging.

Table 7: Alternate Scenarios

All cardholders

	Only credit cards surcharged		**Arbitrary card surcharging**	
	Surcharge price Basis points	Per cent of payments	Surcharge price Basis points	Per cent of payments
Cash	0	62	0	92
Debit card	0	26	100	8
Credit card	100	12	300	0
Change in surplus from no surcharging	*12 bps*		*–4 bps*	

We also consider a fourth scenario where merchants do not surcharge, but instead choose to not accept certain payment methods. A key result is that under most non-acceptance scenarios, the joint surplus is lower than under the surcharging scenario (Table 8). This result is particularly strong for the scenarios where either cash or debit cards are not accepted. This is due to the fact that these methods are fairly inexpensive and, if not available, the share of payments made using relatively expensive credit cards increases for no gain in consumer surplus. However, in some circumstances that non-acceptance may increase consumer welfare; given that credit cards are relatively more expensive than cash or debit cards, dropping credit cards is found to lead to an increase in consumer surplus relative to a baseline of no surcharging. Consumer surplus is of course lower than in the surcharging-at-cost scenario because 10 per cent of respondents would prefer to pay by credit card (and pay a surcharge) but cannot because credit cards are not accepted. Overall, the result of this analysis illustrates that more efficient outcomes occur when the merchant chooses to surcharge consumers at the cost of acceptance, although gains may still be realised by non-acceptance of particularly expensive options.

Table 8: Scenarios Involving Non-acceptance of Payment Methods
All cardholders

	Per cent of payments					
	No surcharging	Surcharging at cost[(a)]	No credit cards	No debit cards	No cards	No cash
Cash	51	61	69	65	100	0
Debit card	18	29	31	0	0	52
Credit card	31	10	0	35	0	48
Change in surplus from surcharging at cost		*baseline*	*–5 bps*	*–30 bps*	*–31 bps*	*–94 bps*
Change in surplus from no surcharging	*baseline*		*7 bps*	*–18 bps*	*–19 bps*	*–81 bps*

Note: (a) Involves surcharges of 10 basis points on cash and 118 basis points on credit cards as per Table 6

7. Conclusion

We apply a novel approach to quantify the demand for card payments and the value individuals attach to making a payment using a card instead of cash. Our results suggest that using DCE techniques to elicit willingness to pay for card payments can provide hitherto unavailable information about how much consumers value card payments or particular features.

Several results are relevant for understanding the use of cash, debit cards and credit cards. The responses to the DCE indicate that cash continues to provide similar (or higher) utility to a debit card payment for around 60 per cent of people for payments of $50. However, the Survey responses indicate that some individuals have a significant preference for using a card to make payments. On average, respondents have a higher willingness to pay for credit cards than debit cards, reflecting the fact that these cards often offer rewards, interest-free periods and access to credit. However, the results suggest that consumers may not necessarily value credit card reward points at their full redemption value.

A key advantage of our approach for evaluating policy options is that the value individuals place on using different payment instruments can be combined with cost data to measure consumer surplus. In the absence of price signals to consumers, who decide which payment method to use, our model suggests there will be inefficient over-use of higher-cost payment instruments, which feeds into higher general prices. We find that when merchants' costs of accepting payments are passed on to consumers through differential surcharges, the changing mix of payments results in a net gain to consumers compared to a scenario where there are no surcharges on payments. Further, given the average cost of each payment method, price signals in general provide a more efficient mix of payment methods than if merchants cease to accept higher-cost instruments.

Appendix A: Demographics

Table A1: Comparison of Sample with Population Benchmarks

Per cent

	Population (2012 data)	Sample (2013 data)
Gender		
Female	52	52
Male	48	48
Age		
18–24 years	12	12
25–34 years	18	19
35–44 years	19	22
45–54 years	18	22
55–64 years	16	15
65+	16	10
Household income		
< \$40 000	26	15
\$40 000–\$79 999	32	38
\$80 000–\$129 999	22	33
≥ \$130 000	21	15
Location		
Capital city	65	74
Owns a credit card	59	69

Sources: ABS; HILDA Release No 12.0; RBA data collected by Colmar Brunton

Appendix B: Methodology – Estimation of Willingness to Pay

The methodology used to estimate willingness to pay follows the model developed by Hanemann *et al* (1991) for double-bounded DCE data.

For all N number of consumers, the ith consumer's willingness to pay (our variable of interest) to use a card instead of cash is specified as a continuous latent random variable represented by:

$$WTP_i = \alpha + \boldsymbol{x}_i'\boldsymbol{\beta} + \varepsilon_i \quad \varepsilon_i \sim N\left(0, \sigma^2\right)$$

Here α is the mean willingness to pay (when all independent variables are zero), $\boldsymbol{x}_i$ is the vector of independent variables, $\boldsymbol{\beta}$ is the vector of coefficients and ε_i is the normally distributed random error term with σ^2 variance.

To obtain the estimates for the above parameters, the latent variable is mapped to the discrete data we observe, which is denoted by y_{i,p_l,p_u} and takes the values:

$$y_{i,p_l,p_u} = \begin{cases} 1 \text{ if } p_l \leq WTP < p_u \\ 0 \quad \text{otherwise} \end{cases}$$

where y_{i,p_l,p_u} is the indicator flag taking the value 1 if consumer i's willingness to pay lies between the lower bound price p_l and upper bound price p_u, or taking the value zero otherwise. p_l is an element of the set L of lower bound prices (in basis points) of $\left\{-\infty, 10, 50, 75, 100, 200, 300, 400\right\}$. A corresponding p_u, which is an element of the set U of upper bound prices $\left\{10, 50, 75, 100, 200, 300, 400, \infty\right\}$, exists for each p_l. The eight ranges of willingness to pay in basis points are: $(-\infty,10)$, $[10,50)$, $[50,75)$, $[75,100)$, $[100,200)$, $[200,300)$, $[300,400)$, $[400,+\infty)$.

The probability of respondent i having a willingness to pay within the range bound by p_l and p_u is given by:

$$\begin{aligned}
\Pr\left(y_{i,p_l,p_u} = 1 \middle| x_i\right) &= \Pr\left(p_l \le WTP_i < p_u\right) \\
&= \Pr\left(p_l \le \alpha + \boldsymbol{x}_i'\boldsymbol{\beta} + \varepsilon_i < p_u\right) \\
&= \Pr\left(p_l - \alpha - \boldsymbol{x}_i'\boldsymbol{\beta} \le \varepsilon_i < p_u - \alpha - \boldsymbol{x}_i'\boldsymbol{\beta}\right) \\
&= \Pr\left(p_u - \alpha - \boldsymbol{x}_i'\boldsymbol{\beta} > \varepsilon_i\right) - \Pr\left(p_l - \alpha - \boldsymbol{x}_i'\boldsymbol{\beta} \ge \varepsilon_i\right) \\
&= F\left(p_u - \alpha - \boldsymbol{x}_i'\boldsymbol{\beta}\right) - F\left(p_l - \alpha - \boldsymbol{x}_i'\boldsymbol{\beta}\right)
\end{aligned}$$

where $F()$ is the (non-standard) normal cumulative distribution function of ε_i.

The log-likelihood function for the full sample is given by:

$$Log - Likelihood = \sum_{i=1}^{N} \sum_{p_l \in L, p_u \in U} y_{i,p_l,p_u} \left[\ln F\left(p_u - \alpha - \boldsymbol{x}_i'\boldsymbol{\beta}\right) - \ln F\left(p_l - \alpha - \boldsymbol{x}_i'\boldsymbol{\beta}\right)\right]$$

where $p_l \in L, p_u \in U$ refers to the eight pairs of price points referred to above (as opposed to every combination of the price bounds).

The log-likelihood function is maximised using a Newton-Raphson numerical optimisation procedure in Stata.

B.1 Calculation of the truncated mean

The mean of the normal distribution above the truncation point is as derived in Greene (2012):

$$E\left(WTP_i \middle| WTP_i > 0\right) = \mu_i + \sigma\lambda\left(\kappa_i\right)$$

where $\mu = \alpha + \boldsymbol{x}_i'\boldsymbol{\beta}$, following the specification above. The inverse Mills ratio $\lambda(\kappa)$ for a distribution that is truncated at zero for values below zero is:

$$\lambda(\kappa_i) = \frac{\phi(\kappa_i)}{1 - \Phi(\kappa_i)}$$

$$\kappa_i = -\frac{\alpha + \boldsymbol{x}_i'\boldsymbol{\beta}}{\sigma}$$

where ϕ is the standard normal density function and Φ is the standard normal cumulative distribution function.

The mean of the distribution above the truncation point is then multiplied by the proportion of the distribution above the truncation point to arrive at the mean of the whole distribution.

Appendix C: Credit Card Holding and Rewards Program Membership

Table C1: Results of Probit Model

(*continued next page*)

	Holds a credit card		**Member of rewards program**	
	Coefficient	Marginal effect[(a)]	Coefficient	Marginal effect[(a)]
		Percentage points		Percentage points
Age (base = 30–39 years)				
18–29 years	–0.58***	–19***	–0.23	–8
40–49 years	0.09	3	0.13	4
50–64 years	0.18	5	0.10	3
65+ years	0.05	2	–0.14	–5
Household income (base = 3rd quartile)				
1st quartile	–0.06	–2	–0.63***	–22***
2nd quartile	–0.05	–2	–0.06	–2
4th quartile	0.28**	8**	0.14	5
Education (base = year 12)				
Year 11 or below	–0.20	–6	–0.15	–5
Trade certificate	–0.17	–5	–0.47*	–16*
Diploma	0.12	4	–0.03	–1
Bachelor degree or higher	0.36**	10**	0.10	3
Labour force status (base = employed)				
Unemployed	–0.98***	–32***	0.06	2
Not in labour force	–0.52***	–16***	0.26	9
Retired	–0.14	–4	0.64***	20***
Gender (base = female)				
Male	0.21**	6**	0.27**	9**

Table C1: Results of Probit Model
(*continued*)

	Holds a credit card		Member of rewards program	
	Coefficient	Marginal effect[(a)] Percentage points	Coefficient	Marginal effect[(a)] Percentage points
Life stage (base = couple with children)				
Couple, no children	–0.30*	–9*	–0.06	–2
Couple, children left home	–0.03	–1	0.15	5
Single, no children	–0.37**	–11**	–0.13	–4
Single, children	–0.26	–8	0.22	7
Single, children left home	–0.25	–7	0.05	2
Other	–0.31*	–9*	–0.03	–1
Location (base = capital city)				
Regional	0.14	4	0.18	6
Preferences				
Speed	0.11	3	0.02	1
To avoid charges	0.10	3	0.00	0
Greater security	0.19*	5*	0.08	3
Draw from own funds	–0.41***	–12***	–0.81***	–29***
Greater privacy	–0.26**	–8**	0.15	5
Constant	0.65**		0.20	
Sample size	931		638	
Pseudo R^2	0.19		0.13	
Correctly classified (per cent):				
Overall	75		70	
$\Pr(+ \mid y = 1)$	89		82	
$\Pr(- \mid y = 0)$	45		50	

Notes: ***, ** and * denote significance at the 1, 5 and 10 per cent level, respectively
(a) Calculated as the average of the sample, i.e. the marginal effect of a change in the categorical variable of interest is calculated for each respondent (given their characteristics) and then averaged

Appendix D: Log-normal Model for Willingness to Pay

Table D1: Log-normal Model – Marginal Effect on Willingness to Pay
Sample of credit card holders (*continued next page*)

	Coefficient	Marginal effect[(a)] Basis points
Card features		
Rewards rebate (basis points)	0.01**	0.2
Interest rate (per cent)	–0.05	–0.9
Financial status		
Revolver	0.53*	11.5
Premium status	0.45	8.8
Charge card	–0.87	–13.2
Age (base = 30–39 years)		
18–29 years	0.73*	19.7
40–49 years	0.08	1.5
50–64 years	–0.17	–2.8
65+ years	–0.30	–4.7
Household income (base = 3rd quartile)		
1st quartile	–0.26	–3.2
2nd quartile	0.45	8.1
4th quartile	0.54*	10.3
Education (base = year 12)		
Year 11 or below	–0.15	–1.7
Trade certificate	0.72**	12.8
Diploma	0.83	16.0
Bachelor degree or higher	0.36	5.4
Labour force status (base = employed)		
Unemployed	–0.26	–4.2
Not in labour force	0.24	4.9
Retired	0.23	4.8
Gender (base = female)		
Male	–0.05	–1.0

Table D1: Log-normal Model – Marginal Effect on Willingness to Pay
Sample of credit card holders (*continued*)

	Coefficient	Marginal effect[(a)] Basis points
Life stage (base = couple with children)		
Couple, no children	0.11	2.5
Couple, children left home	–0.30*	–5.5
Single, no children	–0.68	–10.5
Single, children	–0.50	–8.4
Single, children left home	0.88	30.4
Other	–0.10	–2.1
Location (base = capital city)		
Regional	–0.16	–2.9
Preferences		
Speed	–0.28	–5.6
To avoid charges	0.00	0.0
Greater security	0.24	4.7
Draw from own funds	–0.45	–8.1
Greater privacy	–0.05	–0.9
Constant	2.42	
Sample size	605	

Notes: ***, ** and * denote significance at the 1, 5 and 10 per cent level, respectively
(a) Calculated as the average marginal effect on the sample from a one unit change in the continuous independent variables and a change from the base category to specified case for categorical independent variables

Appendix E: Model Regressors for Predictive Model

Table E1: Regressors Included in Section 6 Predictive Model
(*continued next page*)

Variable category	Description	Comparison with Section 5 explanatory model
Payment diary		
Per cent of debit card payments	Percentage points, continuous between 0 and 1	Excluded
Per cent of credit card payments	Percentage points, continuous between 0 and 1	Excluded
Value of debit card payments	Dollar value	Excluded
Value of credit card payments	Dollar value	Excluded
Number of surcharges paid	Number	Excluded
Demographic		
Male	Boolean	Included
Age	Number	Included in bucketed ranges
Household income	Separate dummy variables of: \$1–\$7 799; \$7 800–\$19 999; \$20 000–\$29 999; \$30 000–\$39 999; \$40 000–\$49 999; \$50 000–\$59 999; \$60 000–\$69 999; \$70 000–\$79 999; \$80 000–\$89 999; \$90 000–\$99 999; \$100 000–\$109 999; \$110 000–\$119 999; \$120 000–\$129 999; \$130 000–\$149 999; over \$150 000	Reduced categories
Personal income	Separate dummy variables of: \$1–\$7 799; \$7 800–\$19 999; \$20 000–\$29 999; \$30 000–\$39 999; \$40 000–\$49 999; \$50 000–\$59 999; \$60 000–\$69 999; \$70 000–\$79 999; \$80 000–\$89 999; \$90 000–\$99 999; \$100 000–\$109 999; \$110 000–\$119 999; \$120 000–\$129 999; \$130 000–\$149 999; over \$150 000	Excluded
State	Separate dummy variables of: Brisbane; Queensland other than Brisbane; Sydney; NSW other than Sydney; Melbourne; Victoria other than Melbourne; Adelaide; South Australia other than Adelaide; Perth; Western Australia other than Perth; Hobart; Tasmania other than Hobart; Darwin; Northern Territory other than Darwin; Canberra; Australian Capital Territory other than Canberra	Reduced categories
Education	Separate dummy variables of: I prefer not to answer; Year 8 or below; Year 9 or equivalent; Year 10 or equivalent; Year 11 or equivalent; Year 12 or equivalent; Trade certificate or apprenticeship; Diploma, certificate etc; Bachelor or Honours degree; Post-graduate qualifications; Other	Reduced categories

Table E1: Regressors Included in Section 6 Predictive Model

(*continued next page*)

Variable category	Description	Comparison with Section 5 explanatory model
Demographic		
Employment status	Separate dummy variables of: Employed, working full-time (more than 35 hours a week); Employed, working part-time (less than 35 hours a week); Self-employed; Unemployed, looking for full-time work (more than 35 hours a week); Unemployed, looking for part-time work (less than 35 hours a week); Not employed, and not looking for work; Student; Beneficiary/welfare; Retired; Look after the house full-time	Reduced categories
Occupation	Separate dummy variables of: Managerial; Professional; Technician or trade worker; Community or personal services worker; Clerical or administrative worker; Sales worker; Machinery operators or drivers; Labourer; Other; Not working	Excluded
Life stage	Separate dummy variables of: Couple with no children; Couple with children living at home; Couple with grown-up children who have left home; Single person with no children; Single person with children at home; Single person with grown-up children who have left home; Other	Reduced categories
Main financial institution	Separate dummy variables of: ANZ; Bank of Queensland; Bank SA; Bankwest; Bendigo Bank; Citibank; Commonwealth Bank; CUA; Heritage Bank; HSBC; ING; Macquarie Bank; National Australia Bank; Police Credit Union; St. George; Suncorp; Teachers Credit Union; Westpac; Other bank; Other building society; Other credit union	Excluded
Household size	Number	Excluded
Card-related		
Premium card	Boolean; 1 where primary card is a premium card (offers prestige services and/or contains premium branding)	Included
Charge card	Boolean; 1 where primary card is a charge card that must be repaid in full every month	Included
Credit card rewards rebate	Basis points	Included
Credit card interest rate	Percentage points	Included
Revolver	Boolean; 1 where respondent has stated that they always or sometimes revolve their credit card balance	Included
Owns a credit card	Boolean	Included; only for debit card regression

Table E1: Regressors Included in Section 6 Predictive Model
(*continued*)

Variable category	Description	Comparison with Section 5 explanatory model
Preference		
Speed of transaction	Boolean; considers speed of transaction in choosing payment method	Included
Reward points	Boolean; considers reward points in choosing payment method	Excluded
Additional charges	Boolean; considers additional charges in choosing payment method	Included
Safety/security	Boolean; considers safety/security in choosing payment method	Included
Own funds	Boolean; prefers to use own funds in choosing payment method	Included
Use borrowed funds	Boolean; prefers to use borrowed funds in choosing payment method	Excluded
Obtain cash-out	Boolean; considers whether cash-out is available in choosing payment method	Excluded
Privacy/ anonymity	Boolean; considers privacy/anonymity in choosing payment method	Included
Availability	Boolean; uses whatever is available in choosing payment method	Excluded
Ease of managing finance	Boolean; considers ease of managing finance in choosing payment method	Excluded

Table E2: Predicted Mix of Payments Using Stated Range of Willingness to Pay
$50 point-of-sale transactions; per cent of payments

	Stated range of willingness to pay(a)	Consumer Use Survey data(b)	Predicted willingness to pay
Cash	50	51	51
Debit card	19	29	18
Debit card/credit card(c)	15	na	na
Credit card	16	20	31

Notes: (a) Assumes respondents not willing to pay a 0.1 per cent surcharge will use cash
(b) Reserve Bank of Australia's 2013 Survey of Consumers' Use of Payment Methods
(c) Respondents' whose willingness-to-pay ranges for debit cards and credit cards are identical

Sources: Authors' calculations based on survey data; RBA

Table E3: Prediction Crosscheck with Stated Willingness-to-pay Range
Per cent of respondents

	Debit card	Credit card
Predicted willingness to pay is:		
In the stated range	53	41
Within 50 basis points of the stated range	68	61
Within 100 basis points of the stated range	76	75
Lower than stated range	33	34
Higher than stated range	14	25

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