



Reserve Bank of Australia

RESEARCH
DISCUSSION
PAPER

**Price Incentives and
Consumer Payment
Behaviour**

*John Simon, Kylie Smith and
Tim West*

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PRICE INCENTIVES AND CONSUMER PAYMENT BEHAVIOUR

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Authors: [simonj](mailto:simonj@rba.gov.au), [smithka](mailto:smithka@rba.gov.au) or [westt](mailto:westt@rba.gov.au) at domain rba.gov.au

Economic Publications: ecpubs@rba.gov.au

Abstract

In this paper we estimate the effect of particular price incentives on consumer payment patterns using transaction-level data. We find that participation in a loyalty program and access to an interest-free period, both of which lower the price of credit card use, tend to increase credit card use at the expense of alternative payment methods, such as debit cards and cash. Specifically, we find that a loyalty program increases the probability of credit card use by 23 percentage points and access to the interest-free period increases the probability by 16 percentage points. Interestingly, the pattern of substitution from cash and debit cards is different in each of these cases. A loyalty program reduces the probability of cash use by 14 percentage points and has little effect on debit card use, while access to the interest-free period has little effect on cash use but reduces the probability of debit card use by 19 percentage points. We find these effects to be economically significant and large enough that they can help to explain observed aggregate payments patterns. An implication is that the Reserve Bank reforms of the Australian payments system are likely to have influenced observed payment patterns.

JEL Classification Numbers: C35, D12, G20

Keywords: consumer choice, retail payment systems, price incentives,
loyalty programs

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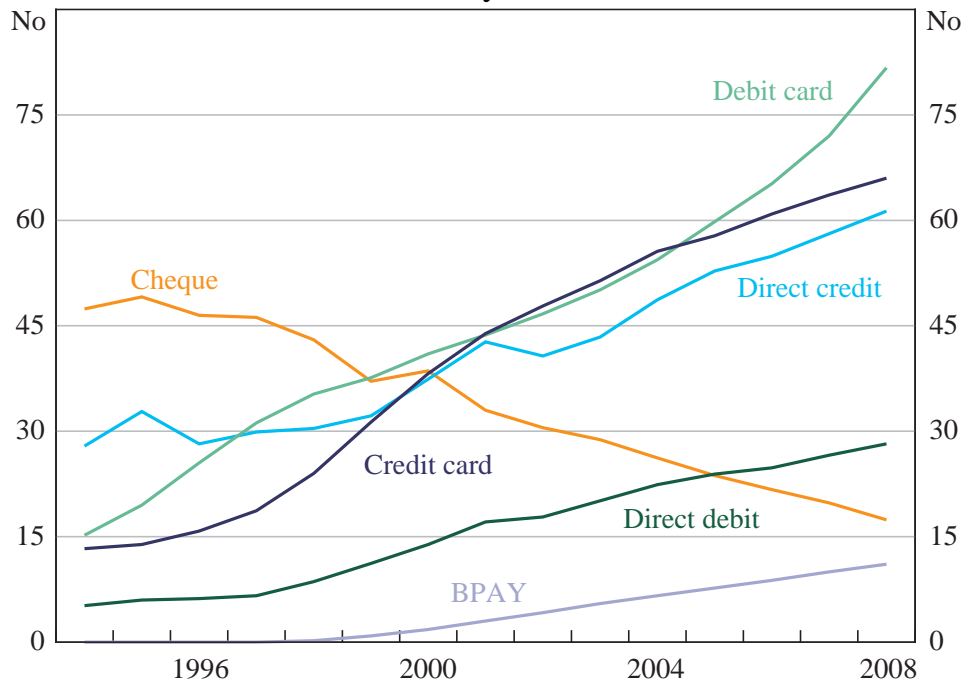
1. Introduction

Over the past decade, payment patterns in Australia have changed substantially. In line with most other countries, electronic means of payment, such as credit cards and debit cards, have grown strongly, while the number of personal cheques written per person has declined significantly (Figure 1). Among electronic payment methods, however, there have been some interesting trends and trend reversals. For example, credit cards enjoyed remarkable rates of growth in the late 1990s, eventually overtaking debit cards as the most common form of non-cash payment. Subsequently, their rate of growth has tailed off and, more recently, there has been a switch back towards debit cards as the most common form of non-cash payment.

These changes in payment method use over a period of substantial reform provide *prima facie* evidence that a relationship exists between price incentives and the use of particular payment methods. The aggregate data, however, are not sufficient to make more than tentative conclusions about this relationship. Data on the payments behaviour of individuals offer the prospect of obtaining a more nuanced and accurate view of the influences on payment patterns.

As part of its review of its card payment reforms, the Reserve Bank of Australia collected detailed data on the transaction behaviour of a broadly representative sample of 662 Australians over a two-week period in 2007. These data provide the first comprehensive transaction-level study in Australia of payment methods used by individuals, including, importantly, cash. In this paper, the data collected from this study are used to estimate econometric models of the holding of credit cards, and the use of credit cards, debit cards and cash. Similar to Bounie and François (2006), our dataset allows us to not only control for demographic influences, but also for transaction-related characteristics, such as merchant type and transaction value. Further, of particular interest to this study, our dataset allows us to identify price incentives for credit cards: whether the consumer participates in

Figure 1: Number of Non-cash Payments per Capita
Per year



Note: Debit and credit card data prior to 2002 have been adjusted for a break in the series due to an expansion of the retail payments statistics in 2002.

Sources: ABS; APCA; BPAY; RBA

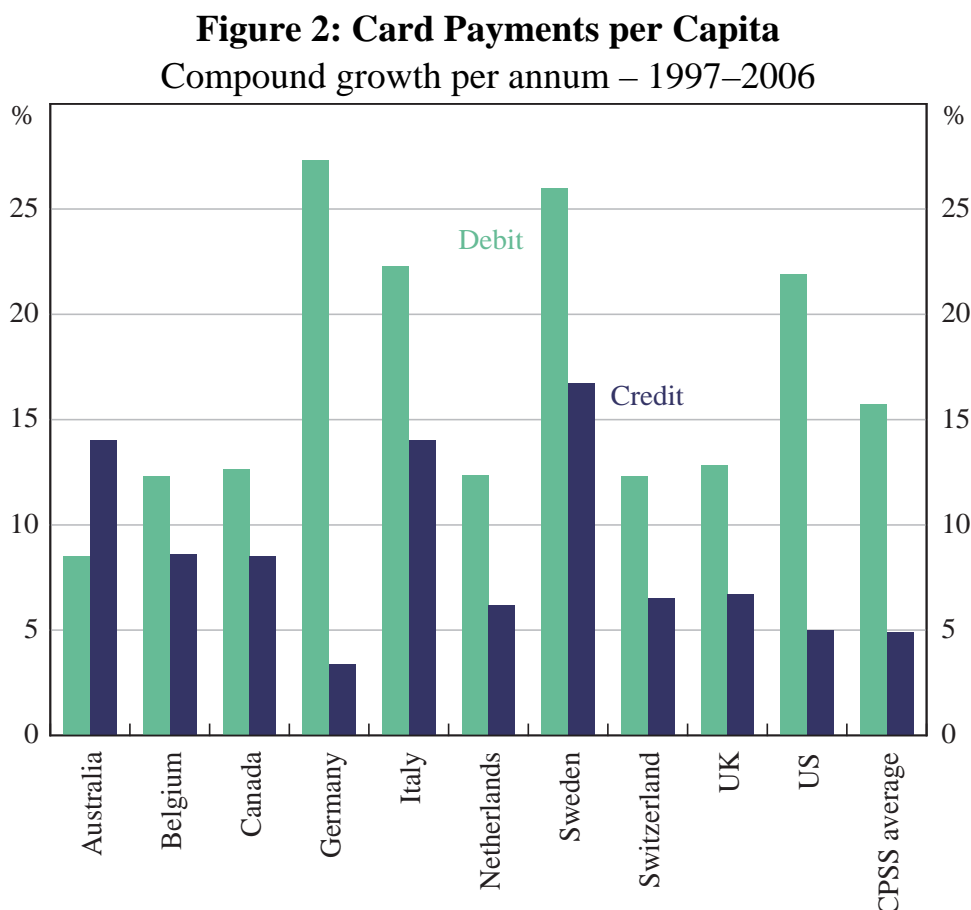
a loyalty program and whether the consumer typically obtains the benefit of the interest-free period.

We use these data to examine a number of aspects of consumer payments. In particular, we consider what effect loyalty programs have on the choice of payment instruments and examine the patterns of substitution between credit cards, debit cards and cash as a result of these programs. We conduct similar analysis on the effect of access to an interest-free period.

The remainder of the paper is structured as follows. In Section 2, we provide a brief overview of the aggregate trends in the Australian payments system over the past decade, as well as some background on the Reserve Bank's reforms. Section 3 examines previous studies related to our paper. Section 4 discusses the data we use and sketches some features of the data. Section 5 outlines the modelling framework and discusses the results, particularly in relation to price incentives. Section 6 concludes.

2. The Australian Payments Landscape

The main payment instruments available to Australian consumers are similar to those in other industrialised countries.¹ One unusual feature of Australian payment patterns until quite recently, however, has been the strong growth in credit card use, relative to debit card use (Figure 2).²



Notes: Incorporates estimate of 2006 credit card use in Japan. ‘CPSS average’ refers to member countries of the Bank for International Settlements Committee on Payment and Settlement Systems.

Sources: ABS; APCA; BIS; RBA

One factor that is likely to have contributed to this trend in Australia was the pricing structure of the credit card and domestic debit card (EFTPOS) systems

1 Further details on these payment instruments and their uses can be found in Emery, West and Massey (2008).

2 Unless otherwise separately identified, in this paper credit cards include credit/charge cards from the MasterCard, Visa, American Express and Diners Club schemes, and debit cards include cards from the domestic EFTPOS system and the MasterCard and Visa debit schemes.

which differs somewhat from many other countries. For many Australian consumers, the effective price of using a credit card to make payments was less than that of using EFTPOS.³ For example, at the time of the Reserve Bank's initial investigation of credit and debit card systems in 2000, an EFTPOS transaction often incurred a cost of around \$0.50 once a certain number of fee-free transactions had been made each month. In contrast, some consumers were effectively paid to use their credit card via the interest-free period and loyalty program rewards. These loyalty program rewards were quite generous; an average expenditure of around \$12 400 earned a \$100 shopping voucher in June 2003.⁴ Hence, combined with an interest-free period (typically up to 55 days), the effective price for a \$100 credit card transaction for a transactor with a loyalty program, prior to the reforms, was around $-\$1.30$.^{5,6} Average annual fees, which can also have some influence on a consumer's choice of holding and, hence, use of a particular payment instrument, were \$61 on a standard rewards card and \$98 on a gold rewards card in June 2002.⁷

One important factor affecting the pricing of these two systems is interchange fees – the fees paid between the merchant's and cardholder's financial institutions (the issuers) each time a transaction is made. In Australia, the average interchange fee in the credit card system has been, and continues to be, substantially higher than the interchange fee in the EFTPOS system. Prior to the reforms, the average interchange fee in the MasterCard and Visa credit card schemes was around 0.95 per cent of the transaction value (paid to the issuer). Similar interchange fees also applied for the Visa Debit system (the only scheme debit system then in

3 RBA and Australian Competition and Consumer Commission (2000).

4 See RBA (2008b) for further details of reward program benefits to cardholders. These are the earliest data available and are sourced from bank websites for the following cards: ANZ Telstra Rewards Visa card; Commonwealth Bank MasterCard Awards card; National Australia Bank Visa Gold card; and Westpac Altitude MasterCard.

5 RBA (2008c). The effective, or marginal, price takes into account the interest-free period and the value of loyalty program rewards. The annual fee is not accounted for in this calculation.

6 A transactor is a credit card holder who pays their bill in full each month and, thus, has access to an interest-free period. In contrast, a revolver is a credit card holder who uses the credit facility of a credit card and incurs an interest charge for each transaction made on the credit card. Revolvers likely faced a positive price for using their credit card because of interest charges.

7 Averages for credit cards with an interest-free period issued by major banks. RBA (2008a) provides additional detail.

operation).⁸ In contrast to most other countries, in Australia the interchange fee in the EFTPOS system flows in the opposite direction – from the cardholder’s financial institution to the merchant’s financial institution – and was around \$0.20 per transaction prior to the reforms. Not surprisingly, this structure of fees provided little incentive for issuers to promote or price the domestic EFTPOS system attractively to cardholders.

The Reserve Bank was concerned that the relative levels of interchange fees between credit and debit cards was not contributing to an efficient payments system. Some particular concerns were that the relative prices to cardholders for card payments did not generally reflect relative costs and interchange fees were not subject to the normal forces of competition. In addition, price signals to cardholders were distorted by credit card schemes imposing rules that did not allow merchants to surcharge at the point of sale. Hence, based on its legislative mandate to promote efficiency and competition in the payments system, the Reserve Bank’s Payments System Board introduced a number of reforms to debit and credit card arrangements, beginning from the start of 2003. These included setting interchange fee benchmarks for the credit card, debit card and EFTPOS systems, and removing scheme rules that prevented merchants from surcharging.⁹ Figure 3 shows the extent to which the reforms have lowered interchange fees in the respective systems, as well as narrowed the difference in fees between the systems.

These reforms have contributed to changes in effective prices facing card users. For credit cards, the reforms have had a number of effects, including: a reduction in the generosity of loyalty program rewards, with an average spend of \$16 700 now required to obtain a \$100 shopping voucher compared with \$12 400 in 2003; an increase in average annual fees of around 40 per cent to be currently \$85 for a standard rewards card and \$140 for a gold rewards card; and a gradual increase in the prevalence of surcharging at the point of sale.¹⁰ In addition, the reforms have also contributed to changes in the types of credit card products offered. With issuers receiving lower interchange-fee revenue, competition has partly focused on interest rates, rather than reward programs, and has led to a proliferation in the

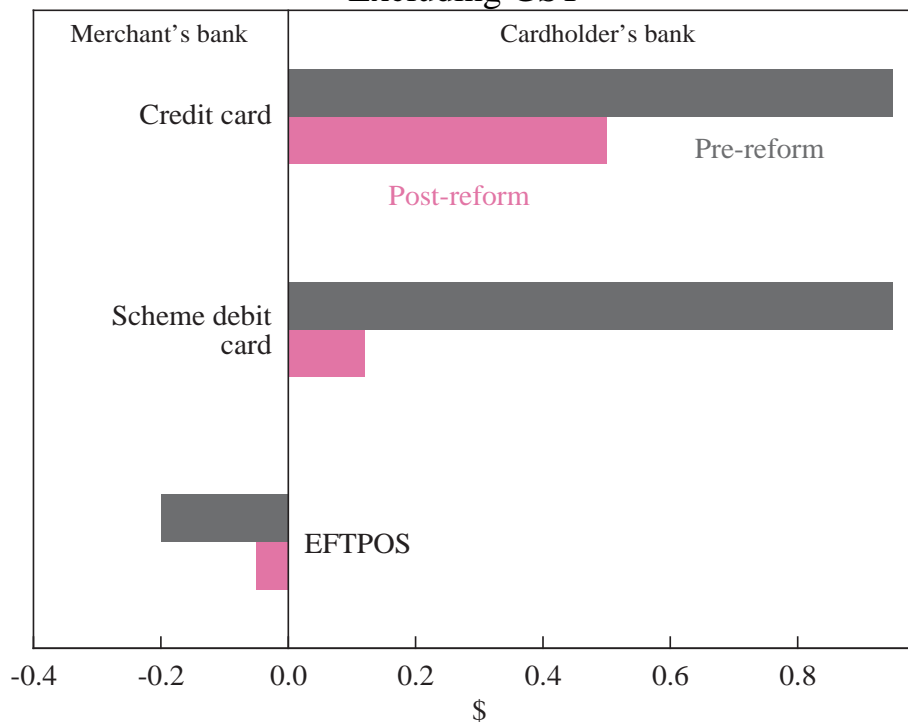
⁸ MasterCard’s debit product was not launched in Australia until November 2005.

⁹ See RBA (2008c) for a detailed discussion of the reforms.

¹⁰ RBA (2008b) and RBA (2009).

number of low-rate cards. These low-rate cards generally do not offer reward points but have both an interest-free period and lower annual fees than do the higher interest rate cards. For the EFTPOS system, the opposite has occurred, with most financial institutions now offering unlimited fee-free transactions for a small fixed monthly account-keeping fee.

Figure 3: Interchange Fees on a \$100 Payment
Excluding GST

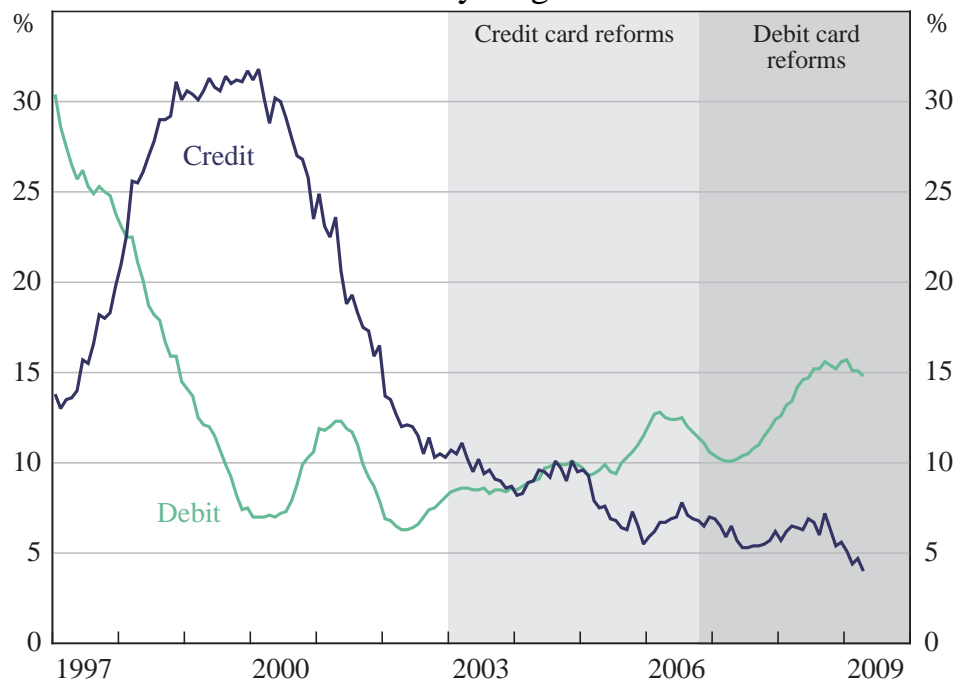


Note: The post-reform data show the benchmark for each system.

Source: RBA

Figure 4 shows growth in credit and debit card payments during this period of significant payments system change. Although some slowing in credit card payment growth was inevitable from the rapid pace experienced over the late 1990s, what is interesting is that there appears to have been a shift in the relative growth in the two card payment instruments. Further, this shift appears to have coincided with the shift in relative prices resulting from the reforms. This issue is explored in further detail later in the paper, using transaction-level data.

Figure 4: Number of Card Payments
Year-on-year growth



Source: RBA

3. Consumer Payments Literature

The academic literature on consumers' use of payment methods remains relatively scant, although this field of payments research has grown considerably in recent times. Earlier literature in this area focused on the influence of demographic variables and payment instrument attributes on consumers' choice of payment instrument; see Stavins (2001) and Klee (2006), for example. More recent papers, such as by Borzekowski, Kiser and Ahmed (2008), Ching and Hayashi (2008) and Zinman (2008), build upon this earlier literature to incorporate price-related variables into econometric modelling. Humphrey, Kim and Vale (2001) use aggregate transaction and price data for Norway to estimate own-price, cross-price and substitution elasticities for cash, debit cards and cheques. They conclude that consumers are quite sensitive to explicit pricing for payment services and also find that debit cards are quite a strong substitute for cheques.

The approach taken in this paper is similar to the approach in Borzekowski *et al* (2008), which estimates a series of probit models of debit card

holding and use. That paper used 2004 data from a special component of the Reuters/University of Michigan Surveys of Consumers. A nationally representative sample of around 1 500 households were asked about their use of PIN and signature debit cards, and open-ended questions to elicit information on the underlying reasons households choose to use debit cards (for example, security and convenience attributes). In addition to demographic variables, data on fees some banks charged cardholders for PIN debit transactions were also incorporated into probit models of debit card use. The results of these models indicate that the imposition of fees for PIN debit transactions encourages households to use signature debit cards instead of PIN debit cards but reduces the overall likelihood of households using debit cards. In fact, the paper finds that a transaction fee of less than 2 per cent of the average transaction amount is associated with a 12 per cent reduction in the likelihood of using a debit card. The authors note that the price response to merchant surcharging is likely to be larger than this, given that transaction fees are generally not disclosed to the consumer at the point of sale.

Ching and Hayashi (2008) estimate a series of multinomial logit models to analyse the effects of demographic variables (including individuals' adoption of technology), payment method attributes (including convenience and security) and loyalty program rewards on consumers' choice of payment methods at the point of sale. The paper uses data from the *2005/2006 Study of Consumer Payment Preferences*, conducted by the American Bankers Association and Dove Consulting. Around 3 000 consumers completed the questionnaire, mainly via the internet. While not a nationally representative survey, it provides a richer source of payments information (for example, data on consumers' credit card loyalty program participation) than can be obtained from sources such as the Federal Reserve's Survey of Consumer Finances. The questionnaire asked consumers about their most frequently used payment method across five merchant categories.

Ching and Hayashi run a hypothetical experiment of abolishing loyalty program rewards and conclude that only a small percentage of consumers would switch from electronic to paper-based payment methods, while consumers would increase their use of debit cards and decrease the use of credit cards. Their paper also finds that those consumers who normally incur an interest charge on their credit card balance are far less likely to make payments with a credit card. Zinman (2008) also

estimates probit models of the use of payment instruments and finds that revolvers are at least 21 per cent more likely to use debit cards than transactors, based on 1995 to 2004 data from the Survey of Consumer Finances. Zinman's results suggest that debit cards are a close substitute for credit cards, cash and cheques.

This paper builds on the existing literature that examines the influence of price-related variables on the use of payment instruments. It takes advantage of a unique transaction-level database that provides rich data not typically available in the questionnaire-style approach underpinning much of the existing literature. In this regard, our dataset is most similar to that used in Bounie and François (2006); a paper that estimates a multinomial logit model of cash, cheque and payment card use incorporating demographic and transaction explanatory variables (for example, transaction amount and merchant type). Our paper extends this type of work by incorporating price-related variables such as loyalty program participation and consumers' transactor/revolver status. The dataset used in Bounie and François (2006) consisted of transaction-level data on 17 000 payments made by around 1 400 French adults over an eight-day period in 2005, captured through a payments diary. Consumers were asked to record the details of the payments they made – the amount, merchant type, type of good, any payment restrictions faced, and the channel used (for example, face-to-face, internet or telephone). The paper discusses the importance of factors such as the transaction amount and merchant environment in determining the payment instrument used; for example, they find that controlling for other factors, the probability of cash use declines as the transaction value increases.

4. Data and Summary Statistics

4.1 The Data

The transaction-level data used in this paper were obtained from a survey of how consumers pay for goods and services, commissioned by the Reserve Bank in 2007 as part of its review of payments system reforms (RBA 2008c). The Reserve Bank employed a private research company, Roy Morgan Research, to help design and conduct the survey, which involved individuals recording the details of every purchase and bill payment they made over a two-week period in a specially

designed pocket-sized diary. For each payment, participants were asked to record information on the payment instrument, the value of the transaction, the merchant category, the channel (for example, point of sale, internet, telephone or mail) and mark a check-box if they were charged a fee by a merchant (or billing organisation) for using the particular payment instrument chosen (a 'surcharge').¹¹

Roy Morgan Research selected a nationally representative sample of 1 000 individuals, aged over 18 years, from its database to participate in the survey. Participants were asked to complete the survey over a two-week period in early June 2007. Completed diaries were received from 677 people. Fifteen individuals were excluded owing to inconsistencies in responses, resulting in a final sample of 662 individuals.¹²

Demographic information on each respondent was provided by Roy Morgan Research, including information on the individual's age, gender, regional location, educational level, income, and credit card holding status (that is, whether they hold a credit card, and if they do, whether they usually pay their bill in full each month). Furthermore, information was available on whether or not the cardholder held at least one credit card with a loyalty program attached to it.

The diary captured data on the use of 9 different payment instruments in 17 different merchant categories and generated a sample of almost 17 000 payments for a total value of around A\$850 000. In addition, the diary captured data on the use of 4 methods of obtaining cash and generated a sample of around 1 800 cash withdrawals for a total value of around A\$320 000. Table 1 presents a selection of

¹¹ Participants were also asked to record details in the diary of every cash withdrawal they made during the survey period, including the method used to withdraw the cash and the amount of cash obtained. In addition to completing the diary, participants were asked to complete a one-page questionnaire on their personal use of automated debits and surcharging experience at the end of the two-week period. This questionnaire was returned by 587 individuals.

¹² While the sample was designed to be representative of the Australian adult population, the response rates were such that ultimately some demographic groups (for example, older people) were over-represented in the final sample. Accordingly, Roy Morgan Research applied weightings to ensure that the final data were more representative of the population as a whole. These weighted data are used in the descriptive analysis in this section. However, the estimation of the econometric models uses unweighted data, since it is not clear whether the weights, which were derived to ensure representativeness of the total population in a few demographic dimensions, would be appropriate for our specific econometric model.

sample statistics and Appendix A contains more detailed information on the fields contained in the diary survey.

| Age (years) | | Education level | |
|-----------------------------|---------|---|---------|
| 18–29 | 22 (10) | Under grade 10 | 14 (15) |
| 30–44 | 28 (26) | Grade 10/11 | 17 (19) |
| 45–59 | 26 (32) | Grade 12 | 10 (8) |
| 60+ | 24 (32) | Technical qualification | 26 (25) |
| | | University degree | 33 (32) |
| Personal income (pa) | | Loyalty program^(a) | |
| <\$20 000 | 39 (40) | Loyalty program | 69 (69) |
| \$20 000–\$39 999 | 28 (27) | No loyalty program | 31 (31) |
| \$40 000–\$59 999 | 16 (15) | | |
| \$60 000–\$79 999 | 9 (8) | | |
| \$80 000–\$99 999 | 5 (5) | | |
| \$100 000–\$119 999 | 2 (2) | | |
| \$120 000+ | 2 (3) | | |
| Gender | | Location | |
| Male | 49 (42) | Capital city | 62 (57) |
| Female | 51 (58) | Regional | 38 (43) |
| Credit card holding | | Transactor/revolver status^(a) | |
| Credit card | 50 (61) | Transactor | 66 (67) |
| No credit card | 50 (39) | Revolver | 34 (33) |

Notes: Roy Morgan Research applied weightings for age, gender, location and credit card holding status. The unweighted shares for these variables are in brackets. The weighted and unweighted shares sum to 100 except for some rounding issues.

(a) Proportion of credit card holders.

Sources: Roy Morgan Research; RBA

4.2 Summary Statistics

4.2.1 Influence of transaction characteristics

Despite strong growth in the use of non-cash payment methods in recent years, cash is still by far the most commonly used payment instrument in Australia, accounting for around 70 per cent of the number of consumer payments and 38 per cent of their value (Table 2). Nevertheless, the diary results suggest that the choice of payment instruments by the consumer is closely related to the transaction

amount. Cash is the most commonly used payment instrument for low-value transactions, accounting for nearly all transactions under \$10 and three-quarters of transactions between \$11 and \$25 (Table 3). Conversely, cheques and BPAY are used relatively more for higher-value consumer payments, together accounting for 29 per cent of the payments above \$500. Cards are used extensively across all but very low transaction values. For transactions between \$25 and \$200, debit and credit cards account for 45 per cent of transactions.

Table 2: Payment Methods^(a)

| | Per cent of number | Per cent of value |
|-----------------------------------|--------------------|-------------------|
| Cash | 70 | 38 |
| EFTPOS | 11 | 14 |
| MasterCard/Visa debit card | 4 | 6 |
| MasterCard/Visa credit card | 9 | 17 |
| American Express/Diners Club card | 1 | 2 |
| Petrol/store card | * | * |
| Cheque | 1 | 9 |
| BPAY | 2 | 9 |
| Other ^(b) | 1 | 3 |

Notes: (a) Amounts less than 0.5 per cent are marked with an asterisk.

(b) 'Other' payment methods include instruments such as money orders and Cabcharge payments.

Source: Roy Morgan Research

Consumers' use of payment instruments also appears to be related to the merchant environment. Cash is used extensively in many merchant categories, for example in take-away food stores and pubs, but less so for travel and insurance purchases (Table 3). Likewise, the share of payments made by debit cards is largest at petrol stations and supermarkets and credit cards' share of payments is largest for travel and insurance payments.

These differences across merchant categories are likely to reflect a number of factors. For example, consumers' desire for quick transaction times for certain purchases like take-away food may lead to high use of cash in these situations. Use of debit cards in petrol stations and supermarkets is likely to reflect, in part, the availability of EFTPOS cash-out facilities. Differences across merchant categories may also reflect different average transaction values and restrictions such as which instruments or channels are available to consumers. For example, the share of payments made by cash is much lower for travel and insurance purchases and this

may partly reflect a ‘channel’ effect as consumers deal with these types of businesses via the internet relatively more than other businesses.

| Table 3: Payment Method Use | | | | | | |
|--|------|---------------|----------------|--------|------|------------------|
| Share of the number of payments, per cent (<i>continued next page</i>) | | | | | | |
| | Cash | Debit card | Credit card | Cheque | BPAY | Other methods |
| Transaction value (\$) | | | | | | |
| 0–10 | 95 | 3 | 1 | 0 | 0 | 0 |
| 11–25 | 74 | 16 | 8 | 0 | 1 | 1 |
| 26–50 | 56 | 23 | 17 | 1 | 2 | 2 |
| 51–75 | 39 | 29 | 24 | 2 | 3 | 3 |
| 76–100 | 37 | 28 | 21 | 3 | 9 | 2 |
| 101–150 | 34 | 29 | 22 | 4 | 6 | 3 |
| 151–200 | 31 | 28 | 24 | 3 | 11 | 3 |
| 201–500 | 31 | 21 | 21 | 7 | 15 | 5 |
| 500+ | 19 | 18 | 30 | 15 | 14 | 5 |
| Merchant category | | | | | | |
| Take-away | 94 | 5 | 1 | 0 | 0 | 0 |
| Pub/bar | 90 | 6 | 3 | 0 | 0 | 0 |
| Small food store | 89 | 7 | 4 | 0 | 0 | 0 |
| Sporting/entertainment | 86 | 6 | 5 | 1 | 0 | 1 |
| Transport | 83 | 7 | 6 | 1 | 2 | 0 |
| Restaurant | 78 | 9 | 12 | 0 | 0 | 0 |
| Other | 69 | 9 | 7 | 5 | 6 | 4 |
| Education/childcare | 67 | 13 | 5 | 9 | 2 | 4 |
| Liquor store | 65 | 19 | 15 | 0 | 0 | 0 |
| Retailer | 64 | 19 | 15 | 1 | 1 | 2 |
| Supermarket | 62 | 25 | 12 | 0 | 0 | 0 |
| Health/medical | 57 | 19 | 20 | 3 | 1 | 1 |
| Professional services | 52 | 13 | 17 | 13 | 2 | 3 |
| Petrol | 48 | 32 | 17 | 0 | 0 | 4 |
| Housing/utilities | 39 | 12 | 13 | 5 | 28 | 3 |
| Holiday/travel | 27 | 20 | 42 | 6 | 2 | 2 |
| Insurance | 26 | 13 | 23 | 6 | 18 | 14 |
| Age (years) | | | | | | |
| 18–29 | 69 | 19 | 8 | 0 | 3 | 1 |
| 30–44 | 65 | 19 | 11 | 1 | 3 | 1 |
| 45–59 | 70 | 14 | 11 | 2 | 2 | 2 |
| 60+ | 79 | 8 | 9 | 2 | 1 | 1 |

Table 3: Payment Method Use
Share of the number of payments, per cent (*continued*)

| | Cash | Debit card | Credit card | Cheque | BPAY | Other methods |
|-----------------------------------|------|------------|-------------|--------|------|---------------|
| Personal income (pa) | | | | | | |
| <\$20 000 | 76 | 13 | 8 | 1 | 1 | 1 |
| \$20 000–\$39 999 | 70 | 18 | 7 | 1 | 3 | 1 |
| \$40 000–\$59 999 | 64 | 18 | 13 | 1 | 3 | 2 |
| \$60 000–\$79 999 | 65 | 16 | 15 | 1 | 2 | 2 |
| \$80 000–\$99 999 | 67 | 12 | 18 | 1 | 1 | 2 |
| \$100 000–\$119 999 | 69 | 6 | 21 | 1 | 3 | 0 |
| \$120 000+ | 65 | 10 | 19 | 2 | 2 | 3 |
| Transactor/revolver status | | | | | | |
| Transactor | 64 | 10 | 22 | 1 | 1 | 1 |
| Revolver | 62 | 19 | 12 | 1 | 4 | 2 |
| No credit card | 79 | 17 | Na | 1 | 2 | 1 |
| Credit card holders | | | | | | |
| Loyalty program | 61 | 12 | 23 | 1 | 2 | 1 |
| No loyalty program | 66 | 16 | 11 | 1 | 3 | 2 |

Notes: Payment methods' shares sum across categories; in some cases the sum does not equal 100 due to rounding. These shares reflect weights applied by Roy Morgan Research for age, gender, location and credit card holding status. This table excludes payments where the cardholder did not provide information on key variables. For instance, payments where a cardholder did not report a payment method or transaction amount were excluded.

Source: Roy Morgan Research

4.2.2 Influence of demographics

Age appears to play some role in determining consumers' use of payment instruments. While cash is used extensively across all age groups, older individuals appear to use cash more than younger people (Table 3). People over 60 years of age use cash for almost 80 per cent of their payments, compared to around 65 per cent for those aged between 30 and 44 years.

The use of debit cards is highest in the younger age groups and declines for older age groups. Conversely, the use of credit cards is relatively low for the youngest age group, reflecting the fact that younger people are not as likely to hold credit cards. Around one-third of respondents aged 18–29 years in our sample held a credit card; this compares to around half for the adult population.

The use of cards also appears to be influenced by an individual's personal income. Credit cards are used relatively more at higher income levels, while debit card use

is highest for middle income bands. Those with a personal income of more than \$100 000 used credit cards for around 20 per cent of their total payments, more than twice the share of those earning under \$40 000. However, it is difficult to separate the influence of higher credit card holding among high-income individuals from higher use of credit cards as income increases. In Section 5, we examine the effect of income on credit card use, conditional on holding a credit card.

4.2.3 Influence of price incentives

In addition to the influence of transaction and demographic characteristics described above, credit card holders' use of payment instruments also appears to be influenced by the relative price of payment instruments. In particular, credit card holders' transactor/revolver status appears to be important.

According to the diary survey, transactors use credit cards relatively more often than revolvers – for around 22 per cent of their transactions compared to 12 per cent for revolvers, and 35 per cent of the value of spending compared to 22 per cent for revolvers. Conversely, revolvers tend to use debit cards more often than transactors (Table 3). In part, this pattern is likely to reflect the fact that for revolvers an additional purchase on their credit card accrues an interest charge immediately, increasing the relative price of credit cards compared to other payment methods.

Loyalty programs are another important factor affecting the relative price of payment instruments. According to data from Roy Morgan's Single Source database, almost 70 per cent of Australian credit card holders aged over 18 years have a loyalty program attached to at least one of their credit cards. Loyalty program participation appears to be more common for transactors, with three-quarters of transactors participating in loyalty programs compared to 59 per cent of revolvers. On average, credit card holders with loyalty programs use their credit cards around twice as often as those who do not participate in a loyalty program (Table 3).

4.2.4 *Merchant surcharging*

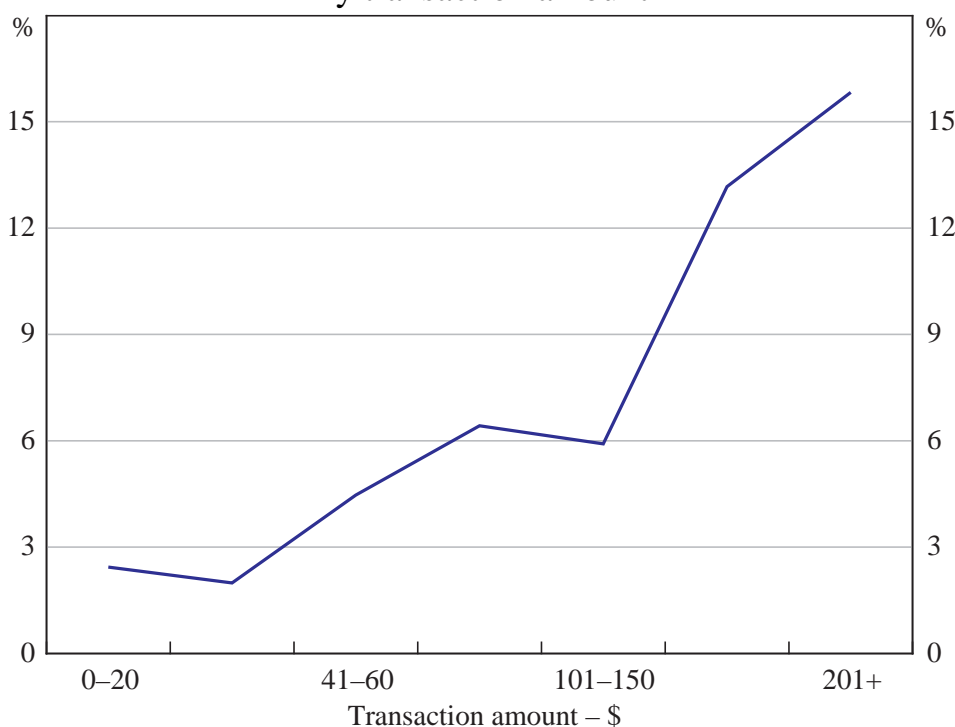
Participants in the diary study were asked to record each transaction they made where they paid a surcharge. However, instances where the merchant applied a surcharge for a particular payment method but where the consumer chose to use an alternative payment method are not observed. Consequently, the sample size for the number of credit card transactions attracting a surcharge is small, limiting its usefulness. Further, obtaining information on the range of choices and limitations the consumers faced when making their decisions is difficult because often it is not readily available to the consumer at the point of sale and it can add a significant reporting burden, reducing the likelihood that consumers will participate in the survey. For example, if anything, the presence of surcharging is likely to be higher than suggested by our survey results, because we do not directly survey whether the merchant applied a surcharge or not, we only observe if the consumer *paid* the surcharge. Given these limitations of the data, it is not possible to incorporate the surcharging variable into the econometric models used below. In addition, Roy Morgan Research noted that some respondents may have incorrectly understood the instructions on surcharging, as a number of respondents reported being surcharged for the use of cash.

Notwithstanding these limitations, there are a number of interesting findings that can be made using the data available. Cardholders reported paying a surcharge for around 5 per cent of credit card transactions. Of those respondents who filled in the automated debits and surcharging questionnaire, and reported facing a credit card surcharge at least once over the two-week period, 44 per cent reported that it affected their choice of payment instrument ‘very much’ or ‘somewhat’, while 52 per cent thought it affected their choice ‘very little’ or ‘not at all’.

Credit card holders appear to be more likely to pay a surcharge the higher the transaction amount, with a noticeable increase in the share of transactions that attracted a surcharge for amounts above \$150 (Figure 5). Only around 1–2 per cent of department store and supermarket credit card transactions were reported as attracting a surcharge compared to around 29 per cent of holiday/travel credit card purchases and 18 per cent of sporting/entertainment purchases. This difference across merchant categories could partly reflect the influence of the payment channel. For example, it was reported that 16 per cent of credit card payments

made over the internet attracted a surcharge, compared to 4 per cent of those made in-person. In addition, people who participate in a loyalty program paid surcharges for credit card transactions at about twice the rate of people without a loyalty program (5.7 per cent versus 2.9 per cent of credit card payments made). Given these interesting statistics, we hope to make greater use of these surcharging data in later work.

Figure 5: Proportion of Credit Card Purchases Attracting Surcharges
By transaction amount



Source: Roy Morgan Research

5. Modelling Consumer Payment Behaviour for Australia

In this section, we present the results of an econometric model for the holding and use of various payment instruments: credit cards; debit cards; and cash. As discussed in Section 4, there are three sets of factors that are potentially important determinants of whether a consumer uses a particular payment instrument: demographic factors; transaction characteristics; and our variables of interest –

loyalty program participation and the interest-free period.¹³ We are especially interested in how these price incentives affect the probability of using different payment instruments. Our dataset, compared with those used in most previous studies, is especially useful for this purpose because it records *actual* payment instrument use, as opposed to *assumed* most frequent use.

5.1 Modelling Framework

5.1.1 Credit card holding

In Australia, for the vast majority of everyday transactions, consumers will generally be able to pay with a credit card, debit card or cash. However, while cash and debit cards are held by almost all consumers, many do not have a credit card.¹⁴ Hence, we first examine the main factors determining the probability of a consumer holding a credit card.

For our dependent variable, we only know the outcome of whether the consumer holds a credit card or not, rather than the utility derived from holding a credit card. Therefore, a latent variable approach is used. The dependent variable, $CChold$, is defined as 1 if the consumer holds a credit card and 0 otherwise and $CChold^*$ is the latent variable (that is, the utility derived from holding the credit card):

$$CChold_j^* = \beta_0 + \sum_{k=1}^N \beta_k X_{jk} + \mu_j \quad (1)$$

$$CChold_j = 1 \left[CChold_j^* > 0 \right]$$

¹³ Loyalty program participation and interest-free period are captured by dummy variables. Loyalty program participation is defined as: 1 if consumer does *not* have a loyalty program and 0 otherwise. The interest-free period is defined as: 1 if the consumer does *not* have an interest-free period (is a revolver) and 0 otherwise (is a transactor). Owing to data limitations, there may be some transactors in the sample whose card does not have an interest-free period. This problem is likely to be relatively small, however, as at the aggregate level only 6 per cent of personal credit card accounts do not have an interest-free period, and revolvers are probably more likely than transactors to choose to hold these cards since they do not usually receive the benefit of any interest-free period.

¹⁴ In Australia, an EFTPOS card is typically issued with the opening of a transaction account; hence, most individuals have a debit card. According to a Roy Morgan Research e-mail, 16 September 2008, around 91 per cent of individuals hold a debit card of some sort, compared to 53 per cent who hold a credit or charge card.

where j is the individual consumer and there is a set of N independent demographic variables, X , for each consumer. We use a probit model to estimate the probability of holding a credit card:

$$P\left(CChold_j = 1 \mid \{X_{jk}\}_{k=1}^N\right) = \Phi\left(\beta_0 + \sum_{k=1}^N \beta_k X_{jk}\right) \quad (2)$$

where $\Phi(\bullet)$ is the standard normal cumulative distribution function.

Aside from demographic variables, we also considered the value of total weekly transactions as an explanatory variable for the probability of holding a credit card. We might expect that a consumer with relatively high expenditure would be more likely to hold a credit card. As the bivariate analysis showed, credit cards are used for all but very low-value transactions, and a consumer that makes either high-value or a large number of transactions may prefer to have a choice of card payment instruments rather than carrying cash. However, it may be equally likely that holding a credit card affects the weekly spending of consumers, either increasing it because they have the ability to borrow for an interest-free period and may make purchases earlier than otherwise, or decreasing it because they are paying interest on credit card debt and so have to reduce consumption.¹⁵ This potential reverse causation means that the value of total weekly transactions may be endogenous, and its inclusion in Equation (2) could bias our estimates.

We attempted to control for this potential endogeneity using an instrumental variables approach. Unfortunately, our dataset does not contain a wide range of variables that both explain the total value of weekly transactions and are independent of factors affecting the decision to hold a credit card. The instrumental variables method did not produce meaningful results because the potential instrumental variables were only weakly correlated with the value of total weekly transactions. For this reason, our preferred approach is to exclude the endogenous

¹⁵ Access to a credit card cannot affect the long-run level of consumption – it merely allows some inter-temporal smoothing of consumption expenditure. In the long run, income will determine consumption, but our sample may include people at differing points in this inter-temporal smoothing cycle, leading to some temporary effect.

explanatory variable and estimate the probit model for credit card holding using only demographic explanatory variables.¹⁶

5.1.2 *Loyalty program credit card holding*

Given our focus on price incentives, we are also interested in determining the characteristics of credit card holders that have a loyalty program attached to one of their cards. Therefore, for our sample of credit card holders, we estimate the following model:

$$P\left(LPhold_j = 1 \mid \left\{ X_{jk} \right\}_{k=1}^N\right) = \Phi\left(\delta_0 + \sum_{k=1}^N \delta_k X_{jk}\right) \quad (3)$$

where *LPhold* is defined as 1 if the consumer holds a loyalty program credit card and 0 otherwise. As with credit card holding, we estimate a model that only includes demographic variables. Again, we considered whether the value of weekly *credit card* transactions might influence the probability of holding a loyalty program credit card. However, the value of weekly credit card transactions is potentially endogenous and we do not have suitable instruments.

5.1.3 *Credit card, debit card and cash use*

Once we establish the characteristics of consumers holding a credit card, as well as credit card holders that have a loyalty program, we turn to the main focus of our paper: whether there is a relationship between price incentives on credit cards and broader consumer payment instrument use. To do this we follow Borzekowski *et al* (2008) and use our transaction-level data (pooling all transactions of all consumers) to estimate separate probit models for the use of

¹⁶ Klee (2006) and Borzekowski *et al* (2008) also estimate payment instrument holding on a set of demographic variables alone.

credit cards, debit cards and cash.¹⁷ Hence, for each payment instrument, the probability of use is modelled as:

$$P\left(Use_i = 1 \mid \{X_{ik}\}_{k=1}^N, \{T_{im}\}_{m=1}^M, LP_i, I_i\right) = \Phi\left(\alpha_0 + \sum_{k=1}^N \alpha_k X_{ik} + \sum_{m=1}^M \phi_m T_{im} + \gamma LP_i + \tau I_i\right) \quad (4)$$

where the dependent variable, Use , takes the value of 1 if the consumer used the payment instrument for a particular transaction – either credit card, debit card or cash – and 0 otherwise; i denotes an individual transaction, so X_i is a set of demographic variables specific to each transaction; there is a set of M transaction-related variables, T ; LP indicates whether the consumer participated in a loyalty program or not; and I indicates whether the consumer regularly pays off their monthly credit card bill or not (that is, whether they are a transactor or a revolver). The standard errors have been adjusted to account for the fact that the observations are only independent across, rather than within, consumers.

We base these regressions only on those individuals who hold a credit card. This approach is consistent with that applied in previous studies; as Ching and Hayashi (2008) note, the focus is on the differences in payment methods between those who participate in a loyalty program and those who do not, rather than between credit card and non-credit card holders.¹⁸

Ching and Hayashi argue that it is possible that the loyalty program variable is endogenous (at least within the context of their dataset). They suggest three reasons why the loyalty program dummy variable may be positively correlated with unobserved consumer preferences for credit cards: consumers may choose loyalty programs because they use credit cards more, owing to a high preference

¹⁷ Because this problem can also be treated as one where the consumer has a number of alternative payment options that are mutually exclusive and exhaustive, we could also use a multinomial logit model, similar to Bounie and François (2006). Our preliminary results from a multinomial logit model suggested similar effects in both sign and magnitude to those found for the less complex probit models.

¹⁸ Also see Bounie and François (2006), Borzekowski *et al* (2008) and Zinman (2008). This focus on the sub-sample of credit card holders is one reason we do not model the two stages of credit card holding and credit card use in the Heckman selection framework. Kohler and Rossiter (2005) provide more detail on other reasons for preferring a two-part model over a selection model.

for credit cards; the incentive of loyalty programs may induce consumers to use the credit card more often, thus the consumer learns the good features of the credit card and views the card more favourably; and card issuers may send pre-approved loyalty program invitations to consumers who have been heavily using credit cards. Their assumption is that there are some unobserved preferences for credit cards that are reflected in loyalty program membership; without controlling for these preferences, they argue the loyalty program dummy variable cannot disentangle the general preference for credit cards from the price effects of loyalty programs.

We consider the possibility that our estimate for the effect of loyalty programs may be affected by the considerations advanced by Ching and Hayashi (2008). We conclude, however, that differences in the nature of the data we use and institutional differences between the US and Australia mean that there is unlikely to be a meaningful endogeneity problem with the loyalty program variable in our regressions.¹⁹

Our general premise is that, once the consumer has chosen to hold a credit card²⁰ (dependent on preferences such as speed and safety), the predominant remaining reason they chose to join a loyalty program is whether there is a net benefit for them to do so; that is, whether they will use the credit card sufficiently to accumulate rewards that outweigh the higher annual fee generally associated with loyalty program credit cards. Loyalty programs do not affect the transactional convenience or other similar attributes of a credit card; thus, conditional on consumers choosing to hold a credit card, the separate decision to enrol in a loyalty

¹⁹In addition to the discussion below, we apply the two-step Rivers and Vuong (1988) endogeneity test on the transaction-level data. This test finds that we cannot reject the null hypothesis that loyalty program holding is exogenous. There are, however, some issues with applying this test in our particular model set-up; because we have a mix of both transaction-level and consumer-level data, adjustments for clustering on consumer-level variables need to be considered. Given that these adjustments are not established for this test, we do not emphasise these results here. Further, our first-stage regression for holding a credit card with a loyalty program does not have particularly high explanatory power. Notwithstanding these concerns, we consider the results to provide some independent grounds to proceed with our assumption that the loyalty program variable is exogenous within the context of our model and dataset.

²⁰As mentioned above, our question of interest requires us to restrict our sample to credit card holders. Therefore, any potential bias from credit card holding on credit card use has been eliminated.

program is, we argue, a reflection of a price effect and is precisely the effect we want to capture with our loyalty program variable.

A particular reason for the difference in conclusions is that we have transaction-level data rather than a single observation of the most frequently used payment instrument for each consumer. While it is plausible that a consumer's most frequently used payment method could influence their loyalty program membership within a consumer-level dataset where the observations are not well anchored in time, we think this concern is significantly reduced with transaction-level data. We do not expect that the consumer's use of a credit card for *a particular transaction* could have any effect on their enrolment in a loyalty program. We therefore suggest that the causation is only one-way – that loyalty program holding has an effect on credit card use but the use of a credit card for a given transaction does not affect a consumer's loyalty program membership over the two-week period of our sample.

In a similar vein, we also suggest that while a loyalty program may increase the use of a credit card – the effect we are trying to measure – it is unlikely that having a loyalty program will change the consumer's perceptions of the non-price features of credit cards (the second endogeneity concern, as raised by Ching and Hayashi 2008). One could argue that these features would be apparent to credit card holders regardless of whether they hold a loyalty program or not – particularly if many of those features are shared with other card-based payment methods to which people have access. These features should already be apparent given that credit cards are a mature and widely accepted payment instrument in the Australian payments system.

Finally, reflecting on Ching and Hayashi's third endogeneity concern, credit card use for a particular transaction in our two-week sample could not reasonably be expected to lead consumers to sign up for, or receive, loyalty program offers within our sample. A reason for this strong conclusion is the significant institutional differences between the Australian and US credit card markets. In particular, third-party credit card providers in Australia do not have access to the 'positive' credit reporting data that are used in the US to make credit card offers. Hence, Australian

providers could not, in fact, make loyalty program offerings to high credit card users because they are unaware of who those users are.²¹

For these reasons, we conclude that loyalty program participation can be treated as a predetermined and exogenous variable in our regressions for payment instrument use.

5.2 Influences on the Probability of Credit Card Holding

The results from our model of credit card holding are presented in Table 4. The coefficients in the second column allow us to gauge only the direction of the variable's effect. Hence, in the last column we also report the marginal effect on the implied probabilities of a change in each of the independent variables, evaluated at the base case.²² While some variables are surveyed in continuous form we converted these into dummy variables to be consistent across all our variables. Hence for all variables, the partial effect measures the estimated change in the probability of interest following a discrete change in the dummy from 0 to 1. The model is parsimonious to the extent that variable categories were excluded when the variables in the category were found to be jointly insignificant.²³

As shown in Table 4, we find that income has a large effect on the probability of holding a credit card, but it is only significant for lower income categories. We find that relative to a base income of \$40 000–\$59 999, the probability of a consumer with an annual income of between \$20 000–\$39 999 holding a credit card is 17 percentage points lower. This effect is even larger for those on an income of less than \$20 000, at around 34 percentage points. The finding that low-income earners are less likely to hold a credit card is not surprising; however, what is interesting is that there is no statistically significant difference between

21 An additional facet of our data is that the loyalty program membership variable is recorded at a date prior to the survey rather than after the survey, so our variable is predetermined.

22 As most of our explanatory variables are multiple-category dummy variables, it is more appropriate to evaluate the marginal effects at the base case, rather than at sample means. Our base case for each dummy variable category was generally chosen as the category with the highest proportion of the sample. An exception to this in the regression for credit card holding was personal income for which we chose a base case of \$40 000 to \$59 999 to reflect the average income of a person with (or currently completing) a university degree.

23 We additionally required that all the excluded dummy variable categories were jointly insignificant.

incomes of \$40 000 and higher. This suggests that the effect at lower income levels could reflect supply-side factors, for example the need to satisfy a certain eligibility criteria to obtain a credit card.

The regional (capital city or not capital city) variable has a significant and negative effect; compared to the ‘base case’ consumer living in a capital city, a person living in a regional location is 12 percentage points less likely to hold a credit card. There also appears to be some variation in credit card holding between the various states and territories.

Table 4: Credit Card Holding

| Variable | Coefficient | Base case | Marginal effect (ppts) |
|-------------------------------------|-------------|-----------------------|------------------------|
| Income (<\$20 000) | -0.90*** | \$40 000–\$59 999 | -34.2 |
| Income (\$20 000–\$39 999) | -0.46** | \$40 000–\$59 999 | -16.7 |
| Income (\$60 000–\$79 999) | 0.15 | \$40 000–\$59 999 | 4.5 |
| Income (\$80 000–\$99 999) | 0.23 | \$40 000–\$59 999 | 6.8 |
| Income (\$100 000–\$119 999) | -0.29 | \$40 000–\$59 999 | -10.2 |
| Income (\$120 000+) | 0.80 | \$40 000–\$59 999 | 18.5 |
| Scheme debit card | -0.37*** | No scheme debit card | -13.2 |
| Cheque book | 0.41*** | No cheque book | 11.5 |
| QLD | 0.34** | NSW/ACT | 9.8 |
| VIC | 0.10 | NSW/ACT | 3.1 |
| TAS | 0.13 | NSW/ACT | 3.9 |
| SA/NT | -0.22 | NSW/ACT | -7.7 |
| WA | 0.18 | NSW/ACT | 5.6 |
| Regional location | -0.34*** | Capital city location | -11.9 |
| Education (< Year 10) | -0.36** | University | -12.9 |
| Education (Year 10/11) | -0.11 | University | -3.8 |
| Education (Year 12) | -0.52** | University | -19.0 |
| Education (Technical qualification) | 0.07 | University | 2.2 |
| Constant | 0.64*** | | |

Number of observations = 579

Pseudo $R^2 = 0.16$

Notes: ***, ** and * denote the 1, 5 and 10 per cent levels of significance respectively. Marginal effects are evaluated at the base case.

The level of education of the consumer is significant. For example, a consumer whose highest educational qualification is less than Grade 10 is 13 percentage points less likely to hold a credit card than a consumer with a university

qualification. This is consistent with Borzekowski *et al's* (2008) finding that higher levels of education tend to increase the probability of debit card holding. What this tends to suggest is that additional education may increase the probability of holding payment instruments aside from the more traditional methods, such as cash.²⁴

It is perhaps not surprising to find that a consumer who holds a scheme debit card is around 13 percentage points less likely to hold a credit card than a consumer without a scheme debit card. For these consumers, the 'scheme' card is likely to be a reasonable substitute for a credit card, including for payments that are not face-to-face, such as internet payments.

In contrast, we find that if the consumer holds a cheque book then they are around 11 percentage points more likely to hold a credit card. While these two payment instruments are used for quite different types of payments, one similar feature is that they may assist with the consumer's personal accounting, because both provide a means to record the details of expenditures.

5.3 Influences on the Probability of Loyalty Program Credit Card Holding

Having established the characteristics of consumers who hold a credit card, an additional interest is to ascertain the characteristics of those consumers who hold a credit card with a loyalty program. The results from our parsimonious model of participation in loyalty programs are presented in Table 5.

While the results above suggested that consumers with lower levels of income are less likely to hold a credit card, we find that lower-income households that do hold a credit card are less likely to hold one with a loyalty program attached. This suggests that these lower-income consumers may be more likely to hold a credit card with lower annual fees and possibly lower interest rates, particularly if they are uncertain as to whether they will always be able to pay off their monthly credit card bill. This is also likely a reflection of their expected value from a loyalty program – with low income levels likely to also have low spending levels, meaning that the benefit they receive from the loyalty program may not offset the annual membership fee. We also find some tentative evidence that higher-income

²⁴ In their sample, only around 52 per cent of households held a debit card.

consumers may be more likely to hold a credit card with a loyalty program than the base case consumer with an income of between \$40 000 to \$59 999. Higher-income consumers may be more certain of their ability to pay off their credit card balance; hence, a loyalty program, as opposed to lower annual fees and interest rates, may be a more attractive credit card product.

Table 5: Loyalty Program Membership Among Credit Card Holders

| Variable | Coefficient | Base case | Marginal effect (ppts) |
|-------------------------------------|-------------|-----------------------|------------------------|
| Income (<\$20 000) | -0.87*** | \$40 000–\$59 999 | -32.3 |
| Income (\$20 000–\$39 999) | -0.28 | \$40 000–\$59 999 | -11.3 |
| Income (\$60 000–\$79 999) | 0.30 | \$40 000–\$59 999 | 11.5 |
| Income (\$80 000–\$99 999) | 0.90** | \$40 000–\$59 999 | 29.5 |
| Income (\$100 000–\$119 999) | 0.55 | \$40 000–\$59 999 | 20.0 |
| Income (\$120 000+) | 0.73 | \$40 000–\$59 999 | 25.1 |
| Regional location | 0.37** | Capital city location | 14.1 |
| Part-time work | 0.64** | Full-time work | 22.7 |
| Looking for work | 0.88 | Full-time work | 29.0 |
| Not looking for work | 0.49 | Full-time work | 18.0 |
| Retired | 0.62** | Full-time work | 22.2 |
| Education (< Year 10) | 0.14 | University | 5.6 |
| Education (Year 10/11) | -0.22 | University | -8.9 |
| Education (Year 12) | -0.23 | University | -9.3 |
| Education (Technical qualification) | 0.40* | University | 14.8 |
| Constant | 0.14 | | |

Number of observations = 299
Pseudo R² = 0.10

Notes: ***, ** and * denote the 1, 5 and 10 per cent levels of significance respectively. Marginal effects are evaluated at the base case.

Interestingly, we find that part-time workers and retirees are more likely to hold a loyalty program credit card than those that work full-time, other things equal. This seems somewhat counter-intuitive, though this variable may be also capturing

effects of other debt holding that are not included in the model.²⁵ For example, compared to retirees, full-time workers are more likely to have other forms of debt, such as a mortgage. Hence, given their potential liquidity constraints, full-time workers may prefer a lower-rate credit card without a loyalty program to avoid high interest charges if they do not pay their credit card bill in full by the due date.

Despite the fact that consumers who live in regional areas are less likely to hold credit cards, those that do are more likely to have a loyalty program attached (than credit card holders in capital cities).

5.4 Influences on the Probability of Credit Card Use

We use the same set of demographic variables, as well as transaction-related and price incentive variables, to determine the main factors affecting payment instrument use. Hence, the variable we are interested in explaining is whether the consumer used a credit card or not for a particular transaction. For these models we include the same set of explanatory variables across the credit card, debit card and cash models for comparative purposes. Table 6 presents a summary of the results for the probability of credit card use.²⁶ Some explanatory variables have been excluded for presentation purposes; the full results are in Appendix B.

5.4.1 Demographic factors

Previous research has shown that demographic factors have an important effect on the probability of using different payment methods (Bounie and François 2006; Klee 2006; Borzekowski *et al* 2008; Emery *et al* 2008). In Section 5.2 we found

²⁵ We do not have any variables on the level or existence of other debt available in our survey. There is also evidence to suggest multicollinearity between the employment status and revolver variables; the employment status variables are jointly insignificant when revolver is also included in the regression. Not surprisingly, a revolver is less likely to hold a loyalty program credit card and instead probably hold lower-rate credit cards without reward programs attached.

²⁶ Again, our base case categories have generally been determined as the category with the highest proportion of the sample for each set of dummy variables. The exception in these regressions is the categories for transaction value. In this case we took the category corresponding to the average transaction value (\$57, for those that hold a credit card); the highest proportion of the sample is accounted for by low-value transactions, that is \$0–\$10.

Table 6: Credit Card Use
By credit card holders

| Variable | Coefficient | Base case | Marginal effect (ppts) |
|---------------------------|-------------|-------------------------|------------------------|
| No loyalty program | -0.65*** | Loyalty program | -22.9 |
| Revolver | -0.43*** | Transactor | -15.9 |
| Male | 0.27** | Female | 10.9 |
| Scheme debit card | -0.37*** | No scheme debit card | -14.1 |
| Transaction (\$0-\$10) | -1.64*** | Transaction (\$51-\$60) | -41.0 |
| Transaction (\$11-\$20) | -0.70*** | Transaction (\$51-\$60) | -24.6 |
| Transaction (\$21-\$30) | -0.23*** | Transaction (\$51-\$60) | -9.1 |
| Transaction (\$31-\$40) | -0.05 | Transaction (\$51-\$60) | -2.1 |
| Transaction (\$41-\$50) | -0.08 | Transaction (\$51-\$60) | -3.1 |
| Transaction (\$61-\$70) | -0.08 | Transaction (\$51-\$60) | -3.2 |
| Transaction (\$71-\$80) | 0.11 | Transaction (\$51-\$60) | 4.4 |
| Transaction (\$81-\$90) | 0.09 | Transaction (\$51-\$60) | 3.5 |
| Transaction (\$91-\$100) | -0.07 | Transaction (\$51-\$60) | -2.7 |
| Transaction (\$101-\$110) | 0.36** | Transaction (\$51-\$60) | 14.2 |
| Transaction (\$111-\$120) | 0.45*** | Transaction (\$51-\$60) | 17.6 |
| Transaction (\$121-\$130) | 0.16 | Transaction (\$51-\$60) | 6.3 |
| Transaction (\$151-\$160) | 0.43** | Transaction (\$51-\$60) | 17.1 |
| Transaction (\$161-\$170) | -0.07 | Transaction (\$51-\$60) | -2.7 |
| Transaction (\$171-\$180) | 0.00 | Transaction (\$51-\$60) | 0.0 |
| Transaction (\$181-\$190) | 0.63* | Transaction (\$51-\$60) | 24.4 |
| Transaction (\$191-\$200) | 0.12 | Transaction (\$51-\$60) | 4.7 |
| Transaction (\$201+) | 0.03 | Transaction (\$51-\$60) | 1.0 |
| Holiday/travel | 0.64*** | Retailer | 24.5 |
| Health/medical | 0.20** | Retailer | 7.8 |
| Petrol | 0.09 | Retailer | 3.7 |
| Supermarket | -0.08 | Retailer | -3.3 |
| Restaurant | -0.44*** | Retailer | -16.5 |
| Small food store | -0.51*** | Retailer | -18.8 |
| Professional services | -0.52*** | Retailer | -19.1 |
| Sporting/entertainment | -0.66*** | Retailer | -23.4 |
| Pub/bar | -0.75*** | Retailer | -25.7 |
| Take-away | -0.93*** | Retailer | -30.4 |
| Constant | -0.13 | | |

Number of observations = 8 575

Pseudo R² = 0.28

Notes: ***, ** and * denote the 1, 5 and 10 per cent levels of significance respectively. Marginal effects are evaluated at the base case.

that personal income can help to explain the probability of a consumer holding a credit card. However, once a consumer holds a credit card, income does not appear to have a statistically significant effect on the probability that the consumer will use their credit card for a given transaction. This is not entirely inconsistent with other studies; for example, Bounie and François (2006) do not find an intuitive income effect in their results for payment instrument use. In contrast, gender does not have a statistically significant effect on credit card holding, but it does play a role in determining the probability of credit card use, with males 11 percentage points more likely to use a credit card for a given transaction than females.

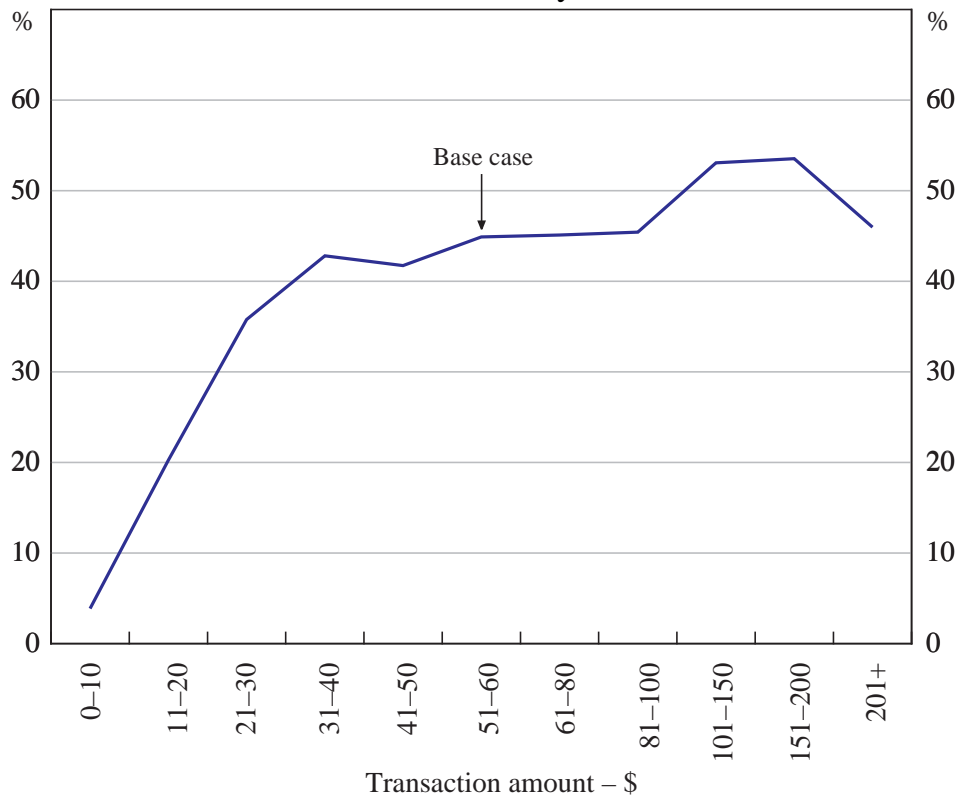
If the consumer also holds a scheme debit card, we find that the probability that the consumer will use a credit card for a given transaction is 14 percentage points lower than otherwise. This result provides some confirmation that scheme debit cards may be substitutes for certain types of transactions, particularly internet transactions. In contrast, despite cheque book holding having a significant effect on credit card holding, it does not significantly affect the probability of using a credit card. This is consistent with the likelihood that these two types of payment instruments are used for quite different types of payments.

5.4.2 Transaction characteristics

Our estimated model in Table 6 controls for a range of transaction-related factors that could affect credit card use. Low-value transaction amounts are significantly less likely to be associated with using a credit card, controlling for all other factors. For example, relative to a base case transaction of \$51–\$60, a consumer is 41 percentage points less likely to make a transaction with their credit card if the value is under \$10. For these low transaction values it is more convenient in terms of tender time to pay with other payment instruments, particularly cash. Further, while this result controls for loyalty program participation, for transaction values of this small size, the benefit of rewards would be quite small because they are accumulated as a proportion of transaction value. For example, a \$10 transaction would only accumulate around 6 cents in terms of a shopping voucher. Figure 6

shows, for a base case consumer, that as the transaction amount increases, the predicted probability of using a credit card tends to increase.²⁷

Figure 6: Predicted Probability of Credit Card Use
For the base case consumer – by transaction amount



Note: The base case consumer is female, lives in NSW/ACT, participates in a loyalty program, is a transactor, does not hold a scheme debit card and made the transaction at a retailer.

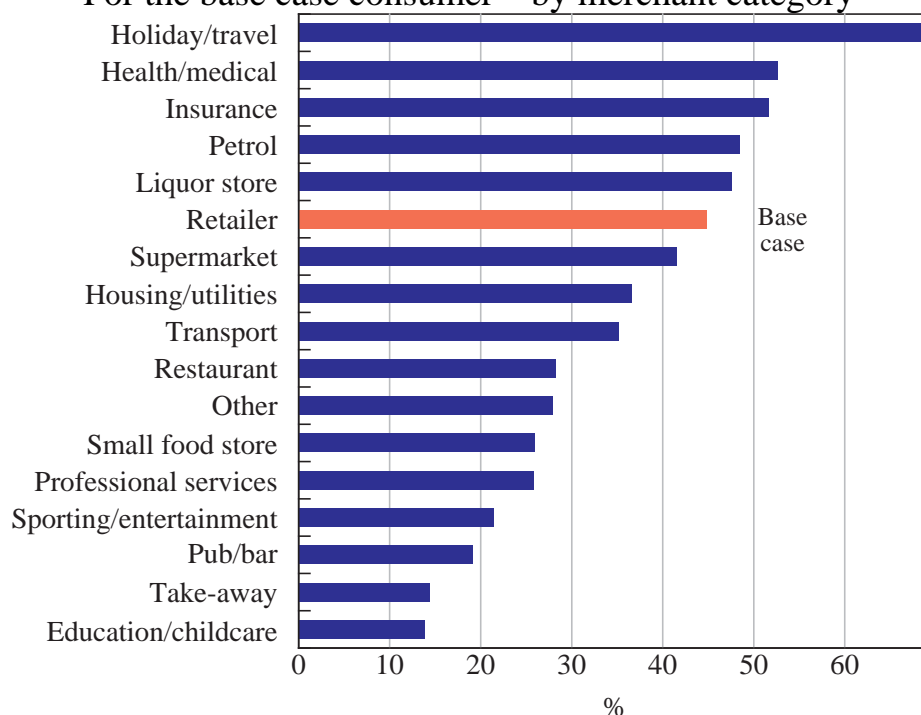
Source: RBA

We also find that the type of merchant has a significant effect on the probability of the consumer using a credit card. Figure 7 shows the predicted probability of a base case consumer using a credit card at various merchant types. Our results suggest that relative to a purchase at a retail store, such as a department store,

²⁷The predicted probabilities shown in Figure 6 are based on a regression with wider transaction-value categories at higher transaction levels than in our preferred regression in Table 6. While our preferred regression illustrates the same point – that the predicted probability of credit use tends to increase with the transaction amount – the estimated effects are more variable for higher transaction values where sample sizes in the narrower categories are relatively small.

Figure 7: Predicted Probability of Credit Card Use

For the base case consumer – by merchant category



Note: The base case consumer is female, lives in NSW/ACT, participates in a loyalty program, is a transactor, does not hold a scheme debit card, and made a transaction between \$51 and \$60.

Source: RBA

consumers are more likely to use a credit card when booking a holiday or travel and paying for health/medical purchases. The effect of holiday purchases may partly capture the relative likelihood that these payments are made online, compared to other merchant categories; a factor that is not included in these regressions because of potential collinearity with the merchant category variables. In Australia, because online EFTPOS is not available, credit cards have tended to dominate the online payments market. In contrast, there are a range of merchants for which the consumer is less likely to use a credit card (relative to the retailer base case); the largest effects were found for education/childcare, take-away and pub/bar purchases. For education/childcare the results likely reflect a lack of merchant acceptance; the survey is likely to include a number of babysitting or tutoring payments, and few tuition or textbook payments, because the survey was conducted around the middle of the school year. For pubs and take-away stores the results may reflect the slow tender time of a credit card transaction; as the consumer typically needs to sign for a credit card transaction, they may feel they are 'holding up' queues in these generally busy merchants. Alternatively, these

merchants may not accept credit cards for similar reasons. As the availability of personal identification numbers (PINs) becomes more widespread for credit cards in Australia, the probability of credit card use at these types of merchants may increase.

5.4.3 *Price incentives*

As foreshadowed by both the aggregate time-series data and the bivariate analysis of our survey data, price incentives on credit cards appear to play a significant role in credit card use. Our model shows a strong relationship between participation in a loyalty program and the probability of credit card use. The results indicate that the probability of a credit card holder using a credit card to make a payment is 23 percentage points lower for a base case cardholder that does *not* participate in a loyalty program, than a cardholder that does have a loyalty program. The effect is reasonably large given that the predicted probability of our base case person using a credit card is 45 per cent. In other words, there is a 45 per cent chance that a credit card holder with a loyalty program (who is female, is a transactor and does not have a scheme debit card), spending \$51–\$60 at a retail store will use a credit card to make the payment. This falls to a 22 per cent chance if the same cardholder does not have a loyalty program.

The results also suggest that access to an interest-free period on a consumer's card and the probability of credit card use are related. The results suggest that the probability of a credit card holder using a credit card decreases by 16 percentage points if the base case cardholder does *not* usually receive the benefit of the interest-free period. This effect is smaller than the 23 percentage point effect found for loyalty programs. One reason for this might be that some revolvers may still need to use their credit card owing to liquidity constraints, despite having to pay interest on these purchases, whereas a transactor that does not have a loyalty program does not face such constraints. The results in the next section also suggest that there is a qualitative difference between loyalty programs and interest-free periods that show up in the substitution patterns implied by the results for debit card and cash use.

5.5 Credit Card Price Incentives and the Use of Debit Cards and Cash

Tables 7 and 8 present a summary of the probit regression results for the use of debit cards and cash (the full results tables are provided in Appendix B). While the tables include the set of significant demographic and transaction-related variables, we focus our discussion on the effects of the credit card price incentives on these other payment instruments.

A comparison of Tables 6 to 8 suggests that participation in a loyalty program or access to an interest-free period increases credit card use at the expense of using debit cards and cash. For debit cards we find that an interest-free period (on a credit card) has a significant effect on use but loyalty program participation does not. A consumer is 19 percentage points more likely to use their debit card if they do not usually pay off their credit card in full and therefore do not have access to an interest-free period; this finding is consistent in sign, but larger in magnitude than the effect found in Zinman (2008).²⁸

For the cash regression we find virtually the opposite effect of credit card price incentives to those found for the debit card regression.²⁹ Access to a credit card interest-free period does not have a statistically significant effect on the probability of cash use. Consumers without a loyalty program, however, are 14 percentage points more likely to use cash for a particular transaction than another payment method.

²⁸ Zinman estimates a marginal effect of around 17 percentage points for 2004 data and around 10 percentage points from the pooled 1995-2004 sample, using his preferred control variable specification.

²⁹ This different finding for the debit card and cash regressions is not driven by multicollinearity between the revolver and loyalty program variables in the cash regression, although there appears to be some interaction between the variables in the debit card regression.

Table 7: Debit Card Use
By credit card holders

| Variable | Coefficient | Base case | Marginal effect (ppts) |
|------------------------------|-------------|-------------------------|------------------------|
| No loyalty program | 0.14 | Loyalty program | 4.0 |
| Revolver | 0.58*** | Transactor | 18.9 |
| Income (<\$20 000) | -0.36*** | \$40 000-\$59 999 | -7.9 |
| Income (\$20 000-\$39 999) | -0.05 | \$40 000-\$59 999 | -1.4 |
| Income (\$60 000-\$79 999) | -0.15 | \$40 000-\$59 999 | -3.7 |
| Income (\$80 000-\$99 999) | -0.33 | \$40 000-\$59 999 | -7.5 |
| Income (\$100 000-\$119 999) | -0.74** | \$40 000-\$59 999 | -13.2 |
| Income (\$120 000+) | -0.26 | \$40 000-\$59 999 | -6.0 |
| Transaction (\$0-\$10) | -1.27*** | Transaction (\$51-\$60) | -16.7 |
| Transaction (\$11-\$20) | -0.51*** | Transaction (\$51-\$60) | -10.5 |
| Transaction (\$21-\$30) | -0.28*** | Transaction (\$51-\$60) | -6.5 |
| Transaction (\$31-\$40) | -0.25** | Transaction (\$51-\$60) | -5.8 |
| Transaction (\$41-\$50) | -0.00 | Transaction (\$51-\$60) | -0.1 |
| Transaction (\$61-\$70) | 0.10 | Transaction (\$51-\$60) | 2.8 |
| Transaction (\$71-\$80) | -0.04 | Transaction (\$51-\$60) | -1.1 |
| Transaction (\$81-\$90) | 0.11 | Transaction (\$51-\$60) | 3.0 |
| Transaction (\$101-\$110) | -0.13 | Transaction (\$51-\$60) | -3.3 |
| Transaction (\$111-\$120) | -0.10 | Transaction (\$51-\$60) | -2.5 |
| Transaction (\$121-\$130) | -0.15 | Transaction (\$51-\$60) | -3.6 |
| Transaction (\$151-\$160) | -0.29 | Transaction (\$51-\$60) | -6.6 |
| Transaction (\$161-\$170) | 0.13 | Transaction (\$51-\$60) | 3.5 |
| Transaction (\$171-\$180) | 0.15 | Transaction (\$51-\$60) | 4.3 |
| Transaction (\$191-\$200) | 0.19 | Transaction (\$51-\$60) | 5.4 |
| Transaction (\$201+) | -0.20 | Transaction (\$51-\$60) | -4.7 |
| Holiday/travel | -0.29 | Retailer | -6.7 |
| Supermarket | 0.26*** | Retailer | 7.6 |
| Restaurant | -0.62*** | Retailer | -11.9 |
| Small food store | -0.28*** | Retailer | -6.5 |
| Professional services | -0.41** | Retailer | -8.8 |
| Pub/bar | -0.98*** | Retailer | -15.3 |
| Take-away | -0.51*** | Retailer | -10.4 |
| Housing/utilities | -0.74*** | Retailer | -13.3 |
| Constant | -0.91*** | | |

Number of observations = 8 575

Pseudo $R^2 = 0.22$

Notes: ***, ** and * denote the 1, 5 and 10 per cent levels of significance respectively. Marginal effects are evaluated at the base case.

Table 8: Cash Use
By credit card holders

| Variable | Coefficient | Base case | Marginal effect (ppts) |
|---------------------------|-------------|-------------------------|------------------------|
| No loyalty program | 0.35*** | Loyalty program | 13.6 |
| Revolver | -0.08 | Transactor | -2.9 |
| Scheme debit card | -0.14 | No scheme debit card | -5.1 |
| Age (18–29 years) | -0.35** | Age (45–59 years) | -11.7 |
| Age (30–44 years) | -0.15 | Age (45–59 years) | -5.2 |
| Age (60+ years) | 0.23** | Age (45–59 years) | 8.8 |
| Transaction (\$0–\$10) | 1.99*** | Transaction (\$51–\$60) | 60.5 |
| Transaction (\$11–\$20) | 1.03*** | Transaction (\$51–\$60) | 39.1 |
| Transaction (\$21–\$30) | 0.52*** | Transaction (\$51–\$60) | 20.4 |
| Transaction (\$31–\$40) | 0.32*** | Transaction (\$51–\$60) | 12.5 |
| Transaction (\$41–\$50) | 0.13 | Transaction (\$51–\$60) | 4.7 |
| Transaction (\$61–\$70) | -0.17 | Transaction (\$51–\$60) | -5.9 |
| Transaction (\$71–\$80) | -0.08 | Transaction (\$51–\$60) | -3.0 |
| Transaction (\$81–\$90) | -0.32** | Transaction (\$51–\$60) | -10.7 |
| Transaction (\$91–\$100) | -0.07 | Transaction (\$51–\$60) | -2.6 |
| Transaction (\$101–\$110) | -0.38 | Transaction (\$51–\$60) | -12.5 |
| Transaction (\$111–\$120) | -0.41** | Transaction (\$51–\$60) | -13.3 |
| Transaction (\$121–\$130) | -0.02 | Transaction (\$51–\$60) | -0.8 |
| Transaction (\$151–\$160) | -0.47* | Transaction (\$51–\$60) | -15.1 |
| Transaction (\$161–\$170) | -0.11 | Transaction (\$51–\$60) | -3.8 |
| Transaction (\$171–\$180) | -0.22 | Transaction (\$51–\$60) | -7.6 |
| Transaction (\$181–\$190) | -0.56 | Transaction (\$51–\$60) | -17.4 |
| Transaction (\$191–\$200) | -0.53* | Transaction (\$51–\$60) | -16.6 |
| Transaction (\$201+) | -0.32*** | Transaction (\$51–\$60) | -10.7 |
| Holiday/travel | -0.35* | Retailer | -11.7 |
| Health/medical | -0.22** | Retailer | -7.6 |
| Petrol | -0.30*** | Retailer | -10.2 |
| Transport | 0.42*** | Retailer | 16.5 |
| Restaurant | 0.79*** | Retailer | 30.6 |
| Small food store | 0.60*** | Retailer | 23.4 |
| Pub/bar | 1.15*** | Retailer | 42.9 |
| Take-away | 0.91*** | Retailer | 35.2 |
| Constant | -0.42** | | |

Number of observations = 8 575

Pseudo $R^2 = 0.38$

Notes: ***, ** and * denote the 1, 5 and 10 per cent levels of significance respectively. Marginal effects are evaluated at the base case.

It is worth examining why the degree of substitution between credit cards, debit cards and cash differs across price incentives and payment instruments. Consider first the effect of the interest-free period on the use of the three payment instruments. Based on interest costs alone, the price of using a credit card with an interest-free period is lower than that of using a debit card, which, in turn, is lower than a credit card where interest (at relatively high rates) is payable on a purchase. It is therefore logical that a cardholder paying interest might use a debit card rather than a credit card.³⁰ Of more interest is why there is little substitution towards cash when the cardholder does not have an interest-free period. Perhaps for transactions that a consumer already prefers to perform on a credit card, debit cards are a closer substitute.³¹ Some support for this interpretation comes from the information in Section 4 on the use of cash; it is most commonly used for low-value transactions, such as take-away meals, while cards are used for larger transactions where speed of the transaction is less important.

The results for the loyalty program variable are somewhat more difficult to reconcile. Indeed, the finding that participation in a loyalty program has no significant effect on debit card use is somewhat at odds with US studies. For example, using a number of similar variables to our model, Ching and Hayashi (2006) and Sprenger and Stavins (2008) find fairly clear evidence that if the consumer has a loyalty program this increases the probability of credit card use and decreases the probability of *both* debit card and cash/paper-based instrument use. Although we suspect our loyalty program effect might not be precisely estimated,³² the results could also suggest that consumers have strong preferences

30 Ching and Hayashi (2008) find that substitution of debit for credit may not occur at all merchants. For example, access to an interest-free period was not found to have a significant effect on the choice of payment instrument at department and discount stores. They suggest that this may be because consumers ‘... borrow from their future incomes when purchasing items that are relatively more expensive’ (p 21).

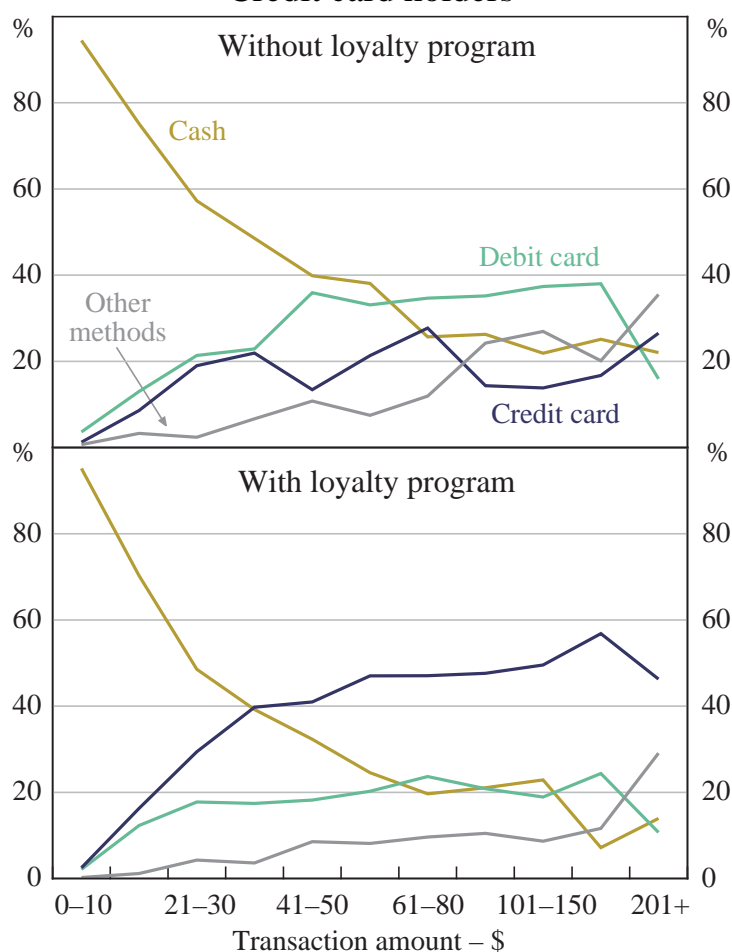
31 To test whether the presence of a loyalty program has a different effect across transaction values for credit cards, debit cards and cash, we estimated models, using wider transaction-value categories, including variables of the interaction of each transaction value dummy variable with the loyalty program dummy variable. The results are somewhat suggestive of the substitution effects described, although a more detailed analysis is an issue for further work.

32 The effect of loyalty program is not particularly robust to various debit card model specifications. As mentioned above in Footnote 29, we suspect there are potential effects of multicollinearity.

about the type of purchases made on debit cards and credit cards. For example, whether or not the purchase is made in a supermarket has a statistically significant effect on debit card use, which, as discussed in Section 4, may reflect factors such as the availability of EFTPOS cash-out at these merchants. Such factors apparently outweigh the benefit of earning reward points if the same purchase is made on a credit card.

Our results do, however, show substitution from cash to credit cards if the cardholder has a loyalty program. This can also be seen quite clearly in our raw data on the use of payment instruments across transaction values. For credit card holders without a loyalty program, cash is the most frequently used payment method for transaction values up to around \$60, whereas for cardholders with a loyalty program, cash is only dominant for transactions up to around \$30 (Figure 8). At higher transaction values, the presence of a loyalty program also appears to increase the use of credit cards.

**Figure 8: Share of Payments – Number
Credit card holders**



Source: Roy Morgan Research

5.6 Implications of Results for Aggregate Payment Patterns

The results above provide some interesting insights into what factors drive consumers' choices about payment instruments. The results may also be able to give us some insight into broader policy issues, particularly in light of the Bank's reforms, which have affected the price signals facing consumers. In this section,

we present a few hypothetical calculations to provide a sense of the aggregate economic significance of these modelling results.³³

If, for some reason, loyalty programs had been removed from all credit cards in 2008, the above results suggest that the total value of credit card spending in 2008 would have been around 20 per cent lower.³⁴ Or, put another way, the total value of credit card payments in 2008 would have been around \$163 billion rather than the observed \$204 billion. Naturally, a change in loyalty programs would not occur in isolation and there would undoubtedly have been other changes occurring if this had happened. Hence, this estimate is best used to judge the economic significance of our parameter estimates rather than as a prediction of what might occur if loyalty programs were removed.

Nonetheless, the scenario still provides a basis for considering some developments that have occurred in the market for credit cards since the reforms. One of these has been a reduction in the value of rewards of around 0.2 percentage points of the amount spent (from around 0.8 percentage points in 2003).³⁵ Another development has been an emergence of low-interest rate credit cards generally without loyalty

33 Ching and Hayashi (2008) conduct a similar policy experiment; however, their conclusions focus on the change in total card payment instruments (debit and credit), rather than just the change in credit card use.

34 For this hypothetical scenario we assume that if there were no loyalty programs there would be a shift from the use of credit cards to cash in line with our regression results. We do not consider the proportion of credit card transactions that may shift to an instrument other than cash; that is, our regression results suggest that if the consumer does not have a loyalty program, they are 23 percentage points less likely to use a credit card for a particular transaction, but 13.6 percentage points more likely to use cash for a particular transaction. Specifically, we use the diary study and retail payment statistics collected by the Reserve Bank to estimate the number of cash payments in 2008 at around 7.7 billion, representing 58 per cent of the share of total payments. Data from the diary study over our estimation sample suggest that 85 per cent of credit card transactions are made by consumers with a loyalty program. Hence, if loyalty programs had been removed, the share of cash transactions would have increased by 13.6 percentage points on the 85 per cent of credit card transactions made by consumers with a loyalty program. This would have increased the overall cash share of total transactions to 69 per cent. This implies a hypothetical number of cash transactions of 9.3 billion – an increase of 1.6 billion. Multiplying this by the average cash transaction of around \$26 implies an increase of \$41 billion in cash payments. Subtracting this \$41 billion from the actual value of credit card payments in 2008 implies a decrease of 20 per cent.

35 Sourced from bank websites for the following cards: ANZ Telstra Rewards Visa card; Commonwealth Bank MasterCard Awards card; National Australia Bank Visa Gold card; and Westpac Altitude MasterCard.

programs, though still with an interest-free period. These cards are aimed at revolver consumers, who represent around 34 per cent of credit card holders.³⁶ Over the past five years there has been a reduction in the accumulation of reward points from these two sources. The results from our hypothetical scenario suggest that the combination of such changes may be large enough to at least partly explain the observed fall in the growth of credit card use since the beginning of the reforms.

We can apply a similar hypothetical calculation to data for the late 1990s to obtain a lower-bound sense of the effect of loyalty programs over the past decade or so. For this earlier period, our estimates suggest that without loyalty programs, annual compound growth between 1994 and 1999 would have been around 12 per cent, compared to actual growth of around 20 per cent. As such, the widespread introduction of loyalty programs in the second half of the 1990s appears to account for some of the rapid growth in credit card use over that period.³⁷ A rough interpolation of our 1990s and 2008 calculations also suggests that without loyalty programs for credit cards, debit cards may have been the dominant payment instrument on a per capita basis throughout the entire period.

6. Conclusion

Over the past decade, the payments landscape in Australia has undergone significant change. This is consistent with the international trend towards a greater use of electronic payment instruments. But it is also likely to reflect to some extent a series of reforms in Australia which have changed the relative prices consumers face when choosing between payment methods. This paper provides estimates of how important price incentives are for influencing consumer payment patterns. We find that participation in a loyalty program and access to an interest-free period both tend to increase credit card use.

The substitution patterns between credit cards, debit cards and cash found in this paper are intriguing. While interest-free periods induce substitution to credit cards from debit cards, loyalty programs induce substitution from cash. We find that for

³⁶ According to the diary study data.

³⁷ RBA and Australian Competition and Consumer Commission (2000).

a base case consumer, with average characteristics, loyalty programs increase the probability of credit card use by 23 percentage points and reduce the probability of cash use by 14 percentage points. Debit card use is relatively unaffected by whether or not a consumer has a loyalty program. A revolver consumer is around 19 percentage points more likely to use their debit card (and 16 percentage points less likely to use their credit card) for a transaction than a transactor consumer.

Where there is no financial cost to accessing the line of credit because there is an interest-free period, consumers tend to use a credit card instead of a debit card; where there is a cost, in the form of interest charges, consumers are more likely to use a debit card. These estimates suggest that, even though in certain circumstances a revolver may need to use credit and cannot substitute to a debit card due to lack of funds, in many cases the two instruments would seem to have a reasonable degree of substitutability. The interest-free period, however, has little significant effect on cash use, possibly because cash tends to be most commonly used for small-value transactions. Nonetheless, consumer preferences between cash and credit cards appear to be significantly affected by relatively minor price changes, such as those provided by loyalty programs. For the probability of debit card use though, we find that the loyalty program price incentive has little effect.

We also find that the magnitude of these results can help to explain aggregate trends. The estimates suggest that the introduction of loyalty programs can account for at least some of the rapid growth in credit card use observed in the second half of the 1990s. Even with our conservative assumptions, the results suggest that debit cards would have remained the dominant payment instrument over the past decade in the absence of the price effects from loyalty programs.

Regardless of the precise numerical effect, the results of this paper suggest that price incentives, and loyalty programs in particular, can be influential when it comes to consumer decisions about which payment instrument to use. Therefore, it seems reasonable to attribute at least part of the changes in payment patterns over recent years to the changed price incentives consumers face as a result of the Reserve Bank reforms.

Appendix A: Diary Study Fields

| Table A1: Fields in the Diary Survey | | |
|---|---|--|
| | Payments ^(a) | Cash withdrawals |
| Date | Yes | Yes |
| Transaction amount | Yes | Yes |
| Method | One of the following methods: 1. Cash 2. Debit card using a PIN 3. MasterCard/Visa debit card 4. MasterCard/Visa credit card 5. American Express/Diners Club card 6. Petrol/store card 7. Personal cheque 8. BPAY 9. Other | One of the following methods: 1. ATM 2. EFTPOS cash-out 3. Over-the-counter 4. Other |
| Channel | One of the following channels: 1. In person 2. Phone 3. Internet 4. Mail | Not applicable |
| Merchant type | One of the following merchant types: A – Supermarket B – Liquor store C – Small food store E – Other retailer F – Petrol/fuel for motor vehicles G – Transport H – Take-away/fast-food J – Restaurant/formal dining K – Pub/bar L – Sporting and entertainment (leisure) M – Holiday travel/hotel accommodation N – Insurance P – Health/medical care R – Housing/utilities S – Education/childcare U – Professional service/home repair/home improvements Z – Other | Not applicable |
| Surcharge paid | Yes | Not applicable |
| Special trip | Not applicable | Yes/No |

(a) Participants were asked to report payments of bills as payments but were asked not to include any repayments of loans such as credit card repayments or mortgage instalments. Participants were asked to record only personal payments and exclude 'business' payments such as those made on behalf of an employer.

Appendix B: Results Tables – Use of Payment Methods

Table B1: Credit Card Use
By credit card holders (*continued next page*)

| Variable | Coefficient | Base case | Marginal effect (ppts) |
|---------------------------|-------------|-------------------------|------------------------|
| No loyalty program | -0.65*** | Loyalty program | -22.9 |
| Revolver | -0.43*** | Transactor | -15.9 |
| Male | 0.27** | Female | 10.9 |
| Scheme debit card | -0.37*** | No scheme debit card | -14.1 |
| Cheque book | 0.00 | No cheque book | 0.0 |
| Age (18–29 years) | 0.27 | Age (45–59 years) | 10.7 |
| Age (30–44 years) | 0.10 | Age (45–59 years) | 3.9 |
| Age (60+ years) | -0.01 | Age (45–59 years) | -0.6 |
| Transaction (\$0–\$10) | -1.64*** | Transaction (\$51–\$60) | -41.0 |
| Transaction (\$11–\$20) | -0.70*** | Transaction (\$51–\$60) | -24.6 |
| Transaction (\$21–\$30) | -0.23*** | Transaction (\$51–\$60) | -9.1 |
| Transaction (\$31–\$40) | -0.05 | Transaction (\$51–\$60) | -2.1 |
| Transaction (\$41–\$50) | -0.08 | Transaction (\$51–\$60) | -3.1 |
| Transaction (\$61–\$70) | -0.08 | Transaction (\$51–\$60) | -3.2 |
| Transaction (\$71–\$80) | 0.11 | Transaction (\$51–\$60) | 4.4 |
| Transaction (\$81–\$90) | 0.09 | Transaction (\$51–\$60) | 3.5 |
| Transaction (\$91–\$100) | -0.07 | Transaction (\$51–\$60) | -2.7 |
| Transaction (\$101–\$110) | 0.36** | Transaction (\$51–\$60) | 14.2 |
| Transaction (\$111–\$120) | 0.45*** | Transaction (\$51–\$60) | 17.6 |
| Transaction (\$121–\$130) | 0.16 | Transaction (\$51–\$60) | 6.3 |
| Transaction (\$131–\$140) | -0.12 | Transaction (\$51–\$60) | -4.7 |
| Transaction (\$141–\$150) | -0.03 | Transaction (\$51–\$60) | -1.1 |
| Transaction (\$151–\$160) | 0.43** | Transaction (\$51–\$60) | 17.1 |
| Transaction (\$161–\$170) | -0.07 | Transaction (\$51–\$60) | -2.7 |
| Transaction (\$171–\$180) | 0.00 | Transaction (\$51–\$60) | 0.0 |
| Transaction (\$181–\$190) | 0.63* | Transaction (\$51–\$60) | 24.4 |
| Transaction (\$191–\$200) | 0.12 | Transaction (\$51–\$60) | 4.7 |
| Transaction (\$201+) | 0.03 | Transaction (\$51–\$60) | 1.0 |
| Holiday/travel | 0.64*** | Retailer | 24.5 |
| Health/medical | 0.20** | Retailer | 7.8 |
| Insurance | 0.17 | Retailer | 6.8 |
| Petrol | 0.09 | Retailer | 3.7 |
| Liquor store | 0.07 | Retailer | 2.8 |
| Supermarket | -0.08 | Retailer | -3.3 |
| Transport | -0.25** | Retailer | -9.6 |

Table B1: Credit Card Use
By credit card holders (*continued*)

| Variable | Coefficient | Base case | Marginal effect (ppts) |
|------------------------------|-------------|-------------------|------------------------|
| Housing/utilities | -0.21 | Retailer | -8.3 |
| Restaurant | -0.44*** | Retailer | -16.5 |
| Other | -0.46*** | Retailer | -17.0 |
| Small food store | -0.51*** | Retailer | -18.8 |
| Professional services | -0.52*** | Retailer | -19.1 |
| Sporting/entertainment | -0.66*** | Retailer | -23.4 |
| Pub/bar | -0.75*** | Retailer | -25.7 |
| Take-away | -0.93*** | Retailer | -30.4 |
| Education/childcare | -0.96*** | Retailer | -31.0 |
| Income (<\$20 000) | 0.24 | \$40 000–\$59 999 | 9.6 |
| Income (\$20 000–\$39 999) | -0.18 | \$40 000–\$59 999 | -7.1 |
| Income (\$60 000–\$79 999) | 0.06 | \$40 000–\$59 999 | 2.2 |
| Income (\$80 000–\$99 999) | 0.06 | \$40 000–\$59 999 | 2.3 |
| Income (\$100 000–\$119 999) | 0.12 | \$40 000–\$59 999 | 4.7 |
| Income (\$120 000+) | 0.19 | \$40 000–\$59 999 | 7.7 |
| QLD | 0.01 | NSW/ACT | 0.4 |
| VIC | 0.04 | NSW/ACT | 1.4 |
| TAS | 0.27 | NSW/ACT | 10.8 |
| SA/NT | 0.50** | NSW/ACT | 19.4 |
| WA | 0.39** | NSW/ACT | 15.6 |
| Constant | -0.13 | | |

Number of observations = 8 575

Pseudo $R^2 = 0.28$

Notes: ***, ** and * denote the 1, 5 and 10 per cent levels of significance respectively. Marginal effects are evaluated at the base case.

Table B2: Debit Card Use
By credit card holders (*continued next page*)

| Variable | Coefficient | Base case | Marginal effect (ppts) |
|---------------------------|-------------|-------------------------|------------------------|
| No loyalty program | 0.14 | Loyalty program | 4.0 |
| Revolver | 0.58*** | Transactor | 18.9 |
| Male | -0.09 | Female | -2.2 |
| Cheque book | 0.17* | No cheque book | 4.8 |
| Age (18–29 years) | 0.18 | Age (45–59 years) | 5.2 |
| Age (30–44 years) | 0.05 | Age (45–59 years) | 1.4 |
| Age (60+ years) | -0.26* | Age (45–59 years) | -6.1 |
| Transaction (\$0–\$10) | -1.27*** | Transaction (\$51–\$60) | -16.7 |
| Transaction (\$11–\$20) | -0.51*** | Transaction (\$51–\$60) | -10.5 |
| Transaction (\$21–\$30) | -0.28*** | Transaction (\$51–\$60) | -6.5 |
| Transaction (\$31–\$40) | -0.25** | Transaction (\$51–\$60) | -5.8 |
| Transaction (\$41–\$50) | -0.00 | Transaction (\$51–\$60) | -0.1 |
| Transaction (\$61–\$70) | 0.10 | Transaction (\$51–\$60) | 2.8 |
| Transaction (\$71–\$80) | -0.04 | Transaction (\$51–\$60) | -1.1 |
| Transaction (\$81–\$90) | 0.11 | Transaction (\$51–\$60) | 3.0 |
| Transaction (\$91–\$100) | 0.00 | Transaction (\$51–\$60) | 0.1 |
| Transaction (\$101–\$110) | -0.13 | Transaction (\$51–\$60) | -3.3 |
| Transaction (\$111–\$120) | -0.10 | Transaction (\$51–\$60) | -2.5 |
| Transaction (\$121–\$130) | -0.15 | Transaction (\$51–\$60) | -3.6 |
| Transaction (\$131–\$140) | 0.39* | Transaction (\$51–\$60) | 12.0 |
| Transaction (\$141–\$150) | 0.19 | Transaction (\$51–\$60) | 5.5 |
| Transaction (\$151–\$160) | -0.29 | Transaction (\$51–\$60) | -6.6 |
| Transaction (\$161–\$170) | 0.13 | Transaction (\$51–\$60) | 3.5 |
| Transaction (\$171–\$180) | 0.15 | Transaction (\$51–\$60) | 4.3 |
| Transaction (\$181–\$190) | 0.06 | Transaction (\$51–\$60) | 1.8 |
| Transaction (\$191–\$200) | 0.19 | Transaction (\$51–\$60) | 5.4 |
| Transaction (\$201+) | -0.20 | Transaction (\$51–\$60) | -4.7 |
| Holiday/travel | -0.29 | Retailer | -6.7 |
| Health/medical | -0.13 | Retailer | -3.2 |
| Insurance | -0.67** | Retailer | -12.5 |
| Petrol | 0.16* | Retailer | 4.5 |
| Liquor store | 0.07 | Retailer | 1.9 |
| Supermarket | 0.26*** | Retailer | 7.6 |
| Transport | -0.44*** | Retailer | -9.3 |
| Housing/utilities | -0.74*** | Retailer | -13.3 |
| Restaurant | -0.62*** | Retailer | -11.9 |
| Other | -0.63*** | Retailer | -12.1 |

Table B2: Debit Card Use
By credit card holders (*continued*)

| Variable | Coefficient | Base case | Marginal effect (ppts) |
|------------------------------|-------------|-------------------|------------------------|
| Small food store | -0.28*** | Retailer | -6.5 |
| Professional services | -0.41** | Retailer | -8.8 |
| Sporting/entertainment | -0.78*** | Retailer | -13.7 |
| Pub/bar | -0.98*** | Retailer | -15.3 |
| Take-away | -0.51*** | Retailer | -10.4 |
| Education/childcare | -0.91*** | Retailer | -14.8 |
| Income (<\$20 000) | -0.36*** | \$40 000–\$59 999 | -7.9 |
| Income (\$20 000–\$39 999) | -0.05 | \$40 000–\$59 999 | -1.4 |
| Income (\$60 000–\$79 999) | -0.15 | \$40 000–\$59 999 | -3.7 |
| Income (\$80 000–\$99 999) | -0.33 | \$40 000–\$59 999 | -7.5 |
| Income (\$100 000–\$119 999) | -0.74** | \$40 000–\$59 999 | -13.2 |
| Income (\$120 000+) | -0.26 | \$40 000–\$59 999 | -6.0 |
| QLD | 0.27** | NSW/ACT | 8.0 |
| VIC | 0.45*** | NSW/ACT | 14.0 |
| TAS | 0.15 | NSW/ACT | 4.3 |
| SA/NT | -0.12 | NSW/ACT | -3.1 |
| WA | 0.08 | NSW/ACT | 2.3 |
| Constant | -0.91*** | | |

Number of observations = 8 575

Pseudo $R^2 = 0.22$

Notes: ***, ** and * denote the 1, 5 and 10 per cent levels of significance respectively. Marginal effects are evaluated at the base case.

Table B3: Cash Use
By credit card holders (*continued next page*)

| Variable | Coefficient | Base case | Marginal effect (ppts) |
|---------------------------|-------------|-------------------------|------------------------|
| No loyalty program | 0.35*** | Loyalty program | 13.6 |
| Revolver | -0.08 | Transactor | -2.9 |
| Male | -0.11 | Female | -3.9 |
| Scheme debit card | -0.14 | No scheme debit card | -5.1 |
| Cheque book | -0.14 | No cheque book | -4.8 |
| Age (18–29 years) | -0.35** | Age (45–59 years) | -11.7 |
| Age (30–44 years) | -0.15 | Age (45–59 years) | -5.2 |
| Age (60+ years) | 0.23** | Age (45–59 years) | 8.8 |
| Transaction (\$0–\$10) | 1.99*** | Transaction (\$51–\$60) | 60.5 |
| Transaction (\$11–\$20) | 1.03*** | Transaction (\$51–\$60) | 39.1 |
| Transaction (\$21–\$30) | 0.52*** | Transaction (\$51–\$60) | 20.4 |
| Transaction (\$31–\$40) | 0.32*** | Transaction (\$51–\$60) | 12.5 |
| Transaction (\$41–\$50) | 0.13 | Transaction (\$51–\$60) | 4.7 |
| Transaction (\$61–\$70) | -0.17 | Transaction (\$51–\$60) | -5.9 |
| Transaction (\$71–\$80) | -0.08 | Transaction (\$51–\$60) | -3.0 |
| Transaction (\$81–\$90) | -0.32** | Transaction (\$51–\$60) | -10.7 |
| Transaction (\$91–\$100) | -0.07 | Transaction (\$51–\$60) | -2.6 |
| Transaction (\$101–\$110) | -0.38 | Transaction (\$51–\$60) | -12.5 |
| Transaction (\$111–\$120) | -0.41** | Transaction (\$51–\$60) | -13.3 |
| Transaction (\$121–\$130) | -0.02 | Transaction (\$51–\$60) | -0.8 |
| Transaction (\$131–\$140) | -0.34 | Transaction (\$51–\$60) | -11.2 |
| Transaction (\$141–\$150) | 0.06 | Transaction (\$51–\$60) | 2.1 |
| Transaction (\$151–\$160) | -0.47* | Transaction (\$51–\$60) | -15.1 |
| Transaction (\$161–\$170) | -0.11 | Transaction (\$51–\$60) | -3.8 |
| Transaction (\$171–\$180) | -0.22 | Transaction (\$51–\$60) | -7.6 |
| Transaction (\$181–\$190) | -0.56 | Transaction (\$51–\$60) | -17.4 |
| Transaction (\$191–\$200) | -0.53* | Transaction (\$51–\$60) | -16.6 |
| Transaction (\$201+) | -0.32*** | Transaction (\$51–\$60) | -10.7 |
| Holiday/travel | -0.35* | Retailer | -11.7 |
| Health/medical | -0.22** | Retailer | -7.6 |
| Liquor store | -0.10 | Retailer | -3.5 |
| Insurance | -0.62* | Retailer | -18.7 |
| Petrol | -0.30*** | Retailer | -10.2 |
| Supermarket | -0.02 | Retailer | -0.7 |
| Transport | 0.42*** | Retailer | 16.5 |
| Housing/utilities | -0.32** | Retailer | -10.7 |

Table B3: Cash Use
By credit card holders (*continued*)

| Variable | Coefficient | Base case | Marginal effect (ppts) |
|------------------------------|-------------|-------------------|------------------------|
| Restaurant | 0.79*** | Retailer | 30.6 |
| Other | 0.14 | Retailer | 5.1 |
| Small food store | 0.60*** | Retailer | 23.4 |
| Professional services | 0.27 | Retailer | 10.4 |
| Sporting/entertainment | 0.92*** | Retailer | 35.3 |
| Pub/bar | 1.15*** | Retailer | 42.9 |
| Take-away | 0.91*** | Retailer | 35.2 |
| Education/childcare | 0.77*** | Retailer | 30.0 |
| Income (<\$20 000) | -0.01 | \$40 000–\$59 999 | -0.5 |
| Income (\$20 000–\$39 999) | 0.17 | \$40 000–\$59 999 | 6.6 |
| Income (\$60 000–\$79 999) | 0.02 | \$40 000–\$59 999 | 0.7 |
| Income (\$80 000–\$99 999) | 0.18 | \$40 000–\$59 999 | 6.9 |
| Income (\$100 000–\$119 999) | -0.00 | \$40 000–\$59 999 | -0.1 |
| Income (\$120 000+) | 0.01 | \$40 000–\$59 999 | 0.3 |
| QLD | -0.15 | NSW/ACT | -5.2 |
| VIC | -0.30*** | NSW/ACT | -10.1 |
| TAS | -0.18 | NSW/ACT | -6.3 |
| SA/NT | -0.24 | NSW/ACT | -8.2 |
| WA | -0.32** | NSW/ACT | -10.7 |
| Constant | -0.42** | | |

Number of observations = 8 575

Pseudo R² = 0.38

Notes: ***, ** and * denote the 1, 5 and 10 per cent levels of significance respectively. Marginal effects are evaluated at the base case.

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