Examining the Usefulness of the Electronic Card Transactions Data as an Indicator for the New Zealand Economy: Some Preliminary Evidence[1]

Corey Allan

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[1] The results presented in this paper are updates of the analysis from my Master of Commerce (MCom) thesis at the University of Otago, supervised by Alfred Haug.

Author contact details
Corey Allan
Motu Economic and Public Policy Research
corey.allan@motu.org.nz

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Motu Economic and Public Policy Research
PO Box 24390
Wellington
New Zealand

Email info@motu.org.nz
Telephone +64 4 9394250
Website www.motu.org.nz

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Abstract

This paper considers the Electronic Card Transactions (ECT) series as an indicator for the New Zealand Economy. These data are generated in the process of administering the electronic funds transfer at point of sale (EFTPOS) system. These series provide national level information on the amount of spending through the EFTPOS network in New Zealand. These could be potentially useful as an indicator variable due to the popularity of debit and credit cards to settle transactions in New Zealand. I consider the potential of the ECT statistics in two ways. First I look at the short run relationships between the card spending series and GDP and consumption. This is done via simple business cycle analysis, in a similar vein to Stock and Watson (1999). Secondly, I test for long run relationships between the amount of spending on debit/credit cards and real GDP/consumption spending. These macroeconomic aggregates are the result of transactions settled by some means, so there may exist a stable long run relationship between these variables. There is evidence of long run relationships between selected ECT series and GDP/consumption, while relatively strong short run relationships are revealed. The results suggest that the ECT series could prove a useful indicator for the New Zealand economy, at least for the short term.

1. Introduction

New Zealanders are prolific users of electronic cards to settle transactions. RBNZ (2012) estimate that each debit card in New Zealand is used 200 times a year, on average. In 2009, there were over 35,000 electronic funds transfer at point of sale (EFTPOS) terminals per million inhabitants in New Zealand, one for every 29 people. Comparable figures for other advanced economies are uniformly lower. In Australia, there were 32,000 terminals per million inhabitants (1:29) and each debit card was used only 52 times a year. In the US, there were 17,000 terminals per million inhabitants (1:60), with each debit card being used 138 times year.[2]

New Zealand also has a unique model for clearing electronic card transactions. New Zealand has two central switching houses which process and clear all electronic card transactions within New Zealand, while many other countries have multiple switching houses and dedicated credit card networks (Hughes 2006). One of the outputs of this system is a record of all card transactions which pass through the network. These form the basis of Statistics New Zealand's (SNZ) Electronic Card Transactions (ECT) statistics, which are the focus of this paper. These are national level statistics on the level of spending on both debit and credit cards in New Zealand.

Minish (2007) claims that these series can be used as a timely indicator of the change in the level of consumption expenditure and economic activity in general. The aim of this paper is to provide an exploratory test of this claim. This is done in two ways. I first consider the strength of short run relationships between the ECT series, GDP and consumption. This is done using simple business cycle analysis in a manner similar to Stock and Watson (1999) for the US and McCaw (2007) and Kim et al (1994) for New Zealand. I then test for long run relationships between the ECT series, GDP and consumption by conducting cointegration tests.

This paper is set out as follows. Section 2 will discuss the data used in the paper. Section 3 will describe the methods being employed, while section 4 will present the results. Section 4.1 presents the results from examining the short run relationships, while section 4.2 presents the results for the existence of long run relationships. Section 5 concludes.

2. Data

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[2] International figures from CPSS Redbook (2012). Population figures used in calculations are from Australian Bureau of Statistics and the US Census Bureau. Figures for the US are for 2008 due to unavailability of data for 2009 in CPSS Redbook (2012).

The ECT data are generated through the process of administering New Zealand based electronic transactions. The two EFTPOs system providers (Paymark Ltd. and EFTPOS NZ Ltd.) supply these data to Statistics New Zealand (SNZ) in a highly aggregated form (Minish 2007). SNZ release information on the total value of card spending, the total number of card transactions, the average transaction value, average spending per capita and the proportion of card spending on debit and credit cards. The ECT series are available from the fourth quarter of 2002 and the sample analysed in this paper runs from this date until the fourth quarter of 2012, giving me a sample of 41 quarterly observations.

Table 1: Information included and excluded from the ECT data

Included	Excluded
All debit, credit and charge card transactions with NZ based merchants Card present transactions at the point of sale, authorised by PIN or signature Card not present transactions (e.g. via internet, phone, payment of invoices etc.) GST	All credit card transactions with non-NZ based merchants (e.g. via internet) Transactions by NZ cardholders while overseas Cash, cheque or hire purchase transactions Automatic payments or direct debits from bank accounts Internet bank account payments ATM withdrawals

Table 1 summarises the information that is collected and what is excluded from the ECT data. There is one discrepancy between the information provided by the two EFTPOS providers. This relates to the treatment of cash out at point of sale. Many merchants offer a sort of ATM service along with accepting debit cards as a means of payment. These transactions are included in the information supplied by one of the providers, but not the other. This information is not separately identified within the data (Minish 2007). These data also include spending by foreign card holders with New Zealand based merchants, either via the internet or spending by tourists or other international visitors. Again, this is not separately identified within the data.

The variables used in this paper are the total value of debit, credit and all card spending. These variables are macroeconomic aggregates which measure the volume of spending through the network in a particular time period. These variables have two key advantages over other currently available indicators of the state of consumer spending and the economy in general. This first advantage relates to the scope of the underlying data. The ECT series are based on a census of all electronic transactions which pass through the network. Other indicators of activity in the retail trade sector, such as the Retail Trade Survey (RTS), are based on a survey of activity within the sector. Other economic indicators, such as the National Accounts, are also based on surveys of activity. This means that these series may be subject to future revision as more information arises which is relevant to activity in a particular quarter. Because they are based on a census, the ECT data avoid this issue.

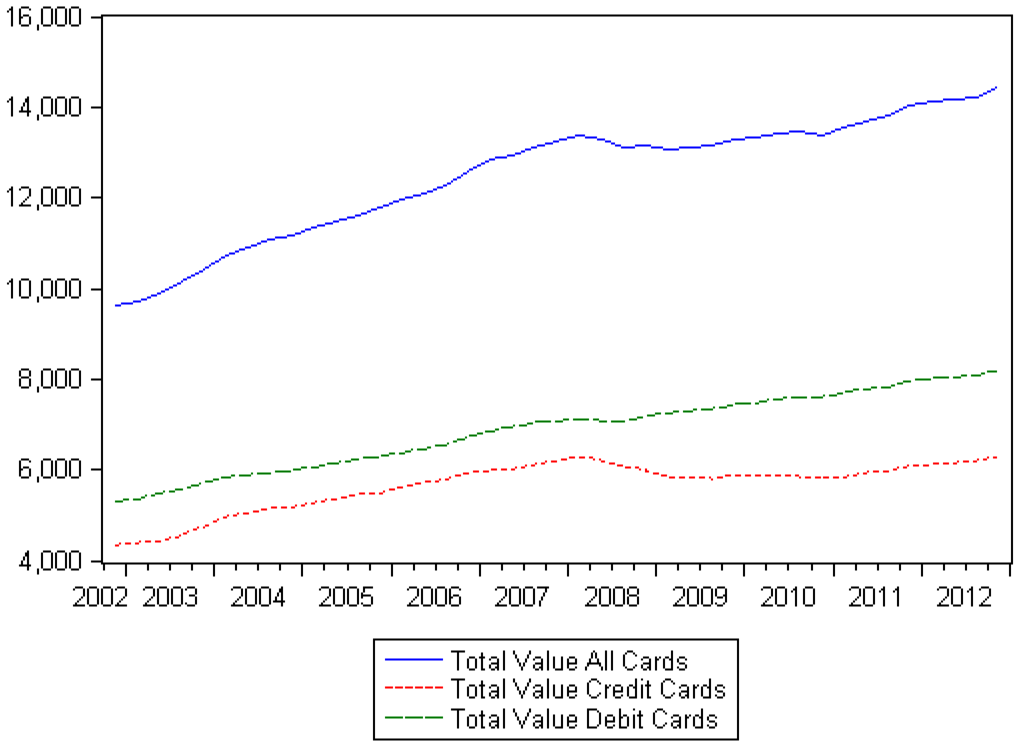
A second key advantage of the ECT data relates to the timeliness of their release. The ECT data are released at a monthly frequency, with a typical delay of two weeks. The RTS, on the other hand, is released at a quarterly frequency with a typical delay of six weeks. This means that the ECT data could be useful to decision makers as it may contain useful information regarding the current state of the economy. It may also prove useful in short run forecasting.

However, there is one weakness of the ECT series. This relates to the way in which the data are collected. From time to time, there are outages in the EFTPOS network.[3] This forces consumers to settle their transactions through another means (such as cash), or forces them to delay making the transaction. These outages can occur for several reasons: operational errors at processing centres, severing of telecom cables which transmit the transaction information, hardware failures and natural disasters. These outages differ in the number of merchants affected and the duration of the outages. The broader the scope of the outage (number of merchants affected) and the longer the duration of the outage, the larger the impact on the ECT series.

Figure 1 plots the total value of card spending, in total and separately for debit and credit cards. The value of card spending has been increasing steadily over the sample period considered here, rising from just under $10 billion in the fourth quarter of 2002 to over $14 billion in the fourth quarter of 2012, an increase of over 40% over the sample period. The debit card series has been increasingly steadily over the sample period, from around $5.5 billion in 2002Q4 to almost $8 billion in 2012Q4 (a 45% increase). Credit card spending has also increased over the sample period, however this series was in decline for most of 2008, before levelling off and beginning to rise slowly again from 2011. Credit card spending was worth just over $4 billion at the beginning of the sample period, growing strongly before peaking at $6 billion in 2008Q1. By the end of the sample period, credit card spending had recovered to its pre-recession levels. Overall, credit card spending grew by almost 50% over the sample period, despite low or negative growth rates since 2008.

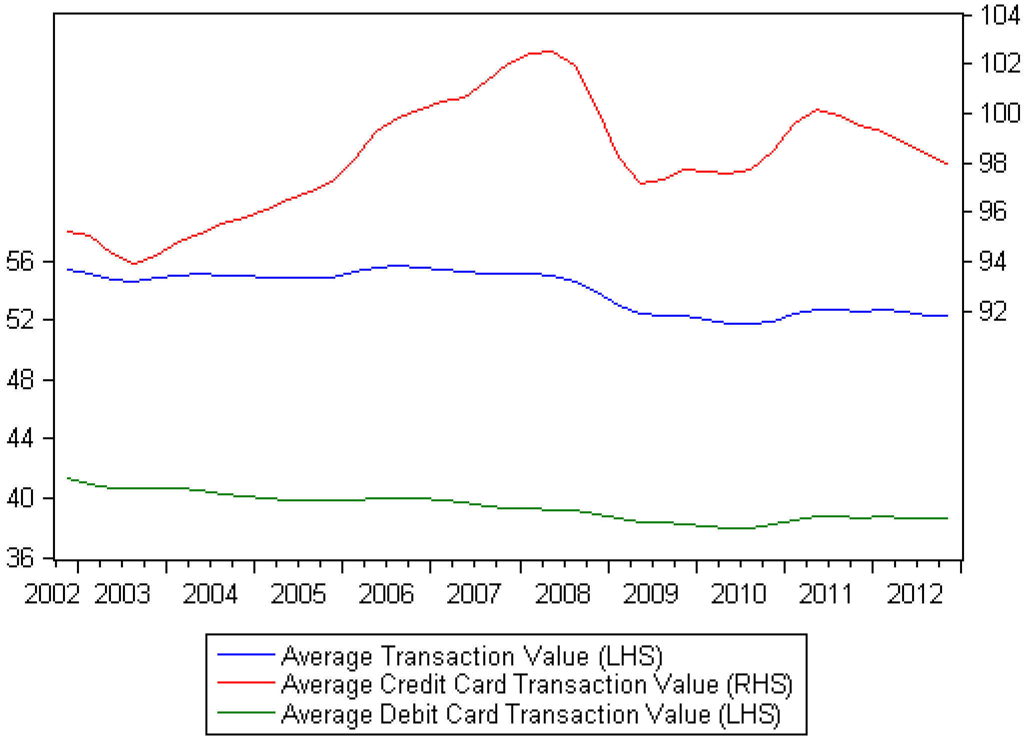
[3] Card transactions may still be processed using the older paper based method. These transactions are processed in a similar manner to cheques and are not included in the ECT series.

Figure 1: Total Value of Card Spending (2006 NZ$)



I consider spending on credit cards and debit cards separately because international evidence finds differences in the reasons consumers use debit and credit cards. Klee (2008) used grocery store scanner data to explore the factors which influence the choice of payment instrument at the point of sale. She found that the key determinant of payment instrument choice was the value of the transaction. For low value transactions, cash was the dominant payment method. Debit cards also featured prominently at the lower end of the distribution of transaction values, which she took as evidence that debit cards are beginning to replace cash as the preferred method of payment for low value transactions. As the value of the transaction increased, credit cards feature more prominently as the preferred payment method. Her results also showed differences in the spread of the distribution of transaction values by payment instrument. Credit cards were used for a much wider range of transaction values than any of the other instruments considered. This means we would expect the credit card series to be the more volatile series.

Figure 2: Average Value of Card Transactions[4]



We see a similar pattern in the ECT data. Figure 2 plots the average value of a card transaction, overall and separately for debit and credit cards. The average value of a credit card transaction is over twice the average value of a debit card transaction. The average debit card transaction has been slowly declining over the sample period, beginning at around 41$ in 2002Q4 but falling to around $30 in 2012Q4. The credit card series shows more variation. The average value of a credit card transaction rose steadily over the first part of the sample period, before reaching a peak of $102in 2008Q1. From here, the average value declined to sit at $98 in 2012Q4.

In the business cycle analysis, I compare the cyclical movements in the total value series against those in real GDP, consumption expenditure and its components (durables, non-durables and services consumption). I look at the short run relationships between the card spending series and the components of consumption spending because people may use their debit and credit cards to t purchase different categories of goods. Minish (2007) shows that the share of card spending in total retail sales varies considerably by industry. Doing this allows me to see if

[4] These figures represent nominal values to better show the variation in the average value of a credit card transaction over the sample period.

the debit and credit card series have different relationships with the different components of consumption.

Table 2 presents summary statistics for first difference of the natural log of the eight series considered in this paper. All series are seasonally adjusted and deflated using the CPI. The average quarterly growth rate for the three total value series is around 1%. The average growth rate for the credit card series is slightly lower due to the low growth post 2008. The credit card series is the most volatile of the three total value series as expected, given the results from Klee (2008). The volatility of the credit card series is very similar to the volatility of the durables consumption series, which could indicate a close relationship between credit card spending and durables consumption. If credit cards are more often used to purchase durable consumption goods, this could also partly account for the larger average transaction value for credit cards.

Table 2: Summary Statistics

Series	Mean	Std. Deviation	Max	Min
$\Delta \log(\mathrm{TOTVAL})$	0.010104	0.008922	0.029241	-0.011157
$\Delta \log(\mathrm{TOTVAL\ CC})$	0.009203	0.013501	0.040994	-0.022869
$\Delta \log(\mathrm{TOTVAL\ DBT})$	0.010837	0.006625	0.024400	-0.007780
$\Delta \log(\mathrm{GDP})$	0.005061	0.006093	0.018819	-0.011031
$\Delta \log(\mathrm{CONS})$	0.006572	0.006803	0.018490	-0.010061
$\Delta \log(\mathrm{DURABLES})$	0.008759	0.013165	0.026115	-0.032794
$\Delta \log(\mathrm{NON} - \mathrm{DURABLES})$	0.004638	0.008786	0.026721	-0.018632
$\Delta \log(\mathrm{SERVICES})$	0.006802	0.006364	0.017228	-0.007711

3. Methods

The business cycle analysis was conducted using similar methods to Stock and Watson (1999) for the US and McCaw (2007) for New Zealand. Univariate business cycle filters are used to extract cyclical information from the series, with the resulting cyclical estimates compared in terms of their volatility and strength of co-movement. Volatility is measured by the standard deviation of the cyclical series, while the strength of the co-movements between the series is measured using dynamic cross-correlations. This also allows me to explore timing relationships between the series.

I employ two business cycle filters to extract cyclical information from the series: the Hodrick-Prescott (HP) filter (Hodrick and Prescott 1997) and the Christiano-Fitzgerald (CF) band pass filter (Christiano and Fitzgerald 2003). The HP filter estimates the trend of a series by minimising the sum of squared residuals, subject to a penalty function on the second differences of the trend series. The smoothness of the trend series depends on the smoothness parameter, λ. The standard value of λ employed for quarterly data is 1600. The trend estimate resulting from this value of the smoothness parameter is a smooth non-linear trend. The cyclical estimate is the residuals from fitting the trend, smoothed with a moving average filter. When applied to the natural log of a time series, the resulting cyclical estimate is interpreted as the per cent deviation from trend. The cyclical series resulting from the HP filter includes the cycles in the series which last up to 32 quarters, using the standard value for the smoothing parameter (Cogley 2001, Pedersen 2001).

The CF filter, on the other hand, extracts from a raw series cyclical movements which occur within a specified frequency range. When conducting business cycle analysis, the CF filter extracts cyclical movements which last between 6 and 32 quarters.[5] The CF filter uses a moving average to estimate the trend of a series. The ideal version of the CF filter would employ a moving average of infinite order, meaning that an approximation to the ideal filter is needed for practical applications. The version of the CF filter employed in this paper is the time-varying asymmetric filter. When estimating the cyclical component of a series at time *t*, this version of the CF filter uses all observations in the sample. An optimising criterion is used to estimate the weights on the moving average. Their criterion minimises the squared deviation of the proposed filter from the ideal filter, weighted by the spectrum of the series (Christiano and Fitzgerald 2003). The authors suggest using the spectrum of a random walk as an approximation to the true spectrum and showed that this approximation works well for US macroeconomic series, even if the true time series representation was quite different.

Testing for long run relationships was done using the two-step procedure for testing cointegration from Engle and Granger (1987). A condition which must be met for two series to be cointegrated is that both series are non-stationary (I(1)). Table 2 displays the results from conducting DF-GLS unit root tests (Elliot et al 1996) on both the ECT series and the reference series. As can be seen from table 2, the DF-GLS unit root tests fail to reject the null hypothesis that the log levels of the series contain a unit root. One surprising result is the finding of a unit root in the first difference of services consumption. However, this should have no effect on the business cycle analysis. King and Rebolo (1993) show that the HP filter produces a stationary

[5] This is the definition of a business cycle from Burns and Mitchell (1946).

cyclical series if the raw series contains up to four unit roots. Christiano and Fitzgerald (2003) show that their filter also produces a stationary cyclical series if the raw series contains up to two unit roots.

Table 3: DF-GLS unit root test results					
	Log first difference		Log levels		
Series	Test Stat	Accept/reject H_0	Test Stat	Accept/reject H_0	Conclusion
$TOTVAL$	-2.724780	Reject	-1.784453	Accept	I(1)
$TOTVAL\ CC$	-2.177386	Reject	-2.176224	Accept	I(1)
$TOTVAL\ DBT$	-3.827765	Reject	-1.623259	Accept	I(1)
GDP	-4.603360	Reject	-1.838369	Accept	I(1)
$CONS$	-1.967131	Reject	-2.273204	Accept	I(1)
$DURABLES$	-1.718801	Reject	-2.713422	Accept	I(1)
$NON-DURABLES$	-5.003915	Reject	-1.388281	Accept	I(1)
$SERVICES$	-0.303786	Accept	-2.717875	Accept	I(2)

I conduct tests for bivariate cointegration between the total value series and GDP and consumption. The presence of cointegration implies the existence of some long run equilibrium relationship between the series. Schreft (2006) notes that macroeconomic aggregates such as GDP and consumption are the result of transactions settled through some means. A long run relationship may exist between the variables if electronic cards are used to settle the same type of transactions and these transactions comprise a relatively constant proportion of GDP or consumption spending.

I estimate a total of six cointegrating regressions. The cointegrating regressions I estimate are of the form:

$$\log y_t = \beta_0 + \beta_1 t + \beta_2 \log x_t$$

Where y_t is either GDP or consumption, and x_t is either the total value of all card spending, debit card spending or credit card spending. I include a linear trend in the cointegrating regression to account for existing consumers switching to using electronic cards to settle transactions. The cointegrating regressions are estimated using the dynamic ordinary least squares (DOLS) estimator of Stock and Watson (1993), with two leads and lags. The results from the cointegration tests are displayed in section 4.2.

4. Results

This section will report the results from examining the short and long run relationships between the ECT variables, real GDP, consumption and its components. Section 4.1 will present the business cycle results, while section 4.2 will present the results from the cointegration testing.

4.1. Business Cycle Analysis

Table 4 presents summary statistics for the cyclical estimates of the series. Again, we see that the credit card series is the more volatile of the card spending series. Credit card spending appears to be the most sensitive of the ECT series to prevailing economic conditions. Credit card spending is also much more volatile than either GDP of consumption over the business cycle. Debit card spending, on the other hand, is much less volatile. This could indicate that credit cards are more often used for discretionary spending, while debit cards are more often used for the more autonomous spending. It could also indicate that consumers are sensitive to the relatively high marginal cost of credit card liquidity, particularly if they have a positive credit card balance at the end of the billing cycle (Arango et al 2011). This may be more likely during recessionary periods.

Table 4: Summary Statistics for the cyclical series

Series	Mean	Std. Deviation	Max	Min
$TOTVAL\ CYCLE$	-0.000261	0.016263	0.034811	-0.026552
$TOTVAL\ CC\ CYCLE$	-0.000610	0.026836	0.054764	-0.045297
$TOVAL\ DBT\ CYCLE$	0.000065	0.009425	0.023378	-0.016182
$GDP\ CYCLE$	0.001115	0.010051	0.023399	-0.017701
$CONSUMPTION\ CYCLE$	0.001339	0.012542	0.022717	-0.027700
$DURABLES\ CYCLE$	0.002520	0.026785	0.040755	-0.064423
$NON-DURABLES\ CYCLE$	0.001120	0.014520	0.025680	-0.036179
$SERVICES\ CYCLE$	0.001024	0.009809	0.018278	-0.020180

Table 5 presents the results from examining the cross-correlations between the cyclical components of the ECT series and GDP. The first column reports the contemporaneous correlation between the series; the second column reports the maximum correlation, while the third column reports the timing of the maximum correlation. The first number in each cell is the result from comparing the HP filtered series, while the second number is the result from examining the CF filtered series.

The results in Table 5 show that the total value series are relatively highly correlated with GDP over the business cycle. The results indicate that card spending moves procyclically with GDP, as expected. The correlations do vary depending on the filter employed, with the HP filtered series exhibiting a stronger contemporaneous and maximum correlation for the credit card series and the combined card series. For the debit card series, the CF filtered series produce the higher correlations.

There are differences in the timing results across the three card series. The combined card series moves contemporaneously with GDP, while the credit card series tends to lag GDP by a quarter. There is some evidence of leading behaviour for the debit card series; results from the CF filtered series show that the debit card series lead GDP by a quarter. The result from the HP filtered series indicates coincident co-movement between the debit card series and GDP. However, the correlations with leads of GDP are slightly stronger than the correlations with the lags.

Table 5: Cross Correlations of Total Value Series (t) with leads and lags of real GDP (t ± i) HP(1600)/CF

Total Value Series	t=0	Max correlation	Max at ±i
$TOTVAL\ CYCLE$	0.7705	0.7705	0
	0.6692	0.6692	0
$TOTVAL\ CC\ CYCLE$	0.7644	0.7740	-1
	0.5702	0.6163	-1
$TOVAL\ DBT\ CYCLE$	0.6810	0.6810	0
	0.7353	0.8072	+1

Table 6 presents the results from examining the cross-correlations between the cyclical components of the ECT series, consumption and its components. The first three columns report the contemporaneous correlation, the maximum correlation and the timing of the maximum correlation, respectively, for aggregate consumption. The remaining columns report the same information for examining co-movements with durables, non-durables and services consumption, respectively.

There are notable differences between the strength of co-movement between the ECT series and consumption and its components. Cyclical movements in both the combined card series and the credit card series are highly correlated with the movements in aggregate consumption, while the debit card series showed a weaker association with aggregate consumption. There are also differences in the strength of association between the different cyclical estimates for the same series. For instance, the combined card spending series is most highly associated with services consumption when the cyclical series are estimated using the HP filter, while it is most highly associated with durables consumption when the cyclical series are estimated using the CF filter. Of the three components of consumption, the debit card series is most highly associated with non-durables consumption.

As with GDP, there are differences in the timing relationships across the three total value series. For aggregate consumption, the results indicate that the combined card and credit card series tend to lag consumption by one quarter, which appears to be driven largely by the timing relationship with non-durables consumption. Both the combined card and credit card series lag non-durables consumption by one to two quarters. These two series move contemporaneously with durables and services consumption. The debit card series on the other hand shows some evidence of leading behaviour. Results from the CF filtered series indicate that debit card spending tends to lead both durables and services consumption by one quarter. As was the case with GDP, the HP filter shows slightly stronger leading behaviour, but the maximum correlations occurs between the contemporaneous observations.

The differences in the timing relationships between the debit and credit card series could be due to differences in how the two cards are used. These differences could be related to the fact that the two card types differ in the source of funds used to settle transactions. Debit cards settle transactions with current deposits. An income shock will lessen the value of an individual's current deposits, meaning they will necessarily spend less on their debit card. Credit cards, on the other hand, settle transactions using future deposits. Consumers may use their credit cards to smooth consumption over time in response to a negative income shock. However, they cannot consistently use their credit card for this purpose if they have a positive balance on their card at the end of the billing cycle, so must then adjust their credit card spending later in order to reduce their credit card debt. Evidence from Arango et al (2011) indicates that consumers with a positive balance on their cards at the end of the billing cycle are quite sensitive to the marginal cost of credit card liquidity.

Table 6: Cross Correlations of total value series (t) with leads and lags of consumption and its components (t ± i) HP(1600)/CF												
	CONS CYCLE			*DURABLES CYCLE*			*NON-DURABLES CYCLE*			*SERVICES CYCLE*		
Total Value Series	t=0	Max correlation	Max at ±i	t=0	Max correlation	Max at ±i	t=0	Max correlation	Max at ±i	t=0	Max correlation	Max at ±i
TOTVAL CYCLE	0.8065	0.8281	-1	0.6935	0.6935	0	0.6238	0.7528	-1	0.8149	0.8149	0
	0.7763	0.8048	-1	0.7739	0.7739	0	0.5425	0.7533	-2	0.6487	0.6487	0
TOTVAL CC CYCLE	0.8036	0.8581	-1	0.7105	0.7105	0	0.5711	0.7781	-2	0.8385	0.8385	0
	0.7012	0.7994	-1	0.7461	0.7461	0	0.4308	0.7673	-2	0.6217	0.6217	0
TOVAL DBT CYCLE	0.6376	0.6376	0	0.5069	0.5069	0	0.6754	0.6754	0	0.6044	0.6044	0
	0.7508	0.7508	0	0.6066	0.6595	+1	0.7016	0.7106	0	0.5280	0.6079	+1

4.2. Cointegration Testing

Table 7 reports the results for the Engle-Granger tests for cointegration. The first three columns report the test statistics, the 5% critical value and the test conclusion for the tests involving GDP, while the latter three columns report the same information for the tests involving consumption spending. The critical values in the Table 7 are calculated using the tables in MacKinnon (2010).

Table 7: Results of Engle-Granger tests for cointegration

	y_t					
	log *GDP*			log *CONSUMPTION*		
x_t	τ-stat	Critical Value (5%)	Conclusion	τ-stat	Critical Value (5%)	Conclusion
log TOTVAL	-5.04556	-4.07074	CI(1,1)	-3.59864	-4.07074	-
log TOTVAL CC	-6.5586	-4.07074	CI(1,1)	-4.7559	-4.07074	CI(1,1)
log TOTVAL DBT	-2.6544	-4.07074	-	-2.41739	-4.07074	-

Cointegration testing revealed three cointegrating relationships between the total value series, GDP and consumption. A cointegrating relationship exists between GDP and the total value of card spending, GDP and the total value of credit card spending, and between consumption and the total value of credit card spending. No cointegrating relationship was revealed between GDP or consumption and the total value of debit card spending. This provides further evidence that credit card spending is more sensitive to economic conditions. As incomes rise (as measured by GDP), credit card spending also rises in response. This could be due to debit cards being used for more autonomous spending which is relatively insensitive to the state of the economic cycle.

5. Conclusions

This paper examined the potential usefulness of the ECT series as an indicator variable for the New Zealand economy. This is done in two ways. I first considered the strength of the short run relationships between the total value of all card spending, credit card spending and debit card spending with real GDP, consumption expenditure and its components. I find that all three card series could potentially be useful as a short run indicator for the state of the economy. Debit card spending, because of its stronger leading behaviour, may prove useful given the timeliness of the release of the ECT statistics. Even though the combined card series and the credit card series tended to lag GDP and consumption, these series may still prove a useful guide for the state of the economy, again due to their rapid availability to forecasters and policy makers.

I also tested for the existence of cointegrating relationships between the total value series, GDP and consumption. I found evidence of three biviarite cointegrating relationships: one between the GDP and the total value of card spending, one between GDP and the total value of credit card spending and one between consumption and the total value of credit card spending. Accounting for these long run relationships may improve the performance of forecasting models which include these variables.

The exploratory analysis conducted in this paper shows the potential of using transactions data as an indicator for the state of the economy. As long as a particular payment instrument (or set of instruments) is used across a wide range of sectors in the economy, and these transactions can readily be measured by a third party, transactions data can provide accurate, timely data on economic activity. The analysis in this paper provides supporting evidence to the claim from Minish (2007) – the ECT data can be used as a timely indicator of the change in the level of consumption spending, or of economic activity in general.

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