Mat-2.4177 Seminar on Case Studies in Operations Research

Determinants of cash usage in Baltic countries

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Client: SEB

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Introduction

This project was carried out within the course Mat-2.4177 Seminar on Case Studies in Operations Research during January 2013–May 2013. The general idea of this course is to let students to work on real problems posed by firms and research institution (Salo, 2012). This research project "Determinants of cash usage in Baltic countries" was proposed by SEB Estonia.

Background

The use of cash is decreasing whereas new payment methods like cards, e-payments and mobile-payments are gaining more users. The global volume of payment transactions using direct debits, credit transfers, cards and checks increased with an annual rate of 6.8% during 2001 – 2009 (Anon. 2012). The largest non-cash payment market is the United States covering more than 40% of the total market. The second largest market with 20% of total market is Europe. In the Euro area the volume of card payments involving non-monetary institutions has increased over 32% from 2007 to 2011, while value of the these transactions has increased 22% over the same time period reaching now over 1146 EUR billions (ECB 2013a).

Decreasing use of cash can benefit people, countries and monetary institutions. Going cashless can be a convenient and safe option for consumers. Countries can use electronic payment systems to fight the shadow economy because, unlike cash, electronic payment systems leave a mark of each transaction (Schneider 2012). For banks, alternative payment methods cause less operational risks than handling cash, and they also increase efficiency.

Previous studies on cash usage have focused on describing the trends in different payment methods in different countries (e.g. Amromin and Chakravorti, 2007), investigating the effect of debit cards on cash demand (e.g. Stix 2004) or in understanding the reasons why people adopt to use electronic payment instruments (e.g. Bounie and Francois 2006). According to Bounie and Francois (2006) the transaction size, type of good purchased and where the purchase is determine the payment method of the consumer. Nevertheless, the academic research on the use of alternative payment instruments with large data is still scarce.

In Estonia, the relative importance of card payments has increased from 24% to 63% during 2000–2011 (ECB 2013b). The relative importance of card payments in Estonia is higher than on average in the European Union, and higher than in the other Baltic countries (Figure 1). However, it has not yet been studied what the determinants of card or cash usage are in Estonia. Understanding customer behaviour and

factors that affect cash usage in Estonia may help SEB to develop cost-efficiently services to drive the Baltics towards a cashless region
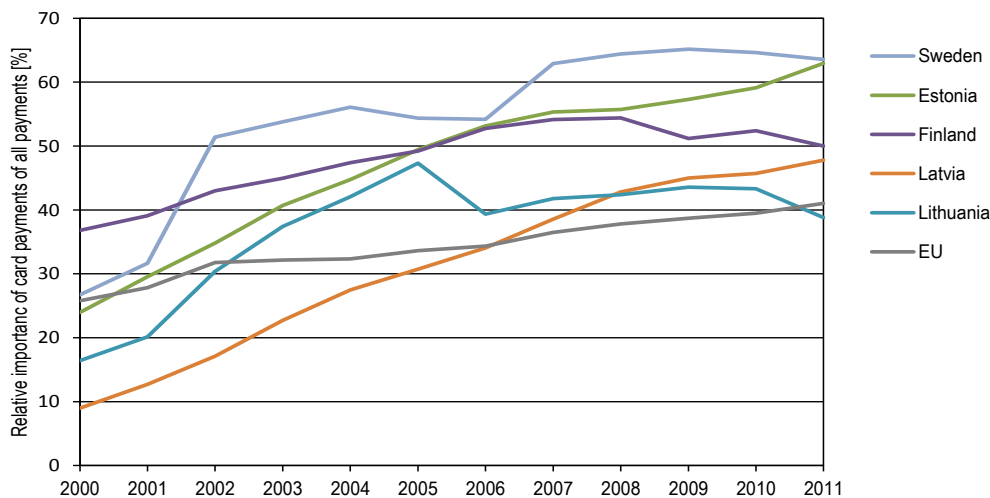

Figure 1. Relative importance of card payments compared to all payment transactions. Only cards issued in the reporting country are included. Data from European Central Bank (ECB 2013b).

Project aims and study questions

The aim of this project was to study the factors that determine cash use in Baltic countries using Estonia as an example. In this project we addressed the following main research questions:

1) What factors affect cash usage in Estonia?
2) Can we identify customer segments that differ in cash usage?
3) How the cash usage has evolved in different customer segments?
4) Can we identify the effect to cash usage by changes in SEB pricelist?
5) Where customers use their cards?

Materials and methods

Data

Customer data

The data used in this project consisted of real customer and transactions data of SEB. The data consisted of personal characteristics of the customers, the number and the volume of their transactions. The data on

personal characteristics described age, mother tongue, gender, location, income/salary, liabilities, usage of bank channels, possible unemployment, and children. The data also included payment merchant category codes (MCCs), which indicate where cards have been used for purchases. The transactions data was aggregated monthly for each customer, and the time-series covered years 2007–2012. Only customers that had done transactions every month between January 2007 and December 2012 and were private customers that had not moved to different region or changed living place type during the study period were included in the dataset. The data consisted of approximately 71000 SEB private customers that were permanent residents in one of the fifteen regions of Estonia. Customers were between 15 to 80 years of age. Analysed customers were picked randomly and the data was depersonalised by SEB. Therefore it was impossible to link data to actual persons.

In this study, we focused on card purchases and cash withdrawals to limit the analysis to transactions that may involve cash. Electronic payments from one account to another were excluded from the analysis. English speaking customers were excluded because of their paucity.

Important dates and changes in pricelists

During the studied period, Estonia started to use euro on the 1st of January 2011. On the 1st of February 2009 the government changed pension withdrawal system: earlier pensions were also paid in post office but after the change approximately 95% of pensions were paid on bank accounts. The main changes in the SEB pricelists are presented in Table 1.

Table 1. Changes in the SEB pricelists 2007-2012.

Pricelist change	From	Changes
1	20.6.2010	increase in the fee of debit card cash withdrawal from cross-use ATM's
		increase in the pricelist cash withdrawal from ATMs abroad
2	1.1.2010	increase in the fees of non-cash transactions (international payments)
		increase in the fees of cash transactions
		increase in the fees of account statements
		increase in the fees of credit cards and debit cards
		increase in the fees of additional services (e.g. archive inquiries)
		increase in the fee of cash withdrawal with debit card from post bank (0.4% of the withdrawal amount, min 30 EEK
		increase in the fee of cash withdrawal for SEB Estonia customers without banking card (0.4% of the withdrawal amount min 20 EEK)
		changes in benefits (e.g. no issuing replacement card of VISA Electron and Maestro card; cash withdrawal from bank office
3	1.4.2009	increase in the fees of non-cash transactions
4	1.5.2009	increase in the fees of non-cash transactions
		increase in the fees of cash withdrawal
		increase in the fees of cash withdrawal from SEB Estonia ATMs and SEB ATMs in Sweden, Lithuania and Latvia
5	5.6.2009	increase in the fee of cash withdrawal
6	28.1.2008	increase in the fees of non-cash transactions (domestic and international payments)

Customer segmentation

A customer segment is a collection of customers that can be characterized by some common features (Malhotra *et al.* 2012). To identify customer segments we used the data of customer transactions data and personal characteristics. The main goals in the identification of segments were relevance and usability of the information: The main goal of the project was to study the determinants of cash usage. Ultimately the information may be useful in promoting the use of cards over cash. We aimed to find segments that differ in cash use, are simple to characterize and large enough for the bank to target marketing efficiently.

We carried out the clustering the customers into all possible combinations of four features: age (young= born after 1979, mid= born in 1950-1979, old= born before 1950), language (EST or RUS), credit card (yes=had card over 10% of the periods / no) and gender. These features were selected because of correlation with cash use ratio. Cash use ratio was the ratio of cash withdrawals and the sum of cash withdrawals and bank card purchases. Only four features were selected to get enough large clusters that have clear interpretation. The clustering was carried out to a representative sample of 10000 subjects for computational reasons. The 95 percent confidence intervals of the medians of each cluster were estimated using bootstrapping (Efron, 1979).

Analysis of card usage in different merchant categories

A merchant category code (MCC) is a four-digit number assigned to a business by MasterCard or VISA when a business first starts accepting card payments. MCC is used to classify the business by the type of goods or services it provides. The data we had included information about from which MCCs customers had made card purchases in between 2009 and 2012. The number of different types of businesses in which customer made purchases with a card correlated with the cash usage ratio (Figure 2). The more customers used bank card, the larger was the number of MCC in which the card was used.
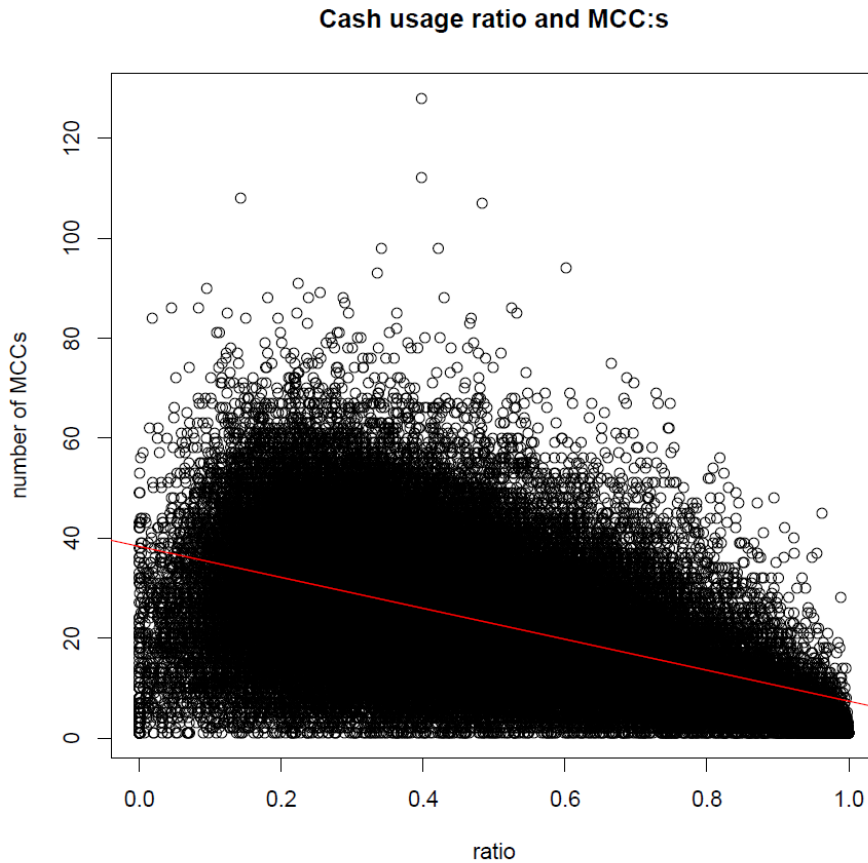
Figure 2: Scatterplot of cash usage ratios and number of MCCs customer made purchases in in 2012

To investigate where people use bank cards and in which merchant categories customer use first their cards we plotted histograms of card usage in each MCC by different people during different years. Comparing these allowed us to see changes in usage in different MCCs as well as finding out which types of businesses most people made purchases in. We also repeated the analysis using only the customers who had used card in very few MCCs, for example in less than 10. That allowed us to find out what kind of places might be the ones that people use cards in first when they are just beginning to use them. It also allowed us to see, how the card usage of the people who used cards in very few places did change when time passed.

Results

Evolution of cash and cash usage during years 2007 – 2012

Figure 3 shows the monthly average card purchases, monthly average cash withdrawals, their sum and cash usage ratio (= cash withdrawals / (cash withdrawals + card purchases) among SEB customers. Over time period from January 2007 to December 2012, the sum of card purchases did not change much. The cash usage ratio has declined steadily. It also shows a yearly seasonal component.

The average cash withdrawals can be decomposed to (number of withdrawals) x (average withdrawal). The average card purchase can similarly be decomposed to (number of purchases) x (average purchase). Figure 4 shows how these four items developed over January 2007 – December 2012. The number of card purchases shows an increasing trend. During the studied time period, it increased from 10 to 17 per month. On the contrary, the number of cash withdrawals shows a decreasing trend. The average number of monthly withdrawals declined from 4 to 3. Both, average purchase and average withdrawal amount, declined during 2008-2009. Since that, the average withdrawal amount surpassed its previous maximum. The average purchase amount is still below its peak.
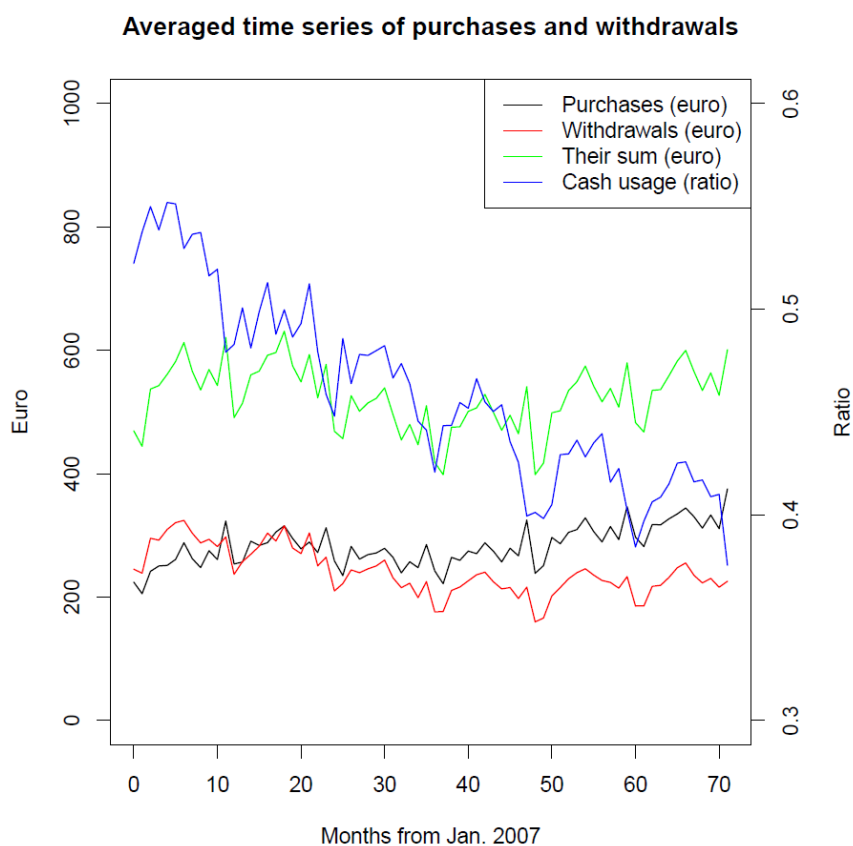

Figure 3: Average monthly cash withdrawals, card purchases, their sum and ratio during years 2007 – 2012
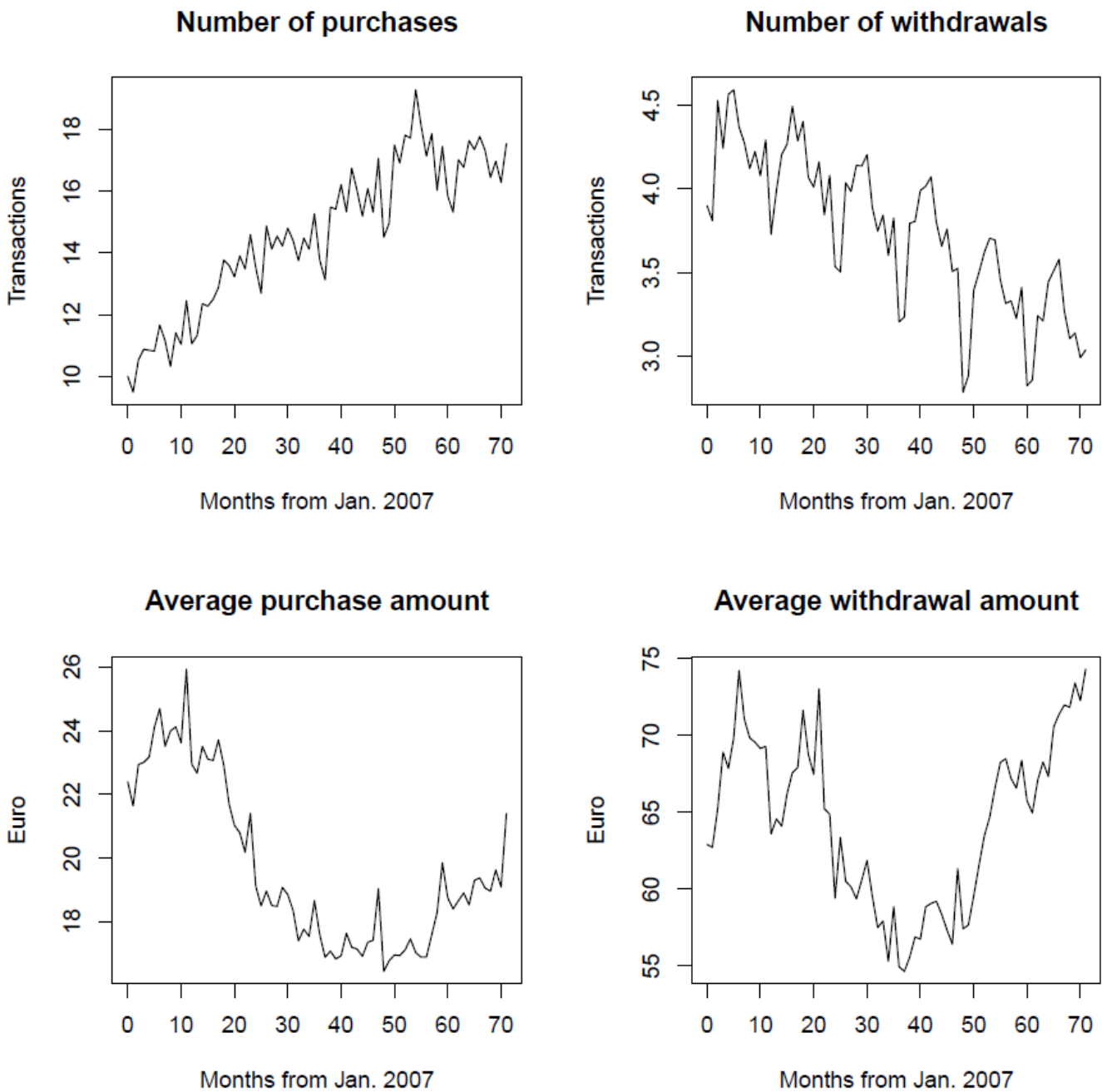
Figure 4: Average monthly number of card purchases, number of cash withdrawals, average card purchases and average withdrawal amounts.

Partial correlations between customer features and cash usage ratio

Partial correlation between two variables measures their correlation when the effect of control variables has been removed.

Figure 5 shows the partial correlations between the customer features, between each customer feature and cash usage and change in cash usage ratio during 2007-2012. The first row shows the partial correlations

between different customer features and the cash usage ratio. The four features with highest correlation with cash usage ratio are, 1) age (old people have higher ratio), 2) language (Russian speaking people have higher ratio), 3) credit card (people with CC have lower ratio), 4) gender (female have lower ratio). However, none of the features has strong correlation with cash usage ratio.

The second row shows the partial correlations between customer features and changes in cash usage ratio. These correlations are very small. Additionally, the figure shows that some features have strong partial correlations between each other. For example, people with credit card more often have loan.
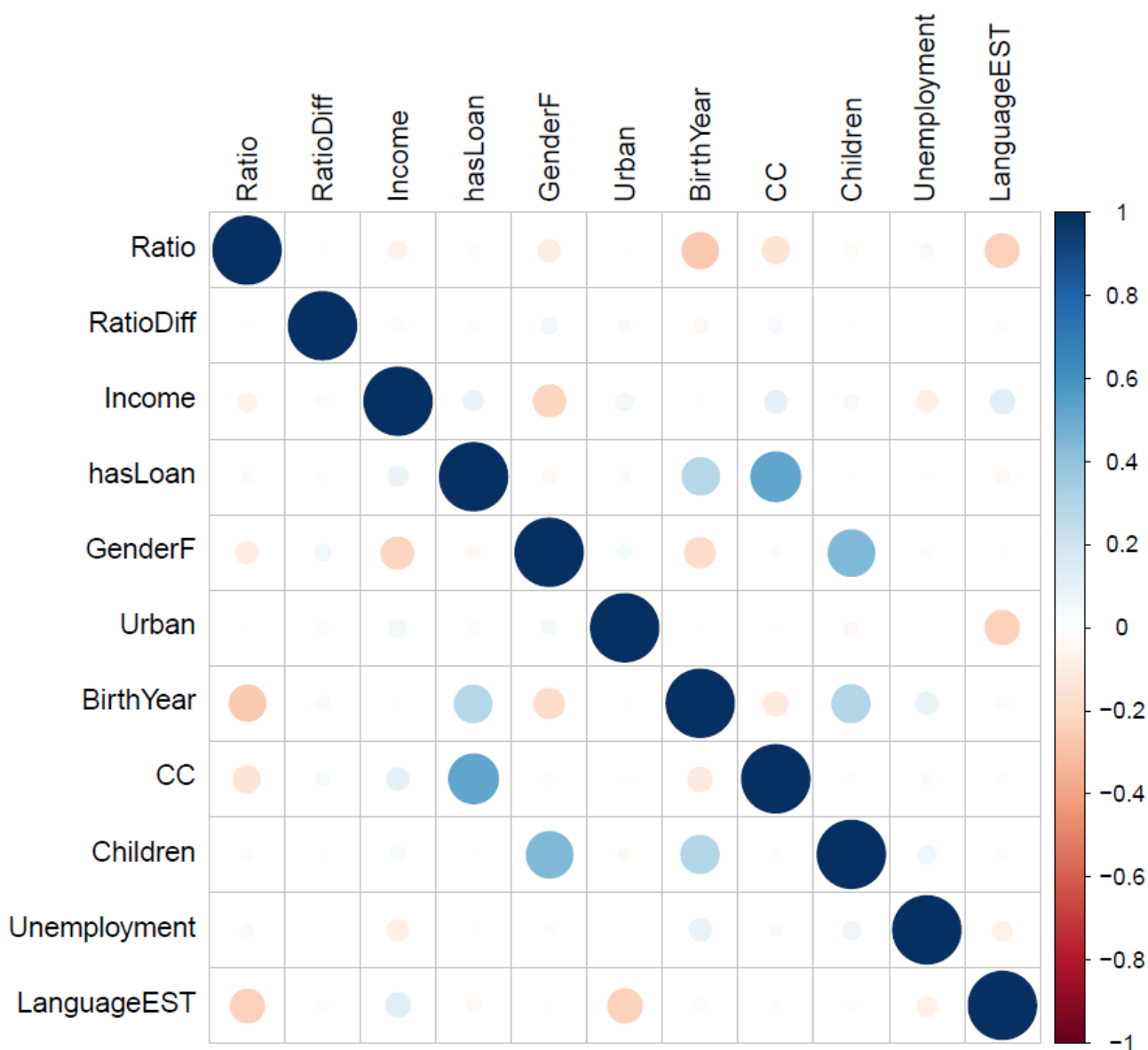

Figure 5: Partial correlations between customer features, cash usage ratio (ratio) and difference in cash usage ratio between 2012 and 2007 (RatioDiff). In the figure CC indicates credit card.

Cash usage in different customer segments

Table 2 shows 18 customer clusters that contain 94% of the sample of 10000 customers. The clustering is based on the four features that had strongest partial correlation with cash usage ratio. The table shows the median cash usage ratio and size of each cluster.

The 10 clusters with the lowest cash usage ratio contain only Estonian speaking people, from all age groups. Lowest cash usage is among young and middle-aged Estonian speaking females with credit cards.

On the contrary highest cash use ratio can be found in clusters 11-18 contain that Russian speaking people and old Estonian speaking people with no credit card. Five clusters with the highest cash ratio stand out. The cash usage ratio of segments 14-18 is between 0.59-0.83 and the segments contain 17 % of the customers. These segments can be divided into two groups: The segments 15 and 16 consist of old Estonian speaking persons without a credit card. The segments 14, 17 and 18 consist of middle aged and old Russian speaking persons without credit card. The old Estonian speaking people with no credit card contain 9.4% of the sample. The middle aged Russian people contain 14.54% of the sample.

Table 2: Characteristics and median cash usage ratios of 18 customer segments that contain 96% of customers. 95% CI stands for the 95 per cent confidence interval of the median.

Index	Gender	Age	CC	Language	SIZE (%)	CUM. SIZE (%)	Median ratio	95% CI
1	F	YOUNG	YES	EST	5,52	5,52	0.32	0.300 - 0.329
2	F	MIDDLE	YES	EST	19,03	24,55	0.34	0.333 -0.357
3	F	YOUNG	NO	EST	5	29,55	0.37	0.348 - 0.382
4	M	YOUNG	YES	EST	4,36	33,91	0.39	0.362 -0.406
5	M	MIDDLE	YES	EST	14,21	48,12	0.39	0.383 -0.409
6	F	MIDDLE	NO	EST	8,08	56,2	0.41	0.391 -0.434
7	M	YOUNG	NO	EST	2,86	59,06	0.42	0.396 -0.440
8	F	OLD	YES	EST	2,53	61,59	0.47	0.448 -0.509
9	M	OLD	YES	EST	1,48	63,07	0.48	0.426 -0.541
10	M	MIDDLE	NO	EST	5,11	68,18	0.51	0.483 -0.543
11	F	MIDDLE	YES	RUS	5,69	73,87	0.52	0.498 -0.551
12	F	YOUNG	NO	RUS	1,41	75,28	0.52	0.456 -0.560
13	M	MIDDLE	YES	RUS	3,82	79,1	0.55	0.522 -0.589
14	F	MIDDLE	NO	RUS	3,01	82,11	0.59	0.553 -0.621
15	M	OLD	NO	EST	3,09	85,2	0.60	0.551 -0.632
16	F	OLD	NO	EST	6,35	91,55	0.68	0.629 -0.710
17	M	MIDDLE	NO	RUS	2,01	93,56	0.70	0.664 -0.739
18	F	OLD	NO	RUS	2,03	95,59	0.89	0.842 -0.903

Figure 6 shows a box plot figure of the average cash usage ratio (over the period from 2007 to 2012) in the 18 largest clusters. The figure shows that the variation within each segment is large.

Figure 7 shows a box plot of the change in cash usage ratio during 2007-2012 in the 18 largest clusters. The largest change in median cash usage ratio was in cluster 7 and then in clusters 3,4,10 and 14. The clusters 3,4 and 7 contain young Estonian speaking people. The clusters 10 and 14 contain middle aged Estonian speaking people without credit card. The smallest change happened in clusters 2, 6, 8 and 18. The clusters 2 and 6 contain middle aged Estonian speaking females. The clusters 8 and 18 contain old females.
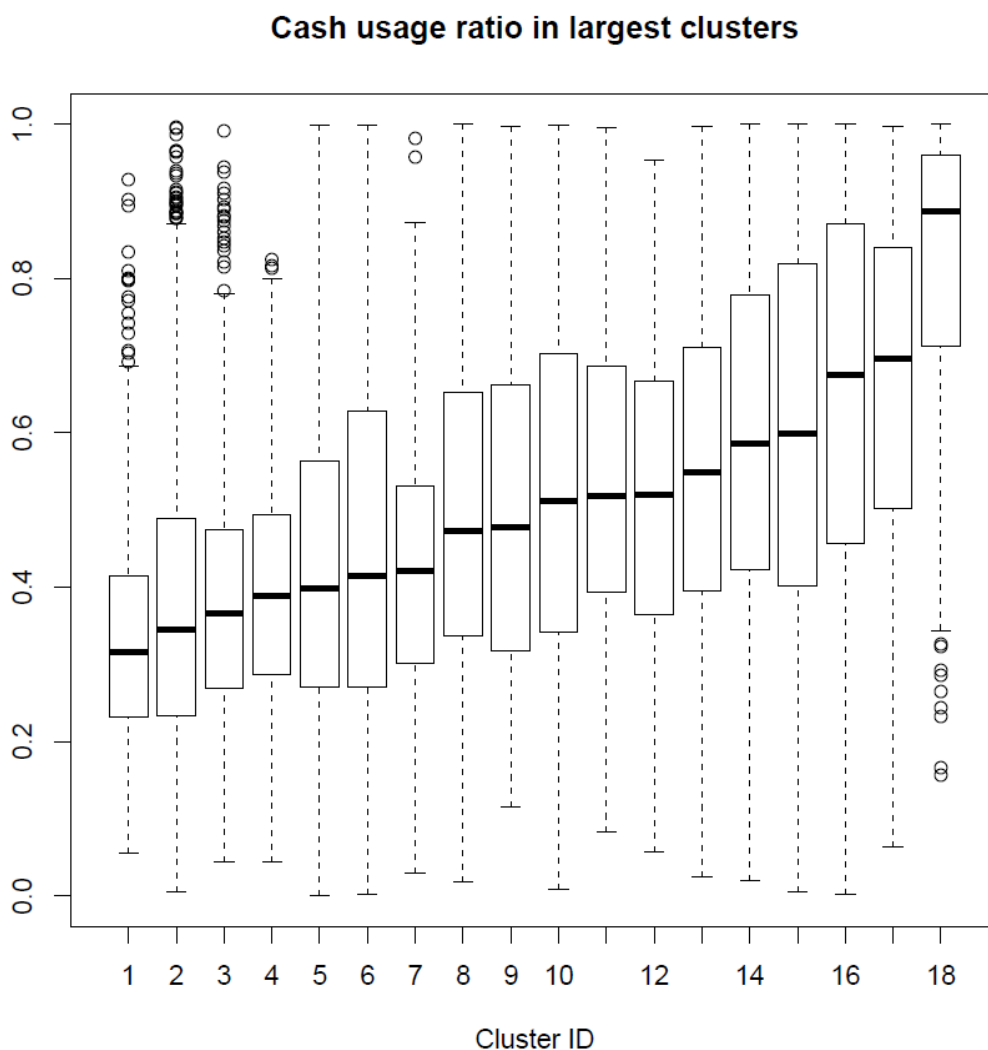

Figure 6: The cash usage ratio in 18 largest customer segments. The boxplots depict the smallest observation, lower quartile, median (black line) upper quartile and largest observation. The circles indicate outliers.

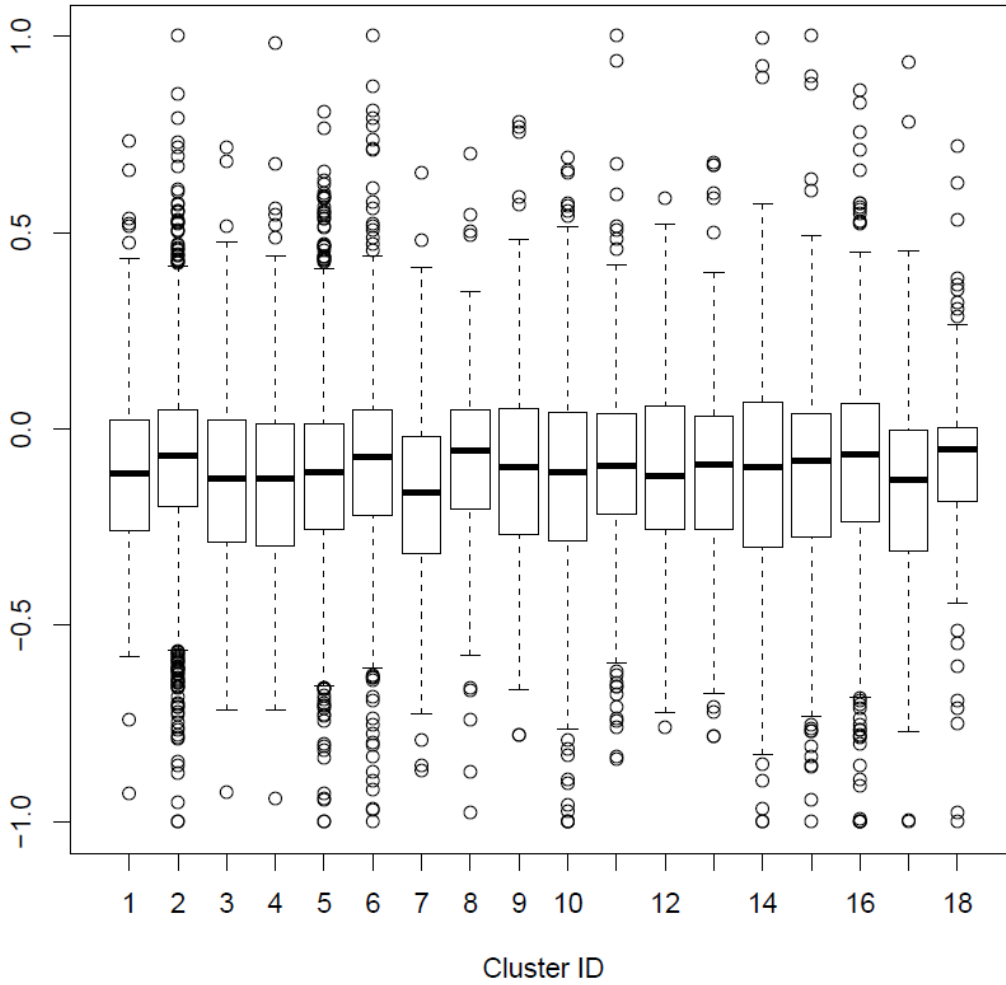## Change in cash usage ratio in largest clusters

Figure 7: A box plot of change in cash usage ratio (between 2007 and 2012) in the 18 largest clusters. The boxplots depict the smallest observation, lower quartile, median (black line) upper quartile and largest observation. The circles indicate outliers

Cash and card usage in different age groups

Figure 8 shows, 1) the average monthly cash to card ratio in years 2007-2012 by age in year 2007, 2) the change in cash to card ratio between years 2007, 2012 by age in 2007. The figure shows that cash usage ratio declined between ages 17-25, after that it increases. The oldest people had the highest cash usage ratio and the people in mid-twenties had the lowest cash usage ratio.
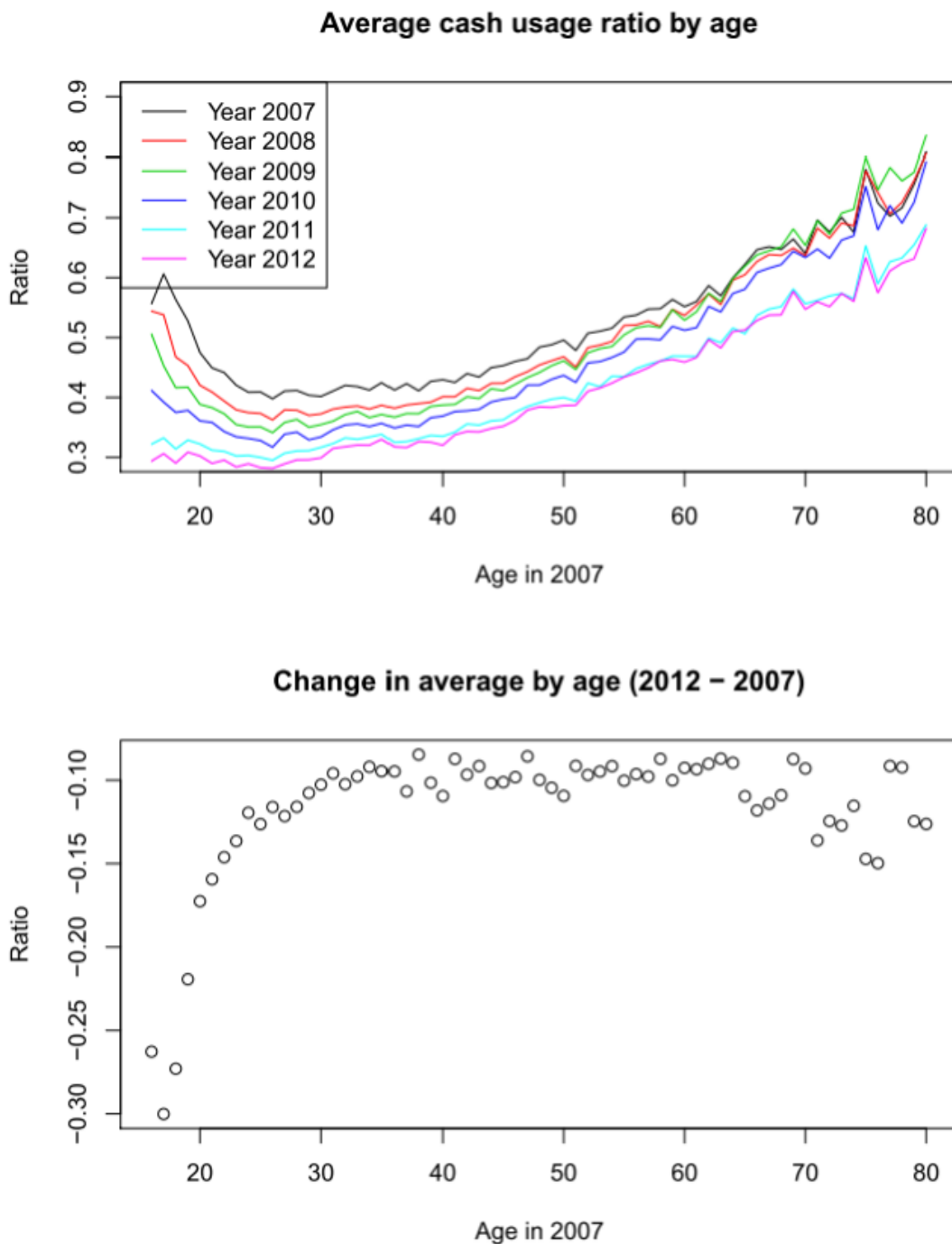
Figure 8: Above: Average monthly cash usage ratio by age in 2007 during years 2007-2012. Below: Change in cash usage ratio between 2007-2012 by age in 2007.

Figure 9 shows, 1) the average monthly cash withdrawals in years 2007-2012 by age in year 2007, 2) the change in the average monthly cash withdrawals between years 2007, 2012 by age in 2007. Cash withdrawals were the highest for around 35 years old people. The cash usage was clearly greater in 2007, 2008 after which the usage dropped for people of 20-60 years in 2007. For people younger than 20 and older than 60 years, the cash withdrawals have increased. These changes have decreased the differences between age groups.

Average cash usage by age
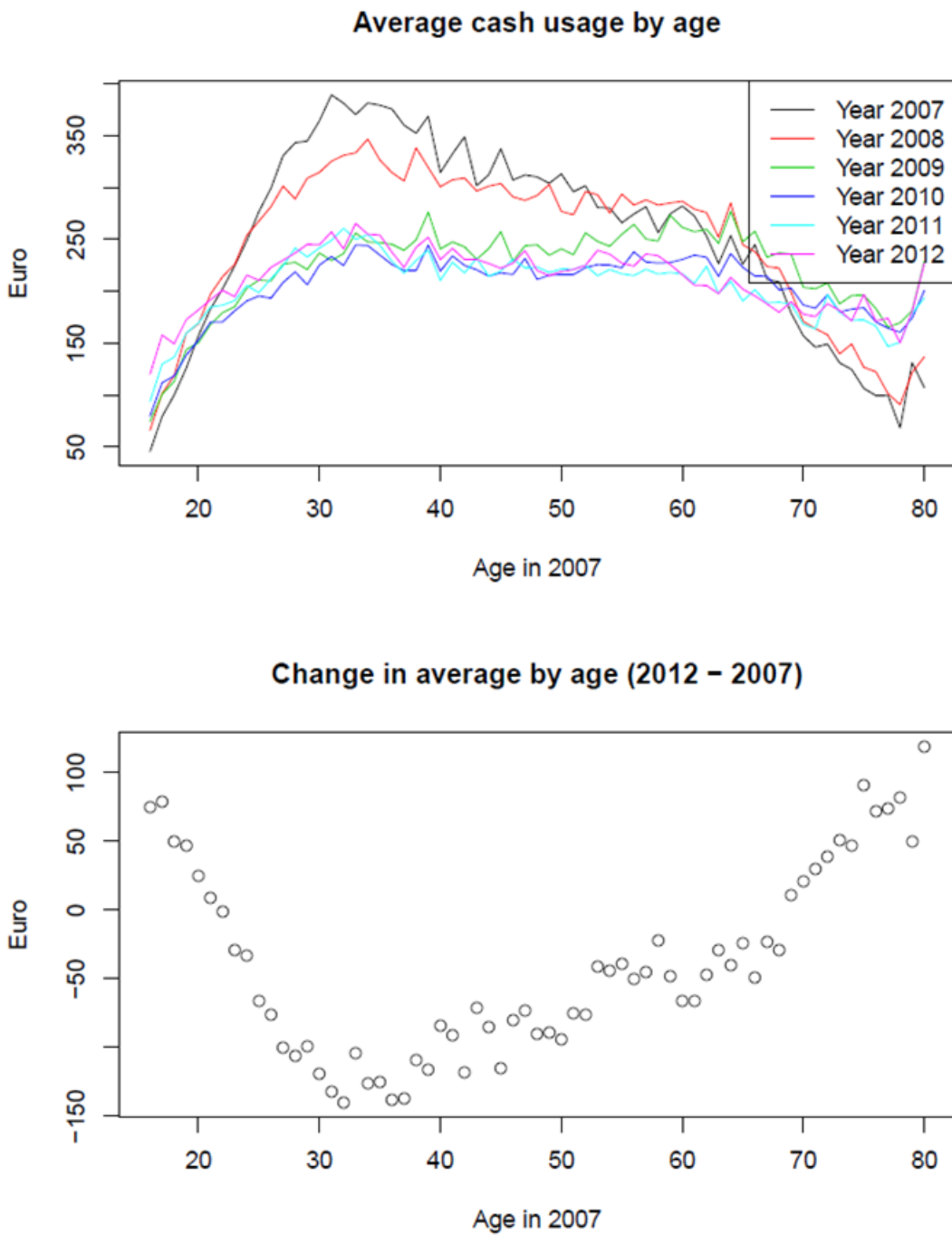

Change in average by age (2012 − 2007)

Figure 9: Above: Average monthly cash withdrawals by age in 2007 during years 2007-2012. Below: Change in cash withdrawals between 2007-2012 by age in 2007.

Figure 10 shows, 1) the average monthly card usage in years 2007-2012 by age in year 2007, 2) the change in the average monthly card usage between years 2007, 2012 by age in 2007. Card usage is the greatest for around 30-year-old people. The figures show the largest increase in card usage for 17-30 year-old people. The card usage decreases steadily for people over 30 year-old.

Average card usage by age
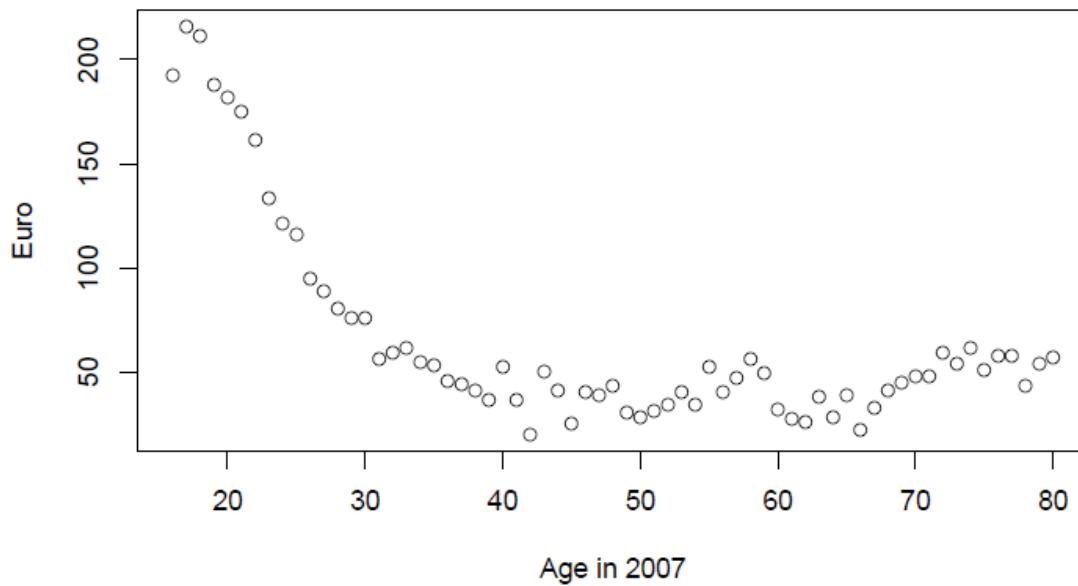

Change in average by age (2012 − 2007)

Figure 10: Above: Average monthly card usage by age in 2007 during years 2007-2012. Below: Change in card usage 2007-2012 by age in 2007

Evolution of cash usage ratio in customer segments

Figure 11 and Figure 12 show the evolution of average cash usage ratio in the clusters 1-18 that are presented in Table 2. All clusters show a decrease in the cash usage ratio and a yearly seasonal component. Many of the clusters show a drop in cash usage ratio between September 2010 and January 2011. After that drop, the clusters 6,8,14,16 and 18 have stayed permanently on a lower level of cash usage ratio than before

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the drop. All of these groups contain middle aged or old females. The only major change during that period is the join to euro in January 2011.
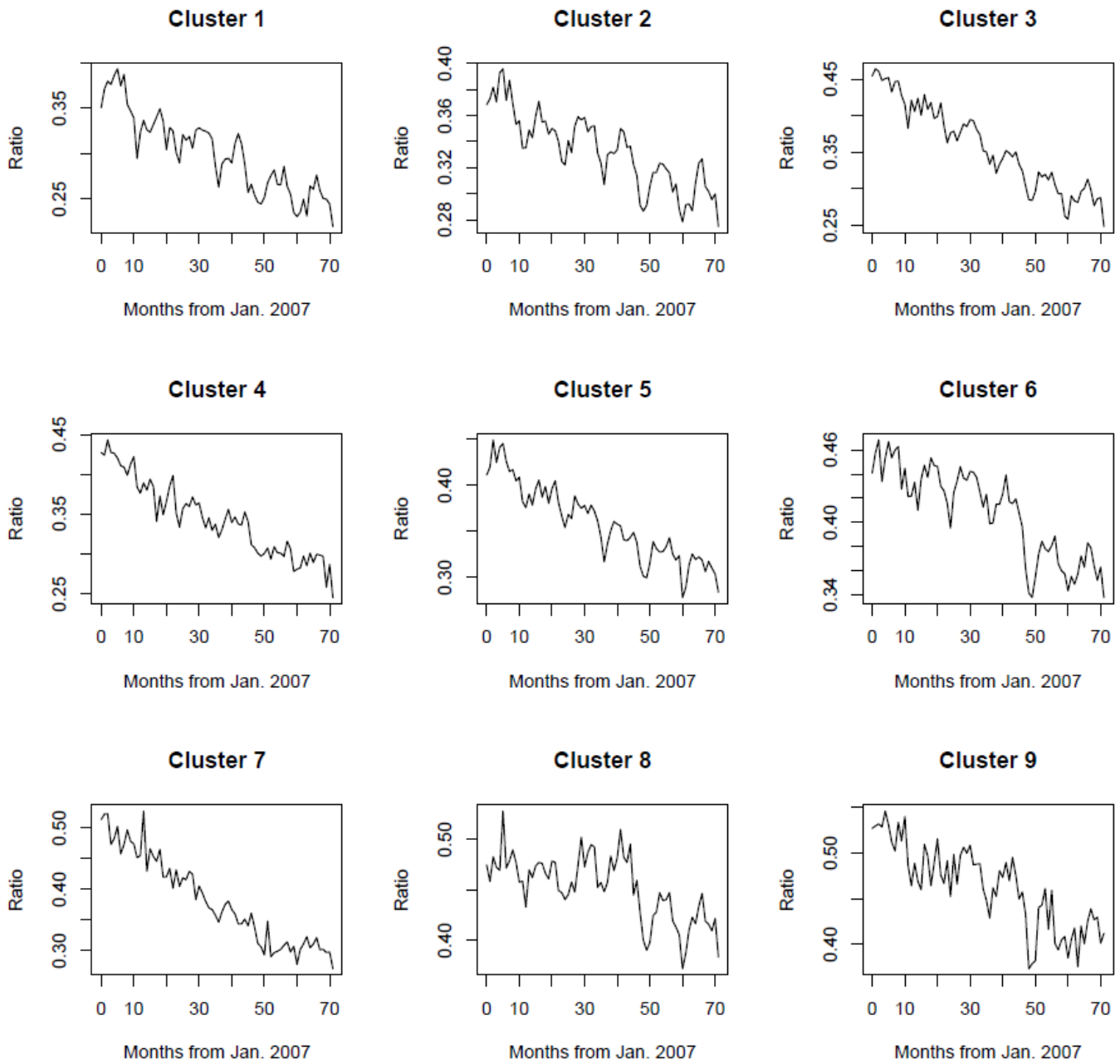

Figure 11: Evolution of cash usage ratio in clusters 1-9.

Cash usage ratio

Cluster 10 — Months from Jan. 2007

Cluster 11 — Months from Jan. 2007

Cluster 12 — Months from Jan. 2007

Cluster 13 — Months from Jan. 2007

Cluster 14 — Months from Jan. 2007

Cluster 15 — Months from Jan. 2007

Cluster 16 — Months from Jan. 2007

Cluster 17 — Months from Jan. 2007
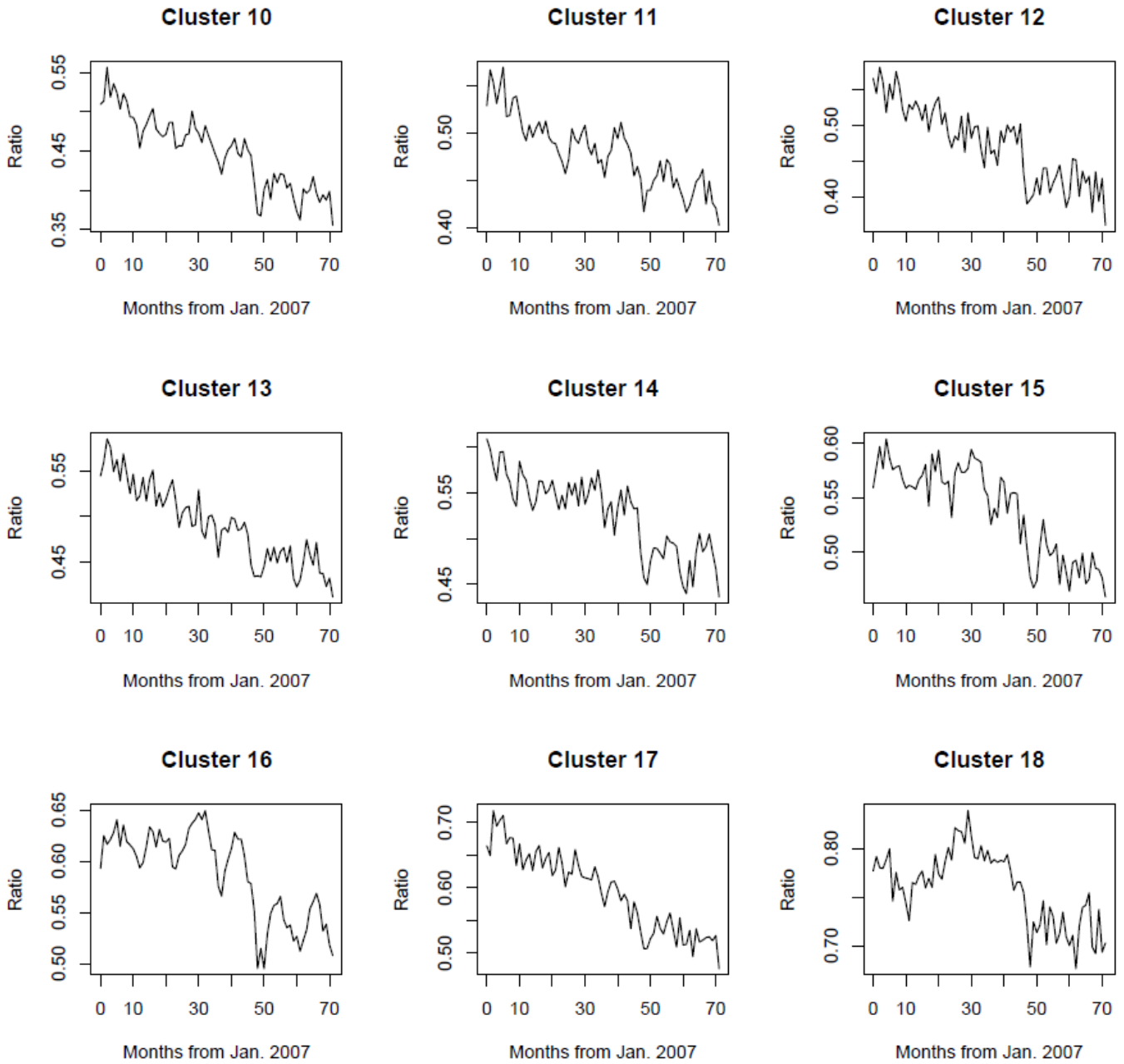
Cluster 18 — Months from Jan. 2007

Figure 12: Evolution of cash usage ratio in clusters 10-18.

Figure 13 and Figure 14 show the evolution of cash withdrawals and card usage in the clusters 1-18. The card usage has mainly increased, and the cash withdrawals stayed constant or decreased.
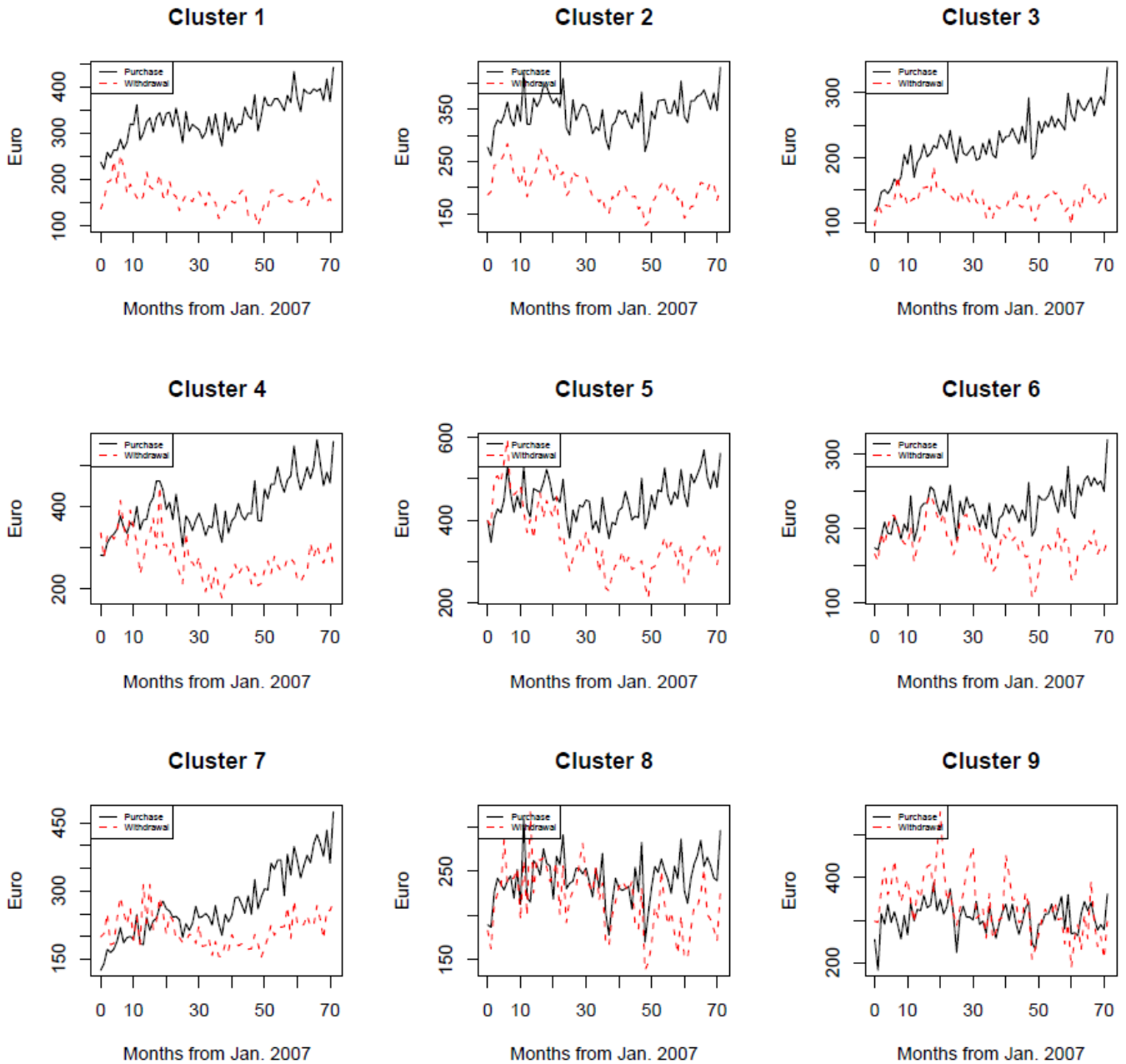
Purchases and withdrawals

Figure 13: Evolution of cash withdrawals and card usage in clusters 1-9.
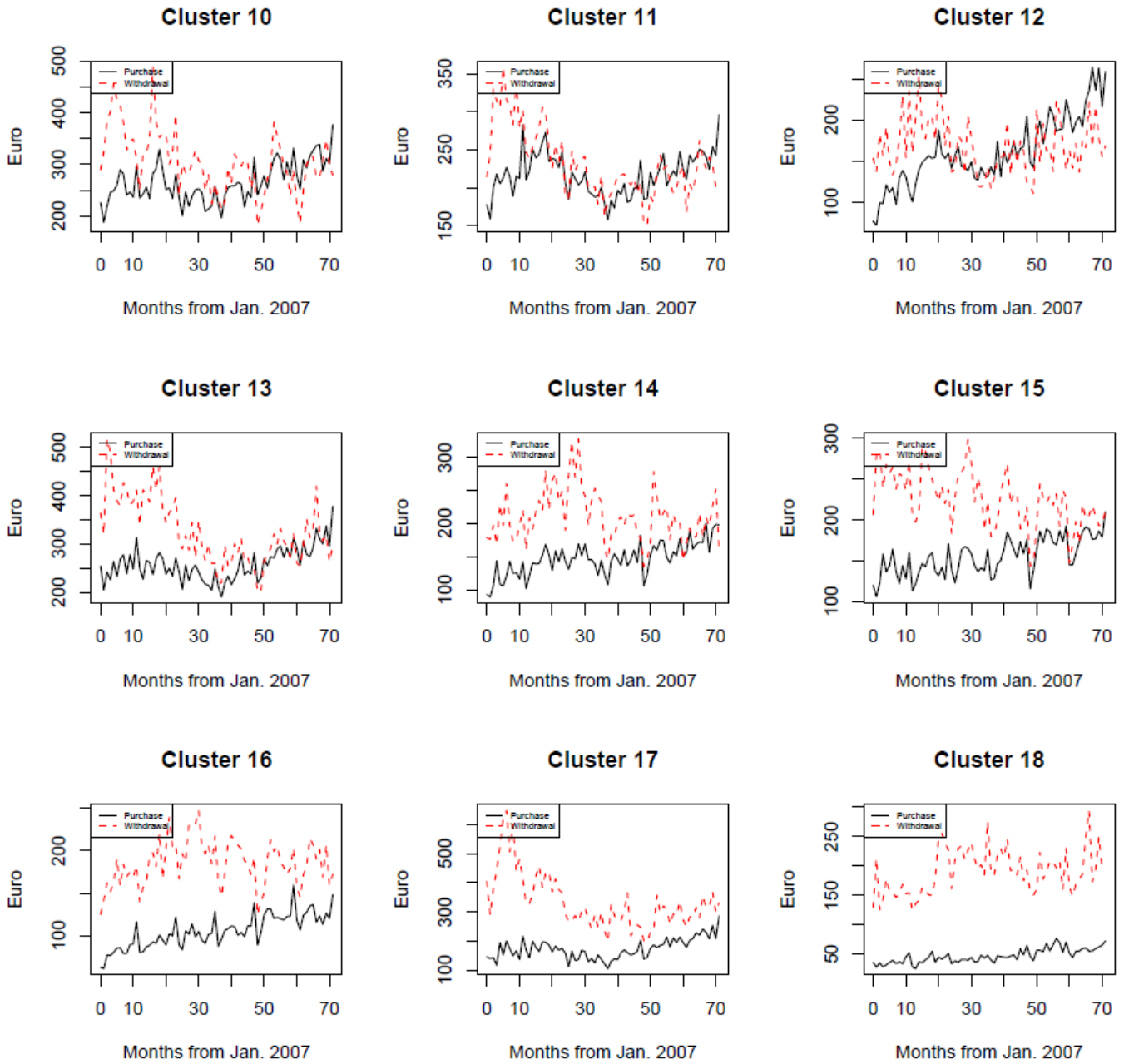
Figure 14: Evolution of cash withdrawals and card usage in clusters 10-18.

Card usage in merchant categories

The largest number of SEB customers in Estonia had made purchases in miscellaneous food stores (5499), supermarkets (5411) and pharmacies (5912) (Figure 15). About 90% of the 70 000 customers we had in our data set had made card purchases in food stores and supermarkets in year 2012 Surprisingly, there was a high number of customers who had made card purchases in pharmacies compared to for example restaurants (5812).

Figure 15: Merchant categories in which the number of customers that made purchases with card is highest. The MCC codes are explained in Table 3.

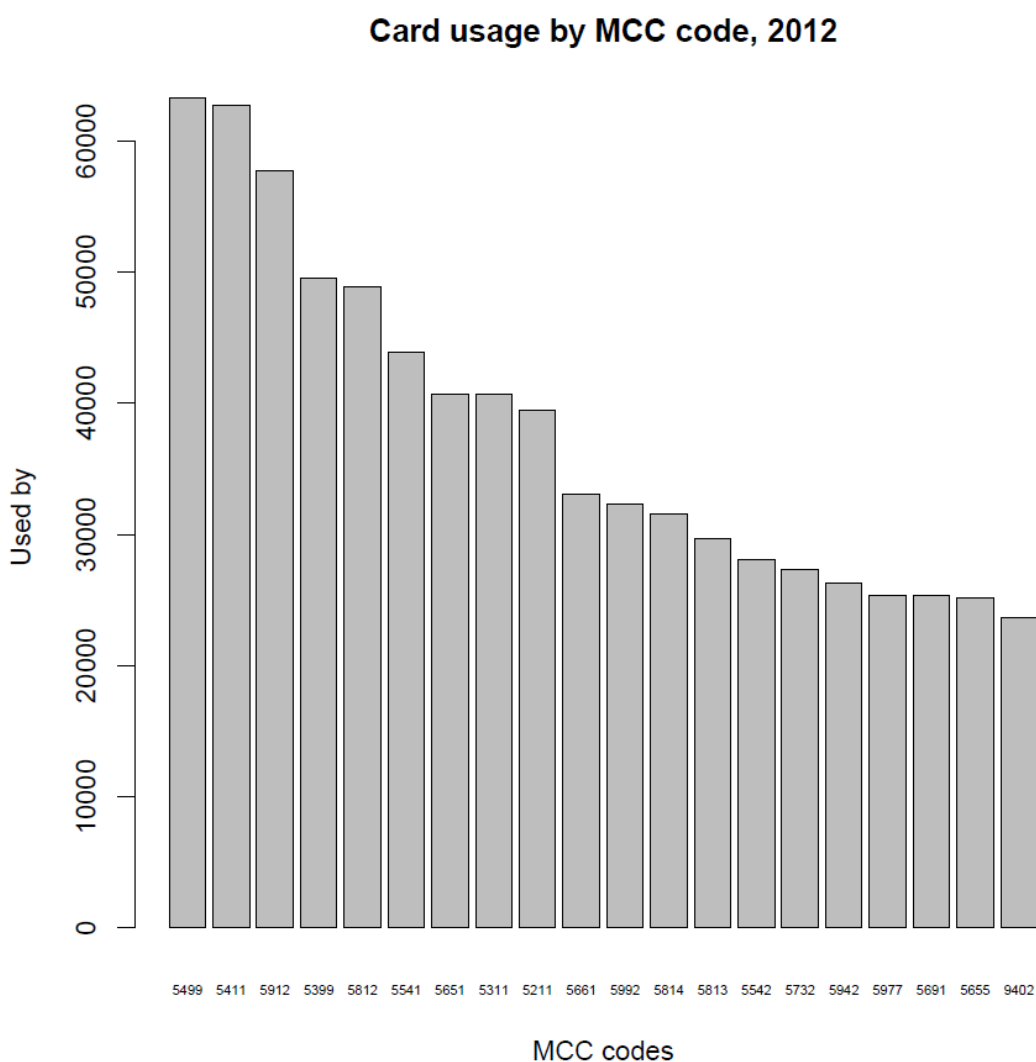**Table 3: Merchant category codes appearing in figures**

4131	Bus lines	5541	Service stations	5912	Pharmacies
4215	Courier Services	5542	Automatic fuel disp.	5921	Beer, wine, liquor
5039	Construction materials	5651	Family clothing	5942	Book stores
5045	Computers	5655	Sports stores	5977	Cosmetic stores
5072	Hardware, equipment	5661	Shoe stores	5992	Florists
5193	Florist supplies, flowers	5691	Men's, women's clothing	6300	Insurance underwriting
5211	Lumber, building mats.	5699	Misc. apparel	7298	Health & beauty spas
5311	Department stores	5712	Furniture	7399	Misc. business services
5399	General merchandise	5722	Household appliance	7523	Parking lots, garages
5411	Supermarkets	5732	Electronics	7832	Movie theatres
5462	Bakeries	5812	Restaurants	7841	Video tape rental
5499	Misc. food stores	5813	Drinking places	9402	Postal services – Gov.
5511	Car & truck dealers	5814	Fast food restaurants		

To investigate in which businesses people started using cards first we plotted histograms similar to Figure 15 using only people who had used cards in less than 10 different MCCs and another one where we used people who did not use cards in year 2009, but did use them in 2012 (Figure 16). Both of those figures showed very similar results so only the one with people who did not use cards in 2009 is shown. The first places where people use cards in are also the ones in which cards are mostly used i.e. food stores, supermarkets and pharmacies. The actual number of customers in the Figure 16 is quite low because our data did not include any of the banks new customers from years 2009-2012, but we believe that it is safe to say that these are the merchant categories where people use cards first, because they are also the categories where people who use cards in very few places use them.

The Figure 17 shows in which merchant categories card usage has increased and decreased the most between 2009 – 2012. The largest increase can be seen in movie theatres (7832) and courier services (4215). In both categories the number of customers that have made card purchases is not high. Two merchant categories in which card payment were fastest decreasing were video tape rentals (7841) and house appliances (5722),

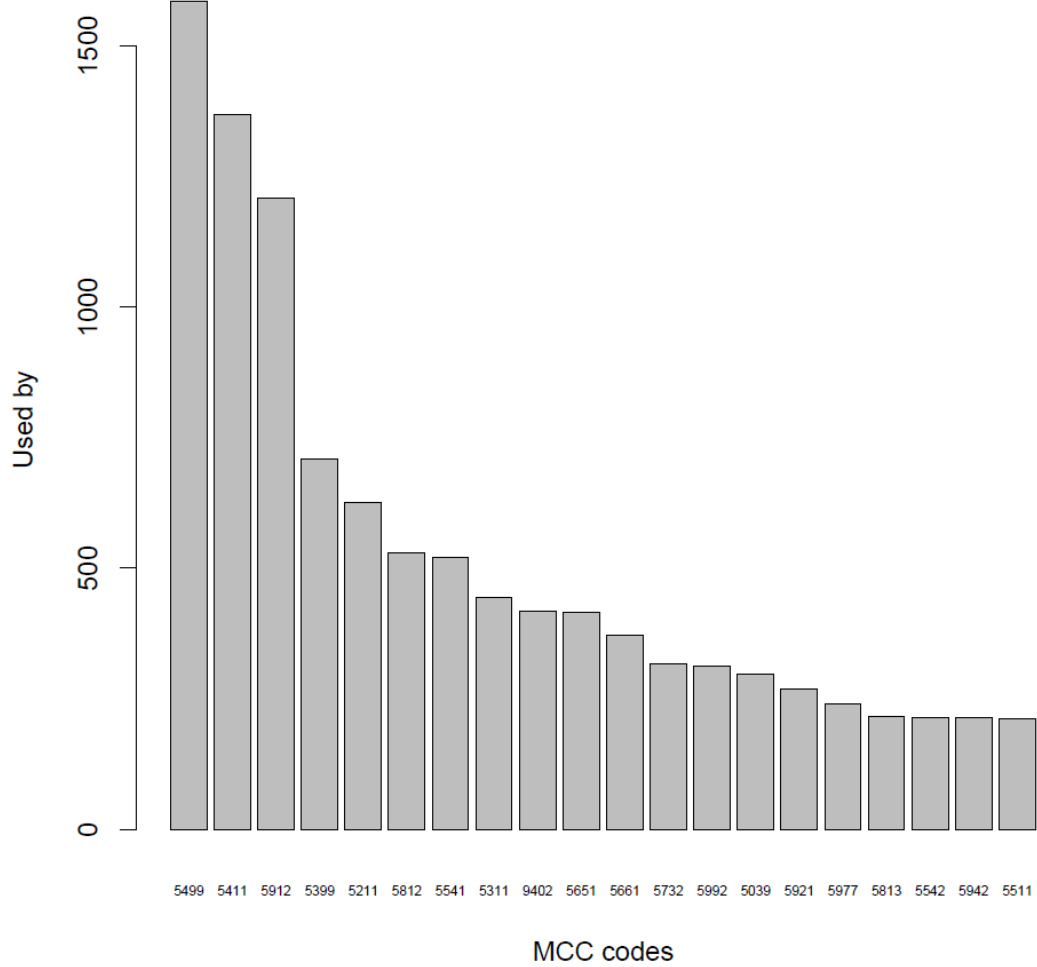## Card usage of people who did not use cards in 2009

Used by

MCC codes

Figure 16: Merchant categories in which card purchases were made by customers that did not use a card in 2009 but used cards in 2012

Most increased MCC usage, 2012

Most decreased MCC usage, 2012

Used by
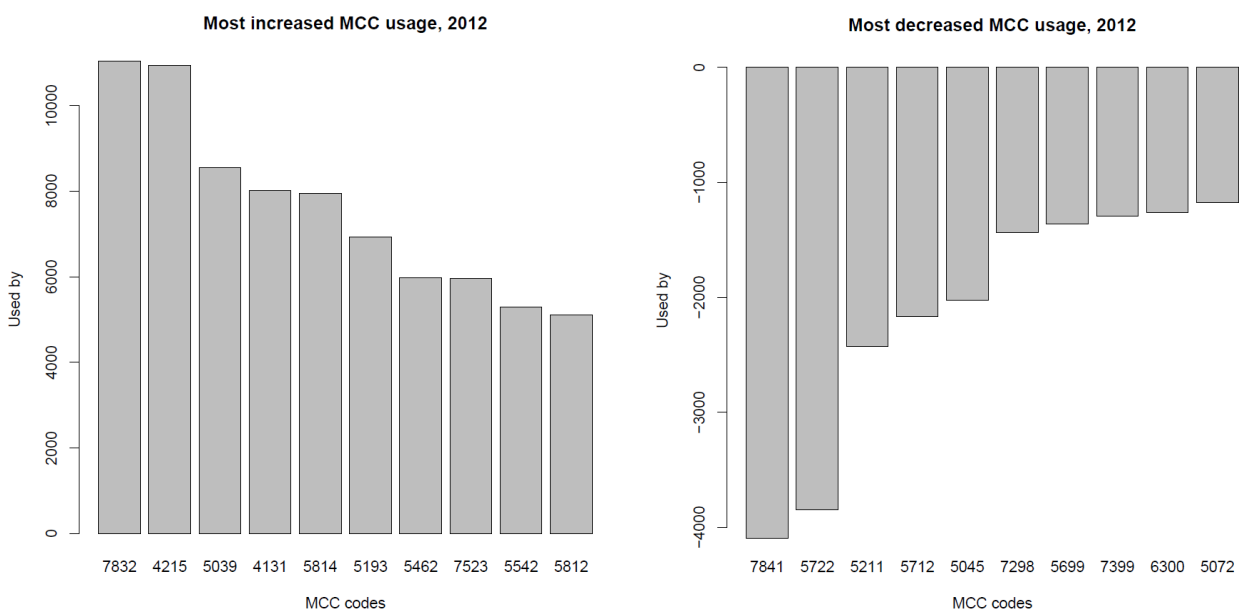
MCC codes

Used by

MCC codes

Figure 17: Most increased and most decreased MCCS 2009-2012

We also tried to get bit deeper in finding out in which businesses people use cards first by how did the MCC usage change between years 2009 and 2012 with group of people who had only used cards less than 10 different types of businesses in year 2009. From Figure 18 we can see that there has been quite significant increase in the use of cards in almost all kinds of businesses. The increase is made all the more significant by the fact that most likely not nearly all of these people are new card users. Many of them might be for example people who are only comfortable using card in their food shopping. Looking at this data and Figure 16, it would seem that people really do use card first almost exclusively in food stores, supermarkets and pharmacies, and later when they become more comfortable using the card, they will use it more in other types of stores and restaurants.
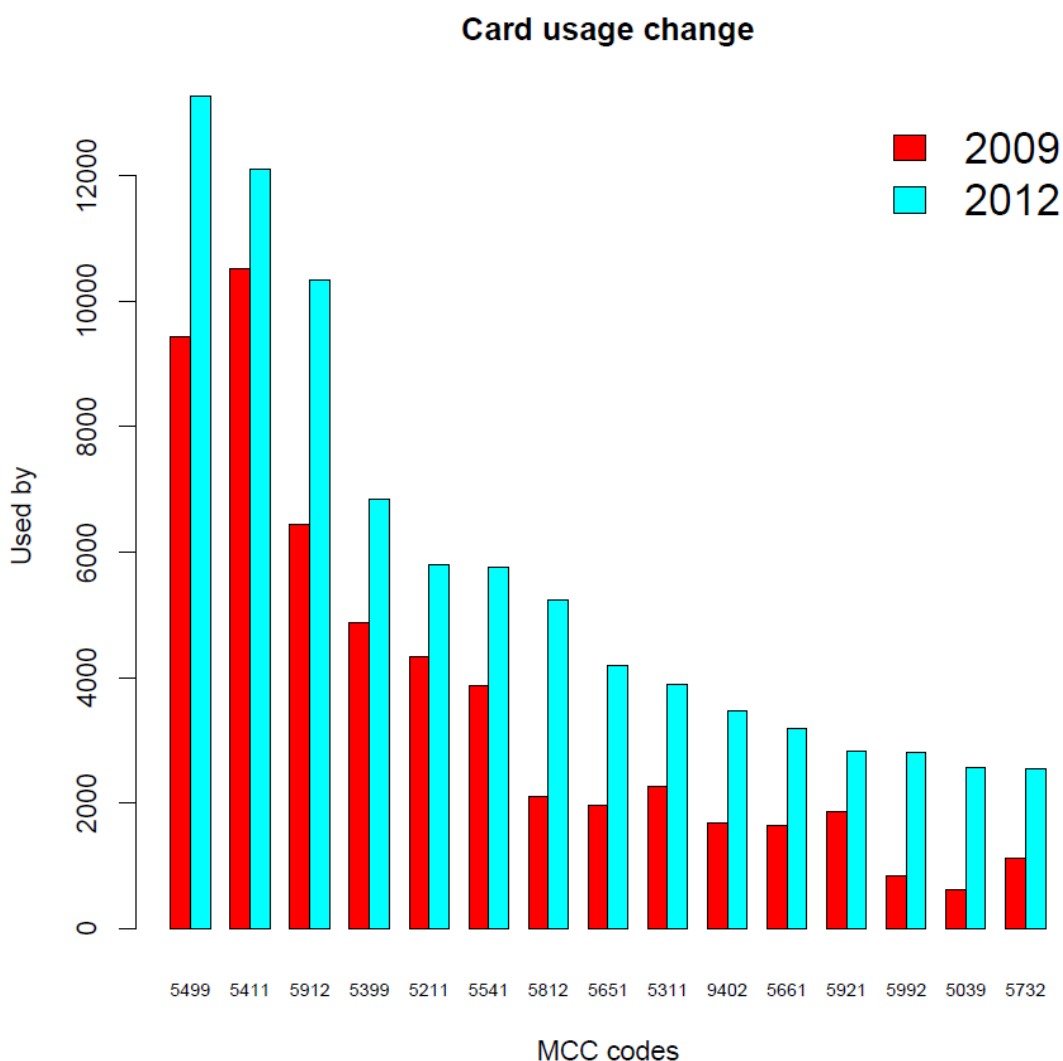

Figure 18: Card usage change in a group of people who used card in less than 10 MCCs in 2009

Discussion

This project work shows that between the study period 2007 – 2012 the SEB customers increased their bank card usage and started to use bank cards for smaller purchases. The findings of the current study are consistent with the general trend of increasing importance of bank card as a payment method in Estonia and other countries of the EU (ECB 2013b). During the same time period also cash withdrawals changed: cash was withdrawn less frequently. The average amount of cash withdrawn decreased until 2008, and increased after 2010. This may be partly explained by the global economic recession.

In this study age, language, ownership of a credit card and gender were found to correlate with cash usage. Customers born before year 1950 had higher proportion of cash use than young or middle-aged customers. The proportion of cash use was higher also within Russian speaking customers. On the other hand customers with a credit card had a lower cash use ratio as well as female customers. Income had only a weak correlation with cash use ratio. This finding supports the result of Bounie and Francois (2006). The customer segments based on the four abovementioned features revealed the customer segments in which cash was the preferred payment type: old Russian or Estonian speaking customers with no credit card. The highest cash use ratio was among old Russian speaking females. Bounie and Francois (2006) found that the selected payment method differs between genders. In this French study probability of using a check instead of cash or credit card is higher when women make payments. Interestingly, in the current study, the cash use ratio of old Russian speaking female customers was almost one third higher than that of corresponding old Estonian speaking female customers. Lowest cash use ratio was found among young and middle aged Estonian speaking female customers that had a credit card. Generally, the cash use ratio was lower among Estonian speaking customers than Russian speaking customers. This indicates that in Estonia mother tongue may be more important factor affecting the choice of payment method than the gender.

The results indicate the age is an important factor affecting cash and bank card usage. Generally older customers had higher cash use ratio than younger customers, especially old males and females with no credit card had high cash use ratio. The highest average monthly card purchases were done by customers of age 30–40 years in 2007. These customers were also the ones that decreased cash withdrawals most between 2007–2012. The customers that increased the most the average monthly withdrawals between 2007–2012 were approximately 20-year-old and over 70 year-old customers in 2007. Interestingly, the young customers also increased their average monthly card purchases four times more than other age classes during the same time period. Among the customers over 70 years in 2007 the cash use ratio was higher after 2009 compared

to earlier years. This shift may be explained with the change in the Estonian pension withdrawal system in 2009. Earlier pensions were also paid in post offices but after the change most pensions were paid on bank account. This may explain the increase in cash withdrawals among older customers. The main finding related to the relationship of age and changes in cash and card usage is that the decrease in cash usage ratio has been similar in all ages above 30 years. This is against the assumption that affecting the old people would be particularly difficult.

Generally, SEB customers decreased the cash use ratio during the studied period but the rate of change varied among customer segments. A drop in cash use ratio was found in many segments between September 2010 and January 2011. After the drop customer segments that contained middle-aged and old females had a permanently lower level of cash usage ratio. This may be explained by the fact that Estonia joined to Euro in January 2011, and female middle-aged and old female customers might have decreased their cash withdrawals because of introduction of a new currency.

To promote bank card usage over cash a bank may try to influence all customers, focus on increasing card use in large customer segments or to concentrate on those customers that use mainly cash. The median cash use ratio in customer segments was less than 0.5 in customer segments that cover over 63% of the SEB customers. This indicates that the bank card is already a widely accepted payment method among the customers. The largest customer segments were middle aged Estonian speaking males and females with a credit card. These two segments cover almost one third of all SEB customers. In the cash use ratios these two segment rank in the low end of the cash use ratio range. In this study the customers that used mainly cash were old Estonian speaking customers with no credit card, and middle-aged Russian speaking customers with no credit card. These customer groups contain approximately 15% of all customers. The highest cash use ratio was among Russian speaking old female customers that were approximately 2% of all SEB customers. Further studies could by be conducted to study how to increase card use among customers that use mainly cash. This study could be carried out by surveying the persons with high cash usage ratio. According to Machauer & Morgner (2001) customer segmentation based on demographic features of the customers is a standard procedure in banking. They argue that segmentation on customer traits, preferences and attitudes might provide more information about customer behaviour than demographic features.

Previous studies may provide insight on where and why people still use cash. In a French study approximately 12 000 self-reported transactions by transactions by individuals over an 8-day period between February 2005 and April 2005 were analysed. The study shows that cash was used for low values transactions (Bounie & Francois 2006). Similar results are also reported from Canada (Arango *et al.* 2011).

The reason for cash use for low value transactions may be supply driven, i.e. small merchants are not willing accept bank cards as payment method because of fees (Wakamori & Welte 2012). The results of the French study support this view: cash was used mainly to purchase goods or services such as "newspapers, tobacco and lotteries", "food and beverages", "restaurant and hotel" and "culture and leisure". Cash was used to purchase goods and services from public administration, or home service provides that do not generally accept bank cards. (Bounie & Francois 2006). In the 1990s the usage of debit cards rise rapidly in many European countries and the United States. Empirical results from Austria, Belgium, Canada, Finland, France, Germany, Italy, the Netherlands, Sweden, Switzerland, the United Kingdom, and the United States indicate that the adoption of POS terminals by merchants was the main reason for the observed increase in the debit card use (Amromin & Chakravorti, 2007). In addition to the possibility to pay with a bank card also personal preferences affect the decision to use card. One reason why people still use cash may be the anonymity provided with cash use. Anonymity may be preferred because of personal reasons, tax evasion or illegal transactions (Amromin & Chakravorti, 2007)

In this study we were not able to identify the effect of changes in the pricelists of the bank services to bank card usage. One possibility is that the changes did not have much of an impact: this may be because many changes in the pricelist were implemented at the same time, and some increased simultaneously both cash withdrawal and debit/credit card fees. However, the changes in pricelists may have contributed to the decreasing trend in cash usage ratio. In this case, however, any of the changes did not have such big effect that it could be noted in the time series describing the evolution of cash usage ratio. From the available data it could not be concluded how a bank could promote the use of bank cards instead of cash by changing fees. However, according to Amromin & Chakravorti (2007) the cost is a crucial factor affecting the adoption of cards.

The analysis of merchant category codes revealed that SEB customers used bank card most in supermarkets and other food stores. When customers started to use bank cards they used the cards first in these categories. Bounie & Francois (2006) also found that bank cards were preferably used in department stores and supermarkets whereas cash in small shops. In the current study bank cards were also widely used in pharmacies. This might be because pharmacies are seen as trustworthy and safe place to use a card. During the study period card usage increased in movie theatres and courier services. We believe this is due to the fact that those are the type of businesses that have only recently started accepting card payments. Two merchant categories in which card payment were fastest decreasing were video tape rentals and house appliances, and we believe that these two might be decreasing because this type of business is moving to the internet.

In this study customer segmentation was done based on the customer features that correlated with cash use ratio. This approach was chosen to obtain customer segments that are easy to characterise and are large enough to target marketing. Another approach would have been to apply statistical methods, for example cluster analysis, to categorizing data points into groups (Hastie *et al.* 2009). In cluster analysis the objective is minimize the ratio of "within the groups variance" to "between the groups variance" subject to a constraint that a certain amount of groups must be formed and that every data point belongs to one group. Hastie et al. (2009) presents several algorithms that are commonly used. The crucial part in any approach is determining the distance between two data points. The challenge in cluster analysis is the choice of a suitable distance function. Another challenge is that some of the commonly used clustering algorithms might yield an outcome that is not easy to interpret. For example, the segments may be characterized by distributions with respect to each feature, which makes the interpretation of the result difficult. Ideally, each cluster should contain people that are equal in every feature. This outcome can be achieved by grouping the people with respect to all combinations of the features. As a disadvantage, the number of clusters grows exponentially in the number of features used, and the number of customers in each cluster decreases. To overcome these difficulties, in the current study the segmentation was done using customer features that correlated with cash use ratio. The validity of the resulting segments was ensured by doing the segmentation to various random samples of the data set.

Pearson (2012) predicts possible trends technology and the potential developments in payments by 2025. Pearson argues that simplicity in payments overrides fashionable technological complexity, which increases the use of Near field communication (NFC) and biometric authorization. In NFC mobile device can be used like a digital wallet. MasterCard has been developing a paypass contactless system that allows consumers to pay with a simple tap on their mobile device. Pearson also states that social networks will be even more important than now in the near future. In these social networks new payment methods that are free of commission and fees could be developed. One example of recent development is the emerge of virtual currencies. If making payments in social networks is simple and trustworthy people are likely to start to use them. In addition, Pearson highlights the importance of anonymity, security and accessibility for the customers. Competition between many alterative electronic payment systems and uncertainty of security issues may even strengthen the role of cash in payments. In the current study customer segments that decreased the most their cash usage ratio between 2007–2012 were young Estonian speaking males and females. It is possible that young customers are more willing to adopt to new payment methods.

References

Anon. 2012. *World payments report 2011*. Capgemini, The Royal Bank of Scotland (RBS) and Efma, 60p.

Amromin, G. & Chakravorti, S. 2007. Debit card and cash usage: a cross-country analysis. *FRB of Chicago Working Paper* No. 2007-04. Federal Reserve Bank of Chicago.

Arango, C. Hyunh, K. & Sabetti, L. 2011. How do you pay? The role of incentive at the point-of-sale. *Bank of Canada Working Paper* 2011-23. Ottawa. Bank of Canada.

Bounie, D. & Francois, A. 2006. Cash, check or bank card? The effects of transaction characteristics on the use of payment instruments. *Telecom Paris Economics and Social Sciences Working Paper* No. ESS-06-05.

ECB 2013a. *Statistics pocket book, January 2013*. Franfurt am Main. European Central Bank, 54 p.

ECB 2013b. *Transactions per type of payment instrument.* European Central Bank. http://sdw.ecb.europa.eu. Accessed 13.2.2013

Efron, B. 1979. Bootstrap methods: another look at the jackknife. *The Annals of Statistics* 7 (1), 1-26.

Hastie, T., Tibshirani, R., & Friedman, J. 2009. *The Elements of Statistical Learning, Data Mining, Inference, and Prediction*, 2nd edition. New York. Springer. 745p.

Machauer, A. & Morgner, S. 2001. Segmentation of bank customers by expected benefits and attitudes. *International Journal of Bank Marketing* 19, 6-18.

Malhotra, N., Birks, D., & Wills, P. 2012. *Marketing research, an applied approach*. Lombarda. Pearson Education Limited. 835 p.

Pearson, I. 2012. Looking to the future. In: *Pay your way 2025: future payments*. Payments Council. 31p. http://www.payyourway.org.uk/the-future-of-payments. Accessed 13.2.2013.

Salo, A. 2012. Seminar for solving client problems in project teams, *INFORMS Transactions on Education* 13 (1), 17-27.

Schneider, F. 2012. *The shadow economy in Europe, 2011. Using electronic payment systems to combat the shadow economy*. A.T. Kearney and Visa.

Wakamori, N., & Welte, A. 2012. Why do shoppers use cash? Evidence from shopping diary data. *Bank of Canada Working Paper* 2012-24. Ottawa. Bank of Canada.

Appendix

Self-assessment

What was done?

First thing we did was agree on how we would do this project. We did a preliminary plan and agreed to meet weekly, and discuss what has been done and what still needed doing. The things we did are pretty much the same we presented in our project plan. First we familiarized ourselves with the data we were given and the subject. After that we proceeded to try and find good customer segments and find out what could be learned from MCCs. After we had customer segments we were satisfied with, we started comparing them to each other and studying the changes within the segments.

How was done?

Our division of labor was pretty flexible. We adjusted everyone's work load according to personal strengths and interest in our weekly meetings. In the beginning we didn't have any clear cut roles for everyone, but when the project moved onwards everyone sort of fell in a role. Dividing the work into smaller parts worked very well for us because everyone was able to work according to their own schedule.

How was the workload?

The actual workload for this course is quite difficult to estimate. We didn't actually count the hours spent on the project. Since almost everything was so new and most of the time we weren't too sure what to do, we spent a lot of time just thinking and figuring things out. In a sense it would have been nice to have been able to spend a little more time with this project and get a bit deeper. We also might have benefitted from spending more time together with the customer, throwing ideas and figuring out what else might be hidden within the data.

If one were to form a "quesstimate" about the workload of the course, one could assume that it took about 10 hours weekly over the length of the course, which would translate to about 6 credits. Add to that the meetings and presentations involving the whole course it might come to about 7 credits. We are also not quite sure if the job of the project manager really involved extra work worth 2 credits, since it involved almost exclusively writing e-mail.

Where did we succeed?

We all feel that our greatest success might be how well our group turned out. Everyone was committed and we had a lot of fun working together. The meeting in Janoinen Lohi was good for team spirit if not for getting work done. Communication within the group worked well. Everyone got to speak their minds in our meetings and outside and information reached everyone superbly. We found meaningful and interesting tasks for everyone and the workload was also shared quite evenly.

We also got quite interesting and good results and we hope that our customer is also satisfied with them. There hasn't been too much academic research in this field with dataset as large as ours.

We also managed to stay on timetable well enough. Few things were delayed a bit but nothing too major. We managed to do almost everything we had wanted before the deadline. Last week has been a bit hectic, but that tends to be the case with schoolwork deadlines.

Where did we succeed less?

Communication with our customer could have worked better. It would have been nice to have a clearer picture of what is most interesting and useful for bank, but at least this way we got a lot of space to do our own things. We got useful comments from the customer in the late phase of project. Unfortunately, at that point it was not possible to do any really big changes. It would also have been nice if we had had more time to explore more carefully the differences between areas and the changes in the ATM-network. As it was, we felt we didn't have quite enough time to focus on them enough, so we decided to focus on what we could do well.

What could have been done better?

In addition to communicating with the customer more and better in the early phase of project, we could have had more clear areas of responsibility for the group members. Although we did find good division of labor this time, it took a bit more time than it should have and it might have led to some problems if everyone in the group hadn't been so motivated. Of course there is only so much that can be decided beforehand, but clear areas of responsibility and flexible division of tasks might have worked better than our current system.