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BUSINESS SCHOOL
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The Use of Card Payment Instruments

A Panel Data Approach

Master's thesis within Business Administration

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Jönköping May 2015

Master's Thesis in Business Adminstration

Title:	The Use of Card Payment Instruments: A Panel Data Approach
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Date:	2015-05-11
Subject terms:	Payment Instruments, Panel data, Country, Cash, Credit, Debit

Abstract

The rapid growth in the use of non-cash payment instruments, specifically debit and credit cards, has become a prominent feature of modern economies. With an interest in the explanation of this phenomenon and differences in use across countries, we apply a model of payment instrument use to model the relationship between the dependent variables (total volume of card transactions, debit card transactions, and credit card transactions) and the five independent variables based on income, infrastructure, substitution, and institutional influences. We estimate the model and perform a regression analysis on a panel of 22 countries over the period 2009 to 2013. We find that crime, bank concentration, and income have positive relationship with the use of card instruments, while cash is found to be both a complement and substitute to card payments. The variable based on infrascture yields insignificant results. With the results, our purpose is to give greater insight into to the use of the card payments and the explanations for differences in use across countries.

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1   Introduction

1.1   Background

Payment systems represent a critical component of a country's financial structure, and act as facilitators of economic activity and growth. A payment system also acts as the economic support mechanism that enables the transfer of funds for individuals, firms, and institutions; this is accomplished predominantly through the use of payment instruments. The efficiency and choice of payment instruments, whether cash or non-cash based, are important for the support of the economy.

The most prevalent payment instruments in use are cash, comprised of banknotes and coins in circulation, and non-cash, specifically debit and credit cards. Statistics show that the use of non-cash instruments is rising, amounting to 336 billion transactions globally in 2013 (*World payments report*, 2014). As the use of non-cash payment instruments grows, there are continued discussions on the features of payment instruments and the effects of usage for individuals and society. Research is centered on the overall costs of payment systems and differences in payment instrument use.

Payment systems cost an estimated 0.96% to 1% of a country's GDP, with cash comprising almost half of the total costs (Kostova et al, 2012). As cash is an expensive payment instrument, the switch to non-cash instruments leads to greater cost efficiency. Humphrey et al. (2006) finds 12 European countries saved $32 billion in bank operation costs in 1999 due to a greater volume of card transactions. The increase in the number of non-cash transactions has been documented in research, and has been evaluated by several different studies. Humphrey et al. (1996) finds that the adoption of non-cash payment instruments is attributed greatly to the availability of payment terminals and the institutional effects in 14 developed countries. Ahmed et al. (2008) finds through U.S. survey data that convenience, acceptance of the instrument, and fees directly affect the use of non-cash instruments over cash use.

Although the trend of the adoption of non-cash payment instruments is complex, the drift from cash to non-cash payment methods is evident. As this is an ongoing phenomenon that impacts economic activity, there is a need for continued research.

1.2   Purpose

The purpose of the thesis is to identify and analyze relationships between critical factors and the use of card payments across a panel of 22[1] countries over the period 2009 to 2013. The factors represent different drivers of card payment instrument use, specifically income, infrastructure, substitution, and institutional influences. We support our analysis through the examination of trends in payment instrument use and the observable effects of government regulation and the financial market structure on usage. Additionally, we investigate the externalities of payment instrument use and the effects for individuals and society.

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[1] The 22 countries include: Australia, Belgium, Brazil, Canada, China, France, Germany, India, Italy, Japan, South Korea, Mexico, Netherlands, Russia, Saudi Arabia, Singapore, South Africa, Sweden, Switzerland, Turkey, the United Kingdom, and the United States.

1.3   Research Questions

The initial research question is how do factors based on income, infrastructure, substitution, and institutional influences impact card payment use across the panel of countries? Additionally, are there identifiable trends in payment instrument use and what differences exist between countries? Furthermore, what are the observed externalities of payment instruments and the resulting effects on society?

1.4   Results

The results from the regression analysis show interesting relationships between the factors and the use of non-cash payment instruments in the period 2009 to 2013. The independent variable of crime demonstrates positive relationships with debit and total card transactions, but a negative relationship with credit card transactions. Therefore, as the crime rate increases we expect greater use of debit cards and less use of credit cards. We attribute this result to security reasons, as debit cards have more security features than credit cards. Additionally, the concentration ratio exhibits a positive relationship with total card transactions. This result supports the view that greater bank concentration leads to a more centralized payment system that leads to a greater volume of non-cash payment transactions. We conclude that cash is a complement to the total volume of card transactions, which we attribute to the increased use of cash and card transactions in our sample in the time period. There was no distinguishable relationship between the number of POS terminals and the non-cash transactions, as the results were not statistically significant. We attribute this inconclusive result to the fact that several countries in our sample have mature payment system infrastructures, and are not experiencing the same type of growth as countries that are just developing the infrastructure. Income demonstrates a very significant positive relationship with the volume of card transactions, and leads us to the conclusion that growth in income is strongly associated with greater use of card payments as the predominant form of payment methods.

1.5   Limitations

Two important limitations of the research are the availability of data and time constraints. Though we found the majority of the data from the Bank for International Settlements (BIS) Committee on Payment and Market Infrastructures for our sample of 22 countries, data on additional countries was fragmented or not available. The statistics on the externalities of card payments (taxes, credit card fraud, and black market) are general and based on previous studies, as there is no official public source for the statistics. The time constraint was a major factor in the development of the thesis, but we worked to the best of our ability as an army of two researchers.

2   Literature Review

The literature on payment systems is continuously growing, but it is also spread across many different areas of interest. For that reason, we analyze the literature from the following perspectives: institutions and payment systems, costs of payment systems, substitution of payment systems, and government regulation.

2.1   Institutions and Payment Systems

In the assessment of defining a payment network, we follow that payment instruments are provided by payment networks, with one or more networks that offers similar instruments represents a retail payment system (Bakos and Nault, 1997).

An important aspect of payment networks is the use of transaction costs, which are costs of exchange between two or more parties and play a role in the design of the network. Guibourg (2001) finds that countries with a lower number of separate networks display greater growth in the volume of transactions. It was also shown that payment networks structure themselves to increase demand for instruments while overcoming potential network effects.

Competition is also an important aspect of payment networks, as there is a large amount of literature that supports its effectiveness. Chakravorti and Roson (2004) demonstrate that competition within a payment system increases transaction volume and consumer and merchant welfare. Evans and Schmalensee (2005) theorize that, while it is difficult to document, competition between payment system operators for a greater customer base causes a greater proportion of revenue from fees to be passed on to the customers. This generates greater benefits for society as a whole.

In a comparison of concentration and competition of the financial sector, Claessens and Laeven (2004) do not find a negative relationship between competitiveness and bank concentration, but they do find greater foreign bank entry in markets where there are fewer entry and activity restrictions to be more competitive.

2.2   Costs of Payment Systems

Recently, there has been great improvement in the estimation of the private and social costs of payment instruments. Private costs refer to all costs incurred by stakeholders in the payment chain; while social costs refer to the costs society bears that reflect resource and production use. Kostova et al. (2012) estimates that the social costs of payment systems amounts to (on average) 1% of GDP per year in the 27 European Union member states. In terms of private costs of the stakeholders, banks and similar infrastructure incur 50% of all costs, while retailers incur 46% of the costs. Due to the relatively high usage of cash, the costs associated with cash amount to almost half of the total costs. The high costs of cash are a result of the indirect costs, specifically the handling and transportation of cash.

As the costs of different payment instruments become more known, there is a greater push for countries and banks to advocate for less costly instruments and to become more cost

efficient. Humphrey et al. (2006) finds that a country may save more than 1% of its GDP by switching from paper based to electronic payments and through a greater emphasis on ATM usage over bank branches for money distribution. In their 12 European country sample, Humphrey et al. (2006) also finds that bank-operating costs were $32 billion lower in 1999 due to greater card usage over cash.

2.3   Substitution of Payment Instruments

Although the trend between the adoptions of noncash payment methods is complex, the drift from cash to noncash payment methods is evident. The literature focuses on how various payment instruments substitute for another, and what induces a change between instruments. Humphrey et al. (1996) analyze the adoption of noncash payment instruments in 14 developed countries in a seven-year period in the early 1990s. The authors find a negative relationship between per capita cash amounts and the number of non-cash transactions per capita in only eight of the 14 countries. Amromin and Chakravorti (2009) further investigate the relationship between debit cards and cash through the analysis of transactional demand for cash and debit card usage in 13 countries. The authors conclude that increased debit card usage reduces the demand for lower denominations of currency, as lower denominations are most useful at POS transactions and higher denominations of currency are more useful for savings and amassing value.

While the previous papers demonstrate substitutability between cash and non-cash payment instruments, they provide little evidence on the substitutability between two non-cash payment instruments. The two most prevalent non-cash instruments are debit cards and credit cards, and we use both in our cross-country analysis. Zinman (2009) finds that there is strong substitution between the two methods in the United States over the period 1995 – 2004, with the most prevalent instrument being debit cards. Zinman attributes 38% of debit card usage to consumers' fears that credits cards will raise levels of personal debt and the fact that many consumers face credit limits.

In an analysis of what drives consumer decisions to use different payment instruments, Ahmed et al. (2008) analyzes a 2004 survey of debit card usage in Michigan, U.S. The authors conclude that the factors that impact instrument usage are: time preferences at POS, convenience, fees associated with instrument, restraint from overspending, the ability to track purchases, and retailers' acceptance of payment instrument.

2.4   Government Regulation

Current literature indicates that government institutions play an important role in the development of payment systems as the systems are often offered by affiliates of a country's financial system. In an overall analysis of financial regulation, Goodhart (2007) analyzes the history of financial regulation in a panel of countries, and finds that there is greater financial regulation in the response to crises in the financial system. In payment systems, the increased pressure of government regulation has been documented in response to retailer's complaints of payment system pricing. Guerin-Calvert and Ordover (2005) analyzes merchant complaints on interchange fees, and finds that the complaints have led to a govern-

ment discussion of high fees. An interchange fee is a particular wholesale fee that is endogenous to the network, and is positive when it is paid by acquirers to issuers. An issue arises in defining when exactly an interchange fee is too high, but it nonetheless leads to increased government interaction in the regulation of payment instruments.

A growing area of research has shown that government regulation can have a negative impact on payment system growth. Deungoue (2008) finds convergence of payment instrument adoption in European countries only following the standardization of regulations of payment systems. Mann (2002) adds to the literature through the study of the use of credit and debit cards in the United States and Japan. He finds that the differences in use between the countries are due to government regulations, and argues that the removal of regulations leads to greater development of the retail payment system. Deungoue (2008) and Mann (2002) both assert that government restrictions and regulations play a greater role than culture in payment system development.

3 Theoretical Framework

3.1 Trends in Payment Usage

We will now present the trend in the use of both cash and non-cash payment instruments from 2009 to 2013. The purpose is to determine how the current state of use and the differences explained by different measures. We find by our indicators that there is increases in the use of cash and card payments in our sample.

3.1.1 Cash

Throughout history, cash in its various forms has been the predominant payment instrument. Recently, there have been ongoing discussions on the relevance of cash and the possibility of replacement by other non-cash payment instruments (see Bergsten, 1967 and Costa and De Grauwe, 2001). Though its relevance may be debated, previous studies and current data demonstrate its importance to the economy.

The total volume and value of cash transactions is difficult to determine with complete certainty because cash does not leave an electronic 'paper trail' as credit and debit cards do. Hence, we calculate two alternative indicators to measure the use of cash across the Euro area and a mix of 17 developing and developed countries. The first estimate is the value of cash holdings per person, and we compare it to the value of cash in circulation as a percentage of GDP. We present both alternatives in Table 1 and Table 2 respectively.

Table 1 shows the value of the cash holdings per person as a first indicator to measure the use of cash, represented in the U.S. dollar, in the respective country.

Table 1- Value of Cash Holdings Per Person (in USD)

2009		2012	
Japan	$6194.28	Japan	$7840.99
Switzerland	$5172.22	Switzerland	$7584.40
Euro area	$3253.50	Singapore	$3970.98
Singapore	$2786.61	Euro area	$3392.80
United States	$2820.99	United States	$2756.81
Australia	$1692.20	Australia	$2452.06
Sweden	$1408.13	Canada	$1793.99
Canada	$1436.00	Sweden	$1370.21
United Kingdom	$1268.41	Russia	$1444.55
Russia	$892.71	United Kingdom	$1384.99
Saudi Arabia	$884.15	Saudi Arabia	$1216.11
Korea	$465.24	Korea	$783.94
Mexico	$371.12	Mexico	$479.36
Turkey	$314.02	Turkey	$402.52
Brazil	$274.20	Brazil	$385.49
South Africa	$145.08	South Africa	$188.98
India	$135.82	India	$174.17

Note: Since the Euro is used as a common currency in Belgium, France, Germany,
Italy, and the Netherlands, these countries are not represented in the table separately.

We estimate the value of cash holdings per person based on the total value of the banknotes and coin in circulation outside of banks divided by the population in 2009 and in 2012. According to this indicator, the Euro area, Switzerland and Japan have the greatest amount of cash holdings per person within the group in both years. In the Euro area, the United States, Singapore, Switzerland and Japan, over $2,000 in cash is held by each person. Conversely, in countries like India, South Africa, Brazil, Turkey, Mexico and South Korea, the value of cash holdings per person is less than $500.

The difference between the highest and lowest values of cash holdings per person in the sample is very large. The countries with the greatest amount of cash holdings per person have cash amounts that are four times greater than those with the lowest cash holdings per person. The differences are attributed to the fact that in countries with higher incomes or GDP, the value of cash holdings per person increases inherently. Conversely, in countries with lower incomes, there is a greater likelihood of inflation and higher interest rates, leading to decreases in the cash holdings (in South Africa, India, etc.). As our sample is comprised of countries with diversified economies, this result is as expected.

The second indicator represents the value of cash in circulation as a percentage of GDP is presented in the following Table 2.

Table 2 – Value of Cash in Circulation as Percentage of GDP

2009		2012	
Japan	18.15%	Japan	19.20%
India	13.09%	Russia	12.34%
Russia	11.93%	India	11.67%
Switzerland	9.50%	Switzerland	10.93%
Euro area	9.28%	Euro area	9.87%
Singapore	8.34%	Singapore	8.12%
United States	6.44%	United States	7.23%
South Africa	6.19%	Saudi Arabia	5.55%
Saudi Arabia	6.17%	Mexico	5.45%
Mexico	5.29%	South Africa	5.03%
Australia	4.35%	Turkey	4.35%
Turkey	4.12%	Brazil	4.26%
Brazil	4.07%	Australia	4.15%
Canada	3.77%	Korea	3.94%
United Kingdom	3.58%	Canada	3.75%
Sweden	3.32%	United Kingdom	3.65%
Korea	3.23%	Sweden	2.60%

Note: Since Euro is used as a common currency in Belgium, France, Germany,
Italy, Netherlands, these countries are not represented in the table separately.

The value of cash in circulation as a percentage of GDP is a convenient measure of money usage. We calculate the indicator based on the value of the banknotes and coins in circulation outside of banks divided by the GDP. It has a simple interpretation and normalization by the GDP allows us to conduct cross-country comparisons without concerns of exchange rate movements. Based on this indicator Japan, India, and Russia have an significant amount of cash in circulation based on their respective GDPs. On the contrary, in Canada, the United Kingdom, Sweden and South Korea there is less value of cash in circulation as a percentage of GDP. According to the results in Table 2, the low percentage of the value of cash in circulation as percentage of GDP could be the signal for the increase in alternative payment instrument usage, such as the use of the card payments. Moreover, we observe that the ranking of countries by the second indicator presented in Table 2 is slightly different from the first indicator in Table 1.

One potential reason for the difference between the results of the two cash usage indicators is changes in country wealth within our sample. The ranking of both indicators can differ since the first indicator is calculated based on the U.S. dollar (USD) while the second indicator is presented as a percentage of GDP. The first indicator is presented in a common denomination for cross-country comparison purposes, but a possible issue is the exchange rate and purchasing power for lower income countries. In countries like India and Turkey, that exhibit lower values of cash holdings per person in USD, could have greater purchasing power in their respective home currencies. Therefore, the value of cash in circulation with purchasing power in the respective home currency can increase among the country group.

The comparison of the two years for both indicators shows that there is a slight increase in the usage of cash in the sample. The results are not completely consistent with previous surveys that indicate that the number of cash payments is declining in relation to the increase usage of the card payments. There are several explanations for this slight increase in cash volume.

First, cash still plays a dominant role in lower denomination transactions. The Reserve Bank of Australia study in 2010 finds that cash is the most frequently used payment method by consumers, accounting for 62% of payments . Cash is also the dominant payment instrument for low value transactions of $25 Australian Dollars (AUD) and under, and for 47% of transactions between $25 AUD and $50 AUD (Bagnall and Flood, 2011). In a U.S. Federal Reserve study, participants who stated a cash preference have a predicted probability of a cash payment of 80% overall in 2014 and if the amount is the transaction is less than $20 USD, the probability increases to 91% (O'Brien, 2014).

Secondly, cash is the primary payment instrument for lower-income individuals. Hence, income plays a significant role in the amount of cash in circulation. A U.S. Federal Reserve study found that 55% of consumers with household income less than $25,000 USD per year prefer cash over non cash payment instruments, while those households making more than $200,000 USD per year exhibit a very strong preference for credit cards (O'Brien, 2014). As our sample includes both low and high income countries, we expect variation in the use of cash.

Finally, it is important to consider the macroeconomic factors in the period 2009 to 2013, such as the euro crisis in the last quarter of 2009 and the subprime mortgage crisis in the United States in 2008. For the crisis period, we need take into consideration the fact that households tend to increase cash holdings to avoid higher costs of the bank transactions and higher interest rate on loans.

The ranking of the cash use can also differ in relation to the public demand across countries and an increasing trend for the usage of the alternative payment systems. In the sample in all countries we observe an increase in the usage of the card transaction (see 3.2. card payments). With the consideration of the all mentioned factors above, the substitution between cash and card payments is high for the countries in the sample (see section 5: Results and Discussion).

3.1.2   Card Payments

For the purpose of our research, we focus on two separate card payments: debit cards and credit cards. According to the Bank for International Settlements (BIS), a debit card is defined as a "card that enables the holder to have their purchases directly charged to available funds on his or her account at a deposit-taking institution". Conversely, a credit card is defined as "a card indicating that the holder has been granted a line of credit". With a credit card, the holder can make purchases or withdraw cash up to a prearranged ceiling. The balance of the credit card at the statement period can be paid in full or in separate installments (*A Glossary of Terms*, 2003). The differences in the foundations of each payment instrument have implications for its use in the countries in our sample.

Across the 22 countries in the sample, there were 185 billion card transactions in 2013. The United States is the predominant leader in card transactions, with nearly 84 billion in 2013. Of the card payments, debit cards are used more frequently and are more widespread across countries than credit cards. In 2013, there were 106 billion debit card transactions compared to 1.157 billion credit card transactions in our sample. Hirschman (1982) conducts market research of consumer behavior towards payment systems, and determines that a major reason that credit cards are not used as often is that they inhibit the ability to control spending. Credit cards also have lower total transaction volume because not as many merchants process credit cards due to high costs (Ahmed et al., 2008).
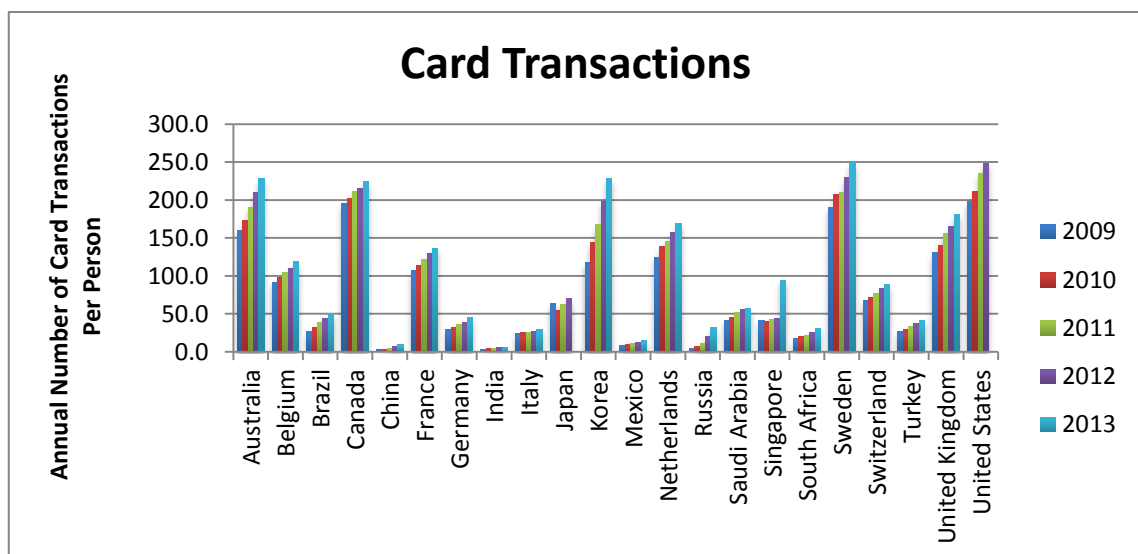
Figure 1 – Annual Number of Card Transactions Per Person

Figure 1 shows the changes in the annual number of card transactions per person in the five year period of 2009 to 2013. As shown by the figure, there is an evident increase in the use of cards as a payment method across countries. In terms of number of card transactions per inhabitant, Sweden is the leader in the group with 249.8 transactions per person per year. Sweden demonstrates strong card usage because of a strong societal push towards cards (specifically debit cards) over cash as the predominant payment instrument. A previ-

ous study of payment systems in Sweden concludes that 89% of transactions in Sweden are made with non-cash payment instruments (Bergman et al., 2007). In Sweden, there are also an average 2.29 cards with a payment function per person, compared to the average number of 2.17 cards per person in our sample. Sweden's high number of card transactions per person juxtaposes that of India, where there were only 5.9 card payments per person in 2013. This is related to the low number of payment cards, where the average is 0.34 per person in India in 2013. The low number of transactions is due to debit cards being used predominantly to withdraw money from ATMs instead of being used to make purchases (Bolt et al., 2008).

Table 3 – Average Transaction Value of Card Payments in 2013 (in USD)

2013			
Australia	$81.70	Netherlands	$46.57
Belgium	$71.26	Russia	$55.77
Brazil	$39.20	Saudi Arabia	$131.29
Canada	$70.26	Singapore	$115.02
China	$396.25	South Africa	$44.00
France	$64.93	Sweden	$57.61
Germany	$81.03	Switzerland	$140.79
India	$52.56	Turkey	$66.88
Italy	$94.92	United Kingdom	$75.51
Korea	$47.51	United States	$56.68
Mexico	$51.23		

Source: Bank for International Settlements (BIS) Japan was excluded due to a lack of data for 2013

The average transaction value based on card payments in 2013 varies greatly across the countries in our sample. As shown in Table 3, the average transaction value for the sample is $88.22, while China had the highest average transaction value at $396.25. Conversely, Brazil had the lowest average value at $39.20. The data shows that in most countries, cards are used for larger value purchases, while cash is used more frequently for low value purchases. This result is considered more socially optimum due to cost incentives and payment habits. Bergman et al. (2007) found that for payments in Sweden, debit and credit cards are socially less costly than cash payments for purchase values above eight euros and 18 euros respectively. Though it seems that the countries in our sample are in line with previous findings that it is better to use cards for larger purchases, there is still a very extensive use of cash in the countries.

An important explanation for the increasing trend of card payments is the number of point of sale (POS) terminals. The number of POS terminals represents the infrastructure that is in place for individuals to complete a payment using a card instrument. In the sample, there is an average increase of 24% in the total number of POS terminals from 2009 to 2013. The largest growth in the number of POS terminals was in Russia, where the number number of terminals rose from 407,000 to 965,500 in the five year period. The average number of POS terminals was 1,717,000 in the sample in 2013.

While there was great growth in the number of POS terminals in our sample over the five year period, Sweden and France actually demonstrate a trend of reducing the number of terminals. The number of POS terminals decreased by 1% and 3% in Sweden and France respectively. Similiarly, in Belgium there was only a 0.1% increase in the number of terminals. A possible cause is that Sweden, France, and Belgium have mature infrastructures in place for POS terminals, and are not experiencing the same rapid growth as countries that are developing the infrastructure, such as India.

The number of POS terminals is important to the growth in credit card usage, as Guariglia and Loke (2004) provide evidence that the transaction value and volume in 14 developed countries is dependent on the extent of the instrument infrastructure. In an analysis of debit card adoption in Norway and the Netherlands, Bolt et al. (2008) concludes that the most important factor in payment method adoption is POS availability. The study finds a 10% rise in the availability of POS terminals leads to a 5.3% increase in debit card usage. A strong possible explanation in the rise of card usage is the increase in the number of POS terminals.

3.2   Regulations and the Financial Sector

We will now present how government regulations and the structure of the financial sector influences the use of cash and non-cash payment instruments. Our conclusion is that both indirectly impact the use of different payment instruments.

3.2.1   Government Regulations

An important obligation of central banks is to guarantee that payment systems operate efficiently and safely. For that reason, it is also critical that central banks pay increasing attention to credit and debit card markets since all around the world. This is because the retail payment systems are changing from cash based payment instruments to non-cash payment instruments, while debit and credit card transactions are becoming an increasingly important instrument of the payment systems.

As our purpose is to investigate the factors that influence payment instrument use, it is also important to examine government involvement and regulations for cross-country differences. In the literature, there are numerous discussions with regard to government intervention and regulation in retail payment systems. The research focuses on whether the governments should regulate payment networks once they are established, and such regulations specifically target debit and credit cards.

Balto (1995, 2000) and Salop (1990) support the government argument and argue that the increasing returns of payment networks leads to monopolistic power that is abused by banks. Specifically, the interchange process is of great importance for regulators because of frequent abuses. An interchange fee is a transaction fee that is paid by one participating financial institution to another in a payment network (*A Glossary of Terms*, 2003). An example of an interchange fee is from an acquirer to a card issuer in respect of a card payment by the cardholder to the merchant (card acceptor). As an opposite point of view, the study of Baxter (1983) defends the interchange mechanism as being an essential requirement of new payment technologies that bring greater social welfare benefits. As Chakravorti and Shah

(2001) conclude in their review of models on interchange, the precise effect of interchange on social welfare is not easy to determine and very sensitive to model specifications. In conclusion, regulators have not come to clear point of view: US regulators have faltered (see Chang and Evans, 2000, for a regulatory history of credit cards), the European Commission has recently sanctioned the interchange for cross-border debit card transactions (European Commission, 2000), and the Australian regulator is preparing a foundation for lowering interchange on credit cards and lifting it on debit cards (Reserve Bank of Australia, et al., 2000).

As shown in the previous studies, governmental intervention differs across countries. Apart from the interchange fee, there are three main regulations that have significant influence on the volume of the credit and debit card transactions: (1) the no surcharge rule, (2) the honour-all-cards rule, and (3) no steering rule.

The no surcharge fee prohibits merchants from establishing prices that are different, depending on the mode of payment (OECD et al., 2006). Although the no surcharge rule was created to restrain competition for credit card network services, this rule affects the transaction volume of the card payments and clearly encourages the use of credit cards. In countries such as Italy, France and Sweden surcharging is generally prohibited. On the other hand, Australia, Switzerland, Netherlands, Canada and Belgium have eliminated the no-surcharge rules. In Finland, surcharging is allowed but the amounts of surcharges are required to be reasonable and not to exceed the payee's actual costs (Bank of Finland, 2011). In 1989 in the United Kingdom the ban on surcharging was lifted, but new regulations were imposed in 2011 and 2012. The new regulations ban merchants from charging consumers more than their direct costs associated with accepting a given means of payment (Consumer Rights Regulations, 2012).

The honour-all-cards rule states that if a card brand is accepted, all cards issued under that brand must be accepted (OECD et al., 2006). This rule supports that an individual with their branded card can use that card in any store that displays acceptance of that brand of card. This leads to credit cards becoming more desirable to consumers and ensures consumer use of cards. The honour-all-cards rule[1] was challenged in the United States by merchants who were opposed to linking the acceptance of the major four-party credit cards to their debit cards (OECD et al., 2006).[2] In contrast, the European Commission has held that the honour-all-cards rule is not restrictive of competition (European Commission, 2013). Application of the honour-all-cards rule differs across countries and it brings many advantages to the customers. Therefore, its influence on the card transaction volume is important.

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[2] Four-party card scheme: a card scheme where the stakeholders involved are: the issuer, the acquirer, the cardholder; and the card acceptor. By contrast, in a three-party card scheme, the issuer and the acquirer are always the same entity (*A Glossary of Terms*, 2009).

Many card payment systems include no steering rules within their merchant conditions. These rules prevent merchants from informing consumers that the merchant has a preference for one form of card over another (OECD et al., 2006). This rule is important given that many consumers hold numerous cards under different brands. Within this rule, merchants are able to select the consumer's card which they have the greatest preference for, and they can then select the one with the lowest fees attached. Steering can be unpleasant for many merchants when it is not a common practice, and customers may be annoyed by requests to use one card over another. On the other hand, for a consumer who holds a single card with multiple identifiers from all the systems, a merchant's choice of payment instrument would likely be less offensive to the consumer. In the European Union and the United States, the application of any rule preventing or limiting merchants from steering customers to more efficient payments instruments refers to no steering rules is prohibited. Additionally, Australia has also eliminated the no steering rules. Although, this regulation supports the merchants, it affects the card users and card transactions in a negative way.

Overall, different countries have different regulations in place that affect the volume and usage of non-cash payment instruments. As there is no standardized regulatory body across countries, the differences in regulations can cause issues when using different payment instruments in different countries.

3.2.2 Financial Sector

Commercial banks are important stakeholders in the payment network and they directly influence the use of payment instruments through their product offerings. Commercial banks are multi-faceted regulated financial institutions that provide payment instruments, such as credit and debit cards, to consumers. Banks also have an important role in providing other financial products and services to consumers, such as loans and mortgages. There are many potential incentives for banks to encourage the use of card instruments over cash, such as profit growth and cost reduction.

Banks incur high costs related to operations of payment services. Gresvik and Owre (2003) find that banks' costs in the production of payment services represents 0.49% of GDP in Norway, while Banco de Portugal (2007) finds banks' costs to be 0.77% of GDP. In a sample of 13 EU countries, the ECB finds through bank level questionnaires that banks' private costs are on average 0.493% of GDP (Kostova et al., 2012). Kostova et al. (2012) finds that due to its huge usage, cash is the most costly of the payment instruments, followed by debit cards. The management of cash leads to several direct and indirect costs, such as: transaction, security, personnel, and forgone interest on cash stock (seignorage) (Bergman et al., 2007). Hence, banks can reduce costs through pricing strategies that induce the use of non-cash payment instruments.

It has been previously observed that commercial banks cross subsidize between payment instruments and other services. Commercial banks may use the market for payment services as a 'loss-leading' product. This implies that banks may price the services below costs, which will lead to a negative profit in this division. The expectation is that customers who hold a payment account will maintain loyalty with the bank and purchase more high profit producing products, such as mortgage and loan offerings (Bergman et al., 2007). As banks

use cross-subsidization to cover the loss in payment services, pricing becomes less transparent and less cost efficient (Gresvik and Owre, 2003). An auxiliary benefit of the promotion of cards over cash is that banks are able to collect fees for card usage and potential overdrafts. An example is the current situation in the United States. The amendments of the Dodd-Frank financial law in the U.S. in 2011 lowered the debit card fee large financial institutions could charge merchants and customers, but it opened the doors for banks to increase fees where they usually would not have. In 2013, financial institutions in the U.S. generated $31.9 billion in overdraft revenue, with fees reaching as much as $50 per person (Nilson Report, 2012). Hence, banks can gain from cross subsidization pricing strategies and fee collection.

The degree of the banking industry concentration plays an important role in the usage of payment instruments. When the market is concentrated, centralized agreements are likely to be implemented that facilitate the use of non-cash payment instruments. An example of the importance of concentration and payment instruments is the usage of giros and checks in the 1990s and 2000s. Europe and Japan exhibited relatively concentrated financial sectors that facilitated the proliferation of the giro as an important non-cash payment instrument. The centralized arrangements for clearing organizations and transfers of funds in Europe and Japan assisted the move from cash to non-cash based payment instruments with the giro, and now with other non-cash payment instruments. This is the opposite of the situation in the United States, where the financial sector was dominated by thousands of banks and financial institutions. The fragmentation of the market inhibited the creation of a nationwide clearing system for checks, and instead the reliance was only on local clearing houses (Humphrey et al., 2001). The fragmentation of the United States financial sector made it more difficult for a centralized clearinghouse for checks, and led to difficulties in the adoption of other non-cash payment instruments.

Banks and the financial structure play an important role in the facilitation of payment services across countries. Banks place a great importance on cost reduction, and use different pricing strategies to create larger profits. The structure of the banking sector also impacts the use and adoption of payment instruments.

3.3   Externalities

We present three perceived externalities of non-cash payment instruments: credit card fraud, the size of the shadow market, and tax evasion and collection. Credit card fraud is a negative result of the global increase in the use of card payments, while the size of the shadow market and tax evasion are decreasing as a result of the increase in non-cash payment instrument use.

3.3.1   Credit Card Fraud

As the volume of card payments continues to increase, cards become increasingly attractive for illicit activities. Credit card fraud is a broad term for theft and fraud committed using a payment instrument, such as a credit or debit card, as a fraudulent source of funds in a transaction. The purpose may be to obtain goods without paying, or to obtain unauthorized funds from an account. Fraud can be either physical with theft of the actual card, or

intangible if data is compromised (European Central Bank, 2014). Intangible theft includes the theft of account numbers, names, expiration dates, and card security codes.

In 2013, the cost of global payment card fraud grew by 19% to reach $14 billion. In the Single Euro Payments Area (SEPA), credit card fraud amounted to €1.33 billion (≈ $1.5 billion) in 2012, an increase of 14.8% from the previous year. In relative terms, credit card fraud affected 0.038% of the total volume of transactions in 2012. In 60% of the cases, the fraud occurred when the card was not physically present, while 23% of transactions occurred at POS terminals, and the remaining 17% occurred at ATM terminals. Debit cards have lower fraud levels than credit cards, as the account is debited faster and there can be a faster reaction by the cardholder. Though the fraud statistics seem large, the 2012 statistics of the SEPA area are still lower than the levels reported between 2008 and 2010. The European Central Bank attributes this to the added security benefits of move to Europay, Mastercard, and Visa (EMV) (European Central Bank, 2014). Conversely, the U.S. is the only country where card fraud is increasingly growing. In 2012, the U.S. accounted for 23.5% of card volume but 47.3% of fraud. In the same period, card issuers lost $3.4 billion and merchants lost $1.9 billion due to fraud (Nilson Report, 2012). Security and volume explain differences between the two regions.

Security differences between the U.S. and European credit cards has an impact on the likelihood of credit card fraud. As previously mentioned, the move to EMV had significant effects on the reduction of European credit card fraud in the period 2008 to 2012. The technology utilizes a chip on the card that validates the transaction through cryptography and other security features, thereby creating a multi layered defense against potential fraud. A common trend in Europe is the greater use of debit cards over credit cards, and debit cards provide an added layer of protection through PIN codes (Security features of payment instruments, 2015). The U.S. is one of the last countries to migrate to the new security features, though there is increased discussion after the security breach of large American businesses.

As shown previously, while studies have found that increase card payment instrument use benefits society, one of the negatives in the increased rate of credit card fraud. Overall, curbing credit card fraud is of major importance to banks, merchants, and consumers. Regulations and improved security features are solutions for the reduction of credit card fraud.

3.3.2 Shadow Market

The shadow economy refers to illegal activities that exist outside of a country's official economy, and it is encompases two areas of activity. The first is undeclared work, which refers to earnings that workers and businesses do not declare to the government to avoid taxes or documentation. Undeclared work is widespread in household services, agriculture, construction, and accounts for two-thirds of the shadow market. The second activity in the shadow economy is unreported income, which is occurs when businesses work predominantly in cash. For instance, mostly small businesses such as small shops, taxis, and bars report only small part of their income to evade the tax burden. Overall, a broad definition

for shadow economy is: "those economic activities and the income derived from them circumvent or otherwise avoid government regulation, taxation and observation" (Schneider and Williams, 2013).

An important influence of the shadow economy is cash, since it is anonymous and difficult to track. For instance, taxi drivers or household service workers deal mainly in cash and they can easily hide part of their income from the government. Hence, card payments make participating in the shadow economy more challenging, as these payment systems create documentation of the transactions.

European countries have confronted the issue of shadow economies through the introduction of new regulations and increased public awareness on the practice of the usage of the card instruments. For example, in Europe the predominant regulation to combat the shadow economy entails the introduction of POS terminals in sub-sectors for example, restaurants and taxis. In 2010, Italy introduced compulsory electronic payments for business-to-business transactions of more than €5,000. France and Turkey have similar regulations on cash transactions. During implementation of the Payment Services Directive more than 10 European member states have banned surcharges on card payments .[3]

According to the findings in the shadow economy study of Schneider (2013), there is a significant correlation between the penetration of non-cash payments in a country and its shadow economy. For example, in 2009 the annual card transaction per person in the Netherlands and the United Kingdom was 125 and 131 respectively, and in 2013 it increased to 169 and 181 respectively. In the same period, the share of shadow economy as a percentage of GDP was 10.2% and 10.9% in 2009 for the Netherlands and the United Kingdom respectively, while in 2013 it decreased to 9.1% and 9.7%. Conversely, in 2009 in Turkey the annual card transactions per person was 26 and in 2013 it increased to 46, while the share of shadow economy as a percentage of GDP shows significant levels when compared to the previous countries, at 28.9% and 26.5% in 2009 and 2013 respectively. As a result, countries with high levels of electronic payment usage, such as the United Kingdom and the Netherlands, have smaller shadow economies than those with minimal levels of electronic payments (Schneider, 2013). In addition to the findings of Schneider (2013), a 10% increase in electronic payments can induce a 5% decline in the size of the shadow economy.

Consequently, there is a tendency for a reduction in the size of the shadow economy through the increased use of card payments instead of cash, and enhanced public awareness within a substantial part of the population, especially for the unconscious members in the shadow economy who have no benefits from sellers who underreport sales. In next section we discuss tax evasion, which is an extension of the shadow economy[4].

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[3] The no surcharge fee prohibits merchants from establishing prices that are different depending on the mode of payment (OECD et al., 2006).

[4] Tax evasion is certainly related to the shadow economy but is not considered an integral part of it.

3.3.3   Tax Evasion and Collection

Tax evasion is defined as the use of illegal means to avoid paying taxes to government tax agencies. Typically, tax evasion schemes involve an individual or corporation misrepresenting or their income to the governmental tax services. Misrepresentation may take the form either of underreporting income, inflating deductions, or hiding money and its interest altogether in offshore accounts (Tax evasion, 2014).

Governments in many countries are faced with large budget deficits when tax revenues are insufficient to fund government spending. In order to reduce the budget deficits, public authorities have focused on addressing tax evasion and fraud.

Cash as a payment instrument can act as an enabler of tax evasion since it is difficult to trace and simple to use. Hence, card payment instruments make participating in tax evasion crime more difficult, as these systems produce documentation of transactions. Hence, most countries initiate positive reinforcement to use the card payments to cope with the tax evasion.Thus, as shown in the following examples of Mexico and South Korea, card payment instruments produce tangible results.

As an important example, the Mexican government in 2003 established a fund to subsidize the cost of POS terminals at small shops, leading to a 200% rise in terminal penetration and a more than 300% increase in POS (point-of-sale) transactions in a five year period. Additionally, the South Korean government encouraged the use of credit cards by providing fiscal incentives. For instance, consumers who initiated card transactions were eligible for an income-tax deduction of up to $4,000 per year. Similarly, fiscal authorities organized monthly raffles that were publicized on national TV, and awarded prizes of up to $75,000 for each transaction exceeding $7.50. South Korean companies were also allotted discounts of up to 20% in their value-added tax and allowed deductions on corporate tax returns if they paid expenses greater than $35 through cards rather than cash. As a result, South Korea has seen a substantial increase in card use in the past 20 years. In the early 1990s, less than 5% of private consumption expenditures were made with card payment instruments, growing to 25% in 2000 and accounting for more than 50% in 2009. This card instrument incentive model, introduced after the financial crisis of 1997, helped the Korean government increase its tax collections from $59 billion in 1999 to $76 billion in 2000 (Schneider, 2013). Since the use of cards can be monitored and tracked, tax collection as a percentage of the country's GDP also increased from 14% in 1996 to 17% in 2000. In Figure 2, we present total tax revenue as a percentage of GDP in 2009 and in 2012.
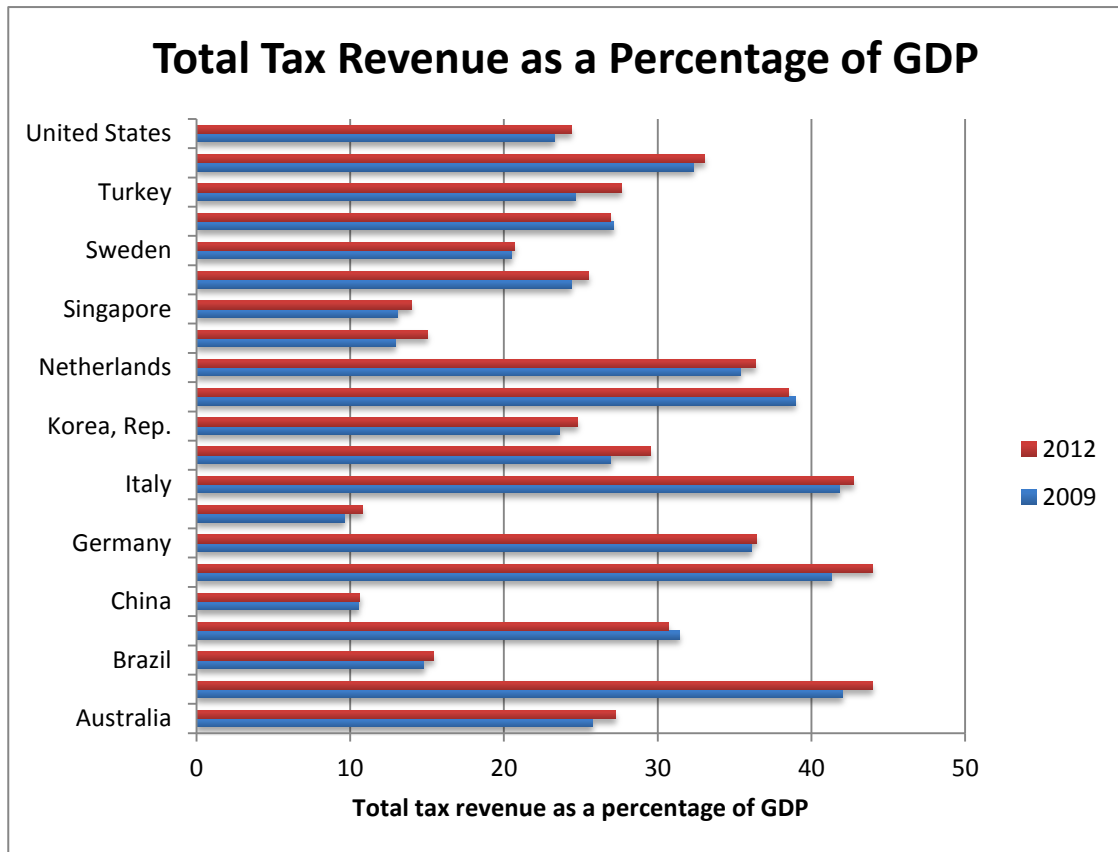
Figure 2 – Total Tax Revenue as a Percentage of GDP

Card payment instruments eliminate a substantial portion of the tax evasion crime. Retailers who do not report some or all of their transactions to avoid paying sales taxes prefer cash transactions. Card transactions, on the other hand, are "above board" and create an audit trail that greatly reduces unreported transactions, thereby raising tax revenues. Therefore, with increase of the card transaction between 2009 and 2012 (see section 3.2: Card Payments) we can conclude that card payments have a significant influence on the increase in the total tax revenue as it is presented in Figure 2. Except for slight decrease in Switzerland, all countries in the sample shows an increase in the total tax value as a percentage of GDP.

4 Methodology

4.1 Research Method

For the purpose of our thesis, we adopt both pragmatic and deductive philosophies in the approach to our question and analysis. Especially in the area of payment systems, we realize that there is no single viewpoint that can completely explain all differences in usage, and there are multiple explanations and externalities. We explain our theory and framework for payment systems before the presentation of the findings and conclusions, so our thesis is grounded in the deductive approach (Lewis et al., 2009). We support our thesis with reliable quantitative data and analysis, and utilize cross-sectional data collection through the examination of a five-year period across 22 countries.

4.2 Data Collection

Our study is predominantly comprised of secondary data. The primary secondary data source is the Bank for International Settlements (BIS) statistics on payments and market infrastructures. We collect additional data and statistics from our sample countries' central banks and the United Nations. Additional sources of data are found through the Bankscope database and scientific articles available through the university library and the Internet, such as the data for banks' total assets to calculate concentration measures. The 22 countries for which we collected data include: Australia, Belgium, Brazil, Canada, China, France, Germany, India, Italy, Japan, South Korea, Mexico, Netherlands, Russia, Saudi Arabia, Singapore, South Africa, Sweden, Switzerland, Turkey, the United Kingdom, and the United States.

4.3 Model of Payment Instrument Use

To gain insight of the influences of payment instrument use across countries, we apply the following model first used by Humphrey et al. (1996):

$$I_i = f(GDP, POS, CASH, CRIME, CR5) \quad (1)$$

Where

I_i = the annual transactions per person for payment instrument i (where i refers to credit card, debit card, and total card transactions)

GDP = the real per capita GDP for each country, in U.S. Dollars

POS = the number of point of sale (POS) terminals per million inhabitants

$CASH$ = the real value of cash held per person, in U.S. Dollars

$CRIME$ = the combined number of robberies, burglaries, and thefts per 100,000 inhabitants

$CR5$ = the concentration ratio of the largest five banks in each country based on total asset value

Our model differs from the initial model proposed by Humphrey et al. (1996) through the addition of different dependent variables measuring the three separate transaction volumes,

and additional information explained through the independent variable *CRIME*. We also consider a larger sample than Humphrey et al. (1996), who initially used the model for 10 countries. As we analyze the period 2009 to 2013, our model and results provide an updated analysis of non-cash payment instrument use.

4.3.1 Independent Variables of the Model

Income Factors

To account for the effect of income on the use of payment instruments, we take into consideration the GDP per capita in U.S. Dollars. The GDP per capita represents the total GDP divided by the number of inhabitants in the country, and is useful when comparing countries because it shows relative performance.

Income is an important indicator for the usage of different payment instruments. Previous surveys of U.S. payment habits show that individuals with higher real income use non-cash payment instruments, like debit and credit cards, more frequently than cash (Avery et al., 1986). Humphrey et al. (1996) finds that higher levels of income per capita are positively associated with greater use of all payment instruments, with the exception of debit cards. Ahmed et al. (2006) confirms the findings of Humphrey et al. (1996), and observes that income is not a strong predictor of debit card usage, as individuals with higher income have better access to credit cards, an important substitute for debit cards. In a similar study of the substitution of non-cash payment instruments for cash in 10 countries, Humphrey et al. (2001) estimates that income, as measured by GDP per capita, has a positive effect on the value of cash holdings.

In the sample, the GDP per capita varies greatly across countries. In 2013, Switzerland has the greatest GDP per capita at $80,366, while India and South Africa have the lowest at $1,566 and $6,633 respectively. Overall in 2013 the average GDP per capita in the sample is $35,574.

Infrastructure and Substitute Factors

The usage of a payment instrument is strongly correlated to the accessibility of the instrument and the acceptance of the instrument at payment sites. To model available infrastructure for the payment instrument, we use data on the number of point of sale (POS) terminals offered by retailers per million inhabitants. The number of POS terminals represents the general availability of the equipment necessary to make a card transaction, specifically for debit cards.

In an analysis of debit card adoption in Norway and the Netherlands, Bolt et al. (2008) concludes that the most important factor in payment method adoption is POS availability. The study finds a 10% rise in the availability of POS terminals leads to a 5.3% increase in debit card usage. Humphrey et al. (1996) finds that greater availability of POS terminals is associated with diminished use of all instruments except debit cards, where the relationship between the two variables is strongly positive.

In the sample, in 2013 Australia had the greatest amount of POS terminals at 34,715 per million inhabitants. Conversely, India had the lowest number of POS terminals at 865 per million inhabitants. Though the number of POS terminals in India is much lower than in other sample countries, from 2009 to 2013 there was a 52% increase in number of POS terminals. The sample demonstrates a growing trend in the expansion of POS terminals, where the average growth from 2009 to 2013 was 21%.

We also include the real value of cash per person (CASH) in U.S. Dollars in the analysis to represent the most significant substitute at this time for card payment instruments. The real value of cash per person is a ratio of the value of currency and coins in circulation compared to the population. Previous survey research on payment habits finds that debit cards serve primarily as a substitute for cash, while debit cards are used instead of cash because of convenience factors (Ahmed et al., 2008).

In the sample, in 2013 Switzerland had the greatest real value of cash per person at $9,544.10, while South Africa had the lowest at $214.60 per person. The largest percentage increase in the value of cash per person was in South Korea at 45.7%, where the value grew from $648.60 in 2009 to $1,193.50 in 2013. In the sample, the average growth in the real value of cash per person from 2009 to 2013 was 13.8%.

Institutional Influences

To assess the impact of the financial sector on instrument use, we include the concentration measurement of each country's banking sector. We measure the concentration ratio as the sum of the total assets of the largest five banks as a ratio of the total assets of the whole banking sector. If the concentration ratio ranges from 0 to 50%, the financial sector can be categorized as ranging from perfectly competitive to oligopoly status. If the concentration ratio is greater than 50%, the financial sector can be categorized as an oligopoly verging on monopoly.

The two prevalent views on the role of concentration in the financial system are 'concentration-stability' and 'concentration-fragility'. Concentration-stability suggests that a highly concentrated banking system is more stable because the few large banks are more profitable, have diversified risk, and are easier to monitor. Conversely, the concentration-fragility view suggests that a highly concentrated system leads to less stability because the few banks are more willing to take on risk, and may underserve 'niche' areas in the economy (Beck et al., 2006).

There are several theories regarding the concentration of the financial sector and the relationship to non-cash payment instruments. Humphrey et al. (1996) concludes that the more concentrated the financial sector is, the greater the possibility that the individual banks will agree to a centralized payment network for POS transactions and payments. Conversely, a study of the U.S. financial structure concludes that relative fragmentation of U.S. banks and strong anti-trust regulations complicates coordination among banks to develop cooperative payment networks (Humphrey et al., 2000).

In our sample, the countries are moderately to highly concentrated, with countries like South Africa and Singapore reporting 93% and 95% concentration of total assets in the largest five banks respectively in 2013. In terms of POS terminals in 2013, in South Africa there were 5,821 terminals per million inhabitants, while Singapore had 27,110. This demonstrates that though both financial sectors are highly concentrated, that does not mean that we can expect similar results in payment network structure. While concentration is an important indicator, there are other factors that influence differences in non-cash payment usage across countries.

The crime rate represents an important institutional effect because it can influence payment habits. To calculate the crime rate, we use aggregated statistics on robberies, burglaries, and thefts per 100,000 inhabitants available through the United Nations. We choose to model aggregated crime statistics over specific card fraud, because of the 'chicken and the egg' concept. Card fraud is a consequence of the inception of cards, not a determinant of its use. In terms of the aggregated crime statistics, we hypothesize that a higher rate of crime likely has a negative relationship with the usage of cash, which will lead to a decreased usage of cash and an increase in various non-cash instruments.

4.3.2 Model Estimation

The purpose of the model and the following regressions is to determine relationships between the factors and the usage of payment instruments across countries and time. We estimate the model in two variations for comparison purposes: a simple OLS regression and an OLS regression with dummies. We include both variations to explore differences in model choice.

We estimate the above model (1) using the following regression equation:

$$I_{it} = \beta_1 + \beta_2 GDP_{it} + \beta_3 POS_{it} + \beta_4 CASH_{it} + \beta_5 CRIME_{it} + \beta_6 CR5_{it} + u_{it} \quad (1.1)$$

Where the subscript term $i = 1, 2, ..., 22$, represents the 22 countries in the sample, while $t = 1, 2, ..., 5$, represents the five year period 2009 to 2013. We run three regressions based on the above equation because of the three different dependent variables I_{it}: total card transactions, debit card transactions, and credit card transactions. We use the same independent variables for every equation, and derive the natural logarithms so that the coefficient estimates (β) represent the elasticities of the independent variables to the dependent variables. We estimate the equation based on panel ordinary least squares (OLS) and the results are shown in Table 4. The adjusted R^2 and the Durbin-Watson statistics are low for all three regressions, due to the fact that the independent variables are trying to explain all variation across the countries. To remedy the weak results, we also include a full set of dummy variables.

As it is not possible to include all institutional, historical, and cultural factors that influence the differences in payment instrument use across countries and times, we also create a full set of country dummy variables (22 in total). The purpose of the dummy variables is to ab-

sorb the differences in per person payment use that may not be explained in (1.1). To avoid perfect collinearity and the dummy-variable trap, we exclude the dummy variable for Germany. Hence, for interpretation purposes Germany becomes the comparison country and the coefficients of the other country dummy variables explain how much the payment instrument usage in the respective country differs from that of Germany (Gujarti, 2003). The inclusion of the dummy variables leads to greater adjusted R^2 and Durbin-Watson values for all regressions with more robust results. Equation (1.1) thus becomes equation (1.2) with the inclusion of the dummy variables:

$$I_{it} = \alpha_1 + \sum_{n=2}^{22} \alpha_n D_{ni} + \beta_2 GDP_{it} + \beta_3 POS_{it} + \beta_4 CASH_{it} + \beta_5 CRIME_{it} + \beta_6 CR5_{it} + u_{it} \quad (1.2)$$

For the purpose of our research, we focus on the volume of transactions instead of the total value of different payment instruments. This decision is modeled after the research of Guariglia and Loke (2004) and Humphrey et al. (2006), who both conduct analysis of payment instruments based on volume.

5   Results and Discussion

Table 4 – Model Estimation: Regression Results

	All Cards		**Credit Cards**		**Debit Cards**	
	OLS	OLS with dummy variables	OLS	OLS with dummy variables	OLS	OLS with dummy variables
Constant	-6.958**	-33.37**	-5.99**	-6.492	-7.72**	-16.397**
Cash	-1.042**	0.658*	-1.14**	0.57	-1.74**	0.352*
CR5	-0.169	1.523*	-0.83*	-0.229	-0.3744	-0.398
Crime	0.0211	0.846	0.0245	-1.529**	0.038	0.529*
GDP	1.96**	1.761**	2.248**	1.315**	2.538**	1.336**
POS	-0.075**	-0.027	-0.063	0.0228	-0.062	0.003
D AUS		0.64		4.965**		1.169**
D BELG		0.274		3.955**		0.854**
D BRZ		4.097**		5.711**		2.531**
D CAN		2.299**		4.869**		1.592**
D CHIN		9.812**		-6.742		5.203**
D FRA		1.693**		4.217**		0.93**
D INDIA		10.006**		-0.981		5.887**
D ITLY		0.6686		2.436**		-0.048
D JAP		0.812		1.877*		-5.095**
D KOR		4.285**		5.398**		2.4057**
D MEX		3.758**		3.234**		1.873**
D NETH		0.064		3.457**		1.083**
D RUSS		2.706**		1.125		1.578**
D SAFR		10.444**		-5.155		6.751**
D SAUDI		8.9765**		-9.5**		6.041**
D SING		1.174		-1.819		1.489**
D SWE		1.567**		5.251**		1.451**
D SWITZ		-0.1764		2.49**		-0.507**
D TURK		5.6838**		4.056**		1.834**
D UK		2.145**		5.036**		1.675**
D US		3.068**		4.74**		1.109**
ADJ R^2	0.799	0.896	0.435	0.954	0.536	0.989
DW	0.791	1.568	0.128	1.66	0.0563	0.898

Overall, the results provide interesting implications of the relationships between the independent and dependent variables and the differences in usage across countries. For the regressions that include the country dummy variables, the adjusted R^2 values are all greater than 0.89, signifying a goodness of fit with the model and significant empirical associations with the results. When we exclude the dummy variables and run a simple panel OLS regression, the adjusted R^2 values are lower, signifying that not all variation in the variables is explained in the model. The Durbin Watson Statistics of the OLS models with dummy variables approximate the value of 2 means that there is no autocorrelation for in the sample. But for the results of the DW Statistics of only the OLS regression with value less than 0.80 can indicate that autocorrelation is likely. But We use both models for comparison purposes. Please see appendix A and appendix B for further information on the data.

Income Factor

As suggested by past literature, the GDP per capita has a positive relationship with the total volume of all card transactions and the separate regressions for credit and debit transactions. The results are very statistically significant, and are associated with greater use of non-cash payment instruments. The results are consistent with the U.S. survey data that previously found individuals with higher income are more likely to use cards as the predominant payment instrument (Humphrey et al., 2000).

Infrastructure and Substitute Factors

The results from the OLS regression including dummy variables show that there is a significant positive relationship between the real value of cash held per person and the total volume of card transactions. There is also a significant positive relationship between cash and debit card transactions. The results are seemingly contradictory as we initially expected an inverse relationship between the variables, but we interpret the results to mean that the value of cash held by individuals complements the use of card payments. A possible explanation for the result is the volume of cash and card transactions grew together during the five-year period of analysis.

In contrast, when we exclude the dummy variables, the coefficients of *CASH* exhibit negative coefficients and are strongly statistically significant. In this situation, we interpret cash to be a strong substitute to card payments. Therefore, an individual will use either cash or card instruments in transactions.

In the regressions including dummy variables, the POS variable exhibits a negative coefficient for total card transactions, but a positive coefficient for the credit and debit card transactions. The results are not statistically significant at the 10% level of significance, so no great generalizations can be made.

Conversely, in the regression excluding the dummy variables the POS variable demonstrates a negative relationship with total card transactions and is significant at the 5% level of significance. The interpretation is as there is an increase in the volume of POS terminals, there will be lower usage of card instruments. A possible explanation for this result is that several countries, including France and Sweden, in our sample experienced negative or not as rapid growth of POS terminals because of an already mature infrastructure.

Institutional Influences

With the inclusion of the dummy variables, the crime rate (based on data of burglary, thefts, and robberies) has a positive relationship with the total card transactions and debit card transactions, but a negative relationship with credit card transactions. Therefore, as crime increases we expect to see an increase in the usage of debit cards and a decrease in the usage of credit cards. An interpretation of this is that debit cards have added security benefits, while credit cards do not (see section 3.3.1: Credit Card Fraud). The results imply that a higher risk of crime induces individuals to carry less cash and creates a higher propensity to use non-cash instruments, specifically debit cards. In the regression that excludes the dummy variables, all coefficients for crime are positive in the three regressions, but are not statistically significant at the 10 percent level of significance.

The results show that the concentration of the financial sector has a positive influence on the usage of total card transactions. Hence, an increase in the concentration of the total assets of the largest five banks positively influences the usage of total card payments. The results support the view that greater financial sector concentration will lead to a standardized payment network that will increase the usage of cards as the predominant payment instruments. An interesting observation is in the separate debit and credit card regressions, the concentration ratio exhibits negative relationships, but the results are not significant at the 10% level of significance.

The Dummy Variables

 The country dummy variables are used to capture variation that cannot be explained through the factors in the model, with the exclusion of the variable for Germany. The country dummies show a significant higher use of credit cards than Germany for: Australia, Belgium, Brazil, Canada, France, Italy, Japan, South Korea, Mexico, Netherlands, Sweden, Switzerland, Turkey, the United Kingdom, and the United States. Conversely, Saudi Arabia exhibits a significant lower use of credit cards. The country variables show a significant higher use of debit cards than Germany for: Australia, Belgium, Brazil, Canada, China, France, India, Korea, Mexico, Netherlands, Russia, South Africa, Saudi Arabia, Singapore, Sweden, Turkey, the United Kingdom, and the United States. Conversely, Japan and Switzerland exhibit significant lower usage of debit cards. Overall, debit cards show greater usage than debit cards in the sample and as explained by the dummy variables.

6   Conclusion

Our research covers many subjects that surround the issue of payment instruments, specifically the usage of card payment instruments compared to cash. We have two general conclusions that deserve attention and more focus in the future.

Our first conclusion is there is evidence of combined growth in both cash and non-cash payment instrument usage across the countries in our sample. There are many discussions in both the academic and non-academic spheres on if cash is 'dead' and what its fate will be if it is replaced by other payment instruments (see Bergsten, 1967 and Costa and De Grauwe, 2001). We found that the volume and use of cash demonstrates that it is not yet obsolete, as its usage is actually growing across the countries in our sample. During the period 2009 to 2012, there was a 1% increase in the value of cash in circulation as a percentage of the GDP. The explanations for the cash growth include cash as the predominant payment instrument for low value transactions, and as the primary payment instrument for low-income individuals. Additionally, we attribute this growth to past and present instability in the financial markets, specifically the Euro Crisis and the U.S. subprime mortgage crisis. The use of card payments has also grown, from 127 billion card transactions in our sample in 2009 to 185 billion in 2013. The growth is pervasive across all countries in the sample, and we attribute the growth to increased access to financial services and the growth in the volume of POS terminals.

Additionally, we find that government regulations and the structure of the financial sector impact the use of payment instruments. The government regulations can either work for or against the use of non-cash payment instruments, but there is no centralized agreement on what regulations should be in place today. The greater the concentration of the financial sector, the more likely there is a centralized payment infrastructure in place that facilitates the growth of non-cash payment instruments. Credit card fraud is a negative result of the global increase in the use of card payments, while the size of the shadow market and tax evasion are decreasing as a result of the increase in non-cash payment instrument use.

Our second conclusion pertains to the results from model analysis. The results from the regression analysis show interesting relationships between the factors and the use of non-cash payment instruments in the period 2009 to 2013. The independent variable crime demonstrates positive relationships with debit and total card transactions, but a negative relationship with credit card transactions. Therefore, as the crime rate increases we expect greater use of debit cards and less use of credit cards. We attribute this result to security reasons, as debit cards have more security features than credit cards. Additionally, the concentration ratio exhibits a positive relationship with total card transactions. This result supports the view that greater bank concentration leads to a more centralized payment system that leads to a greater volume of non-cash payment transactions. We conclude that cash is a complement to the total volume of card transactions, which we attribute to the increased use of cash and card transactions in our sample in the time period. There was no distinguishable relationship between the number of POS terminals and the non-cash transactions, as the results were not statistically significant. We attribute this inconclusive result to

the fact that several countries in our sample have mature payment system infrastructures, and are not experiencing the same type of growth as countries that are just developing the infrastructure. Income demonstrates a very significant positive relationship with the volume of card transactions, and leads us to the conclusion that growth in income is strongly associated with greater use of card payments as the predominant form of payment methods.

6.1   Suggestions for Future Research

As payment systems and instruments are an integral part of society and the economy, further research is always necessary. For future research, we suggest examination of other non-cash payment instruments, specifically mobile payment instruments. As it was out of the scope of our thesis at this time due to a lack of public data and credible sources, we hope that further research can contribute to this area and determine what factors influence adoption of other payment instruments.

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Appendix A

Table 5. Descriptive Statistics

	All Card Trans.	Cash	CR5	Credit Trans.	Crime	Debit Trans.	GDP	POS
Mean	89.864	2519.910	0.637	31.643	1904.394	58.126	33680.687	14504.178
Median	56.101	1767.511	0.602	16.320	1614.150	40.562	40129.315	15067.465
Maximum	267.367	9544.124	0.980	159.982	5934.800	206.950	83390.070	36995.122
Std. Dev.	77.280	2215.041	0.173	35.744	1724.972	56.046	21011.661	10457.540
Skewness	0.650	1.309	0.073	1.333	0.770	0.819	0.061	0.117
Kurtosis	2.929	2.230	6.806	2.252	3.972	4.907	3.771	7.175
Jarque-Bera	10.95108	5.916822	102.2583	9.299450	47.68223	50.12847	28.29196	178.4993
Probability	0.004188	0.051901	0.000000	0.009564	0.000000	0.000000	0.000001	0.000000
Observations	110	110	110	110	110	110	110	110

The above table represents the descriptive statistics of the dependent and independent variables in the regression analysis. The descriptive statistics are based on the unlogged data, while in the regression we take the natural logs of all values. The variables are all positively skewed, while the independent variable cash and the dependent variable credit transactions are highly skewed to the right. The variables CR5, all debit transactions, and POS have high levels of kurtosis, signifying a peaked distribution of the data instead of a more flat distribution. The Jarque-Bera statistic and the corresponding probability tell us if there is normal distribution. At the 5% level of significance, only the variable cash is normally distributed (p value= 0.051901 > 0.05). The other variables are non-normally distributed.

Appendix B

Table 6. Pairwise Correlation Table

	All Card Trans.	Cash	CR5	Credit Trans.	Crime	Debit Trans.	GDP	POS
All Card Trans.	1							
Cash	0.124	1						
CR5	-0.122	-0.186	1					
Credit Trans.	0.709	0.128	-0.132	1				
Crime	0.619	0.277	0.010	0.062	1			
Debit Trans.	0.907	0.115	-0.091	0.357	0.791	1		
GDP	0.645	0.732	-0.056	0.327	0.670	0.676	1	
POS	0.255	0.203	0.283	0.135	0.326	0.263	0.436	1

We represent the pairwise correlation table above since we use more than one independent variable in our regression. The purpose of the examining these correlations is to identify whether our regression analysis has collinearity. The highest correlation value among the variables is 0.97 between debit transactions and all card transactions which can be the one of the indicator of collinearity problem. As follows, the correlation between credit transactions and all card transactions, GDP and cash, debit transactions and crime show high values respectively, 0.709, 0.732 and 0.791.