

**Nijmegen School of Management  
Department of Economics and Business Economics  
Master's Thesis Economics (MAN-MTHEC)**

# **The role of institutions on cross-country card payments**

By Stefan Meijwes (s1025933)

Nijmegen, 13 October 2022

Program: Master's Program in Economics  
Specialisation: International Business  
Supervisory: André van Hoorn

## **Abstract:**

The number of card payments has increased rapidly over the last 10 years. Card payments have become substitutes for cash payments because they outweigh cash payments on speed, cost and simplicity. However the number of card payments per country differs between countries. This paper performs a cross-country analysis on institutions and card payments and in addition does a within country analysis on corruption and card payments. The role of social trust, uncertainty avoidance and corruption is researched on the number of card payments. This is done by using an OLS and GLS regression and for the within country analysis a fixed effect model is used. The main findings are that social trust and uncertainty do not play a significant role in the number of card payments. But, countries that display lower levels of corruption correlate with higher numbers of card payments. Further, the paper found that a change in corruption level leads to a change in the number of card payments. However this change in the number of card payments takes some years. This paper has some limitations on the comparability of the data and whether a causal relationship can be found. In future research the focus should be laid on understanding causal relationships between characteristics and card payments.

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# 1. Introduction

The technological progress has open doors for customers to pay via different forms of payments. At the moment cash is still the dominant form of payment (Zandi, 2016). However alternatives such as card payments are becoming substitutes and will become a more dominant form of payment in the future. Paying by card is time-efficient and prevents merchants from the loss of existing clients who are not able to pay by cash. The payment transformation has been accelerated by the Covid-19 pandemic. Payments without human exchange became the number one payment form to prevent the spread of the Covid-19 virus.

Before the pandemic card payments already grew in volume. In 2017 nearly 70 billion payments were registered in Europe and payment cards have been the fastest growing means of payment in Europe (ECB, 2019). This increase in the number of card payments has been helped by the introduction of contactless payments which incentivizes customers to pay more by card. This trend of switching from cash payments to noncash payments raises the question which payment forms will grow in the future and what drives people to switch from cash payments to card payments.

## 1.1 Research Problem

The transformation to a noncash payment society has stimulated the number of studies on card payments and electronic payments. Both the effects and main determinants of card payments have been researched (Goczek et al, 2015; Zandi, 2016; Amromin et al, 2007). Scholars have been investigating the impact of macro-economic variables on card payments. Examples of such macro-economic variables are the number of credit cards, the amount of ATMs or the maximum amount you can pay by card (Bolt, 2008). Also credit card companies and governments play a role when people make the decision on which payment form to use (Scott, 2007). Other studies have investigated individual characteristics for example social status of the customer, having experience with e-payments, the perceived risk or the ease of use. These variables influence the adoption of electronic payments (Javantari, 2021). On the contrary, card payments also influences these macroeconomic variables like economic development or consumption pattern (Aldaas et al, 2021). This paper performs an analysis on the relationship between institutions and card payments.

Veblen's institutional theory argues that consumption is not only determined by macro-economic and individual factors but also institutions. According to Veblen they shape consumption behaviour. Recent studies have not paid much attention to these institutional characteristics. Institutions are deeply ingrained in society and drives consumer behaviour towards new technologies. Consumers follow routines when making purchases (Murillo, 2004). They use the same payment form as a routine and therefore it takes time to change to a different payment form, in this case card payments. The

adoption of a new technology will take longer or might not happen in countries with particular institutions.

On an annual basis, electronic payments have been growing all over the world. But large variations in growth have been seen around the world (ECB, 2019; JP Morgan, 2019). Technological progress is one of the drivers behind the growth in card payment usage instead of cash payments. Even though, on the European continent every country has great accessibility to Internet and computers, credit cards and education. Still, huge differences are seen between European countries when we look at the number of card payments in a country. Scandinavian countries like Denmark, Sweden and Finland have adopted the technological advantages of electronic/card payments and display on average 300 card payments per inhabitant per year (ECB, 2019). In for example Spain, Germany and Greece the shift towards card payments has not yet happened. These countries display on average 50 card payments per inhabitant per year. Cash is still the predominant form of paying and plays a big role in these countries. So within Europe where most countries sustain economic development and are well-educated the adoption of card payments instead of cash has been different in terms of speed. Such a trend is also seen in Asia. In Japan, residents are attached to cash and therefore the adoption of digitized forms of payments have not yet started. Also Malaysians review cash as a more reliable option . On the other hand a similar country such as South Korea is seen as the champion of cashless societies in Asia. The same is true for India and Singapore where card payments and electronic money are the most used transaction form.

A potential reason for preferring cash transactions than noncash transactions is protection. Consumers have to trust financial institutions in order to drive them towards more card payments than cash payments. Studies found that trust has a positive impact on the card payment usage in a country (Chen et al. 2022). People that have less trust in credit institutions prefer having cash over having their cash installed at a bank account. However this positive relationship is the strongest when the country has a well-established institutional environment (Buriak et al. 2019). Security also has been a factor that affected the adoption of electronic payment system. It positively impacted the customers willingness to use EPS instead of cash payments. However additional research should be done on the relationship between institutions and the adoption of card payments.

## 1.2 Research Motivation

The shift from cash to card payments have been recognized by scholars and non scholars. Both found that card payments significantly affect spending patterns (Zandi, 2016). The introduction of electronic payments has both its advantages and disadvantages. The first advantage of card payments is that they are more cost friendly. The average bank cost of an electronic payment is one third of the cost of cash (Bolt, 2005). Still, the cost of providing the option to pay by card is not captured in this comparison. A second advantage lays down in the process of accepting a bill payment at point of sale. Paying by card is faster and more efficient and guarantees a greater pool of customers(Zandi, 2016). Lastly, the

simplicity of card payments over cash payments is the key reason for successful adoption. This advantage is even more present when card payments become contactless payments and because they are likely to surpass regular card payments in the future we have to investigate if institutions steer people to the simplistic card payment (Bezhovski, 2016).

The dependency on the technological capacity of financial institutions will become heavier by this trend and therefore we have to give attention to the consequences of this trend. The two areas that are important for adopting electronic payment systems are adequate knowledge of technology and security of transactions (Khairun & Yasmin, 2010). If the risk of getting attacked by hackers or other online intrusions is present, consumers will move away from card payments. Technological improvements contribute to a safer environment but institutions have to be established in a way that they accept the new technology and payment form (Murillo, 2004). Studies researched consumer credit card experiences and their causes and effects. They found that people overspend when using credit cards compared to cash (Sotirouopoulos, 2012). Overspending damages the spending patterns of customers. People will buy products and services which they eventually will never use. Also people spend more money than thought about beforehand. This overspending could affect long term economic positions of especially young people. Therefore understanding whether institutions play a role in the shift from cash to card payments also helps to detect future overspending. Students and young consumers are vulnerable to overspending due to a lack of financial literacy (Manning, 2000). This can lead to credit card debt and this can start a worse well-being or depression (Sotirouopoulos, 2012). This group also has the lowest preference for cash by demographics (ECB, 2019).

So the shift to card payments damages the youngest people in their consumption behaviour. The ECB also recognized this and underlined the importance of financial education. Children under the age of 15 should use notes and coins when paying for things out of their pocket money (ECB, 2021). Then children learn to save for future spendings and understand what to do with money. A preference for cash substitutes affects the amount central banks have to supply. Currency demand goes down together with a change in consumption pattern which leads to adjustments to monetary policies (Amromin, 2007). Despite scholars have investigated the impact of individual and macroeconomic variables on the type of payment. Less attention is given towards the institutional impact on the rise of card payments around the world.

The world payments systems is step by step changing from physical money to electronic forms of payments (Premchand & Choudry, 2015). As a result the future of cash is under threat. However the European Central Bank has said that the main goal is to continue providing supply of cash and that cash as a payment remains widely accepted in the Eurozone. It will guarantee the accessibility of cost-free cash (ECB,2021). Because having availability to multiple alternatives payment forms positively impacts a country's economy.

### 1.3 Research Objective

The undermined topic of the relationship between institutions and card payments raises the question what institutional factors play a role in the number of card payments in a country. In other words what factors contribute to the shift from cash to card payments. To answer this question we find out about the role institutions have on card payments.

*“ What institutional factors play a role in the number of card payments in a country ?”*

After the paper has performed a cross-country analysis. We focus on a within country analysis. If institutions change in a country do then the number of card payment also change.

*“ Does a change in an institution correlate with a change in the number of card payments within a country?”*

The goal of this paper is to perform a cross country and within country analysis on institutions and card payments. It makes a contribution to the scarce existing literature but is one of the first that investigates multiple institutional variables and includes more than one country in the sample.

### 1.4 Research Methodology

This paper tries to investigate the relationship between institutions and card payments. We use country-level data which consists of both cross country and panel data. The sample consist of 37 countries of which 27 countries are a member of the European Union and the Euro Area and the other 10 countries are not. The including countries are primarily Western and located in Europe and the collected data is from 2000 to 2020.

### 1.5 Research Outline

Section 2 reviews the background of this paper and explains the hypotheses. Section 3 is about the gathered data and the data methods used in this paper. Section 4 describes the results obtained between institutions and card payments. Section 5 start a discussion on findings and the limitations of the paper and section 6 summarizes and concludes.

## 2 Background and Hypotheses Development

### 2.1 Card payments

Scholars use electronic payments and card payments as substitutes in their papers. Electronic payments can be defined as every type of transaction which is performed online. Including all electronic payment devices such as computers, smartphones and payment cards (Aldaas, 2021). Electronic Payment Systems, EPS, have become crucial for transactions for consumers and businesses. Systems as PayPal fulfilled the role as intermediary for electronic users (Oney et al, 2017). In this paper we refer to the following two types of electronic payments as card payments. The first type of card payments is the credit card. This type of payment is the most common around the world. Credit cards are plastic payment card with which you make transactions offline and online. These cards are often produced by large credit institutions like Mastercard or Visa. When making a transaction via a credit card you borrow money from the financial institution with which you make the payment. No direct withdrawal from your bank account is made. A credit card payment requires the processor to put money into your account and charge the transaction later. This can take some few days. Contactless payments are an option for credit cards but are often not used. The second card payment transaction is the debit card, in other words the bank card. This payment also contains a plastic card which allows individuals to make transactions. However this payment results in a deduction of the amount of money on your bank account. This option also has a contactless payment option and is getting used more and more.

These two payment forms are the most common used form of e-payment in the world (Kim et al, 2010). New e-payments such as e-Wallets or e-money are getting more attention especially in Asia but are not included in this paper because the amount of payments and users is small compared to credit and debit card payments. A different form of card payment are local e-payments and these contribute to a large market share in some countries. In the Netherlands for example, IDEAL a local e-payment institutions has more than 50% market share and other European countries are adopting a similar e-payment credit firms.

### 2.2 Hypotheses Development

#### 2.2.1 Social trust and card payments

Payments require an interaction process with unique features which is shaped by formal and informal institutions. In the 2000s card payments were introduced as an alternative option to cash payments. Due to trust issues consumers did not choose to pay by card regularly (Oney et al, 2017). Transactions became dependent on financial institutions with which no interaction experience was registered. Therefore trust became essential for the acceptance of electronic payments (Rouibah, 2012). Trust is

defined as the expectation that the other partner will not engage in opportunistic behaviour (Chiles, 1996). Most of the time, trust is built within a process of long term interactions. In the initiating phase trust is key when it comes to adopt electronic payments. A consumers initial trust directly influences the decision to pay more by card. Because card payments are still considered as the uncertain option compared to cash payments. This trust can change after experiencing it (Lu et al, 2011).

For risk averse people the strategy to reduce risk is through carrying cash (Pietrucha et al, 2020).

Higher trust levels means more willing to take risk and giving preference to electronic payments (Lu et al. 2011). It also reduces transaction costs and strongly positive influences the advantage of electronic payments. Societies that have lower trust levels will have more fear towards electronic payments. In these societies cash is still seen as the secure option because of having physical contact with the money. As a result more cash payments will be performed compared to card payments. In a latter stage the number of card payments could increase when trust issues are solved. However trust gets impacted over time by threats such as frequent malfunctioning, fraud and the amount of e-payment machines in a country (Nor, 2010). Thus the lack of trust has been a factor that contributed to the slowing down development of e-payments (Oney et al, 2017).

Trust plays a role in making the decision to switch from cash to noncash payments(Purwandari, 2022). A higher trust level means more trustworthy towards others. As a result people feel less insecure about making a transaction without actual money in their hand. They trust the financial institution relatively more than people with low levels of trust. This will lead to more card payments in the first stage. After experiencing paying electronically numbers will increase even more. By comparing both transactions, card payments outweigh cash payments on quickness, safeness and costs. Consumers will encounter these advantages and will eventually shift most payments from cash to noncash. For countries that display a low trust level, consumers feel insecure about making card payments. They have to experience card payments in order to shift most payments. Card payment consumers face the potential risks that other consumers give as reason to not pay by card. But they are informed by these risks and experience the benefits of card payment. Informing these consumers takes time. Therefore we expect that the number of card payments is higher in countries with high trust levels.

In general transactions are driven by trust. Authors found that trust is positively related to Electronic Payment Systems use (Oney et al. 2017). They gathered data from 329 students from Eastern Mediterranean Universities. Trust was measured asking 4 questions and the authors used a structural equation modelling study. Besides finding that trust impacted EPS they also found that past experience with EPS had a positive impact on the perceived trust and perceived protection to the users of EPS. Kim et al, (2010) also found that trust has a positive and significant effect on the use of Electronic Payment Systems. The paper conducted a survey in South Korea where EPS have gained recognition. They found that trust is associated with consumers use of EPS. Data was primarily received from people aged 30 or below but this portion of the society represents the population that prefers card payments over cash payments. Trust impacts large purchases in E-commerce (Kim et al, 2012). Welly

et al, (2010) researched the factors affecting the electronic payment transactions. By focusing on Indonesian students they performed a Multiple Linear Regression Analysis where they found a coefficient of 0.387 for perceived trust. Other papers investigated cross country trust determinants of card payments in Poland. The paper found that GDP per capita and trust influenced card payment in Poland (Goczek et al, 2015). These authors also found that individuals that do not possess a credit or debit card are more risk averse because of a lack of information. This is in line with the theoretical argument that people with low trust levels use less electronic payments. After receiving information they start expanding their transaction via card payments. . Maqableh (2015) findings showed that the individual's perceived risk about the payment influences the decision to purchase a product through Internet, which is an electronic payment. Thus trust is a key factor that drives the adoption of electronic payment systems in a country. Prior research focuses on single countries. This paper performs a cross-country analysis to investigate the impact trust has on electronic payments in a country. We expect a positive relationship between social trust and electronic payments. Therefore we posit the following hypothesis.

**Hypothesis 1:** The higher the social trust level the higher the number of card payments

### 2.1.2 Uncertainty Avoidance and card payments

Hofstede's cultural dimensions have been incorporated in many papers within economics. One of his dimensions is classified as uncertainty avoidance. This dimension measures how people cope with anxiety. People avoid uncertain situations and prefer standards and regulations(Hofstede, 1980). Studies on the adoption of electronic payments and IT have included uncertainty avoidance the most out of the Hofstede dimensions (Leidner et al, 2006). The adoption of electronic payments are new situations and are seen as threats for people that display high levels of uncertainty avoidance. Countries that score high on the dimension of uncertainty avoidance are more resistant towards change than people from countries that display low uncertainty avoidance levels. This means that it play a role in the acceptance of a new payment system. The paper of Al-Okaliy et al. (2020) found that uncertainty avoidance has a strong impact on the acceptance of JoMoPay system, a Jordan Mobile Payment System. New innovations such as electronic/card payments are unknown situations for people who are used to pay by cash. One of the characteristics of e-commerce and specifically credit cards is feedback delay. This also affects people's e-commerce adoption and is an important aspect for cultures who score high on uncertainty avoidance to prefer cash over card payments (Merhi & Ahluwalia, 2017).

Customers that have a strong drift of uncertainty avoidance may have a stronger privacy concern (Lu et al. 2017). Card payments are less private vs cash payment and therefore they dislike card payments

In short, people with a tendency of uncertainty avoidance prefer cash over cards payments. They dislike uncertainty and concluded that card payments are the uncertain payment form. Secondly, cash payments were the habit payment form for most consumers before the adoption of cards payments. Because card payments is seen as the new payment form it will be hard to change habits from consumers that are uncertainty avoidant.

Lu et al. (2017) found that uncertainty avoidance had a significant influence on the adoption of mobile commerce in China. Measuring uncertainty avoidance at a local level. Mensah (2020) found that uncertainty avoidance was significantly linked to the perceived use of e-management and Hwang (2008) found a similar result. The paper showed that uncertainty avoidance impacts online trust and this trust influences the adoption of electronic payments. So it directly and indirectly, via trust, impacts the number of card payments. Deufel (2019) is one of the few researchers that focuses on the cultural impact on electronic payments, by using power distance and uncertainty avoidance. The uncertainty avoidance had an impact on the payment choice when looking at 14 European countries. This dimension has the biggest explanatory power of all other dimensions of Hofstede's framework. Uncertainty avoidance was negatively influenced to the use of credit cards, PayPal and online bank transfers. E-commerce places the buyer in a weaker position. Involved risks such as receiving a product without payment or getting the wrong product and the availability of personal and financial information drives uncertainty avoidant people away from card payments (Merhi & Ahluwalia, 2017). These findings contribute to the theoretical arguments that countries who score high on uncertainty avoidance have a preference for cash over card payments and therefore we posit the following hypothesis.

**Hypothesis 2:** The higher the score on uncertainty avoidance the lower the number of card payments

### 2.1.3 Corruption and card payments

Corruption defined as the abuse of public gain has been a recognized problem within economics. However the link with card payments has been overshadowed (Goel et al. 2012). Corruption has better chance of success by circulation of cash money. Such payments are difficult to trace and therefore the corrupt activities are hard to link back to the criminal. Observational studies have identified the use of digital technology as an important factor to reduce corruption (Mistry et al. 2012). The introduction of technologies like digital payments and mobile payments could attribute to reduce corrupt activities (Setor et al. 2021). Card payments are transparent and solve the problem of information asymmetry. It provides more detection in order to apply penalties and it encourages transparency because transactions are no longer difficult to document (Jatau et al. 2014). Larger transactions should be performed obligatory via electronic/card payments because those transactions often implies a corrupt payment (Singh & Bhattacharya, 2017).

Corruption has a direct effect on the number of card payments. Corrupt activities will be performed via cash payments. Those forms of payments are insecure and difficult to trace back. Therefore bribes can take easier place. The introduction of card payments makes it harder to perform illegal activities. Therefore corruption is negatively related to card payments. If corruption is high in a country payments will be less via cards because of transparency. Despite of this argument the relationship between corruption and card payments cannot be taken for granted. Corruption also influences the number of cash transactions. Because of the theoretical argument that people shift from cash to card payments because the benefits of card payments outweigh the advantages of cash this relationship is not of importance. If cash transactions reduce, the number of card payments will increase because consumers place the same amount of transactions each year, it even increases slightly each year. Setor et al. (2021) conducted a research in which they tried to answer the question: Does the implementation of digitized forms of payment reduce corruption rates? They found that there is a high likelihood that corruption reduces if economies becomes cashless. However socio-technical issues as poverty and digital illiteracy need to be in place in order to reduce corruption. The authors state that this conclusion is only accountable to developing countries. In these countries, the introduction of digital payments has reduced the amount of barriers governments have to make at money transfers. Customers and governments are directly in contact to finalize the payment. Credit and debit card transfers are rather difficult to conduct anonymously and therefore it contributes to successfully reduce corruption, money laundering and other cash-related fraud in a country (Goh et al. 2019). The level of corruption is also related to the circulation of cash (Singh & Bhattacharya, 2017). Because the circulation of cash is related to the number of electronic payments, corruption impacts the adoption of electronic payments. But to be able to increase the number of electronic payments levels of corruption needs to be low. The institutional environment plays an important role in the implementation of new forms of payments (Elodomyaty et al, 2019). Good governance of corruption steers consumers to a higher number of bank accounts and savings. Lower corruption leads to higher savings which indirectly impacts the number of card payments. To use money from your bank account to perform payment the easiest way is through card payments. So indirectly it affects the number of card payments(Elodomyaty et al, 2019). Mehotra and Goel (2011) found that less paper based transactions has led to less corruption. Their sample were 12 European countries and is the only research that has European countries in their sample. The conclusion was that transactions with credit cards reduced corruption, cheques were positively associated with corruption. At last, direct debits had no significant effect on corruption levels. Goh et al, (2019) found that all cashless payments are negatively related to corruption in a country. The paper states that a cashless economy will be helpful to combat corruption but it also takes several other measures to remove systematic corruption in a country like transparency and accountability. Thus corruption is negatively related to the number of card payments. We posit 2 hypotheses. The first hypothesis is for the cross-country analysis and the second hypotheses is for the within country analysis.

**Hypothesis 3** : The lower the corruption level the higher the number of card payments

H3 refers to the cross country analysis on corruption and card payments. However countries would like to combat corruption in their country for multiple reasons. Therefore we would like research if a country lowers their corruption does this correlate with a change in the number of card payments in a country. This change is likely to happen after some years. Combatting corruption will lead to directly less cash payments and as a result more card payments. But in the long term people have more faith in the government in detecting possible fraud and corrupt activities and therefore are less risk averse when it comes to card payments. But, it seems that the change in card payments is going to happen not directly after the change in control of corruption but after 2, 3 or 4 years. Therefore we posit a hypothesis on an within country analysis.

**Hypothesis 4** : A positive change in the corruption level leads to a positive change in the number of card payments within in a country.

### 3 Data and Method

This paper investigates the relationship between institutions and card payments by performing a cross-country and within country analysis. This is researched by using 3 individual institutional variables. To measure the card payments we look at the number of card payments per million inhabitants. By doing this we exclude the fact that population size can be important in determining the number of card payments per country.

#### 3.1 Sample

A sample is created of 37 countries worldwide. Because card payment data is limited available, the number of countries is also limited. For most European countries data was gathered from the ECB database. For the rest of countries card payment data was found on the website of the local central bank such as the Bank of England, the FED or the Bank of Malaysia. Sources can be found in the references. The countries are primarily Western orientated countries because these countries publish their payment statistics online. If the sample contains similar countries this could potentially bias the results found in this paper. The period of the collected is 2000 to 2020. This period captures all phases of card payment adoption. For most countries during the period of 2000 to 2009 card payment had started their way in most societies. After the financial crisis card payments got a huge boost in volume and value and in the last couple of years card payments have become popular due to the introduction of contactless payments, mobile and internet payments. This period captures these three stages. Also data is not available from before 2000. The year 2021 is left out because card payment data for the ECB countries was only available until 2020.

#### 3.2 Research Design

Country level data is used in the data analysis. To investigate the role institutions play on the number of card payments we use a couple of data methods. In our basic model we use 2 types of regressions. First we perform an Ordinary Least Squares Regression. This is done with all independent variables included in one regression and with three separate regression with 1 independent variable in each regression as a robustness check. This is done because the correlation between the independent variables is high. Also we check for the countries in the sample by running a regression with only the ECB countries included. Beforehand we check the assumptions of an OLS regression such as heteroskedasticity and autocorrelation. These test can be found in the Appendix. If these assumptions cannot be supported then we perform a GLS regression that takes into account the present heteroskedasticity and autocorrelation. This is the design for the cross country analysis. In the second phase we run a model that checks for fixed year and country effects. This model is performed with only the corruption variable included as independent variable. As a robustness check we add lagged variables of corruption to the model. To check if a change in corruption correlates with a change in

card payments some years later. Also in this model we check for the sample by running the same fixed effect model but only with ECB countries.

### 3.3 Data and Variables

#### 3.3.1 Dependent Variable

For all models card payment is the dependent variable. Card payments per million inhabitants (CPM) is the measurement to correct for population size. The ECB data was measured as all card payment except cards with an e-money function. Because this paper is about card payments and not electronic money. This measure suits our paper the most. For the other countries a similar measurement was taken. Some countries did not have such a measurement than the volume of both credit and debit cards is taken as a measurement. This data was not given per million inhabitants and therefore we divided this through the population size. So the numbers represent card payments per million inhabitants. Countries card payment data ranged from 1,000 to 400,000. This means that per million inhabitants, 400 million card payments were registered in that specific country.

#### 3.3.2 Independent Variables

Then the analysis includes independent variables. The first independent variable is (TRUST). This variable measures how inhabitants of countries answered the following question ‘‘would you say most people can be trusted’’. Then a percentage is given for each country ranging from 0 to 100. Which means that for example 47% said that most people can be trusted. Other categories respondents could give as answer were ‘‘need to be careful’’ or ‘‘do not know’’(WHS, 2021). The second independent variable is (COR). This variable measures the control of corruption index of a country. It ranks countries by their perceived levels of corruption in the public sector. A higher rank means a less corruptive country. The third independent variable is (UA) this measures the uncertainty avoidance of inhabitants in a particular country. It refers to how people cope with anxiety. Countries that score low on UA will have more card payments because they are less likely to not choose for the risky option which in this case is the payment by card.

#### 3.3.3. Control Variables

The paper also controls for some variables. The following control variables are added to the regression. The first control variable is (ATM). This variable shows the amount of ATMs, Automated Teller Machines, per 100,000 inhabitants. This variable also takes care of comparability by showing the data per 100,000 inhabitants. The value of 155,63 means that 155 ATMs are located per 100,000 inhabitants. A negative relationship is expected because the more ATMs are around, the easier it is to

get cash money and therefore people will pay relatively more by cash than when ATMs are difficult to find. The second control variable is (GDP). This variable measures the total value added of final goods and services per capita. GDP is included as control variable because if the GDP of a country is high this means more income which people can spend and therefore more transactions can be made in a particular country. The third variable is (ROL). This variable measures a country's rule of law. It defines as that the law is applied fairly and equally enforced. A strong rule of law can reduce the risk of paying by card and therefore a higher number of card payments is expected. Therefore we expect a positive relationship. The fourth control variable is (GE). This variable captures the Government Effectiveness of a country. A government that is more effective leads to more desired changes and more confidence from a consumers perspective. This will positively relate to the number of card payments in a country. The fifth control variable is (TER). This variable measures the school enrolment to tertiary education. This variable is measured in percentages. The higher this value is the more people will get educated and because it is found that people that are more educated are paying by card we expect a positive coefficient. Finally, we include a dummy variable (ECB) which only takes into account the countries from the ECB database. All these countries are from the same database and therefore we would like to see if there is a significant difference between these countries and the rest. This variable is only included if the full sample is used.

### 3.4 Empirical models and estimations

The empirical model for this analysis is shown below. It shows the relationship between trust, uncertainty avoidance and corruption on the number of card payments. The formula is shown below.

$$CPM_{it} = \beta_1 TRUST_i + \beta_2 UA_i + \beta_3 GDP_{it} + \beta_4 ATM_{it} + \beta_5 GDP_{it} + \beta_6 ROL_{it} + \beta_7 GE_{it} + \beta_8 TER_{it} + \beta_9 ECB_{it} + u_i + \epsilon_{i,t}$$

Subscript  $i$  means that the variable differs among the number of observations. In our case the countries is the variable of observation. The subscript  $j$  means that the variable variates over time. So multiple years are included for this variable in the model. This model is used in the first part of the analysis. Which tries to investigate whether institutions play a role in the number of card payments. Here a cross country analysis is performed. Also the variables are standardized to a mean of 0 and a standard deviation of 1 because the coefficients became too large because of huge differences in value between the variables.

### 3.4.1 Variation of the empirical model

In the second part of the data analysis we perform a country within analysis on corruption and the number of card payments. The empirical model of above shows which variables are included. In this part only corruption will become an independent variable because it differs over time. We test if a change in the corruption level leads to a change in the number of card payments in country  $i$ . All other control variables are included in this variation of the model. Because we have know only time variant variables we perform a fixed effect model. This means that country fixed effects ( $\sigma_i$ ) and year fixed effects ( $\mu_t$ ) are added to the model. We do this to tackle the problem of omitted variable bias and to treat variables that could also influence the relationship as fixed. Finally as a robustness check we check if a change in corruption leads to a change in the same year of some years later. Here you can see the variation of the model.

$$CPM_{it} = \beta_1 COR_{it} + \beta_2 ATM_{it} + \beta_3 GDP_{it} + \beta_4 ROL_{it} + \beta_5 GE_{it} + \beta_6 TER_{it} + \beta_7 ECB_i + \sigma_i + \mu_t + \epsilon_{i,t}$$

Subscripts refer to the same identifiers as above.  $\sigma_i$  is defined as country fixed effects and  $\mu_t$  defines as the year fixed effects,

The lagged variables are seen as follows: Corruption\_L3. This means that a change in corruption at time  $t$  leads to a change in the number of card payments 3 years later. In this robustness check everything else is still the same only 4 lagged variables are added to the model.

## 3.5 Descriptive statistics and correlation matrix

Table 1 shows the key characteristics of the paper. Each country is showed and their respective values for card payments, social trust, corruption, uncertainty avoidance and whether the country is an ECB country. Table 2 shows the correlations between all variables included in the model. Both tables can be found on the next pages.

Table 1: Descriptive statistics of the variables used in the regression analysis per country

	CPM	TRUST	COR	UA	ECB
AUSTRALIA	184.209.85	48.5	1.911	51	0
AUSTRIA	53.768.905	49.8	1.696	70	1
BELGIUM	108.721.76	.	1.466	94	1
BULGARIA	8.010.375	17.1	-0.173	85	1
CANADA	128.222.00	46.7	1.919	30	0
CYPRUS	45.285.238	6.6	0.956	.	1
CZECH REPUBLIC	38.462.571	21.1	0.445	74	1
GERMANY	39.665.476	44.6	1.833	65	1
DENMARK	213.833.48	73.9	2.338	23	1
SPAIN	59.292.368	41	1.001	86	1
ESTONIA	135.261.71	33.9	1.148	60	1
FINLAND	199.291.71	68.4	2.280	59	1
FRANCE	121.895.24	26.3	1.360	86	1
GREAT BRITAIN	172.320.00	40.2	1.796	35	0
GREECE	20.042.19	8.4	0.092	112	1
HUNGARY	32.914.095	27.2	0.360	82	1
CROATIA	71.199.625	13.6	0.131	80	1
IRELAND	100.412.95	.	1.600	35	1
ITALY	30.277.667	26.6	0.286	75	1
JAPAN	2.691.00	33.7	1.421	92	0
LATVIA	68.981.667	22.2	0.346	63	1
LITHUANIA	50.312.667	31.7	0.420	65	1
LUXEMBURG	156.894.50	.	2.001	70	1
MALTA	31.076.211	.	0.796	96	1
MALAYSIA	21.946.00	19.6	0.200	36	0
NETHERLANDS	152.170.95	58.5	2.017	53	1
NORWAY	355.224.00	72.1	2.114	50	0
NEW ZEALAND	72.125.00	56.6	2.287	49	0
POLAND	44.064.00	24.1	0.524	93	1
PORTUGAL	108.260.14	16.9	0.992	104	1
ROUMANIA	11.373.025	12.7	-0.215	90	1
SINGAPORE	145.024.00	34.4	2.174	8	0
SERBIA	161.489.00	16.3	-0.373	92	0

SLOVAKIA	37.520.00	21.4	0.249	51	1
SLOVENIA	62.367.952	25.3	0.892	88	1
SWEDEN	202.043.43	62.8	2.185	29	1
UNITED STATES	348.442.00	37	1.418	46	0

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Table 2: Matrix of correlations of the variables used in the regression analysis

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) Number of card payments	1.000									
(2) Social trust	0.550	1.000								
(3) Control of Corruption	0.571	0.889	1.000							
(4) Uncertainty Avoidance	-0.373	-0.713	-0.633	1.000						
(5) Number of ATMs	-0.033	-0.141	0.084	0.258	1.000					
(6) GDP per Capita	0.414	0.830	0.854	-0.574	0.076	1.000				
(7) Rule of law	0.547	0.845	0.960	-0.609	0.110	0.834	1.000			
(8) Government effectiveness	0.536	0.841	0.950	-0.652	0.071	0.816	0.961	1.000		
(9) Tertiary school enrollment	0.316	0.304	0.279	-0.015	0.043	0.307	0.308	0.280	1.000	
(10) ECB	0.196	-0.160	-0.207	0.314	-0.129	-0.348	-0.181	-0.196	0.011	1.000

## 4. Results

The results are summarized in Table 3. First, 4 OLS regression were performed. The first three regressions have included each one independent variable. This is done because high correlation was found between the independent variables. In the end an OLS regression was performed with all independent variables together. Beforehand the assumptions were tested to prove the need of an OLS regression. However the assumption of no autocorrelation and homoscedasticity were rejected. These test can be found in the Appendix. Therefore we performed a Generalized Least Square regression, this is the fifth regression. Then as a robustness check we only included the ECB countries. The other regression show significant coefficients for the ECB dummy meaning which gives us a reason to check for this. First a simple OLS regression is performed and after the GLS regression.

### 4.1 Social Trust and card payments

Hypothesis 1 predicts that social trust is positively related to the number of card payments in a country. The result is shown in table 3. Social trust is positively related to the number of card payments. However only in the first regression a significant coefficient is found. Even a negative coefficient is found when only the ECB countries are included in the sample. This means that trust will leads to less card payments. A theoretical reason for this finding could be that the trust in the financial institutions is still low even if the social trust is high. Trust in financial institutions is a better measurement for trust. A more analytic explanation is that the power of the model lays within the non ECB countries and because they are removed in the sixth regression the explanatory power disappears. A different explanation which we already mentioned is the high correlation between uncertainty avoidance corruption. This statement is partially evidenced by the significant coefficient when only capturing social trust ad independent variable. Because of these findings we cannot support hypothesis 1. There is no relationship between social trust and card payments.

### 4.2 Uncertainty Avoidance and card payments

Hypothesis 2 predicts a negative relationship between the uncertainty avoidance dimension and the number of card payments in a country. Uncertainty Avoidance (UA) is negatively and significant related to the number of card payments in all OLS regressions. For both the full sample and ECB sample the same coefficient is found. However in the GLS regression the coefficient becomes positive and when the sample only contains ECB countries it even becomes significant. It means that people that dislike uncertain situations prefer card payments. This is not in line with our hypothesis. This results can be explained by the following. In the literature review we describe card payments as a

uncertain payment form. However in developed countries card payments have sustained reputation as a type of payment that is not uncertain any more. This could mean that we find positive coefficients. A different remark is that the uncertainty avoidance dimension is gathered in 1980. These rankings could have differed over time and this has an impact on the findings. Because of the unexpected findings and that the GLS regressions is a more suitable model than the OLS regression we cannot support hypothesis 2.

### 4.3 Corruption level and card payments

Hypothesis 3 predicts that corruption levels are negatively related to the number of card payments in a country. However because the variable Corruption is measured as having a high number means that the corruption in the country is low, we expect a positive coefficient. In all regressions we found a positive and significant coefficient which is in line with our hypothesis. Therefore we support hypothesis 3. Countries with lower corruption levels display higher numbers of card payments.

Table 3: Basic empirical model; trust, uncertainty avoidance, corruption and the number of card payments

	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) GLS	(6) ECB	(7) GLS ECB
Social trust	0.308*** (0.0601)			0.0385 (0.122)	0.0959 (0.0625)	-0.221 (0.117)	0.153 (0.0796)
Uncertainty avoidance			-0.157** (0.0527)	-0.211* (0.0834)	0.0712 (0.0390)	-0.290** (0.0918)	0.227*** (0.0669)
Control of Corruption		0.812*** (0.145)		0.753*** (0.175)	0.0852* (0.0352)	0.713*** (0.185)	0.109** (0.0380)
Number of ATMs	0.0115 (0.0489)	-0.0307 (0.0477)	0.0104 (0.0522)	0.0246 (0.0557)	0.0760*** (0.0206)	-0.0439 (0.0468)	0.0653** (0.0210)
GDP per capita	-0.127 (0.0917)	0.0840 (0.0758)	0.199** (0.0665)	-0.160 (0.0963)	0.0245 (0.0184)	0.146 (0.100)	0.161*** (0.0328)
Rule of Law	0.219 (0.142)	-0.214* (0.105)	0.130 (0.123)	-0.0796 (0.140)	0.0169 (0.0254)	0.0496 (0.134)	0.00280 (0.0340)
Government Effectiveness	0.166 (0.118)	-0.0828 (0.120)	0.190 (0.114)	-0.146 (0.158)	-0.00715 (0.0203)	-0.135 (0.153)	0.0103 (0.0216)
Tertiary school enrollment	0.166** (0.0635)	0.191*** (0.0496)	0.193*** (0.0538)	0.237** (0.0758)	0.0869*** (0.0234)	0.134** (0.0430)	0.0341 (0.0226)
ECB	0.879*** (0.190)	1.010*** (0.182)	1.117*** (0.198)	1.029*** (0.193)	0.704*** (0.0499)	0 (.)	0 (.)
_cons	-0.770*** (0.170)	-0.868*** (0.172)	-0.965*** (0.182)	-0.877*** (0.168)	-1.120*** (0.0420)	0.264*** (0.0517)	-0.422*** (0.0471)
Observations	359	411	396	344	344	304	304
Number of Countries	37	37	37	37	37	27	27

Robust standard errors in parentheses. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

#### 4.4 Change in corruption and change in card payments

Hypothesis 4 predicts that a change in corruption leads to a change in the number of card payments. Table 4 shows a positive coefficient however only for the ECB countries the coefficient is significant. For the full sample the coefficient was significant at a 10% interval level. Then table 5 shows the robustness check with the lagged variables. It shows that two lagged variables are significant for both samples. For  $t+3$  both coefficients are significant and for  $t+4$  one of the two coefficients is significant. This means that a change in corruption correlates with a change in the number of card payments 3 or 4 years later. This finding is in line with the theory that it takes time to change consumption patterns to a new technology. According to the results we can support hypothesis 4. A change in corruption correlates with a change in the number of card payments within a country. However a change in card payments may take longer than the change in corruption.

Table 4: Fixed Effect model with control of corruption as independent variable

	(1) Full Sample	(2) ECB
Control of Corruption	0.169 (0.0914)	0.225* (0.0873)
Number of ATMs	-0.288*** (0.0515)	-0.278*** (0.0502)
GDP per Capita	0.559*** (0.0887)	0.610*** (0.113)
Rule of Law	0.273** (0.104)	0.284** (0.104)
Government Effectiveness	-0.347*** (0.0668)	-0.358*** (0.0668)
Tertiary education enrollment	-0.114* (0.0440)	-0.0992* (0.0441)
_cons	-0.915*** (0.115)	-0.983*** (0.116)
<i>N</i>	411	371
<i>Number of Countries</i>	37	27

Robust standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Table 5: OLS regressions including lagged variables

	(1) Full Sample	(2) ECB
Control of Corruption	0.0227 (0.175)	0.0546 (0.162)
Control of Corruption_L1	-0.117 (0.130)	-0.0217 (0.127)
Control of Corruption_L2	0.0158 (0.117)	-0.0446 (0.105)
Control of Corruption_L3	0.247* (0.108)	0.260* (0.106)
Control of Corruption_L4	0.177 (0.0948)	0.186* (0.0854)
Number of ATMs	-0.211 (0.125)	-0.210 (0.120)
GDP per Capita	0.509*** (0.131)	0.477* (0.206)
Rule of Law	0.243 (0.228)	0.269 (0.227)
Government Effectiveness	-0.321 (0.192)	-0.329 (0.192)
Tertiary education enrollment	-0.0669 (0.103)	-0.0468 (0.104)

<i>_cons</i>	-1.091*** (0.265)	-1.160*** (0.274)
<i>N</i>	368	328
<i>Number of Countries</i>	37	27

Robust standard errors in parentheses  
\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

## 5. Discussion

### 5.1 Findings and Interpretation

The results show that the three institutional variables do play a role when it comes to the number of card payments. We found that social trust (TRUST) is positively related to the number of card payments in a country. However only in one regression the coefficient is significant. Prior research has found a positive and significant relationship between trust and the number of card payments. But, their methods and measurement of trust differs from this paper. First, prior papers used different data methods such as Partial Least Square Estimations, Growth mixture modelling or SEM. This paper does not use such methods and instead uses a different methodology. Secondly, this paper measures trust as social trust. Gozcek et al. (2015) uses the same measurement however other papers use perceived trust as measurement of trust (Maqableh, 2015). This is a more exact measurement and more powerful to investigate whether trust has a positive impact on the use of card payments. It captures also trust in financial institutions which is directly related to the use of card payments. Finally, a possible reason for this finding is the high correlation between social trust and corruption. By adding these two variables into one regression it could be that all explanatory power of trust is captured within the corruption variable. Therefore the regression with only TRUST included as independent variable shows a significant coefficient because the other two highly correlated independent variables are not taken care of in the model.

The finding that corruption positively relates to the number of card payments is in line with prior findings. They also found a positive and significant coefficient which we did too. We can interpret this result as follows. Countries that display lower levels of corruption will have less money laundering activities because it becomes difficult to extract. These corrupt activities are done by cash and therefore the cash amount drops and the number of card payments increases because the total transactions are stable over time. An indirect effect is that card payments increase because of the good governance of corruption by governments. People get more trust in the local government to combat corrupt activities and therefore are more willing to pay by card. A different finding is that a change in corruption positively is related to a change in the number of card payments. The regression with the full sample found a positive and significant relationship at the 10% significance level and the regression with only ECB countries finds it at the 5% significance level. The fixed effect model with the lagged variables showed that a change in corruption is positively related to a change in the number of card payments 3 and 4 years later. This finding is in line with the theory that culture is deeply rooted in society and that it takes time to change.

The last finding is that the relationship between uncertainty avoidance and the number of card payments is mixed. The OLS regression found a negative and significant coefficient whereas the GLS regression a positive and significant coefficient found. This finding is in line with Deufel (2019) who

also found negative and significant coefficient when using OLS regressions. However other papers found no significance coefficients. The finding of a positive coefficient is a surprising result. People that dislike uncertain situations display a higher number of card payments. A possible reason for this finding could be that card payments are not considered as uncertain payment form compared to cash payments. Card payments are now around for some years and therefore they are not considered as risky or uncertain. However then the coefficient must be 0 and a positive coefficient is still difficult to explain. Again here also could the results be impacted by the high correlation between the independent variables.

For the control variables we also found some unexpected results. In the cross-country analysis we only found for tertiary education school enrolment and the number of ATMs significant coefficients.

However in the fixed effect models almost all variables showed significant coefficients. This could mean that also for these variables it holds that a change in these variables is more correlated with the number of card payments rather than the actual presence. For the variable Government effectiveness we expected a positive relationship but we found a negative coefficient. In other words a government that is ineffective positively relates to the number of card payments in that country. We also found for the variable tertiary education a negative coefficient in the fixed effect model rather than a positive coefficient. A potential reason could be that the measurement is not right of this variable. For example, does the school enrolment to tertiary education measures education levels in society. A different question is: Does going to tertiary education leads to more intelligence and smartness. So measuring education in this way is maybe not the appropriate choice.

## 5.2 Limitations

This paper has some limitations. First, from an economist perspective we would like to investigate causal relationships. Does x leads to y. This paper tries to research if institutions have an effect on the number of card payments cross country and within a country. However the methodology used cannot conclude that there is a causal relationship between institutions and card payments. Adding to this, do institutions really impact the choice between cash and card payments. Having more social trust will not automatically lead to preferring card payments over cash payments. This paper includes the number of ATMs as one of the control variables. The number of ATMs in a country directly influences the amount of cash payments. The less opportunity for getting cash money the less payments by cash. An important note here is that the amount of ATMs is determined by the demand of cash money so this relationship is self-fulfilling. Institutions shape a culture in which card payments can be a more used payment option however the number of ATMs and the maximum amount you can by card are variables that have a more causal relationships. Some countries organize events where only card payments are allowed these things contribute to a more card payment society.

A different limitations is linked to the sample. The chosen countries in this research impacts the results. The sample consists of mostly developed countries. These countries are similar in education levels, GDP per capita and rule of law. Also institutions show similar patterns but for example on uncertainty avoidance the chosen countries differ which is also the case for the number of card payments. Having a sample with similar countries makes it difficult to perform a cross-country analysis. Because differences are not huge and therefore makes it hard to get conclusions from the research. Having a sample that mostly consists of developed countries makes it difficult to generalize the founding results. A different limitation of the sample is the amount of countries. The sample consists of 37 countries which is not much and for some countries data is only available for a couple of years. If countries from South America and Africa were introduced to the sample, results could be different and a better overview of card payments around the world can be made. But registering payment data is difficult especially in countries that lack financial institutions. A final point on the sample is the comparability of the data. Part of the dataset is gathered via the ECB database. To expand the number of countries data is taken from separate databases. However this sets limitations to the comparability of all countries in this research. This has to be taken into account.

Also the research design has its limitations. This paper tries to investigate whether certain institutions in a country correlate with a higher number of card payment. Secondly it researches whether a change in corruption leads to a change in the number of card payments. The research does not investigate institutional determinants for card payments. It could be that that institutions and card payments are correlated because of a different variable. This research designs cannot provide such an analysis which is an limitation of this paper. Also the choice for these 3 institutional characteristics is a limitation which has to be taken into account. Other institutional characteristics could play a role and are a better choice when it comes to influencing card payments. For these 3 institutional characteristics prior research has been done that is the reason why these variables were included. On this topic limited research has been performed and when research is done the chosen design is a survey based research or macroeconomic characteristics are included. But the chosen variables also included limitations. The variables social trust and uncertainty avoidance are measured on a country level. However these variables are better to measure at an individual level. Because the social trust level measurement for a country means that every person in that country has the same social trust level. In reality this is not the case, it differs between age, gender and place of living. So these variables show some limitations. However if you want to measure these variables at an individual level however then a survey based research needs to be done and it becomes difficult to have a large sample with multiple countries.

### 5.3 Future Research

Future research can take the limitations into account by performing researches that solve some of the problems in this research. First research can be performed on the institutional determinants of card

payments. This can be done via regressions but also with an Instrumental Variable Analysis. Then a relationship can be found via the chosen variables rather than a correlation which is one of the limitations of this research. Such an analysis can be performed with institutional characteristics but variables like the number of ATMs is a more suitable option.

If future research would like to focus on a cross country analysis then more characteristics have to be included and the dataset has to be larger. Data is not available for a large country set this is also a option for future research to create a large dataset. To perform a within country analysis a large dataset is not necessarily but it gives room for investigating what characteristics really impact the choice of payment. Because institutions are specific for cultures and thus countries and therefore investigating what institutional characteristics drives people towards card payments, in order words a within country analysis, is also interesting for future research.

For future research the sample has to increase in size and type of countries. In the future card payments can be the most common payment form in the world. Therefore it is interesting to get this topic more attention in future researches. More developing countries lack formal institutions and therefore informal institutions do play a role in the adoption of card payments. Thus including these countries is of importance in the future if data is available. Finally, light can be shed on other electronic payments. In 10 years, card payments could have become what cash is now and new payments such as e-money can be the new form of payment. Then this topic can be interesting in the future and what variables influences the decision to switch from card payments to e-money

## 6. Conclusion

### 6.1 Research Question

This research performs a cross country analysis on what institutions do play a role in the number of card payments and follows it up by a within country analysis on corruption and the number of card payments. This study is done because less attention is given to the relationship between institutions and card payments around the world. Three institutional variables are chosen, social trust, uncertainty avoidance and corruption. In the cross-country analysis we run OLS and GLS regressions and as a robustness check we divide the sample in ECB and non ECB countries. The results show that only corruption plays a significant role in the number of card payments. For trust not much significance is found and for uncertainty avoidance results are mixed. In the within country analysis we run a Fixed Effect model and also perform a robustness check on ECB and non ECB countries. We also add lagged variables of corruption to the model in order to check if a change in corruption leads to a change in the number of card payments in some years later. We found that a change in corruption correlates with a change in the number of card payments. This is the strongest for t+3 and t+4. In other words a change in corruption correlates with a change in card payments 3 or 4 years later within a country. This paper has some limitations on the sample and chosen variables however it contributes to the scarce literature on institutions and electronic payments. It can start a new discussion on this relationship rather than keeping the focus on the macroeconomic variables. Thereby investigating the direct effect of institutions on card payments is interesting and a greater pool of countries is necessary.

### 6.2 Practice & Policy

Institutions shape the interaction process and therefore the type of payment within a country. Countries that want to shift their payments towards card payments have to see if institutions such as social trust and corruption are in place to get the desired change. Institutions have to be understood whether they play a role for consumers that would like to shift their payments to more electronic payments. For policymakers such as central banks it is important to know how much cash money there is in circulation. On the basis of this number are policies created. Because in the future society is going toward a electronic/digital money society the adoption of card/electronic payments will take place in most developed countries. However the speed with which this happens depends on the institutional environment.

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## Appendix

### White's heteroskedasticity test OLS regression (1)

White's test	df	p
H0: Homoskedasticity		
Ha: Unrestricted heteroskedasticity		
chi2(34) = <b>230.92</b>		
Prob > chi2 = 0.0000		
Cameron & Trivedi's decomposition of IM-test		
chi2		

### Autocorrelation test OLS regression (1)

#### Linear regression

autotrust	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
L	1.075	.007	<b>148.42</b>	0	1.06	1.089	***
Constant	.089	.005	16.73	0	.079	.1	***
Mean dependent var		0.040	SD dependent var			0.798	
R-squared		0.984	Number of obs			351	
F-test		22029.025	Prob > F			0.000	
Akaike crit. (AIC)		-619.977	Bayesian crit. (BIC)			-612.256	

\*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$

### White's heteroskedasticity test OLS regression (2)

White's test	df	p
H0: Homoskedasticity		
Ha: Unrestricted heteroskedasticity		
chi2(34) = <b>272.50</b>		
Prob > chi2 = 0.0000		
Cameron & Trivedi's decomposition of IM-test		
chi2		

### Autocorrelation test OLS regression (2)

#### Linear regression

autocor	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
L	1.085	.008	<b>135.56</b>	0	1.069	1.1	***
Constant	.092	.006	16.07	0	.08	.103	***
Mean dependent var		0.038	SD dependent var			0.780	
R-squared		0.979	Number of obs			398	
F-test		18375.265	Prob > F			0.000	
Akaike crit. (AIC)		-600.819	Bayesian crit. (BIC)			-592.846	

\*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$

### White's heteroskedasticity test OLS regression (3)

White's test	df	p
H0: Homoskedasticity		
Ha: Unrestricted heteroskedasticity		
chi2(34) = <b>269.13</b>		
Prob > chi2 = 0.0000		
Cameron & Trivedi's decomposition of IM-test		

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chi2

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Autocorrelation test OLS Regression (3)

**Linear regression**

autoua	Coef.	St.Err.	t-value	p-value	[95% Conf	Intervall]	Sig
L	1.085	.007	<b>150.78</b>	0	1.071	1.099	***
Constant	.089	.005	16.60	0	.078	.099	***
Mean dependent var		0.036	SD dependent var			0.811	
R-squared		0.984	Number of obs			383	
F-test		22735.820	Prob > F			0.000	
Akaike crit. (AIC)		-642.877	Bayesian crit. (BIC)			-634.981	

\*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$

White's heteroskedasticity test OLS Regression (6)

White's test	df	p
H0: Homoskedasticity		
Ha: Unrestricted heteroskedasticity		
chi2(44) = <b>183.70</b>		
Prob > chi2 = 0.0000		
Cameron & Trivedi's decomposition of IM-test		
chi2		

Autocorrelation test OLS Regression (6)

**Linear regression**

autoecb	Coef.	St.Err.	t-value	p-value	[95% Conf	Intervall]	Sig
L	1.062	.009	<b>119.36</b>	0	1.045	1.08	***
Constant	.096	.006	16.95	0	.085	.107	***
Mean dependent var		0.048	SD dependent var			0.681	
R-squared		0.980	Number of obs			299	
F-test		14246.956	Prob > F			0.000	
Akaike crit. (AIC)		-541.866	Bayesian crit. (BIC)			-534.465	

\*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$