IMPACT OF DIGITAL PAYMENTS ON THE ECONOMIC GROWTH OF A COUNTRY- A CASE OF THE CZECH REPUBLIC

ANIRUDH SRIVASTAVA, PAVEL ŘEŽÁBEK

Abstract:

The way we pay has been evolving over a large period now with the slow fade out of paper money the digital system of payments is seen to pique the interests of consumers, institutions, and businesses. It is simply due to the more efficient features it displays over fiat money and this is what the paper tries to identify if whether there exists an impact of these digital payments over the economy of the Czech Republic by carrying out a linear and multiple regression employing selected indicators from 2015 to 2020. To test for heteroscedasticity in the obtained regression models the Breusch pagan test was employed. The results showed us that there does exist an impact of these digital payments but not enough that a switch or larger usage be employed to such a payment system this could also be due to the insufficient transactional value data available for such digital payments the access to more data can also allow to recognize the real demand of digital payment products by consumer which will enable more supply of digital payment system and providers, thus more wide-ranging research with more digital payment inclusive data could be carried out to identify the real impact of these payment systems over an economy.

Keywords:

Cash, Cashless payment systems, Economic Impact, Technological Innovation, Research and Development.

JEL Classification: O33, O31, O40

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Introduction

Digital payments could be seen as a possible medium to conduct everyday transactions in the nearing future not only because it provides the user with convenience by accessing all the payments options from his/her smart device but also helps in working with the few problems associated with cash which could pose to be significant in the longer run. Economies around the world can use the aid of digitization and digitizing the way how we conduct transactions as the integrations of such gives these economies the needed push to better performance in terms of efficiency, research and development, and economic growth. New theories of economic growth associate innovation and technological advancements as positive spillovers over the economy which could induce economic growth, although it is still very early to rule out this theory work. In the practical sense, however, countries such as Nigeria, India, Sweden, and some other digital advancing countries could serve as an example of why digitization might be the important step towards further growth but also why it might be important on the sidenote to work with elements supporting the digital economy and society.

This paper tries to seek whether digital payments have an impact on the economy of the Czech Republic. This paper briefly considers two parts, the literature review and theoretical background summarizes the studies which have previously tried to observe the impact of digital payments on their respective economies which have resulted to a reasonable impact for the economy but also show that these payments are still in an early stage for us to classify if the impact is considerable enough in terms of economic growth to make a switch to these systems. The empirical part considers the Czech Republic as the reference area to study whether digital payments hold an impact on the economy or not. As the Czech Republic possesses a niche to recognize possible growth benefiting technologies and holds the front runner spot for a large share of sectors in the CEE region. The study uses the time frame between 2015-2020 to study the impact of digital payments, the analysis utilizes the simple and multiple linear regression statistical method to study the impact with the adoption of the Breusch-pagan analysis method to test for heteroscedasticity in the obtained regression model. The analysis uses data obtained from the Czech national bank's Time series system ARAD, European Central Bank (ECB) Statistical Data Warehouse (ECB SDW), and the Czech Statistical Office (CZSO). The obtained results suggested that there was an impact on the economy but again not considerable enough for the economy to use the digital payments on a larger scale than the ones used currently. However, the results are limited to the latest data available from the data sources as the data over cashless payments remained sparse across the sources for data of cashless payments which have led to the possibility to research this field with more wide-ranging available data to observe an accurate impact of the digital payments on the economy.

1   Literature review and theoretical background

The theoretical part can be described by taking into consideration the determinants to be for a digital payment economy or which is now being addressed as the cashless or less-cash economy, this is mainly due to the reason that money in paper form poses some complexities such as friction cost of cash, non-intrinsic features that make the cash increase general price levels but causes a fall in the value of the money or in simpler terms the cash which bought you 10 apples now buys you 5 apples so your country's monetary unit now buys less than it used to. If we trace the origins of a cashless economy, it can be traced to the 1990s with the introduction of electronic banking but as technology and banking are evolving the payment systems infrastructure is also witnessing massive changes to come on par with the idea of a cashless economy. In a cashless economy, there is substantial use of digital payments which act as the medium of exchange, a unit of account, and a store of value, cashless economy not only helps in the payments system but also has a positive impact on the economic growth, employment levels, and R&D.

A big advocate of the cashless economy could be the continent of Africa. Recently, countries in Africa have started to adopt the cashless economy model to their economies and countries like Nigeria have seen a significant positive impact on their economic growth. In a study, it was

found that the introduction of the cashless economy model could help in the growth of financial stability in the country, by conducting an experiment in Awka, Anambra state they also found the adoption of this model may also help in eliminating corruption and money laundering. However, they also highlighted some problems associated with adopting such a system, the level of illiteracy being very high makes it difficult for the general masses to understand this type of system and almost being of no use to the illiterate section of the society. A public enlightenment program by the government was suggested to help this section of society understand its uses. Another issue found was the level of internet-related fraud which could pose a problem when the system is in full use, to eliminate such a risk a complete internet security framework was recommended which should help in mitigating this risk (Okoye and Ezejiofor, 2013)

A cashless economy model is slowly but surely being tested out in various countries step by step to study its effect on the economy and more. Sweden could be regarded as one of the first countries paving its way successfully towards an almost cashless society. On the Swedish central bank's (Sverige Riksbank) website there are published various articles advocating the use of cashless payments and move towards a cashless society. The central bank of Sweden is currently working on the e-krona project with its work originating in 2017 to examine the need for a digital currency. According to the central bank, the cash now constitutes only 1% of the GDP with the decrease of cash transactions by 10% a year while the use of digital payments sets to increase every year. In a study it was found that the transaction values with the Swedish crowns decreased by 50% between 2007 and 2018, the most important reason which he highlighted was the development of this system has been left onto the market by the politicians' (Arvidsson, 2019). This market constitutes of banks, payment receivers, card operators, automated clearinghouses and payers, etc. This makes it easier for them to develop the system according to the customer demand and the current demand in Sweden is increasing every day for electronic services than cash. The high trust of consumers in the Riksbank along with the banking and payments system has allowed them to trust the digital payments system enough to use it daily. The swedes' interest in technology also helps them to develop the willingness to use the digital payments system to fulfill the idea of a cashless society.

Figure 1: Transaction values for the Digital Economy sector for the Czech Republic, Sweden
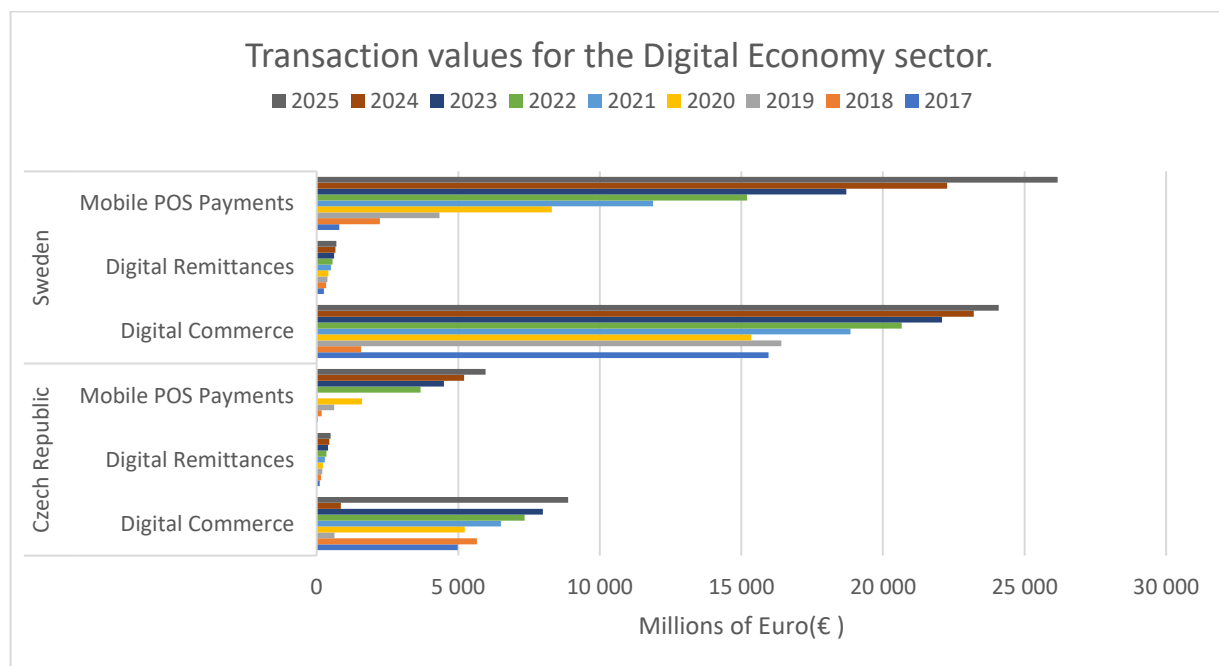
Source 1: Statista

Figure 2: Transaction values for the Digital Economy sector for France and Germany
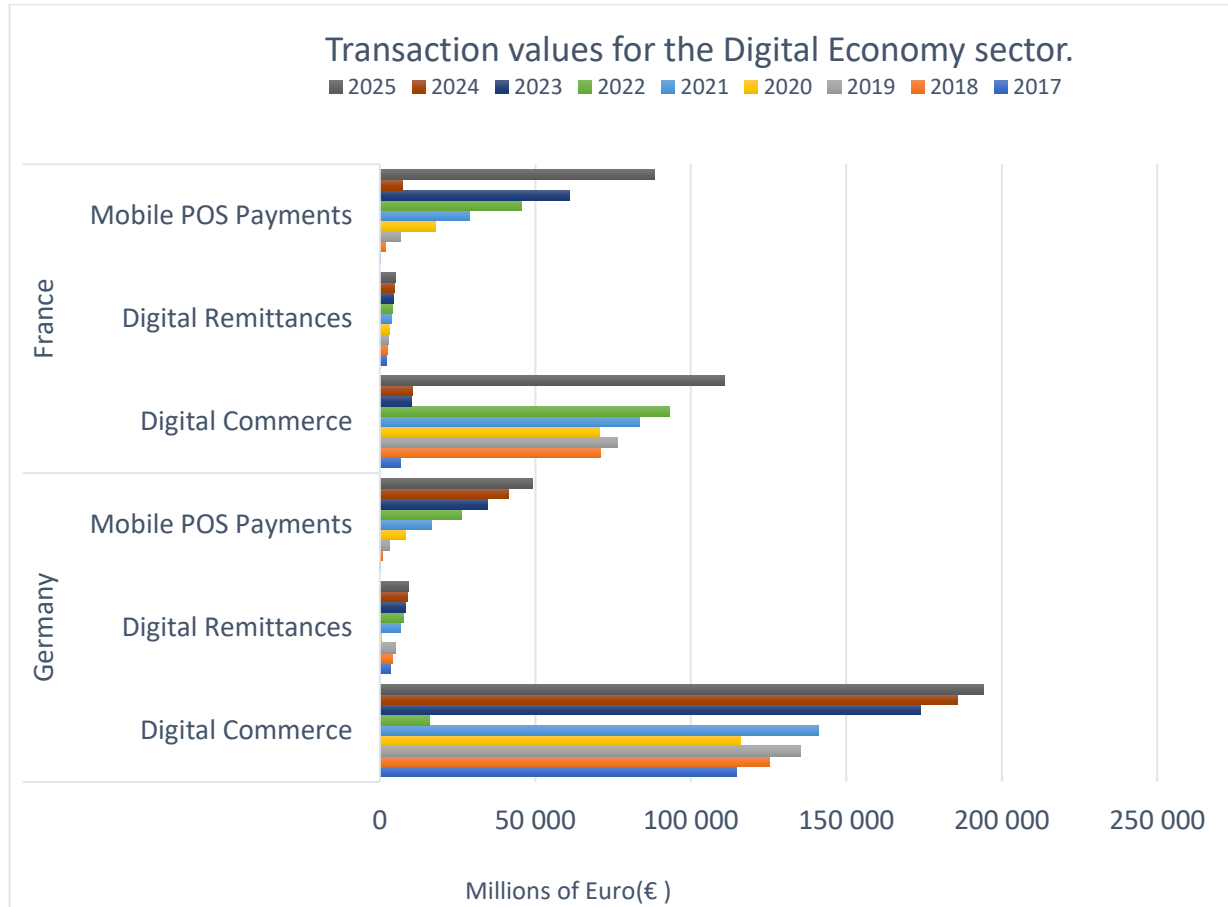
Source 2: Statista

In (Figure 1) we can see the transaction values for selected European countries (Czech Republic, Sweden). The predicted values for the countries compiled by Statista are based on Statista's primary research being the Statista global consumer survey, along with analysis of past and current trends and their impact on the key market and macroeconomic indicators. Statista also conducts discussions with market experts to achieve a complete overview of the possible future trends.

From the figure we can observe an upward trend after the year 2020 as 2020 saw a dip due to the coronavirus pandemic, but despite the pandemic affecting the economy the digital payments still saw an increase in sectors of POS payments and Digital commerce as people were trying to use digital methods of payment to be free of the spread of coronavirus through the exchange of money in paper form. There is a decrease in the mPOS payments for the Czech Republic as the data provided for the table did not include the total payments by mPOS due to the unavailability of the end-year 2021 data.

COVID-19 in a way supported the idea of a cashless economy to conduct transactions in the economy, as the use of digital payments can reduce the risk of contact to bacteria through the exchange of banknotes and coins however, this study has yet to be completely proven by the WHO so, for now, we can only assume the risks associated through the exchange of cash. The upwards trend in the transaction value of digital payments shows the acceptance of digital payments by the citizens and residents of the respective countries. Sweden is leading the race in Europe to transform into a cashless society with a decrease in the use of cash and more use of digital-based payments to support the idea of a cashless economy. The countries' population's interest in technology is why the mobile and digital payments companies like Swish, Vipps, etc. have more than 13 million users across the Nordic countries using their platform to conduct transactions.

In (Figure 2) we can see the transaction values for the digital economy sector in France and Germany, the countries respectively boast a higher market share of the digital economy sector with it set to grow at a rapid pace till 2025 the reason for this gap between the Czech Republic and western European economies can be the number of lags in certain variables determining the growth of the digital payments. Czechia has yet to make effective investments to avail the complete benefits of a digital economy and sector however, the government has complete knowledge of the idea and is making strides to incorporate the digital systems into their workings.

Economic growth for a country is subject to various factors some of them being the level of productivity (Kaderabkova, 2020), the levels of inflation (Cermakova, 2022), and most importantly the investments into innovation and technology (Hejdukova, 2020) which can induce economic growth (Cermakova, 2021). Investments into innovation and technology can result in a knowledge spillover, an estimate based by Solow showed that 90% of US output came from the result of technological change. Solow's model has paved way for a new field in economics called growth accounting, in growth accounting, there is an attempt empirically measure the variables that induce economic growth. However, Solow's model and other studies based on the neo-classical growth model were bounded by not measuring investments into innovations but rather the Total Factor Productivity (TFP). TFP is a measure of the productive efficiency of a nation which is calculated by dividing the economy-wide total production by the weighted average of inputs (Labor & Capital) but improvements in technology do not show much of an impact when measuring TFP. Incremental innovation is defined as an improvement to existing technology, an innovation is called radical if it could not have evolved through incremental improvements in the technology it displaces.

General Purpose Technologies (GPT) are a form of radical innovation GPT's in their initial stages have a limited number of uses it is when they are diffused through the economy to evolve as much more complex technologies with positive increases in the economic outputs they produce (Lipsey and Carlaw, 2000).

Technology and its improvements have wide reached effects which not only allow for growth but also for possible knowledge spillovers which can affect the economy on a large scale (Novotna, 2021). Technological innovation can be described by the continued theory of the endogenous growth theory, The endogenous growth theory postulates technology and its progress is the core determinant of economic growth (Vorlicek, 2015). The theory explains why the economic growth is the result of internal factors rather than external factors.

The technological change is subject to certain sectors in an economy, the R&D sector which is important for the growth in a country along with the investments into innovation results to economic growth increased innovation could result in increased productivity (Romer, 1994). Technological progress depends on the economic decisions of economic agents (Howitt and Aghion, 1998). Technological innovations are important for the firms and consumers as the firms require inputs to turn them into goods and services these same goods and services are purchased by the consumers, from the inputs till the final purchase of goods and services they are highly dependent on technological innovation, better forms of technology allow for a more efficient, faster and convenient system to carry out transactions.

The digital payments system we use today are much more technologically advanced in conducting millions of transactions each day and do not pose major critical dangers to the payments system. This certain system could lead to a set of advantages in emerging and developing economies as well as developed economies. In a working study in Afghanistan to show the role of defaults and financial incentives on the saving decisions of Afghan Employees through a new phone-based savings account. It was found that the average participating employee had a balance of 12,615 afghanis which equals 38.9% of the average monthly salary over the 6-month evaluation period. Those who had no matching incentive also accumulated 18% of a month's salary showing automatic enrollment is also cost-effective. They also found that such an application helped them cut down on unnecessary spending which allowed the participant to save more money using the mobile platform M-Pasandaz (Blumenstock, Callen and Ghani, 2017).

Digital payments systems can also help in promoting financial inclusion which is a less explored potential for stimulating economic growth. In research, it showed that the digital payments and financial inclusion can have large impacts on the world economy. In extensive research, the author found that financial inclusion and digital payments would impact individual tax revenue by $4.1 trillion globally (Maherali, 2017). These extra added funds could be wisely used by the governments to stimulate an economy and effectively impact the fiscal policy. In a study by the Boston Consulting Group (BCG), it was found that the use of cashless payments can help in better working of the central banks and commercial banks, As the digital payments can help in providing more eclectic supervision which can better the central banks' monetary and fiscal policies. When the European Sovereign debt crisis happened in 2012 several economists argued that moves by the central bank to cut interest rates to below zero would not be of help without a ban on cash. As paying money to banks for their own deposits would not in any way be beneficial for the consumer (Massi *et al.*, 2019).

Cash currently poses some problems one of them being the tax gaps, these gaps arise due to the undeclared payments done in cash which creates a problem for proper taxes to be levied on the respective individual. According to the Internal Revenue Service (IRS) of the United States of America, the tax gap could be defined as the difference between the true tax liability for a given tax year and the amount that is paid on time. These underreported taxes can make up a large bulk of the taxes to be paid to the government. In a report by the Internal Revenue Service (IRS), between 2011-2013 approximately $245 billion was constituted with underreported individual income tax constituting to about 70% of the underreporting tax gaps in the year 2011-2013, 45% of the underreported individual income tax was owed on business income for which the IRS has no way to verify it, 11% was constituted with corporate income tax and 0.3% was to the estate tax. In the case of the European Union, the VAT gap in 2019 was 9.6% with an expected increase to 13.7% by 2021. The VAT gap could be explained by the *difference between the VAT Total Tax Liability (VTTL) and the VAT revenue actually collected* (Zvinys, 2020). The Czech Republic had a tax gap of 12% in 2018 which when expressed in Euros is approximately €2.187 Billion. With the effect of coronavirus already visible on the economies around the world the VAT non-compliance will also rise as a result of the COVID-19 pandemic.

According to a report by the European Commission the VAT gap is caused by fraud and tax evasion, corporate insolvency, corporate bankruptcy, maladministration, and legal tax optimization.

Figure 3: VAT Revenue in the Czech Republic vs OECD
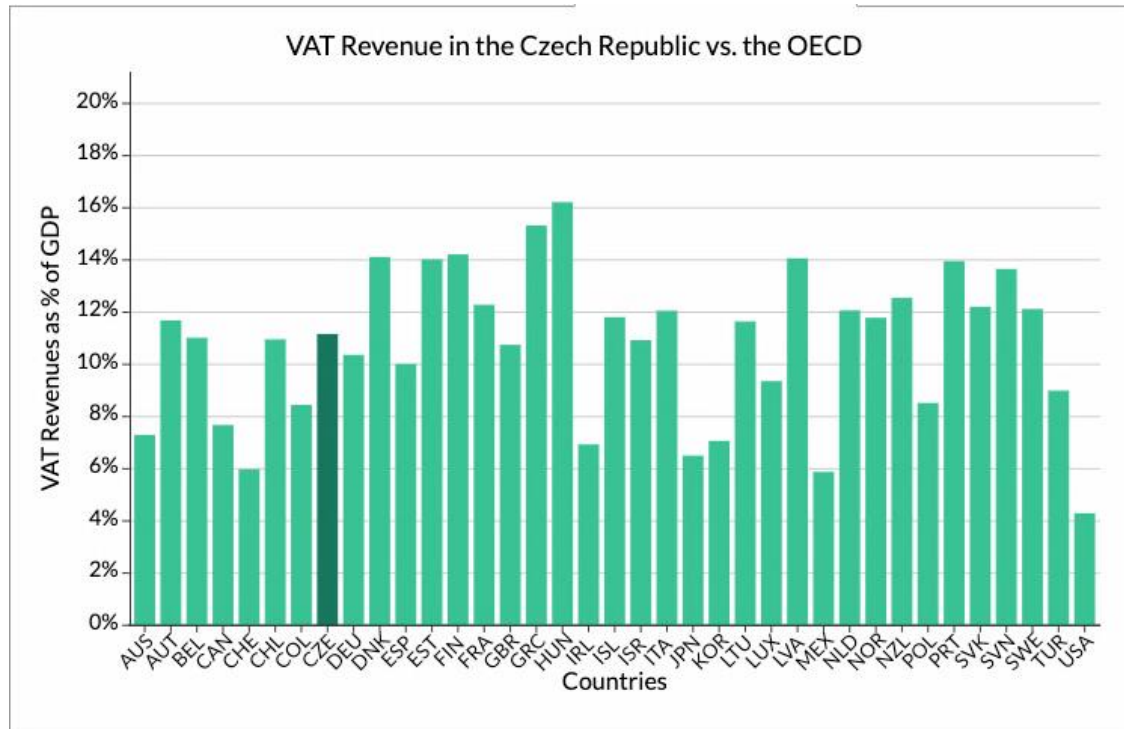

Source 3: Tax foundation.org

As seen in Figure 3 the VAT revenues from the Czech Republic make up about 11.5% of the GDP which is a quite significant amount, VAT non-compliance can have an effect on the VAT revenues as well as the government fiscal policy as the government cannot track of every non-compliant member which in turn makes it difficult to enforce taxes to reach the optimum set up by the government for VAT revenue collection. Such gaps cause internal market distortions which could be linked to organized crime.

In a report by OECD titled "Technology tools to tackle Tax evasion & Tax fraud." the report lays down solutions and compare pieces of evidence from various countries that are currently reforming their system which conducts and reports transactions for Tax declaration purposes. The OECD found that the data recording technology is the best system to incorporate to limit tax frauds and evasions, the data recording technology records transactions automatically saving work of recording each manually or even storing them on a system and later compiling data. Hungary can stand as an example for the incorporation of electronic cash registers which led to an increase of VAT revenue by 15% such increase in revenues not only help in curtailing the tax fraud and tax evasion problems but generate additional revenue which could be invested for the economic growth of a country through further R&D, innovations and technological advancements.

If we consider the Czech Republic in terms of access to technology and other determinants of economic growth, Czechia surely possesses one of the highest standards towards identifying and utilizing possible improvement to economic growth tech, with strides in technology to always improve overall worker efficiency (Jasova, 2021) but also the improvement of technology has started to play a bigger part as surely new tech can enhance the productivity and output for a worker but the improvements in the technology can provide even larger scope for achieving the maximum growth potential. Digital payments should not be restricted to the basic identity of cryptocurrencies but also rather research and likely invest more in useful long-term projects. Projects such as WEB 3 which shortly but briefly is a major improvement in technology for the internet or WEB 2 or World Wide Web (WWW) by incorporating the features of blockchain-like decentralization and token-based economics into its functioning. The biggest advantage of WEB 3 is focusing and tackling the problems which WEB 2 poses such as the collection of personal data by private networks which are then sold to advertisers and would be also stolen by hackers.

In figure 4 we can see the revenue made by Facebook using only advertising as the company has been blamed multiple times to utilize user data and target consumers with specific interest related ads and also often shift the consumer decision or likely influence it with the ads by taking into consideration the consumers behavior to content on their applications across the system (Potuzak, 2021). This data is just for Facebook whereas most companies now utilize this feature which is why the cookies that we accept every day allows to track and send back relevant information to the servers.

Figurek 4: Facebook's revenue through advertising (by Fiscal Quarter)
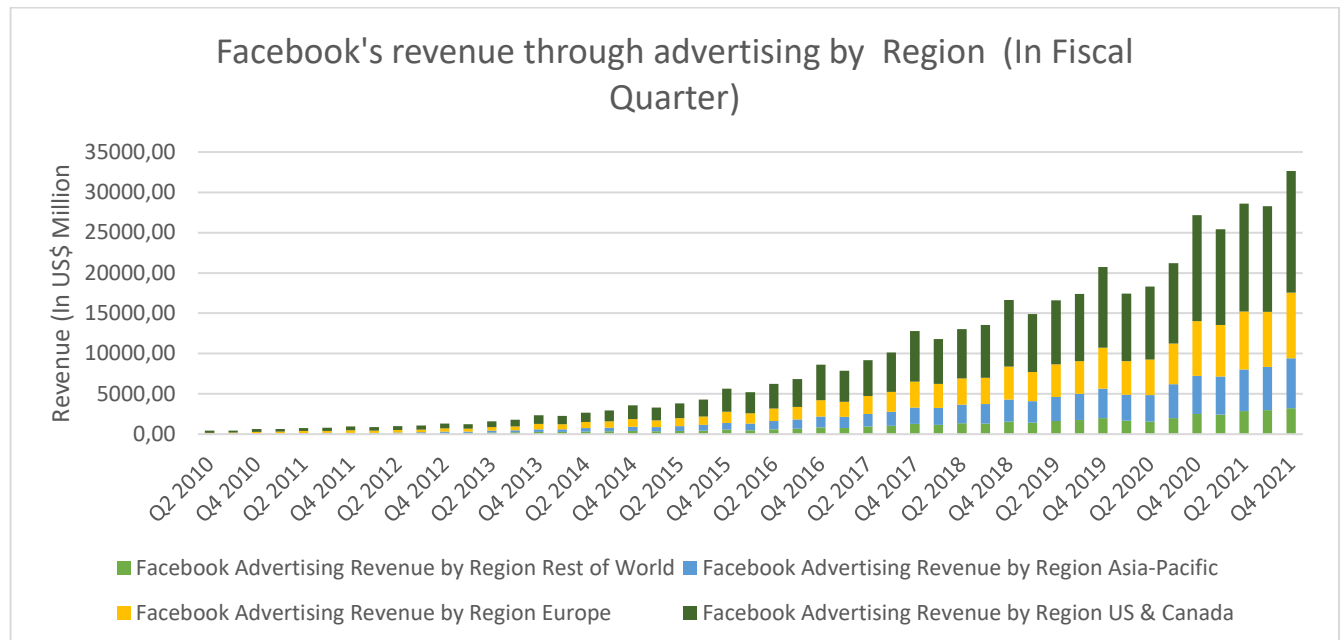
Source 4: Dazeinfo/Facebook, Inc.

As this is not the final line, regularly we click on "I accept" without really reading the Terms and conditions which could very well be saying to click away and consent to the tracking and advertisement usage. Hence it is more than important to invest, research and implement technologies that give the user more control, access, and security than the firms "promising" it.

With WEB 3 the network is decentralized hence an individual entity cannot control or could say it is not "backed by". The open access of such a network by decentralization means no single party can boast exclusive rights over the platform or similarly limit access for individuals.

The cryptocurrency is native to the WEB 3 so instead of relying on traditional payment markets which are connected to governments, third-party merchants, and restricted by borders WEB 3 used "tokens" and "crypto-assets or currencies" to conduct transactions. This also is giving rise to the development of new models for economies with which the field of such study is on the rise and is found under "tokenomics". But as every project, law, and theory takes time to develop and to be put in concrete as a fact, this wave of new technology, decentralization and possible solutions to curtail the complexities of using paper money will also take time to develop as we are still in the early game for such working given it has been a maximum of 15-20 years since this working arose and about 5-10 years since it actually started getting noticed by people capable of making such transformations.

2   Future of the Payments systems in the Czech Republic

The position of the Czech Republic is that of a digital challenger in the area of a digital economy and society according to a report by McKinsey, further progress in digitization can benefit the GDP of the Czech Republic by EUR 26 billion this additional growth to the GDP can make the Czech Republic attractive for investors and further increase competitiveness.

2.1   Present scenario

The country has increased its spending on technological innovations from 1.090 billion euros in 2015 to 1.370 billion euros in 2020

The country alongside has seen an increasing status of the digital payment systems with the projected data for the growth of average consumer spending with the mPOS payments in the Czech Republic which is to rise from 1,520 EUR in 2021 to 2,641 EUR to 2025 which is the result of the data compiled by Statista according to the Statista global consumer survey and macroeconomic indicators, along with which the user base is set to grow to a total of 2,3 million users by 2025 the current number of users of this mode of payment stands at 1,8 million users, the growing numbers of users in the country can help the retailers as the mPOS system possesses less setting up costs, operating costs and offers a much more flexible system with carrying additional features than the traditional POS system.

O2 and wire card partnered up to offer a product called eKasa which is a fully online mPOS system, TECS which is a market-leading payment solutions integrator has its systems in the Czech republic which partnered up with Spire Payments to offer mPOS services with products like the SPm2 and SPm20, Česká spořitelna, MasterCard, Vodafone, and Wincor Nixdorf had seen the need to tap into the mPOS markets as the wide-ranging small businesses required a better and easier payment method system both for the retailer and the consumer ease of use, since then the companies have introduced products like the Vodafone eDesk by Wincor Nixdorf and Vodafone, mPOS solutions by Česká spořitelna and Albert by Wincor Nixdorf.

Merchants in Czechia have also started accepting cryptocurrencies as a form of payment these types of payments are also seeing used by utility companies, Pražská Plynárenská which supplies almost 550,000 homes in Czechia with gas and electricity had also started accepting crypto as a form of payments from 2019. The company Alza started accepting bitcoin payments in 2018 which resulted in a massive number of orders placed through the new form of payments and inducing higher crypto turnovers month to month.

2.2   Future Scenarios

To support the integration of technologically advancing payment systems there has to be the utilization of the large ICT graduate pool to boost research and development, according to data from Eurostat the percentage of ICT specialists as a percentage of total employment in the Czech Republic has increased from 3.5% to 4.4% between 2015 and 2021 with the increase in the number of enterprises recruiting ICT specialists, There is a real opportunity to utilize the unemployed persons in Human Resource in Science and Technology (HRST) to help them adopt more digital skills and adoption of better skills through public enlightenment programs, digital innovation hubs (DIHs), career guidance, etc. The Czech Republic could benefit from the ISO 20022 complete implementation which is a step towards payments processing standardization, through this the banks across the world can drive business efficiencies and be ready to work with the ever-changing market trends. Despite being around for a long time the switch to complete use has been slow, SWIFT is planning to introduce updates to the ISO 20022 messaging for the major services it operates by end of 2022. Solutions are being tested to avoid or minimize data truncation. Due to ISO 20022, the change is merely noticeable to consumers but the access to more data points allows for better accounting and financial data, more transparent payments, and more flexibility in the payment system infrastructure. Target 2 and EURO1 payments are getting an update for the adoption of ISO 20022 by the Euro system and EBA clearing. Alongside US Federal Reserve, the clearinghouse, Bank of England, and more are simultaneously planning this shift to the new standard of payments.

Figure 5: GBARD (Government budget allocations for Research and Development)
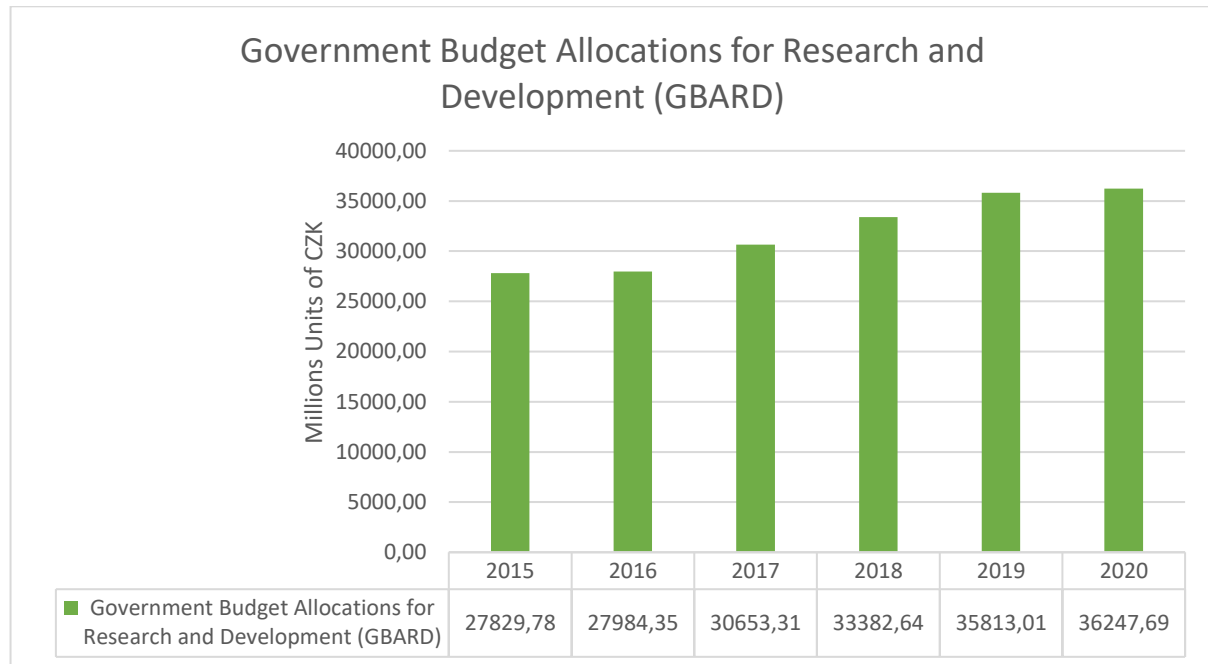
Source 5: Eurostat

Some direct costs such as the cost to effectively incorporate digital payment systems through the use of tools to help the functioning of such systems across the economy are being implemented of which the accurate cost remains undisclosed. The indirect costs could be linked to the cost to upgrade the users' and retailers' hardware and software to work efficiently with the digital payments system, increased hiring of ICT specialists who can work with the technology to ensure a smooth operation without any lapses in the system. Czech recovery plan of 7 billion euros in grants sanctioned by the European Commission includes 91 investment measures and 33 reforms. 42% of the plan will be working towards the needs to support the climate objectives and 22% of the plan will work towards digital transitions. The transitions would be supported by investing 585 million euros in programs which include but are not limited to new university programs in fast-growing digital fields and upskilling and reskilling courses for citizens. 650 million euros would be invested towards the digital transformation of businesses, digital innovation hubs (DIHs), very high-capacity networks, and 5G networks.

3   Cryptocurrencies, business and central bankers

Although quite versatile in making financial transactions, cryptocurrencies should still be considered an investment or speculative financial assets rather than pure equivalent to cash or money. A well-functioning currency should have at least three functions which are not yet fully met by cryptocurrencies. First, to be a store of value, the currency needs to show stability and limit every day price fluctuations. Second, the currency should serve as a unit of account and should foster understanding of the value of goods and services while enabling their easy comparison to each other. This is something cryptocurrencies can struggle with due to their high volatility. Last but not the least, currencies should serve as a universal and generally accepted mean of exchange. To a certain degree, cryptocurrencies meet this condition, however their general acceptance can still be questioned.

Cryptocurrencies and other crypto assets are generally considered legal but their regulation may vary across jurisdictions. The reasons for regulation typically includes a consumer and investor protection against market manipulations, limitation of risks related to online fraud and cyber-attacks as well as anti-money laundering initiatives to disable funding of criminal acts. EU legislation also sticks to these principles. EU laws do not prohibit financial institutions from holding or offering services in cryptocurrencies but the institutions have to follow a wide range of directives (e.g. AML, CRD/CRR) in order to be able to use them.

Given the popularity cryptocurrencies and striving for financial innovations, many central banks consider issuing their own digital currencies. These should provide households and businesses with a new form of central bank money and a new way to make payments while ensuring that the public has continued access to a risk-free form of money (Bank of England, 2020). Central bank digital currencies go in tandem with the technological advances leading to fully digital economy and offer a number of opportunities. On the other hand, their implementation can also raise significant challenges to financial stability and monetary policy conduct as it may change traditional channels through which a central bank can apply its influence on financial markets and the real economy. Current initiatives therefore seek to find optimal digital currency design, if they were to be introduced (Bank of England, 2020).

4   Model and discussion

The technological change is subject to certain sectors in an economy, the R&D sector which is important for the growth in a country along with the investments into innovation results to economic growth increased innovation could result in increased productivity field (Romer, 1994). Technological progress depends on the economic decisions of economic agents (Howitt and Aghion, 1998). "Sustained economic growth requires innovation and innovations cannot be decoupled from creative destruction, which replaces the old with the new in the economic realm and also destabilizes established power relations in politics." (Acemoglu and James A. Robinson, 2015)
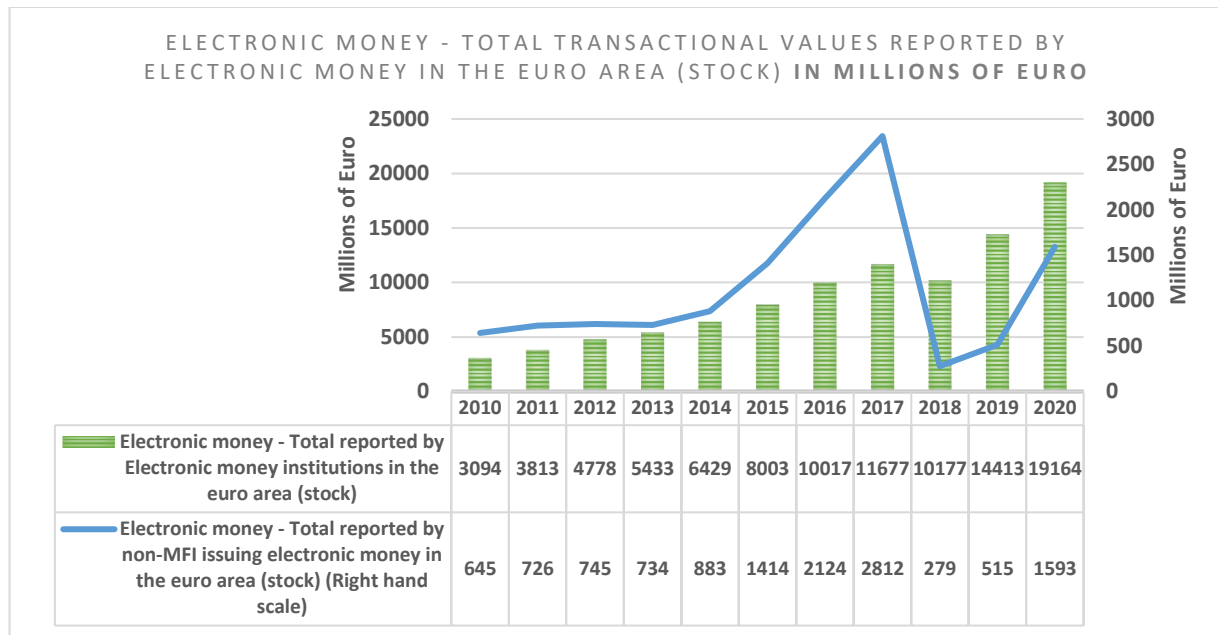
Digital payments could be classified as a form of technological progress in which there has been radical innovation with the evolvement of basic digital payments systems, In a report by Visa and analysis by Moody's Analytics to show the impact of electronic payments on economic growth, it was found that between the period 2011-2015 the electronic payments added almost $296 billion to the GDP of the 70 countries/regions included in the study, out of which it also showed that the use of electronic payments could add 0.11% at an average to the GDP of the Czech Republic(The Impact of Electronic Payments on Economic Growth, 2016).

To highlight the effects of the cashless payments, the paper involves the empirical part to be partially in line with some of the authors who have attempted to highlight the effect of cashless payments on economic growth, the importance of technology advancement on society, etc.,,,(Humphrey, Pulley, and Vesala, 2005; Humphrey *et al.*, 2006; Pece, Simona and Salisteanu, 2015). To obtain a general overview of how the sectors are doing in the Czech Republic the Czech national bank, the Czech Statistical Office, European central bank statistical data warehouse and Eurostat carry out surveys and post publications for the potential of a digital payments system which shall be incorporated to study the effect of digital payments on the economy of the Czech Republic

The analysis will utilize the Regression statistical methods selecting the indicators of cashless payments on the economic growth of the Czech Republic. The Breusch pagan test methods have been adopted to test the presence of heteroscedasticity in our obtained regression model, heteroscedasticity is a circumstance in which the variability of a variable is unequal across the range of values of a second variable that predicts it leading to complex riddled regression results.

In figure 6 we can observe the reported electronic money by electronic money institutions and the non-MFI, the data for the Czech Republic seemed to be very scarce from the source library hence why the Euro Area has been observed as a whole to identify the increasing transactional value of electronic money in the euro area. This graph can show us that the institutions, consumers, and businesses have started to build trust on such mediums of exchange or store of values.

Figure 6: Electronic money – Total transactional values reported by Electronic money in the euro area (stock) In millions of Euro

ELECTRONIC MONEY - TOTAL TRANSACTIONAL VALUES REPORTED BY ELECTRONIC MONEY IN THE EURO AREA (STOCK) **IN MILLIONS OF EURO**

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Electronic money - Total reported by Electronic money institutions in the euro area (stock)	3094	3813	4778	5433	6429	8003	10017	11677	10177	14413	19164
Electronic money - Total reported by non-MFI issuing electronic money in the euro area (stock) (Right hand scale)	645	726	745	734	883	1414	2124	2812	279	515	1593

Source 6: Eurostat OECD library

Figure 7: Selected Indicators for regression detailed table

Variable type	Variable	Variable Description	Source of Data
Explained variable	Real GDP	GDP of the Czech Republic at current prices	Czech National Bank; ARAD (Natural Logarithm)
Explanatory Variable	Total EFTPOS Card Payments	EFTPOS payments across the regions of Czech Republic compiled into one as per year of analysis by the CNB	Czech National Bank; ARAD (Natural Logarithm)
Explanatory Variable	Total non-MFI Payments	Total electronic non-MFI payments across the regions of the Czech Republic into one as per year of analysis by the CNB	Czech National Bank; ARAD (Natural Logarithm)
Explanatory Variable	Total Electronic Credit Transfers	Electronic Credit Transfers across the regions of Czech Republic compiled into one as per year of analysis by the CNB	Czech National Bank; ARAD (Natural Logarithm)
Explanatory Variable	Total Cheques	Cheques across the regions of Czech Republic compiled into one as per year of analysis by the CNB	Czech National Bank; ARAD (Natural Logarithm)
Explanatory Variable	Currency	Total Currency supply in the Czech Republic	Czech National Bank; ARAD (Natural Logarithm)

Control Variable	Total Electricity Production	Gross Electricity Production in the Czech Republic	Czech Statistical office (CZS0) (Natural logarithm)

Source 7: Czech National Bank's ARAD time-series system, Czech statistical office (CZSO), Own calculation

Our regression model could thus be explained by the following multiple regression equation:

$$LN\ LnRealgdpt = \beta_0 + \beta_1 LnEFTPOSt + \beta_2 LnTotalnon - MFIPayments + \beta_3 TotalCheques + \beta_4 TotalElectronicCreditTransfers + \beta_5 LnElectricityProductiont + \epsilon_t$$

Figure 8: Percentage change of variables y-to-y

YEAR	TOTAL PAYMENTS INVOLVING NON-MFIS	% CHANGE Y-TO-Y	CARD PAYMENTS (EXCEPT CARDS WITH AN E-MONEY FUNCTION ONLY)	% CHANGE Y-TO-Y	CREDIT TRANSFERS ELECTRONICALLY	% CHANGE Y-TO-Y	EFTPOS	% CHANGE Y-TO-Y	CURRENCY	% CHANGE Y-TO-Y
2015	162373.8	-	424.6	-	161747.2	-	381.4	-	510,1	-
2016	248557.2	53%	507.2	19%	247864.2	53%	450.6	18%	556,7	9,14%
2017	296134.9	19%	602.7	19%	295322.7	19%	526.5	17%	593,9	6,68%
2018	153453.5	-48%	710.6	18%	152480.1	-48%	604.4	15%	618,6	4,16%
2019	58871.6	-62%	807.6	14%	149735.4	-2%	656.4	9%	644,4	4,17%
2020	156566.7	166%	926.2	15%	154318.5	3%	713.6	9%	711,9	10,47%

Source 8: Own calculations

Figure 9: Graphical representation of % Change of cash and cashless payments y-to-y in the Czech Republic
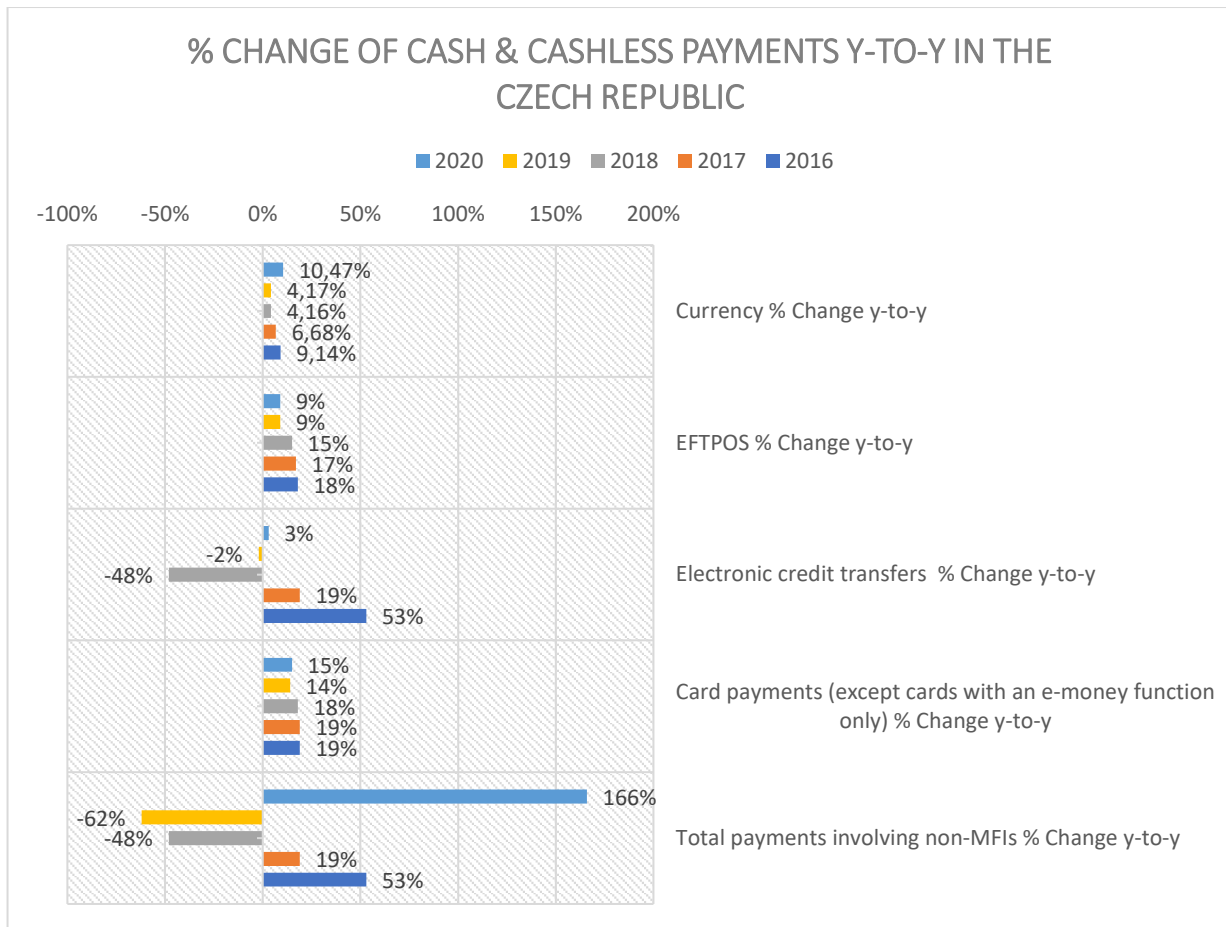
Source 9: Own calculations

The Breusch pagan test to test presence of heteroscedasticity in the obtained regression model
The formula notation of the Breusch pagan test can be denoted by (Breusch and Pagan, 1979)

$$\widehat{\varepsilon^2}_t = \alpha + \beta_1 x_{1,t} + \beta_2 x_{2,t} + e_t$$

$$\widehat{\varepsilon^2}_t = squared\ original\ regression\ estimated\ residuals,$$
$$\alpha = regression\ constant,$$
$$\beta_1, \beta_2 = regression\ coefficients,$$
$$x_{1,t}, x_{2,t} = original\ regression\ independent,$$
$$e_t = regression\ residuals.$$

According to the Breusch pagan Lagrange multiplier statistic p-value:

The newly obtained regression model would be used to compute the test statistic which is then tested for p-value using the chi-square distribution method. To compute the test statistic for the Breusch-pagan test the following formula is used

$$X^2 = n * R^2_{new}$$

Where,
$X^2 = Test\ Statistic;$
$n = number\ of\ observations;$
$R^2_{new} = newly\ obtained\ r\ squared\ after\ regression\ with\ predicted\ squared\ residuals$

If the Breusch pagan multiplier statistic p-value < α level of statistical significance then residuals were heteroscedastic with $(1 - \alpha)$ level of statistical confidence.

If the Breusch pagan Lagrange multiplier statistic p-value > α level of statistical significance then residuals were homoscedastic with $(1 - \alpha)$ level of statistical confidence.

Figure 10: Breusch-Pagan tests for heteroscedasticity

4.1.1.1 Breusch-Pagan tests	Test statistic	P-value	Heteroscedastic/Homoscedastic
EFTPOS Card payments & non-MFI payments on Real GDP	$Test\ statistic: LM = 3.07083$	$with\ p - value = P(Chi - square(3) > 3.07083) = \mathbf{0.380833}$	*Homoscedastic*
Cheques & Electronic Credit Transfers on Real GDP	$Test\ statistic: LM = 2.85729$	$with\ p - value = P(Chi - square(3) > 2.85729) = \mathbf{0.414155}$	*Homoscedastic*

Source 10: Own calculations using GRETL

Figure 11: Regression table results for slected indicators using GRETL

Model 1: OLS, using observations 2016-2020 (T = 6)
Dependent variable: l_RealGDP

Constant = 13.0673	coefficient	std. error	t-ratio	p-value
l_Electricity~	2.10842	0.357416	5.899	0.0276 **
l_Totalcheques	−0.540064	0.0476037	−11.35	0.0077 ***
l_TotalElectronicCreditTransfers~	−0.0202123	0.0300968	−0.6716	0.5710

Model 2: OLS, using observations 2016-2020 (T = 6)
Dependent variable: l_RealGDP

Constant = 7.93888	coefficient	std. error	t-ratio	p-value
l_Electricity~	2.10842	0.357416	5.899	0.0276 **
l_Totalcheques	−0.540064	0.0476037	−11.35	0.0077 ***
l_TotalElectronicCreditTransfers~	−0.0202123	0.0300968	−0.6716	0.5710

Model 3: OLS, using observations 1992-2020 (T = 29)
Dependent variable: l_RealGDP

Constant = 10.9441	coefficient	std. error	t-ratio	p-value
l_CurrencyCZK	0.710120	0.0159496	44.52	8.27e-27 ***

Model 4: OLS, using observations 1-210
Dependent variable: l_RealGDP
Breusch-Pagan test for heteroskedasticity -

Test statistic: LM = 0.469704; with p-value = P (Chi-square (1) > 0.469704) = 0.493123

Constant = 8.96391	coefficient	std. error	t-ratio	p-value
l_R&Dexp	0.441297	0.0203264	21.71	2.30e-55 ***

Figure 12: Regression result explanations and effect with different models

Type of Model for regression	Regression result explanation and its effect
Model 1: OLS, using observations 2016-2020 (T = 6) Dependent variable: l_RealGDP	, the total non-MFI payments predicted coefficient is negative and statistically significant at the 5% significance level thus an increase in 1% of total non-MFI payments would decrease the Real GDP by -0.03%. The EFTPOS card payments predicted coefficients are positive and significant at the 1% level thus a 1% increase in the EFTPOS card payments could increase the Real GDP by 0,33%. The total electricity production predicted coefficient is positive and statistically significant at the 10% level thus a 1% increase in the total electricity production in the Czech Republic can increase the real GDP by 0,15%.
Model 2: OLS, using observations 2016-2020 (T = 6) Dependent variable: l_RealGDP	From the above regression table, we can highlight some important points, payments by cheques predicted coefficients are negative and statistically significant at the increase in 1% of payments by cheques would decrease the Real GDP by -0.54%. the electronic credit transfer payments predicted coefficients are negative and not statistically significant. The electricity production predicted coefficient is positive and statistically significant at the 5% significance level thus a 1% increase in the total electricity production in the Czech Republic could increase the real GDP by 2,1%.

Model 3: OLS, using observations 1992-2020 (T = 29) Dependent variable: l_RealGDP	To show an impact of cash as well on the economy of the real GDP of the Czech Republic the latest available data for the total currency and the real GDP were obtained for the period of 1992-2020 and a simple linear regression was carried out, the results suggested that cash can contribute significantly to the growth of an economy for a country, a 1% increase in the currency could increase the real GDP by 0.71% which is a considerable amount. This could lead us to the factor of the heavy cash usage to be clearly visible on the economy of the Czech Republic and the higher trust by the users to use such a medium of exchange for their everyday transactions in the economy.
Model 4: OLS, using observations 1-210 Dependent variable: l_RealGDP	This model is carried out using the simple linear regression method, the results suggest that the predicted coefficient of R&D is positive and statistically significant at the 1% level thus a 1% increase in the R&D expenditures across the regions can increase the GDP across the regions by 0,44% which would result to a higher net increase of Real GDP at the country level.

5   Conclusion

The objective of this paper was to identify whether there exists an impact of digital payments on the economy of the Czech Republic. The paper identified studies based on the existing use of digital payments in respective economies which have proved to be successful in creating an impact contributing to the economic growth either directly or indirectly. But as correlation is not causation the study and the larger topic of digital payments have the possibility of further research with better augmenting data and more data points to consider this is largely due to the scant data highlighting the use of digital payments in an economy. For this to work effectively it can be observed that the European Union is effectively working in making a Digital EU due to mainly the benefits it brings increased productivity due to improved technology, higher digital skills among individuals allowing them to successfully use the available products for access to the online marketplace and digital payments, improved data points due to the ISO 20022 allows for better security for consumers, institutions and businesses. The larger idea is not to get rid of cash as cash still accounts for a larger part of household spending being done as compared to cards. Cash is still trusted by consumers and during times of liquidity trap people prefer it more, the wider usage can also be seen in the Czech economy and also the regression result of model 3. At the same time, the Czech government's plan for the 7 billion euro grant by the European Commission is to invest upwards of 20% in the digital transformation of the economy which is good for the Czech economy but also for the Digital Europe idea.

Digital payments in the coming years would see a surge of usage as the consumers become more digitally aware, the endogenous growth theory continued by Paul Romer also acknowledges the importance of innovation, research, and development which would affect the economic growth of a country with positive spillovers over the economy. However, the theory still needs more empirical proof but if we acknowledge real research and development, innovation, and investments into factors such as innovation, R&D, science, and technology then there has been recognizable economic growth across economies hence I would say that effective investments into such factors which could also be very well the determinants of economic growth are very important to sustain times of downfall currently visible in the pandemic. A more intrinsic value worthy medium of exchange would have a positive effect on the economy as the effect of inflations could be minimized which would save a larger share of

revenue to be invested or redistributed into the economy which could financially include more sections of society and give them access to credit lines, liquidity, etc.

Large amounts of cash belonging to the dark economy are still being moved as it benefits everyone in the process but defrauds the governments and consumers of their revenue. "The use of cryptocurrency as part of criminal schemes is increasing and the uptake of this payment medium accelerating. However, the overall number and value of cryptocurrency transactions related to criminal activities still represent only a limited share of the criminal economy when compared to cash and other forms of transactions. A range of constraints is related to the use of cryptocurrencies, with high volatility likely a major factor in criminals' reluctance to use cryptocurrencies for long term investments" (Publications Office of the European Union, 2021). Hence, I would believe that applying a newer, more secure, and efficient form of payments alongside cash payments could be introduced if the results are that of recognizable then a switch or less cash move should be made. This area of research should be expanded by employing more expansive data from official data sources to cover various forms of digital payments which would give us the exact effect of its usage over an economy and help us identify the more efficient system of payments.

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