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Article

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Cashless Payments and Economic Growth: Evidence from Selected OECD Countries

Abstract: This study investigates the relationship between cashless payments and economic growth in selected OECD countries. Using annual data from 2007 to 2016, our results indicate that: Firstly, cashless payment stimulates economic growth in OECD countries. Specifically, the growth-enhancing effect is found in debit card payment while credit card, e-money and cheque payment have no impact on economic growth; Secondly, the positive relationship between economic growth and debit card payment is robust after controlling for the effect of endogeneity, omitted variable bias and outliers. Based on the findings, this study offers some imperative policy recommendations.

Keywords: Cashless payments; Economic growth; Organisation for Economic Co-operation and Development (OECD); debit card payment

JEL classification: G20; G21; G23

I. Introduction

World Payment Report (2015) reported that cashless transactions increased by 7.6% from 2012 and achieved 358 Billion in U.S Dollar in 2013. Besides, study by European Central Bank (ECB) shows that cashless payments are growing gradually in the European Union. As such, there was an increase of 6.0 and 2.8 percent in 2013 and 2014, respectively for the total number of cashless payments in the European Union. From 2000 to 2014, there was an exponential growth on card payments and

this implies that the substitution of cash has become more and more popular. In a worldwide context, possibilities and tendencies of the cashless economy are worth to be explored due to the enormous interest among the academic intellectuals, commercial firms, and policy-makers. A Transformation from cash to cashless economy is confidently believed to have tremendous benefits. As such, cashless payments are found to have a positive influence on economic growth (Hasan et al, 2012; Oyewole et al, 2012; Zandi et al, 2013; Tee and Ong, 2016; Zandi et al, 2016).

Specifically, the positive impact of cashless payments on economic growth is depend on three possible transmission channels. The consumption channel as suggested by Zandi et al (2013) argue that cashless payments provide immediate credit to consumers, thereby facilitating the purchase of goods and services. Subsequently, this would increase the private consumption and contributes to higher economic growth. Next, the investment channel of cashless payment has been pointed out implicitly by Hasan et al (2012). As such, cashless payments reduce costs connected to paper-based transactions, leading to lower operating costs and achieves economies of scale among the merchants. Subsequently, this would lead to business expansion and greater level of investment in the economy, thereby contributing to economic growth. Similarly, the government expenditure channel of cashless payment is mentioned implicitly by Kearney and Schneider (2011), in which cashless payment facilitates tax collection by the government. Hence, cashless payments improve fiscal balance of the government and more revenues can be used for pro-growth policy, thereby enhancing economic growth.

To date, many empirical studies have examine the importance of financial sector development to productivity and growth (King and Levine, 1993; Rajan and Zingales, 1998; Beck, Levine and Loyaza, 2000; Graff, 2003; Rioja and Valev, 2007; Cojocar, Falaris, Hoffman, and Miller, 2016; Park and Shin, 2017; Dilek, Serdar and Hakan, 2017; Law, Kutan and Naseem, 2018; Ibrahim, 2019). However, part of the financial innovations in the sector in recent times is the cashless payments (Mustapha, 2018), which has not been examine extensively. Moreover, the existing studies mainly focus on European Union countries (Bolt et al, 2008; Hasan et al, 2012; Tee and Ong, 2012; Mustapha, 2018), high-income nations (Zandi et al, 2013; Zandi et al, 2016) and Nigeria (Oginni et al, 2013, Oyewole et al, 2013). Notably, the existing studies suggest that cashless payments stimulate economic growth and the growth-enhancing effect of credit and debit card payment is the highest among different cashless payment instruments.

However, little attention has been paid on the nexus between cashless payments and economic growth in OECD countries. The existing findings based on the countries mentioned above may not be generalized to OECD countries, due to their different economic structure and level of technology adoption.

Apart from this, there are two reasons on why OECD countries are worth to study. First, the mobile broadband penetrations in OECD are over 99 percent (OECD, 2017a), and this high level of technology adoption is expected to facilitate cashless transaction, thereby generating higher economic growth.

Second, the OECD Committee on Consumer Policy has undertaken various efforts in promoting the use of cashless payment among the economic agents. Since the 2009 OECD conference on empowering e-consumers, the committee agreed to explore the developments and consumer issues involving the use of mobile operators' networks and the internet to make payments. Subsequently, an assessment on the trends and challenges has been carried out during 2010 and 2011. The assessment serves as a fundamental to the development of the consumer policy guidance on mobile and online payments in 2014 (OECD, 2014). The policy guidance aims to strengthen consumer protection in mobile and online payment, thereby avoiding online payment fraud. Moreover, the policy guidance attempts to enhance the accessibility of cashless transaction in all layer of the society. Taken together, the high penetration rate of mobile broadband and consumer policy guidance are expected to enhance cashless transaction, leading to higher private consumption and economic growth for OECD countries.

In line with the above reasons, it is interesting to examine the impact of cashless payments on economic growth in OECD countries. Specifically, this study aims to answer the question that which cashless payment instruments (debit card, credit card, e-money and cheque) would result in growth-enhancing effect for OECD countries.

Member countries of OECD are employed as the sample in this paper. Moreover, following the study by Hasan et al (2012) and the availability of cashless payments data for OECD countries, this study defines cashless payment as debit card transaction, credit card transaction, e-money transaction and cheque transaction. Furthermore, this study employs Random Effect (RE) model with robust standard error to examine the impact of cashless payments on economic growth for OECD countries. To ensure the results are robust, this study employs three robustness checks, in which: (1) this study replaces all the explanatory variables with its own lagged values to address the endogeneity issue arises from the reverse causality between dependent and independent variables. This method has been widely used in the empirical research on finance and economics to mitigate reverse causality issue in the model (Green Malpezzi and Mayo, 2005; Gupta, 2005; Mackay and Phillips, 2005; Brinks and Coppedge, 2006; Jensen and Paldam, 2006; Bania, Gray and Stone, 2007; Aschoff and Schmidt, 2008; Spilimbergo, 2009; Stiebale, 2011; Buch, Koch and Koetter, 2013; Ibrahim, 2019); (2) this study includes additional growth-related variables into the model to avoid omitted variable bias and (3) this study remove the outliers inherit in the data by using winsorization technique as suggested by Lim, Hooy, Chang and Brooks (2016)

Notably, the empirical results indicate that: Firstly, cashless payment is found to be growth-enhancing in OECD countries. As such, debit card payment is found to stimulate economic growth significantly. While credit card, e-money and cheque payment are found to have no impact on economic growth in OECD countries. Secondly, the positive relationship between economic growth and debit card payment is robust after controlling for the effect of reverse causality, omitted variables bias and outliers.

Based on the above findings, this study contributes to the literature on two fronts. First, this paper provides new evidence on the impact of cashless payments on economic growth for OECD countries. While the existing literature as mentioned above mainly focus on European countries, high-income nations and Nigeria, this study evaluates the implication of cashless payments on growth in OECD countries. Due to different economic structure and levels of technology adoption, the positive impact of cashless payments on growth may not be generalized for OECD countries. Therefore, this study is important because it informs the policy maker on whether the country should continue to promote cashless payments or retain the conventional payment method such as cash.

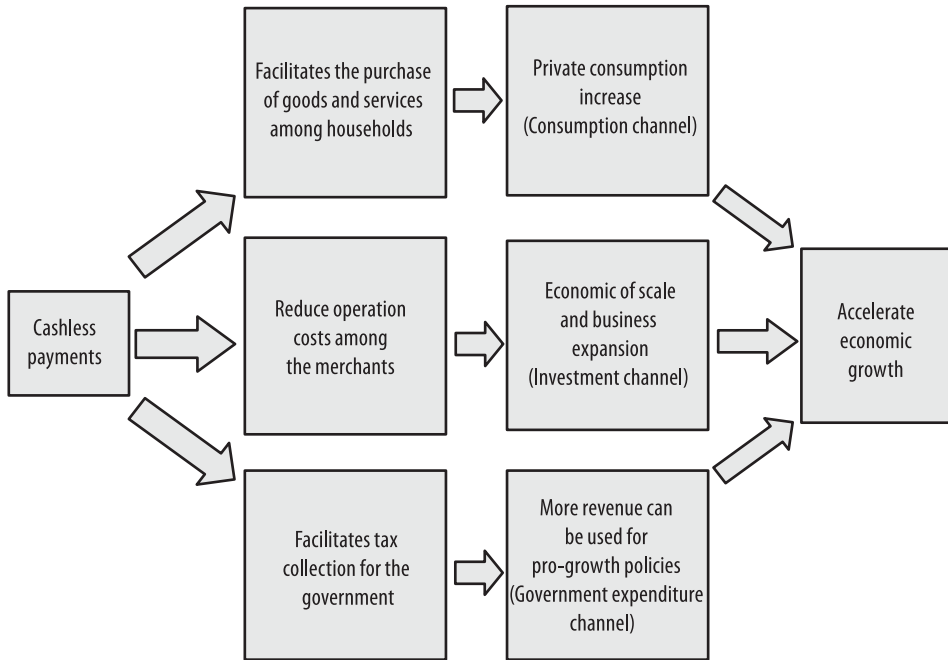
Second, if cashless payments are found to stimulate economic growth, this study go further and identify which cashless payment would result in the highest growth-enhancing effect for OECD countries. Similarly, if cashless payments are found to reduce economic growth, this study would be able to identify which cashless payment is responsible for the decline in country's growth rate. This is important as it provides direction to the policy maker on which cashless payment should be promoted or removed in order to achieve higher economic growth for the nation.

This paper unfolds as follow. Section II reviews the possible transmission channels of cashless payments, followed by the empirical studies on the nexus between cashless payments and economic growth. Section III illustrates the data, empirical model and methodology used in this study. Section IV presents estimation results and followed by the robustness checks in section V. Section VI provides the discussion for the estimation results. Section VII sets forth conclusions and policy recommendations.

II. Literature Review

A. Transmission channels of cashless payments

Cashless payments are found to have a positive impact on economic growth. Based on the existing studies, Figure 1 summarize three possible channels on how cashless payments influence economic growth positively.

Figure 1: Transmission channels of cashless payment on economic growth

The first channel is the consumption channel and it has been well illustrated by Zandi et al (2013) and Zandi et al (2016). As such, cashless payments provide immediate credit to consumers, thereby smoothing their consumption. Subsequently, this would increase the private consumption and stimulates economic growth. As such, Zandi et al (2013) show that cashless payments boost private consumption by 0.7 percent and the rise in consumption is found to contribute 0.17 percent to the GDP growth for a group of high-income countries.

The second channel is the investment channel. As pointed out by Hasan et al (2012), cashless transactions reduce costs connected to paper-based transactions, thereby facilitating the operating costs for merchants. Subsequently, this lower operating costs would result in economies of scale among the merchants, leading to business expansion and greater level of investment in the economy, thereby contributing to economic growth.

The third channel is the government expenditure channel. Cashless transactions are found to facilitate tax collection by the government (Kearney and Schneider, 2011, 2013), and therefore more revenues are generated for the government to improve their fiscal balance and to boost the government expenditures. Theoretically, higher

government expenditures would stimulate the aggregate demand, thereby fostering economic growth through the multiplier effect (Keynes, 1936).

B. Empirical findings on the nexus between cashless payments and economic growth

Cashless payment is an economic activity where the action of trading products and services happens without the use of physical cash (Paul and Friday, 2012) but electronic transfer and cheque payment. E-payment is part of the cashless payment that provides an electronic exchange of monetary substances without physical contact of the transacting parties (Snellman, Vesala and Humphrey, 2001). As such, E-payment is the payment caused by using credit cards, debit cards, stored value cards, mobile wallets, and automated teller machines (Oginni et al, 2013). Additionally, cheque payment is considered as cashless payment (Tee and Ong, 2016) because both paper and non-paper cheque payment do not involve physical cash transaction.

Notably, cashless payments have been gradually complement and replace the usual paper based payment arrangements (Scholnick et al, 2008). In this regard, the economic impact of cashless payment have been examined from the perspective of banking, financial economics, macroeconomics, monetary and regulatory economics (Humphrey, Pulley and Vesala, 1996; Berger, 2003; Bolt, Humphrey and Uittenbogaard, 2008; Scholnick et al, 2008; Hasan, Schmiedel and Song, 2009; Kahn and Roberds, 2009; Hasan, Renzis and Schmiedel, 2012; Oginni et al, 2013; Oyewole et al, 2013; Zandi et al, 2013; Tee and Ong, 2016; Zandi et al, 2016; Mushkudiani, 2018).

The innovation in payment system has caused a change in the choice of payment among the consumers. As such, Humphrey et al (2001) show that there exists a substitution effect between cheques and electronic cards. Moreover, Visa (2003) shows that there is an increasing growth in the use of electronic cards among U.S. consumers expenditure relatively to cheques and cash. Furthermore, the use of electronic cards has boost U.S. consumer spending by USD 6.5 trillion in the last two decades (Visa, 2003). In this regards, consumers are expected to benefit from the convenient payment instruments, both in terms of timing and costs. Therefore, cashless payment is expected to facilitate consumption, thereby increasing economic growth.

Empirically, Hasan et al (2012) found that electronic retail payments (debit and credit card payments, credit transfers, direct debits and cheque payment) stimulate trade and consumption, leading to higher economic growth for a group of 27 European countries from year 1995 to 2009. Moreover, the study found that the growth-enhancing effect for card payments (credit and debit cards) is the strongest among different payment instruments. In contrast, cheque payments are found to have the least macroeconomic impact on growth due to the substitution effect with electronic cards. In conclusion, the study supports the adoption of policies promoting a swift

migration to efficient and harmonized electronic payment instruments in order to promote higher economic growth.

In a later study, Zandi et al (2013) investigate the economic impact of electronic cards (credit and debit card) adoption for a group of 56 high-income countries from year 2008 to 2012, the pooled OLS estimator shows that greater usage of electronic cards contributes USD 983 billion to the real GDP in the countries studied. In detail, the study shows that electronic card usage increases private consumption by 0.7 percent and subsequently leads to an increase in GDP growth by 0.17 percent per year across the 56 countries studied. Furthermore, the study demonstrates that a future 1 percent increase in electronic card usage would generate an annual increase in consumption by 0.056 percent and subsequently improve growth by 0.032 percent. Next, Zandi et al (2016) reaffirm the positive impact of cashless payment on economic growth for a group of 70 countries from year 2011 to 2015. Interestingly, Prabheesh and Rahman (2019) found that credit card has the effect of consumption smoothing in Indonesia. They study the role of credit card in the context of Monetary Policy Transmission in Indonesia done earlier by other scholars like Sharma et al. (2018), Juhro and Iyke (2019). Similarly, Narayan (2019) also nicely examined whether Fntech matter for Indonesia's economic growth.

For the banking sector, Berger (2003) found that cashless payment improves banking productivity by reducing their operating costs. As such, the innovation in the payment system has reduce the costs of their back-office activities, which represent the majority of banks operating costs. Therefore, the switch from paper to electronic payment instruments allow the banks to enjoy gain in productivity and economies of scale. On the other hand, cashless transaction is found to improve banking performance by increasing their revenues (Humphrey et al, 2006, Mustapha, 2018). Hence, it can be argued that cashless payment facilitates banking performance, leading to business expansion and greater investment in the economy, therefore stimulates economic growth. Evidently, Bolt et al. (2008) found that the use of cashless payment instruments saves an estimated 0.7 billion Euro for Norway bank and 2.9 billion Euro for the Netherlands bank. The saving has contributes to 0.35% of GDP and 0.61% of GDP respectively in 2004.

For the government, cashless transactions are found to facilitate tax collection. Study by Kearney and Schneider (2011, 2013) demonstrate that there is a strong negative relationship between the size of cashless transactions and shadow economy. As such, the improved traceability of cashless payment makes it more difficult for tax evaders to conceal their earnings. Similarly, Immordino and Russo (2016) found a negative relationship between Value Added Tax (VAT) evasion and the payment with credit and debit cards in Europe. Therefore, the presence of cashless payments are expected to generate more revenues for government to conduct pro-growth policies.

On the other hand, there are studies examine the direct relationship between cashless payment and economic growth. As such, Oginni et al. (2013) found that there is a negative relationship between cheque payments and real GDP per capita in Nigeria. This may attribute to the high transaction cost of cheque payment in developing country, which in turn outweigh the benefit of cheque payment on growth. In contrast, Oyewole et al. (2013) found out that the application of electronic payment (debit and credit cards) stimulates trade and economic growth for Nigeria.

However, study by Tee and Ong (2016) show that the positive relationship between cashless payments (card payment, electronic money, cheque payment and telegraphic transfer) and economic growth prevails only in the long-run. The study employs Panel VECM on five selected European countries from year 2000 to 2012 and found that the adoption of one type of cashless payment will affect another type of cashless payment in the short-run. However, in the long-run, all cashless payment instruments are found to affect economic growth significantly.

From the above-mentioned literature, it can be argued that cashless transaction is of “systematic-wide important” (Hasan et al, 2012) because it facilitates transaction between consumers and commercials as well as improve government revenue. Subsequently, this would has a significant impact on the economic performance (Cirasino and Garcia, 2008). In particular, the globally accepted payment options improve the accessibility to funds on deposit and immediate credit among consumers (Visa, 2003), thereby increasing their purchasing power and hence expenditure on goods and services. For the merchants, cashless payment reduce costs connected to paper-based transactions, leading to lower operating costs and achieves economies of scale (Hasan et al, 2012). Subsequently, this would lead to business expansion and greater investment in domestic economy. Furthermore, cashless transaction facilitates tax collection by the government and therefore more revenues can be used for pro-growth policies. In sum, an efficient payment infrastructure facilitate trade, services, transfers of funds and fostering economic interactions (Hassan et al, 2012). This increases consumption and trade, thereby fostering economic growth (Zandi et al, 2013, Zandi, et al, 2016).

As observed from the above-mentioned empirical studies, there is limited study on the impact of cashless payments on economic growth for OECD and ASEAN countries. The existing studies mainly focus on European Union countries (Bolt et al, 2008; Hasan et al, 2012; Tee and Ong, 2012; Mustapha, 2018), high-income nations (Zandi et al, 2013, Zandi et al, 2016) and Nigeria (Oginni et al, 2013, Oyewole et al, 2013). Therefore, this study aims to fill in the gap by examining the relationship between cashless payments and economic growth in OECD and ASEAN countries.

C. Hypothesis development

In line with the above-mentioned transmission channels of cashless payments and literature review, it can be hypothesized that:

- H1: Economic growth is positively associated with debit card payment.
- H2: Economic growth is positively associated with credit card payment.
- H3: Economic growth is positively associated with e-money payment.
- H4: Economic growth is positively associated with cheque payment.

Hypothesis 1 to 4 are set to confirm that there is a positive relationship between cashless payments and economic growth in OCED and ASEAN countries. Cashless payments provide immediate credit to consumers, thereby increasing their purchasing power and hence spending on goods and services (Zandi et al, 2013, Zandi et al, 2016). Moreover, cashless payments facilitate operation costs for business, leading to economies of scale and contributes to economic growth (Bolt et al, 2008). In addition, cashless payments facilitate tax collection by the government (Immordino and Russo, 2016) and therefore more revenues can be used to stimulate economic growth. Thus, it can be concluded that cashless payments increase consumption, investment and government spending, thereby fostering economic growth.

III. Data, empirical model and methodology

A. Data

As mentioned above, the definition of cashless payment is followed the study by Hasan et al (2012) and the availability of data for cashless payment instruments. Therefore, the cashless payments used in this study are the growth rate of debit card, credit card, e-money and cheque transaction. Furthermore, some countries have been removed from this study because: (1) unavailability of cashless payments data and (2) the definition for each cashless payment is not consistent with the rest of the countries. Therefore, this study arrive at the final panel sample of 15 OECD countries (Table 1). The panel data are unbalanced, covering the period 2007 to 2016. Table 2 shows the list of variables used in this study.

Table 1: List of sampled countries (Sample period: 2007-2016)

15 OECD countries	Australia, Belgium, Canada, France, Germany, Italy, Japan, Korea, Mexico, Netherlands, Sweden, Switzerland, Turkey, United Kingdom, United States
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Table 2: List of variables

Variables	Descriptions	Unit of measurement	Source
GDP	Real GDP growth rate	Annual %	WDI
Cashless payment indicators			
Debit	Debit card transaction value	Annual %	BNM, BOT, BIS
Credit	Credit card transaction value	Annual %	BNM, BOT, BIS
E-money	E-money transaction value	Annual %	BNM, BOT, BIS
Cheque	Cheque transaction value	Annual %	BNM, BOT, BIS
Control variables			
Inflation	Inflation rate	Annual %	WDI
Population	Population growth rate	Annual %	WDI
Secondary	Secondary school enrollment	% of gross	WDI
Openness	Trade openness	% of GDP	WDI
Additional variables for robustness check			
FDI	FDI net inflow	% of GDP	WDI
FD	Domestic credit to private sector	% of GDP	WDI
GCF	Gross capital formation	% of GDP	WDI
ICT	Broadband subscriptions	Per 100 inhabitants	WDI
INS	Institutional quality	Scaled from 0 to 50	ICRG

Notes: WDI indicates World Development Indicator.
 BNM indicates Bank Negara Malaysia. BOT indicates Bank of Thailand
 BIS indicates Bank of International Settlement.
 ICRG denotes International Country Risk Guide.
 Sample period: 2007-2016.

B. Empirical model

The empirical model below is applied in this study to examine the impact of cashless payments on economic growth in OECD countries. As such:

$$GDP_{it} = \beta_0 + \beta_1 Cashless_{it} + \beta_2 Inflation_{it} + \beta_3 Population_{it} + \beta_4 Secondary_{it} + \beta_5 Openness_{it} + \beta_6 Year_{it} + \mu_i + \varepsilon_{it} \quad (1)$$

where GDP is the growth rate of the real Gross Domestic Product. Despite the Gross National Income is a better indicator of national welfare (Tan, Tang and Devi, 2019), the existing literature mainly uses the real GDP growth rate instead of real GNI growth rate to measure the impact of cashless impact on economic growth (Bolt et al, 2008; Tee and Ong, 2016; Zandi et al, 2013; Zandi et al, 2016). Therefore, in line with the previous studies, this study employs the real GDP growth rate as an indicator of country's economic growth.

Next, *Cashless* refers to the vector of cashless payment instruments (growth rate of debit card transaction, credit card transaction, e-money transaction and cheque transaction). Furthermore, control variables such as inflation (*Inflation*), population growth rate (*Population*), secondary school enrolment (*Secondary*) and trade openness (*Openness*) have been included in the model. The inclusion of the variables allow the model to capture the impact of inflation, demographic changes, human capital and international trade on growth, respectively. Moreover, those control variables have been widely used in economic research to examine the determinants of country's growth rate (Abbas and Mujahid-Mukhtar, 2001; Abdullah, 2013; Law, Azman-Saini and Ibrahim, 2013; Law, Kutan and Naseem, 2018; Lau and Yip, 2019).

Furthermore, to avoid the omitted variable bias in the model, additional variables such as net inflow of FDI, domestic credit to private sector, gross capital formation, broadband subscriptions and the measure of institutional quality have been included into the model in the robustness check section. The inclusion of the variables allows the model to take into account of the impact of foreign direct investment, financial development, investment, information and communication technology (ICT) development and institution quality on growth, respectively. Moreover, the inclusion of those variables is motivated by the economic growth literatures (Solow, 1962; Law, Azman-Saini, 2012; Law, Kutan and Naseem, 2018; Bahrini and Qaffas, 2019; Hanivan and Nasrudin, 2019; Rath and Hermawan, 2019).

Notably, there are various measures for the ICT development such as number of fixed telephone subscriptions per 100 inhabitants, number of mobile cellular subscriptions per 100 inhabitants and number of internet users per 100 inhabitants (Bahrini and Qaffas, 2019). However, recent empirical works show that the number of fixed broadband subscriptions per 100 inhabitants has a profound influence on economic growth, employment and firm competitiveness as compared to the conventional measures (Kolko, 2012; Jayakar and Park, 2013; Kumar et al, 2015; Rath, 2016; Pradhan et al, 2018). Hence, in line with the recent empirical studies, this study uses the fixed broadband subscriptions per 100 inhabitants as a proxy of ICT development.

Next, there are two datasets of institutions and governance, namely the World Governance Index (WGI) by Kaufmann et al (2008) and the International Country Risk Guide (ICRG), a monthly publication of Political Risk Services (PRS). The former have been criticized especially for their lack of theoretical foundation (Law, Azman-Saini, 2012). Therefore, this study uses the PRS indicators to measure the institutional quality. In particular, this study follows Law, Kutan and Naseem (2018), in which five PRS indicators are used to measure the overall institutions: (i) corruption; (ii) law and order; (iii) bureaucratic quality; (iv) government stability and (v) democracy and accountability. The five institutions indicators are re-scaled from 0 to 10, and therefore higher values indicate better institutional quality and vice versa. Lastly, the institutions indicator is obtained by summing the above five indicators (Law and Azman-Saini, 2012; Law, Kutan and Naseem, 2018)

In addition, the year dummy (*Year*) is incorporated in the model to control for the year effect. The μ_i is the country specific effect and ε_{it} is the error term.

C. Research methodology

This study employs the static panel method to quantify the relationship between economic growth and cashless payment for OECD countries. The model selection tests (Breusch-Pagan Lagrangian Multiplier test, Poolability F-test and Hausman test) show that Random Effect (RE) model is appropriate in the context of this study. Moreover, robust standard error is computed for the random effect model to take into account of the heteroscedasticity and autocorrelation in the error term within country.

Next, three robustness checks have been conducted to ensure the validity of the baseline results. First, this study replaces all the explanatory variables with its own lagged values to address the endogeneity issue arises from the reverse causality between dependent and independent variables. The rationale for the practice is explicitly identified in statements such as the following: “We avoid poor-quality instrumental variables and instead address potential biases from reverse and simultaneous causation by ... lagging” (Clemens, Radelet, Bhavnani and Bazzi, 2012); and “The variable is expressed as a percentage of GDP. The lagged variable was used in both cases to avoid possible simultaneity problems” (Vergara, 2010). Notably, the practice is common across a wide variety of disciplines in economics and finance in order to mitigate endogeneity issue in the model (Green Malpezzi and Mayo, 2005; Gupta, 2005; Mackay and Phillips, 2005; Brinks and Coppedge, 2006; Jensen and Paldam, 2006; Bania, Gray and Stone, 2007; Aschoff and Schmidt, 2008; Spilimbergo, 2009; Stiebale, 2011; Buch, Koch and Koetter, 2013, Ibrahim, 2019).

Second, additional growth-related variables will be included into the model to avoid the omitted variable bias. Those variables are shown in Table 2 above. Third, this study control for the effects of outlier by using the winsorization technique. As such, this study removes the outliers inherit in the data at (i) 1st and 99th and (ii) 5th and 95th percentiles as suggested by Lim, Hooy, Chang and Brooks (2016).

IV. Estimation results

A. Descriptive statistics

As observed, E-money is found to have the highest growth rate in transaction value, followed by debit card payment and credit card payment. Moreover, the growth rate for cheque transaction is found to be negative, indicating that the used of cheque as a mean of transaction has been reduced in the OECD economies. Therefore, it can be expected that E-money payment would have the highest positive impact on growth,

followed by debit card and credit card. While cheque payment is expected to have no impact on growth due to its decreasing role as a mean of transaction in OECD countries. Next, as mentioned above, this study employs unbalanced panel data and therefore the number of observation is vary across variables.

Table 3: Descriptive statistics

Variables	Mean	Std. dev	Kurtosis	Skewness	Sample observation
GDP	1.658	2.541	5.399	-0.344	150
Debit	7.439	13.806	7.769	-0.818	140
Credit	4.849	12.882	6.755	0.544	131
E-money	10.571	299.473	41.699	2.326	82
Cheque	-10.024	357.589	66.682	0.117	134
Inflation	2.091	2.123	5.925	1.539	150
Population	0.769	0.544	5.563	-0.633	150
Secondary	107.465	19.306	4.829	1.629	150
Openness	75.231	37.597	2.890	0.912	150
FDI	5.026	10.427	29.015	4.435	150
FD	113.826	47.220	2.207	-0.170	142
GCF	23.091	3.779	3.035	0.320	150
ICT	29.173	9.374	3.106	-0.874	149
INS	27.016	6.159	2.335	-0.452	150

Notes: All series are based on original data values.

Next, Table 4 shows the correlation of the variables used in the analysis. Notably, all the explanatory variables are not highly correlated as the correlation is less than 0.8 (Gujarati, 2003). Therefore, there is not multicollinearity error in the model.

Table 4: Correlation matrix

Variables	Debit	Credit	E-money	Cheque	Inflation	Population	Secondary	Openness	FDI	FD	GCF	ICT	INS
Debit	1.000												
Credit	-0.065	1.000											
E-money	-0.092	0.186	1.000										
Cheque	-0.214	0.426	0.152	1.000									
Inflation	-0.042	-0.202	0.140	0.152	1.000								
Population	0.133	-0.025	-0.050	-0.094	0.343	1.000							
Secondary	0.436	-0.287	0.137	-0.258	-0.091	0.011	1.000						
Openness	0.108	-0.128	-0.485	-0.171	-0.148	0.235	0.505	1.000					
FDI	0.169	-0.084	-0.598	-0.001	-0.126	0.042	0.389	0.490	1.000				
FD	-0.269	0.186	-0.174	0.234	-0.347	0.007	-0.334	0.029	-0.001	1.000			
GCF	-0.122	0.031	-0.059	0.221	0.434	0.349	-0.169	0.161	-0.104	0.428	1.000		
ICT	0.299	0.189	-0.329	-0.149	-0.561	-0.067	0.244	0.675	0.294	0.325	0.099	1.000	
INS	-0.109	-0.099	-0.121	-0.075	-0.035	-0.131	0.209	0.477	0.067	0.036	0.157	0.475	1.000

Notes: All statistics are based on original data values.

Sample period: 2007- 2016

B. Panel regression results

Table 5 present the baseline results for Eq. (1) above. As observed, debit card and cheque payment are found to have a positive impact on economic growth. While E-money is found to exert negative pressure on growth and credit card payment has no impact on economic growth. However, the baseline results may suffer from various econometrics issues such as reverse causality, omitted variable bias and outliers. Therefore, further robustness checks are required to ensure the consistency and validity of the results. Thus, inferences will not be made based on the baseline results, but will be made based on the results from robustness checks.

Table 5: Baseline results for Eq. (1).

Variables	1	2	3	4
Debit _{it}	0.0352** (0.0157)			
Credit _{it}		0.00688 (0.00955)		
E-money _{it}			-0.000278*** (8.16x10 ⁻⁵)	
Cheque _{it}				0.000439*** (6.58x10 ⁻⁵)
Inflation _{it}	0.164** (0.0820)	0.182* (0.109)	0.126 (0.142)	0.161 (0.150)
Population _{it}	0.811* (0.475)	0.752 (0.647)	-0.302 (0.216)	0.479 (0.532)
Secondary _{it}	-0.00338 (0.00612)	-0.00100 (0.00741)	-0.0173 (0.0206)	0.00288 (0.00776)
Openness _{it}	0.00160 (0.00389)	0.00235 (0.00491)	0.00691 (0.0124)	0.000605 (0.00536)
Constant	1.048 (0.802)	1.276 (0.867)	3.401** (1.610)	1.174 (0.804)
Observations	140	131	82	134

Notes: Baseline results are estimated using Random effect model with robust standard error. Robust Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Time dummies are included in the model, but the results are not reported to save spaces.

V. Robustness checks

A. Control for reverse causality

Endogeneity may arise from the non-zero correlation between the explanatory variables and the error term. This would lead to reverse causality between the dependent and independent variables, which in turn produce bias estimate parameters. To mitigate, this study replaces all the explanatory variables with its own lagged values. Hence, Eq. (1) can be re-written in the following form:

$$GDP_{it} = \beta_0 + \beta_1 Cashless_{it-1} + \beta_2 Inflation_{it-1} + \beta_3 Population_{it-1} + \beta_4 Secondary_{it-1} + \beta_5 Openness_{it-1} + \beta_6 Year_{it} + u_i + \varepsilon_{it} \quad (2)$$

Table 6 shows the estimation result for Eq. (2). Notably, after controlling for the effect of reverse causality, only debit card payment is found to be the important factor in affecting the economic growth for OECD countries. Thus, the subsequent analysis will only focus on the nexus between economic growth and debit card payment.

Table 6: Estimation results for Eq (2).

Variables	1	2	3	4
Debit _{it-1}	0.0359*** (0.0124)			
Credit _{it-1}		0.00818 (0.0110)		
E-money _{it-1}			4.05x10 ⁻⁵ (0.000101)	
Cheque _{it-1}				2.00x10 ⁻⁵ (7.29x10 ⁻⁵)
Inflation _{it-1}	0.225*** (0.0756)	0.275*** (0.0920)	0.0293 (0.197)	0.158 (0.131)
Population _{it-1}	0.756** (0.303)	0.735** (0.320)	0.161 (0.146)	0.502** (0.255)
Secondary _{it-1}	-0.00787 (0.0109)	-0.00887 (0.0182)	-0.0162 (0.0242)	0.00327 (0.00971)
Openness _{it-1}	0.00283 (0.00540)	0.00333 (0.00664)	0.00749 (0.0120)	-0.000276 (0.00624)
Constant	1.695* (0.978)	1.998 (1.725)	2.789 (1.855)	1.246 (0.906)
Observations	125	116	72	120

Notes: The above results are estimated using Random effect model with robust standard error. Robust Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Time dummies are included in the model, but the results are not reported to save spaces.

B. Control for other control variables

The second robustness check is to include additional growth-related variables such as net inflow of foreign direct investment (FDI), domestic credit to private sector (FD), gross capital formation (GCF), natural log of fixed broadband subscriptions per 100 inhabitants (LnICT) and natural log of institutional quality index (LnINS) into the model. This allows the model to avoid the omitted variable bias. Notably, the positive relationship between economic growth and debit card payment is consistent throughout all the equations in Table 7. This further ascertains that the growth-enhancing effect of debit card payment is not influenced by the inclusion of additional variables into the model.

On the other hand, credit card, E-money and cheque payment are found to have no impact on economic growth. The results are not reported here to conserve space, but they are available upon request.

Table 7: Estimation results for Eq (2) with additional control variables

Variables	1	2	3	4	5	6
Debit _{it-1}	0.0336*** (0.0121)	0.0350*** (0.0125)	0.0295** (0.0115)	0.0343*** (0.0120)	0.0355*** (0.0121)	0.0248** (0.0117)
Inflation _{it-1}	0.217*** (0.0807)	0.280*** (0.106)	0.185*** (0.0659)	0.339*** (0.115)	0.235*** (0.0780)	0.255** (0.114)
Population _{it-1}	0.754** (0.304)	0.751** (0.319)	0.489* (0.261)	0.853*** (0.309)	0.715*** (0.266)	0.474** (0.230)
Secondary _{it-1}	-0.00730 (0.0115)	-0.00688 (0.00998)	-0.00454 (0.00841)	-0.0108 (0.00993)	-0.00813 (0.0113)	-0.00694 (0.00915)
Openness _{it-1}	0.00183 (0.00603)	0.00414 (0.00626)	-0.000188 (0.00377)	0.00201 (0.00383)	0.00183 (0.00518)	-0.00483 (0.00443)
FDI _{it-1}	0.00399 (0.0111)					0.0143 (0.0100)
FD _{it-1}		0.00364 (0.00472)				-0.000295 (0.00405)
GCF _{it-1}			0.135*** (0.0345)			0.148*** (0.0336)
LnICT _{it-1}				0.771 (0.474)		0.466 (0.644)
LnINS _{it-1}					0.744 (0.949)	1.176* (0.678)
Constant	1.722* (1.024)	0.975 (1.374)	-1.183 (1.276)	-0.784 (1.583)	-0.616 (3.382)	-6.345*** (2.339)
Observations	125	118	125	124	125	117

Notes: The above results are estimated using Random effect model with robust standard error. Robust Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Ln denotes natural logarithm. Time dummies are included in the model, but the results are not reported to save spaces.

C. Control for outliers

Furthermore, this study employs the winsorisation technique as suggested by Lim, Hooy, Chang and Brooks (2016) to remove the outliers inherent in the data at (i) 1st and 99th percentiles and (ii) 5th and 95th percentiles. The estimation results based on Eq. (2) are shown in Table 8, in which the economic growth is positively associated with debit card payment with the exclusion of outliers from the data.

Similarly, credit card, E-money and cheque payment are found to have no influence on economic growth. The results are not reported here to conserve space, but they are available upon request.

Table 8: Estimation results for Eq. (2)

Variables	1 st and 99 th percentile	5 th and 95 th percentile
Debit _{it-1}	0.0238*** (0.00896)	0.0262** (0.0132)
Inflation _{it-1}	0.282** (0.138)	0.168** (0.0777)
Population _{it-1}	0.616*** (0.229)	0.416* (0.241)
Secondary _{it-1}	-0.00504 (0.00854)	-0.00334 (0.00794)
Openness _{it-1}	-0.00450 (0.00386)	-0.000247 (0.00366)
FDI _{it-1}	0.00459 (0.0131)	-0.00823 (0.0152)
FD _{it-1}	-0.000834 (0.00431)	0.00191 (0.00503)
GCF _{it-1}	0.135*** (0.0323)	0.135*** (0.0344)
LnICT _{it-1}	0.755 (0.752)	0.0609 (0.757)
LnINS _{it-1}	1.070 (0.682)	1.241* (0.658)
Constant	-7.009*** (2.101)	-5.626** (2.215)
Observations	117	117

Notes: The Random effect model with robust standard error is applied on the winsorized data. Robust Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Ln denotes natural logarithm. Time dummies are included in the model, but the results are not reported to save spaces.

VI. Discussion

Table 5 to 8 have consistently show that economic growth in OECD countries is positively associated with debit card payment. Hence, hypothesis 1 is supported in which debit card payment facilitates economic growth for OECD countries. Notably, the result concurs with the study done by Hasan et al (2012), Zandi et al (2013) and Zandi et al (2016), in which debit card payment stimulate economic activities and subsequently enhance the economic growth. Unlike credit card, the amount of fund in debit card is generated from personal saving account. Therefore, greater usage of debit card will not lead to debt accumulation among households. In fact, debit card provides immediate access to fund for consumers, thereby facilitating private consumption and therefore contributes to economic growth.

Next, credit card and cheque payment are found to have no influence on OECD economic growth. The results contradict to earlier studies, in which credit card enhances economic growth in European and high-income countries (Hasan et al, 2012, Zandi et al, 2013) and cheque payment is positively related to economic growth in European markets (Hasan et al, 2012). As mentioned earlier, the findings based on European and high-income countries may not be generalized to OECD countries due to its different economic structure and level of technology adoption.

Economic growth of OCED countries is found to have no responses with respect to the increase in the growth rate of credit card transaction value. This might due to the offsetting effect from the positive and negative impact of credit card payment. The positive impact of credit card payment is illustrated above (Zandi et al, 2013; Zandi et al, 2016), in which credit card provides immediate credit to consumers, thereby increasing their purchasing power and lead to higher aggregate demand in the economy. Subsequently, economic growth increases. While the negative impact of credit card is debt accumulation among the households, which in turn increases default rate in the economy and have a bearing on the country's economic growth (Kang and Ma, 2009). This is particularly true in the context of OECD countries. As such, easy credit and the rise in property prices in the aftermath of 2007/08 Global Financial Crisis have led to a substantial increase in the household debt (OECD, 2017b). Therefore, the positive and negative effect of credit card payment offsetting each other, resulting insignificant impact on economic growth for OECD countries.

For cheque payment, Hasan et al (2012) show that the transaction value for cheque is the highest among the cashless payment instruments in the 27 European countries. The high transaction value would imply that cheque payment remains as an important cashless payment instrument in the European economy. In line with this, Hasan et al (2012) found that there exists a positive relationship between economic growth and cheque payment. However, in the context of this study, cheque payment is found to have no impact on economic growth for OECD countries. One possible explana-

tion for this is the substitution effect between electronic card payment (debit card) and cheque payment (Hasan et al, 2012). As such, consumers and merchants would prefer electronic card payments over cheque payment because of its convenience in making purchases and lower transaction cost. Consequently, this would reduce the usage of cheque payment and subsequently the role of cheque payment in stimulating economic growth will be reduced. This argument is coincided with the descriptive statistics in Table 3 above, in which the growth rate of cheque transaction has been reduced by almost 10 percent in the sample period of this study. Therefore, cheque payment has limited impact on country's economic growth, given its decreasing role as a mean of transaction in OECD countries.

Next, there is no past study on the impact of E-money on economic growth, and therefore no comparison can be made. In this study, the E-money is found to have no relationship with economic growth for OECD countries. This may possibly due to the concerns on cyber security among the economic agents. Evidently, the World Economic Forum's 2017 Global Risk Report found that cyber risk is identified as the risk of highest concern in doing business in more than one third of OECD countries. In this regards, consumers and merchants would feel reluctant to conduct massive purchases by using the E-money payment. Therefore, resulting in insignificant impact on growth.

By and large, our results are in line with the thesis that cashless payments can have a significant impact on countries' economic growth. Specifically, this study contributes to the existing literature in revealing the impact of cashless payments on economic growth of OECD countries. Results indicate that debit card payment accelerates economic growth for OECD countries. Therefore, this study highlights the importance of debit card payment as the engine of growth for OECD economy.

VII. Conclusion

This study provides new evidence on the impact of cashless payments on economic growth in selected OECD countries from 2007 to 2016. The existing findings mainly derived from a group of developed countries which come from different regions and therefore the results may not be generalized to OECD countries, due to different economic structure and levels of technology adoption. In this regards, this paper contributes to the existing studies in two ways: Firstly, this study reveals the relationship between cashless payments and economic growth in OECD countries. Secondly, this paper provides evidence on which cashless payment would result in growth-enhancing effect in OECD countries.

Our empirical results indicate: Firstly, there is a positive and significant relationship between cashless payment and economic growth in OECD countries. In particu-

lar, debit card payment is found to enhance economic growth. While credit card, e-money and cheque payment are found to have no influence on OECD economic growth. Secondly, the positive relationship between economic growth and debit card payment is robust after controlling for the effect of reverse causality, omitted variable bias and outliers.

As a policy suggestion, OECD countries should promote cashless payments further and priority should be given to debit card payment as it exerts the highest positive impact on economic growth. Hence, country would be able to reap the benefit from cashless economy.

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