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DIGITAL PAYMENT INSTRUMENTS, INSTITUTIONAL QUALITY, AND CORRUPTION: EVIDENCE FROM ASEAN

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ABSTRACT

Objective: This study analyzes how digital payment methods, institutional quality, and corruption levels relate in ASEAN countries. It examines how digital payment systems and factors such as the rule of law and regulatory quality affect corruption levels, as measured by the Corruption Perceptions Index (CPI).

Research Design & Methods: This study uses a quantitative method called Panel Vector Autoregression (PVAR) to look at how variables relate to each other in panel data. It focuses on five ASEAN countries: Indonesia, Malaysia, Thailand, and Singapore, with data collected from 2010 to 2024.

Findings: Research shows that in the short term, only bank credit and the quality of regulation have a significant impact on changes in corruption levels. The formal financial sector and high-quality regulation are important for perceptions of corruption. Digital payment instruments such as ATMs and e-money have a dynamic relationship, but do not have a significant direct impact in the short term.

Implications: Research indicates that preventing corruption needs improvements in institutions, regulations, law enforcement, and digitized payment systems. Digital transformation in finance should be combined with institutional reforms to boost transparency, accountability, and integrity in the economy.

Contribution & Value Added: This study looks at how digital financial systems, the quality of institutions, and corruption are connected in the ASEAN region. It uses a PVAR approach to analyze both short-term and long-term relationships between these factors. The results aim to show how digital transformation and governance quality can help decrease corruption in developing countries.

Keywords: Digital Payment, Corruption, Institutional Quality, Panel Vector Autoregression, ASEAN.

JEL codes: D73, E42

Article type: research paper

INTRODUCTION

Corruption is widely understood as the abuse of power and public office for personal gain (Lambdsdorff, 2007). This phenomenon is an ongoing global problem because it has severe economic, political, and social consequences that affect individuals, businesses, and society as a whole. Corruption hampers economic growth, distorts the allocation of public resources, weakens government structures, and undermines development efforts (Budiono and Suryanto, 2018). According to the World Bank, 2017, an estimated USD 1.5 trillion equivalent to nearly 2% of global GDP is spent annually on bribery, highlighting the magnitude of the problem (Le, 2025).

Although corruption is often associated with inefficiency in the public sector of developing countries, it also permeates the private sector and developed countries (Scholl and Schermuly, 2020). In an increasingly globalized and financially integrated world, corruption significantly impacts economic efficiency and institutional credibility. Cultural and political factors may have only limited short-term effects, but they shape the dynamics of corruption in the long term (Abramo, 2008; Achim, 2016). Therefore, combating corruption requires not only legal reform but also structural transformation of the financial system and governance.

Most empirical studies on corruption have primarily focused on government institutions, public administration reform, and law enforcement mechanisms. However, the role of central banks and payment systems in influencing the dynamics of corruption has received relatively little attention (Adhikari and Bhatia, 2010). Corruption often involves financial transactions that are concealed through anonymous cash payments. Therefore,

it is important to examine corruption from the perspective of the financial system. Institutional reforms take a long time to implement, but adjustments to central bank policies and the modernization of payment systems can yield faster results (Adhikari and Bhatia, 2010; Muralidharan et al., 2014).

Administrative measures such as streamlining bureaucratic procedures, strengthening oversight, and increasing transparency are important tools for combating corruption. Recently, digital technology and cashless payment systems have been identified as potential tools for reducing corrupt practices (Alam et al., 2023; Sakuntala et al., 2024). Cash transactions are often associated with tax evasion, illegal fundraising, and bribery due to their anonymity and limited traceability. In contrast, electronic payment systems enhance transparency, leave a digital trail, and improve monitoring capabilities. Governments can restrict the circulation of large-denomination cash and promote digital payments to reduce opportunities for corruption (Goel and Mehrotra, 2012; Singh and Bhattacharya, 2017).

The emergence of financial technology (fintech), electronic payments, and mobile money has introduced new mechanisms that could alter the incentives for corruption. During the 2010s, the adoption of digital payment methods such as mobile wallets, e-money, and electronic transactions grew rapidly alongside increasing internet and smartphone penetration, as well as regulatory support and digital financial infrastructure in various ASEAN countries (The ASEAN, 2024). About 80% of adults with financial accounts in ASEAN have used digital payments, while the value of digital payment transactions across the six major ASEAN economies reached approximately USD 806 billion in 2022 and is projected to continue rising in the coming years (World Economic Forum, 2023)

From a theoretical perspective, Becker (1968) theory of the economics of crime suggests that illegal behavior decreases as the probability of detection and the expected punishment increase. Empirical studies show that higher demand for cash is associated with the growth of the underground economy (Drehmann et al., 2002; Schneider and Enste, 2000). Corruption and the shadow economy often reinforce each other, especially in developing countries (Dreher and Schneider, 2010). Additionally, stricter capital controls in highly corrupt countries can inadvertently increase the incentives for bribery as individuals seek to circumvent regulatory barriers (Raimi et al., 2013).

Beyond financial structures, institutional quality plays a crucial role in shaping corruption outcomes. A robust legal system characterized by the rule of law and sound regulations enhances law enforcement and reduces the abuse of power. Conversely, a weak legal framework and unclear enforcement mechanisms can undermine anti-corruption efforts (Olujobi and Yebisi, 2023). Public trust in institutions is influenced by perceptions of corruption. High levels of corruption erode trust and reduce political participation (Beesley et al., 2022; Hakhverdian and Mayne, 2012; Torcal, 2014). Empirical evidence shows that financial transparency and a robust legal system increase the expected costs of corruption and create a deterrent effect (Montes and Luna, 2021).

At the corporate level, corruption affects liquidity management and cash holdings. Companies operating in a corrupt environment may hold excessive cash to facilitate bribery or conceal illegal payments (Nguyen and van Dijk, 2012; Thakur and Kannadhasan, 2019; Tran, 2022). Conversely, less transparent financial practices tend to prevail in highly corrupt environments (Murdock et al., 2023; Thai et al., 2025). These findings underscore the central role of liquidity and payment structures in the dynamics of corruption.

Studies show that digital wage payments and biometric payment systems significantly reduce leakage and corruption in public programs (Adhikari and Bhatia, 2010; Muralidharan et al., 2014). Cross-country evidence suggests that controlling the money supply can effectively reduce corruption rates (Singh and Bhattacharya, 2017). Similarly, adoption of non-cash payments in developing countries has been found to be negatively correlated with corruption (Setor et al., 2021). Wachs et al. (2021) found that higher levels of technology use in public procurement across European Union countries were associated with higher levels of corruption, suggesting that digitalization alone is not sufficient without a strong institutional framework. Therefore, the interaction between digital payment systems and the quality of the legal and institutional framework is a critical dimension of research.

Although the existing literature is growing, several gaps remain. First, most studies analyze digital payments in aggregate without distinguishing between specific instruments such as ATM transactions, credit cards, and e-money. Second, research that simultaneously examines the interaction between institutional quality indicators such as the rule of law and regulatory quality and different non-cash payment instruments remains limited. Third, empirical studies focusing on developing countries in Southeast Asia remain scarce, particularly in the post-fintech expansion and post-pandemic contexts. This study addresses this gap by examining the dynamic relationship between corruption, institutional quality, and various non-cash payment methods in ASEAN (Indonesia, Malaysia, Thailand, and Singapore) during the period 2010–2024.

By focusing on these three economies, which are characterized by rapid digital financial transformation and varying institutional capacities, this study seeks to address the following research questions:

1. Do various types of non-cash payment instruments reduce corruption levels?
2. Does institutional quality amplify or moderate the effects of digital payments on corruption?
3. Is there a dynamic two-way relationship between corruption and the development of payment systems?

LITERATURE REVIEW

Theoretical Foundations of Corruption

Conceptually, corruption is defined as the abuse of public power for personal gain (Lambsdorff, 2007). This definition serves as the basis for empirical measurement through the Corruption Perceptions Index (CPI) published by Transparency International. The CPI is widely used in cross-national studies because it reflects the perceptions of businesspeople and experts regarding the level of corruption in the public sector.

Theoretically, Becker (1968) emphasizes that individuals engage in illegal behavior when the expected benefits exceed the expected costs. In the context of corruption, the probability of detection and the severity of punishment are key determinants. A financial system that enhances transaction transparency will increase the probability of detection, thereby reducing the incentive for corruption.

In addition, principal-agent theory explains that corruption arises due to information asymmetry between those in power (agents) and the public (principals). This information imbalance allows agents to prioritize their personal interests over the public interest (Nurkey et al., 2021). When monitoring mechanisms are weak, agents are more likely to abuse their power (Gong, 2008; Simonović, 2018). Therefore, strengthening governance and oversight systems is crucial to combating corruption.

Institutional Quality and Corruption

The quality of institutions plays a fundamental role in determining a country's level of corruption. Two key indicators frequently used are the Rule of Law Index (RLI) and the Regulatory Quality Index (RQI). Both are part of the Worldwide Governance Indicators published by the World Bank. Institutional theory posits that formal institutions such as legal systems, regulations, and law enforcement mechanisms create constraints and incentives that influence economic behavior (Bogart et al., 2010; Neef and Ekasingh, 2007). Strong institutions enhance the credibility of law enforcement and reduce the likelihood of abuse of power.

Montes and Luna (2021) show that a strong legal system and financial transparency increase the expected costs of corruption, thereby creating a deterrent effect. Similarly, Hakhverdian and Mayne (2012) found that a weak rule of law correlates with low public trust in political institutions. In the context of developing countries, weaknesses in the legal framework often hinder the effectiveness of anti-corruption policies (Olujobi and Yebisi, 2023). Regulatory ambiguity and weak policy implementation can create ample discretion for officials, increasing the potential for administrative corruption. Therefore, theoretically, an increase in the Rule of Law Index (RLI) is expected to reduce corruption levels, as reflected in improvements in the Corruption Perceptions Index (CPI), while an increase in the Regulatory Quality Index (RQI) can enhance the effectiveness of policies and corruption control mechanisms.

Cash Economy, Underground Economy, and Corruption

The relationship between cash use and corruption has long been a concern in the economic literature. Schneider and Enste (2000) showed that an increase in the shadow economy is correlated with an increase in the demand for cash. Drehmann et al. (2002) also found that cash demand increases when informal economic activity expands. Dreher and Schneider (2010) emphasized the reciprocal relationship between corruption and the shadow economy, particularly in low- and middle-income countries. Cash is anonymous and difficult to trace, making it a key instrument in illegal transactions, including bribery. Singh and Bhattacharya (2017), using panel data from 54 countries, found that the amount of currency in circulation is positively related to the level of corruption. This study emphasizes that central bank control of the cash supply can be an effective anti-corruption policy instrument. This theory supports the argument that the greater the reliance on cash transactions, the greater the opportunity for corruption. Conversely, non-cash payment systems increase the transparency and accountability of transactions.

Digital transformation in payment systems introduces new mechanisms for monitoring financial transactions through electronic recording that increases transparency and can be audited (Relly, 2012). Various studies have shown that digitizing payments can reduce leakage and corruption, such as the shift in wage payments from cash to bank transfers in public programs in India (Adhikari and Bhatia, 2010), implementation of a biometric payment system that speeds up the payment process and reduces corruption (Muralidharan et al., 2014), and cross-country findings showing that increases in non-cash transactions are negatively correlated with levels of corruption (Setor et al., 2021). This finding aligns with Becker (1968) theory, which states that increasing the probability of detection through digital footprints can reduce incentives for corruption. However, the effectiveness of digitalization remains dependent on the quality of institutions, as the use of technology without strong institutional oversight does not always reduce corruption (Wachs et al., 2021).

Disaggregated Non-Cash Instruments: ATM, Credit Card, and E-Money

Most previous studies measure non-cash payments using aggregate indicators, which may overlook the distinct characteristics of each payment instrument. In practice, ATM, credit card, and e-money transactions operate through different mechanisms that impact financial transparency and potential corruption in different ways.

ATM transactions primarily provide access to cash through the banking system. Although these transactions are recorded electronically, the end result is the withdrawal of physical cash, which can then be used anonymously. Consequently, the impact of ATM use on corruption remains theoretically ambiguous, as the availability of cash can still facilitate untraceable transactions. In contrast, credit card payments are processed entirely within the banking system and leave a detailed digital record of every transaction. This enhances financial traceability and transparency, making it harder to conceal illegal payments. Therefore, wider use of credit cards is generally expected to reduce opportunities for corruption.

Electronic money is a fully digital payment instrument integrated with modern financial technology systems. Transactions conducted via digital wallets or mobile payments are recorded in real time and can be monitored more effectively by financial institutions and regulators. Therefore, electronic money has the greatest potential to increase transparency and reduce corruption. [Tran \(2022\)](#) found that companies operating in highly corrupt environments tend to hold more cash to facilitate bribery payments. Thus, payment methods that reduce reliance on cash can help curb corrupt practices.

METHODS

The Panel Vector Autoregression (PVAR) model combines the traditional Vector Autoregression (VAR) framework with panel data techniques. This model is widely used to assess dynamic interactions among macroeconomic and institutional variables because it treats all variables as endogenous and allows for feedback effects over time ([Antonakakis et al., 2017](#); [Koengkan and Fuinhas, 2020](#)). Unlike conventional regression models, which distinguish between dependent and independent variables, the PVAR framework assumes that all variables interact simultaneously. This is particularly relevant to this study because corruption, institutional quality, and the development of digital payments can dynamically influence one another.

The Panel Vector Autoregression (PVAR) model has several key advantages in empirical analysis ([Antonakakis et al., 2017](#); [Koengkan and Fuinhas, 2020](#)). This model allows all variables to be treated as endogenous, ensuring that potential endogeneity among variables does not introduce bias in the estimation results. Furthermore, the PVAR model can incorporate lag structures into the model without omitting relevant variables, thereby enabling a more comprehensive analysis of the dynamic relationships among variables. This method also allows for the control of country-specific fixed effects and the inclusion of global shocks affecting all countries as time-specific fixed effects. Another advantage is the PVAR's ability to be applied to panel datasets with relatively short time series, which is typically a characteristic of research in developing countries. Given the sample structure of this study, which consists of four ASEAN countries (Indonesia, Malaysia, Thailand, and Singapore) over the 2010–2024 period, the PVAR approach is considered an appropriate method for analyzing the dynamic interactions among institutional quality, cashless payment systems, and corruption levels. Corruption is measured using the Corruption Perceptions Index (CPI) published by Transparency International, while institutional quality is represented by the Rule of Law Index (RLI) and the Regulatory Quality Index (RQI) from the World Bank. Non-cash payment instruments include ATM transaction values, credit card transactions, and electronic money transactions (in U.S. dollars).

Basic PVAR model equation in this study is mathematically expressed as follows:

$$Y_{i,t} = \mu_i + \delta_t + \sum_{j=1}^p A_j Y_{i,t-j} + \epsilon_{i,t}$$

Specifically, the equation used to analyze the effects of digital payment instruments and institutional quality on the corruption level (ΔCPI) is expressed as follows:

$$\Delta CPI_{i,t} = \alpha + \sum_{j=1}^p \beta_{1j} \Delta CPI_{i,t-j} + \sum_{j=1}^p \beta_{2j} \Delta \ln ATM_{i,t-j} + \sum_{j=1}^p \beta_{3j} \Delta \ln CREDIT_{i,t-j} + \sum_{j=1}^p \beta_{4j} \Delta \ln EMONEY_{i,t-j} + \sum_{j=1}^p \beta_{5j} \Delta RLI_{i,t-j} + \sum_{j=1}^p \beta_{6j} \Delta RQI_{i,t-j} + e_{i,t}$$

After conducting the PVAR regression, this study will perform a number of tests. These include the Granger-Wald causality test to identify causal relationships among variables, the optimal lag test to determine a reasonable lag range, the unit root test to assess stability, variance decomposition analysis to determine the influence of one variable on another, and the impulse response function (IRF) to evaluate the response of variables

to shocks. All these steps will be performed using Eviews. Furthermore, the study will detail the model testing and regression results and discuss the relationship between non-cash payments, the quality of legal institutions, and corruption levels in four ASEAN countries.

Table 1. Operational Variables

Variables	Variable description	Unit data	Source
ATM	ATM transaction amount (US Dollar)	Logarithm	World Bank
Credit	Credit card transactions (U.S. dollar)	Logarithm	World Bank
eMoney	Electronic money transactions (U.S. Dollar)	Logarithm	World Bank
RLI	Rule of law index	Index	World Bank
RQI	Regulatory quality index	Index	World Bank
CPI	Country corruption index	Index	Transparency International

RESULT

Stationary Test

Table 2. Root Test on First Different

Variable	ADF - Fisher Chi-square		st difference	Result
	Statistic	Prob.		
Corruption (CPI)	56.9617	0.0000	d=1	Stationary
ATM	34.0390	0.0000	d=1	Stationary
Credit Card	33.8881	0.0000	d=1	Stationary
Emoney	22.7457	0.0037	d=1	Stationary
RLI	56.8342	0.0000	d=1	Stationary
RQI	64.5870	0.0000	d=1	Stationary

Based on the results of the unit root test using the ADF–Fisher Chi-square method, all research variables showed a probability value (Prob.) < 0.05, namely the variables Corruption (CPI), ATM, Credit Card, E-money, RLI, and RQI. The test results also showed that all variables were stationary at the first-difference level (1st difference / d=1).

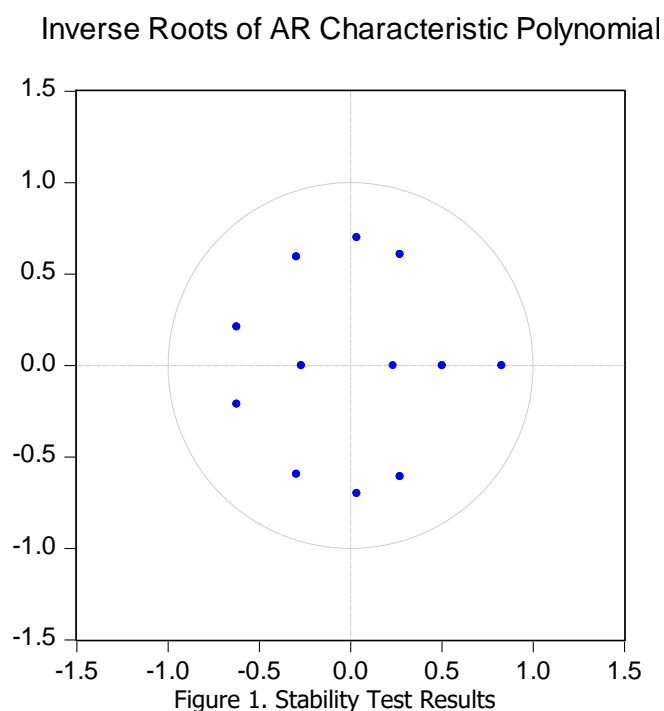
Optimum Lag Test

Table 3. Optimum Lag Test Results

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-274.4634	NA	0.004790	11.68597	11.91987*	11.77437*
1	-237.9248	62.41999	0.004743	11.66354	13.30084	12.28227
2	-198.8888	56.92758*	0.004485*	11.53703*	14.57773	12.68612

The lag length tests indicate that the optimal lag is determined based on the minimum value of the information criteria. LR, FPE, and AIC yield the best results at lag 2, while SC and HQ yield the best results at lag 0. Since AIC and FPE are frequently used in VAR analysis, the recommended optimal lag is lag 2. Therefore, the subsequent VAR model will be estimated using lag 2 to analyze the dynamic relationships among the variables.

Uji Stability



The results of the VAR stability test show that all modulus values are below 1, with the largest value being 0.827654. A VAR model is considered stable if all modulus values of the roots are less than one. These results indicate that the VAR model satisfies the stability conditions, so the model estimates are valid and further analyses such as the Impulse Response Function (IRF) and Variance Decomposition (VD) can be performed.

Panel VAR-granger causality Wald test

Table 4. Granger causality test

Null Hypothesis:	Obs	F-Statistic	Prob.
LN_ATM does not Granger Cause CPI	52	1.42829	0.2499
CPI does not Granger Cause LN_ATM		0.22112	0.8024
LN_CREDIT does not Granger Cause CPI	52	0.79208	0.4589
CPI does not Granger Cause LN_CREDIT		2.69265	0.0781
LN_EMONEY does not Granger Cause CPI	52	1.39029	0.2591
CPI does not Granger Cause LN_EMONEY		2.72423	0.0760
RLI does not Granger Cause CPI	52	1.01969	0.3685
CPI does not Granger Cause RLI		1.65241	0.2025
RQI does not Granger Cause CPI	52	2.99811	0.0595
CPI does not Granger Cause RQI		6.39068	0.0035
LN_CREDIT does not Granger Cause LN_ATM	52	10.4716	0.0002
LN_ATM does not Granger Cause LN_CREDIT		0.43798	0.6479
LN_EMONEY does not Granger Cause LN_ATM	52	0.92511	0.4036
LN_ATM does not Granger Cause LN_EMONEY		2.06239	0.1385
RLI does not Granger Cause LN_ATM	52	2.53931	0.0897
LN_ATM does not Granger Cause RLI		0.21619	0.8064
RQI does not Granger Cause LN_ATM	52	0.34817	0.7078
LN_ATM does not Granger Cause RQI		1.21662	0.3054
LN_EMONEY does not Granger Cause LN_CREDIT	52	0.38889	0.6800
LN_CREDIT does not Granger Cause LN_EMONEY		1.01156	0.3714
RLI does not Granger Cause LN_CREDIT	52	0.80180	0.4546
LN_CREDIT does not Granger Cause RLI		0.44418	0.6440
RQI does not Granger Cause LN_CREDIT	52	0.37708	0.6879
LN_CREDIT does not Granger Cause RQI		2.40586	0.1012
RLI does not Granger Cause LN_EMONEY	52	4.87707	0.0119

LN_EMONEY does not Granger Cause RLI		0.25622	0.7750
RQI does not Granger Cause LN_EMONEY	52	3.87218	0.0278
LN_EMONEY does not Granger Cause RQI		0.83475	0.4403
RQI does not Granger Cause RLI	52	0.87156	0.4249
RLI does not Granger Cause RQI		2.09827	0.1340

Based on results from the Granger Causality test with 52 observations and a 5% significance level, the test results indicate that the CPI does not have a significant causal relationship with most variables, as all probability values are greater than 0.05. However, there is a one-way causal relationship from CPI to RQI, with a probability value of 0.0035 (<0.05), indicating that changes in the level of perceived corruption can affect regulatory quality (RQI). Furthermore, at a more lenient significance level (10%), there are indications of a causal relationship from the CPI to LN_CREDIT (0.0781) and the CPI to LN_EMONEY (0.0760), as well as from the RQI to the CPI (0.0595).

Among financial system variables, a one-way causal relationship was found between LN_CREDIT and LN_ATM with a probability of 0.0002 (<0.05), indicating that an increase in credit disbursement plays a role in driving the development of ATM infrastructure. Furthermore, there is a causal relationship from RLI to LN_EMONEY (0.0119) and from RQI to LN_EMONEY (0.0278), indicating that the quality of legal and regulatory institutions contributes to the development of electronic money usage.

Overall, the results of the Granger causality test indicate that the causal relationships in the model are limited and largely one-directional, particularly from institutional governance and the financial sector toward the development of digital payment instruments, as well as certain interactions with the CPI. These findings suggest that changes in the quality of institutions and the financial sector play a greater role as driving factors rather than as variables influenced by other variables in the short term.

Johansen Cointegration Test

Table 5. Johansen Cointegration Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.660875	134.7678	95.75366	0.0000
At most 1 *	0.622850	87.18674	69.81889	0.0011
At most 2	0.409970	44.28185	47.85613	0.1042
At most 3	0.272277	21.06827	29.79707	0.3534
At most 4	0.116043	7.083520	15.49471	0.5679
At most 5	0.036942	1.656241	3.841466	0.1981

The Johansen cointegration test shows that, at the 5% significance level, there are two cointegration relationships in the model. The Trace Statistic values for the "None" and "At most 1" hypotheses are greater than the 5% critical value, and the probability is < 0.05 , so the null hypothesis is rejected. However, for the hypotheses "At most 2" and beyond, the Trace Statistic values are smaller than the critical values with a probability > 0.05 , so the null hypothesis cannot be rejected. This means there are two cointegration equations, indicating a long-term relationship between the variables.

PVAR Regression Analysis

Table 6. PVAR Regression Results

	D(CPI)	D(LN_ATM)	D(LN_CREDIT)	D(LN_EMONEY)	D(RLI)	D(RQI)
D(CPI(-1))	0.009615 (0.13113) [0.07332]	-0.002159 (0.01148) [-0.18812]	-0.005852 (0.00825) [-0.70962]	0.042669 (0.02988) [1.42807]	-0.128638 (0.19858) [-0.64779]	0.169751 (0.17513) [0.96929]
D(CPI(-2))	-0.065723 (0.12740) [-0.51587]	0.026469 (0.01115) [2.37333]	-0.006028 (0.00801) [-0.75224]	-0.006220 (0.02903) [-0.21426]	0.450041 (0.19294) [2.33258]	0.314279 (0.17015) [1.84703]
D(LN_ATM(-1))	3.224913 (1.91844) [1.68101]	0.259681 (0.16794) [1.54628]	-0.002998 (0.12066) [-0.02485]	-0.145585 (0.43714) [-0.33304]	-5.891172 (2.90529) [-2.02774]	4.348568 (2.56221) [1.69720]
D(LN_ATM(-2))	-0.369550 (2.01675) [-0.18324]	0.411604 (0.17654) [2.33145]	0.044453 (0.12684) [0.35046]	0.026982 (0.45954) [0.05872]	5.032781 (3.05416) [1.64784]	-0.564288 (2.69350) [-0.20950]

	D(CPI)	D(LN_ATM)	D(LN_CREDIT)	D(LN_EMONEY)	D(RLI)	D(RQI)
D(LN_CREDIT(-1))	-1.176694 (2.48575) [-0.47338]	-0.174899 (0.21760) [-0.80376]	0.170156 (0.15634) [1.08840]	0.054789 (0.56641) [0.09673]	4.167322 (3.76441) [1.10703]	-3.918581 (3.31988) [-1.18034]
D(LN_CREDIT(-2))	6.828347 (2.52814) [2.70094]	-0.539457 (0.22131) [-2.43755]	-0.291163 (0.15900) [-1.83119]	0.100480 (0.57607) [0.17442]	-5.537012 (3.82861) [-1.44622]	0.117046 (3.37649) [0.03466]
D(LN_EMONEY(-1))	-0.409977 (0.62883) [-0.65197]	0.026296 (0.05505) [0.47770]	-0.024448 (0.03955) [-0.61817]	0.291537 (0.14329) [2.03464]	0.808223 (0.95230) [0.84870]	0.851206 (0.83985) [1.01353]
D(LN_EMONEY(-2))	0.088132 (0.60489) [0.14570]	-0.003092 (0.05295) [-0.05839]	-0.057225 (0.03804) [-1.50418]	0.084987 (0.13783) [0.61660]	0.177861 (0.91605) [0.19416]	0.982982 (0.80788) [1.21675]
D(RLI(-1))	0.211074 (0.10657) [1.98062]	-0.016358 (0.00933) [-1.75345]	0.006117 (0.00670) [0.91268]	0.007712 (0.02428) [0.31758]	-0.308518 (0.16139) [-1.91165]	-0.224067 (0.14233) [-1.57427]
D(RLI(-2))	0.030539 (0.12350) [0.24728]	0.002863 (0.01081) [0.26478]	-0.011264 (0.00777) [-1.45014]	-0.039953 (0.02814) [-1.41975]	-0.393270 (0.18703) [-2.10272]	0.014474 (0.16494) [0.08775]
D(RQI(-1))	-0.319251 (0.12424) [-2.56962]	0.007369 (0.01088) [0.67755]	-0.003850 (0.00781) [-0.49277]	-0.007407 (0.02831) [-0.26165]	-0.029089 (0.18815) [-0.15461]	-0.355285 (0.16593) [-2.14116]
D(RQI(-2))	0.102678 (0.13507) [0.76020]	-0.000995 (0.01182) [-0.08416]	0.018047 (0.00849) [2.12444]	0.059583 (0.03078) [1.93595]	0.011885 (0.20455) [0.05810]	-0.192474 (0.18039) [-1.06697]
C	-0.291532 (0.39110) [-0.74542]	0.028819 (0.03424) [0.84175]	0.087303 (0.02460) [3.54927]	0.152857 (0.08912) [1.71526]	0.844655 (0.59228) [1.42612]	0.479295 (0.52233) [0.91760]

The results of the Panel Vector Autoregression (PVAR) estimation indicate that not all variables have a significant effect on the level of corruption as measured by the Corruption Perceptions Index (CPI). The variable with a significant effect is bank credit at the second lag, with a t-statistic value of 2.70094. This indicates that an increase in credit activity in the formal financial system is associated with an increase in the CPI value, suggesting an improvement in perceptions of corruption. Bank credit can enhance the transparency and accountability of economic transactions and reduce informal economic practices that are prone to corruption.

Institutional factors play a significant role in the dynamics of corruption. The Regulatory Quality Index (RQI) variable shows a significant influence on changes in the CPI with a t-statistic of -2.56962, indicating that the quality of government regulations affects perceptions of corruption. Good regulations can enhance oversight and transparency, as well as reduce the abuse of power. The Rule of Law (RLI) variable has a t-statistic of 1.98062, which is close to the significance threshold, suggesting that the enforcement of the law also influences the dynamics of corruption.

The estimation results also reveal a dynamic relationship among other variables within the system. Changes in the CPI at the second lag have a significant positive effect on ATM infrastructure development, with a t-statistic of 2.37333, indicating that improvements in governance and a reduction in corruption levels can enhance confidence in the financial system and encourage investment in banking infrastructure. Additionally, Regulatory Quality also has a significant effect on banking credit growth with a t-statistic value of 2.12444, suggesting that a robust regulatory framework can enhance financial system stability and encourage credit expansion. In the digital payment system, the e-money variable exhibits an internal persistence effect with a t-statistic of 2.03464, reflecting a pattern of sustained growth in the use of electronic transactions over time.

Overall, PVAR estimates indicate that institutional factors and financial system developments play a role in influencing the dynamics of corruption, although not all digital payment instruments have a direct impact in the short term. Regulatory quality emerges as the institutional factor most consistently influencing changes in the CPI, while developments in bank credit suggest that strengthening the formal financial system can contribute to increased economic transparency. These findings indicate that anti-corruption efforts do not solely depend on technological transformation within payment systems but are also significantly influenced by the quality of institutions and regulatory frameworks that support more transparent and accountable economic governance.

DISCUSSION

The estimation results indicate that not all variables in the system have a significant impact on changes in the Corruption Perceptions Index (CPI) in the short term. The banking credit variable at the second lag has a t-statistic value of 2.70094, which is greater than the critical value (2.0048), indicating a positive and significant effect on changes in the CPI. This finding indicates that an increase in credit activity in the previous period may contribute to an improvement in perceptions of corruption levels. This is likely because credit expansion through the formal financial system can enhance transparency and accountability in economic activities, thereby reducing the scope for informal transactions often associated with corrupt practices. Additionally, the Regulatory Quality (RQI) variable at the first lag showed a significant effect with a t-statistic of -2.56962, indicating that regulatory quality in the previous period had a significant impact on changes in the CPI. These results confirm that regulatory quality plays a crucial role in shaping the dynamics of corruption, as effective regulations can strengthen oversight mechanisms, enhance public accountability, and limit opportunities for abuse of power (Abdella et al., 2023; Liang et al., 2021; Moss and Buachoom, 2026). Meanwhile, Rule of Law (RLI) also yields a t-statistic of 1.98062, which is close to the threshold for statistical significance. This suggests a tendency for the quality of law enforcement to influence the dynamics of corruption, although its effect is not as strong as that of regulatory quality in this model.

Meanwhile, other variables such as ATM payments, e-money usage, and the CPI from the previous period did not show a statistically significant effect on changes in the CPI at the 5% significance level. This suggests that the influence of these variables on changes in corruption levels is likely indirect or requires a longer period of time to produce a significant impact. The characteristics of e-money usage in ASEAN countries during the study period were still dominated by small-value retail transactions such as transportation payments, daily shopping, or other digital services (Ludwina et al., 2022; Woon Chong et al., 2022). Thus, the impact of e-money on the broader economic transaction structure which is often a source of systemic corruption remains relatively limited. Furthermore, the development of the digital payment ecosystem in the ASEAN region is still in a transitional phase, so its impact on economic governance is not yet fully apparent in the short term.

The equation describing the dynamics of ATM infrastructure reveals several variables with significant effects. The change in the CPI at the second lag has a t-statistic of 2.37333, indicating that changes in the corruption rate during the previous period have a significant impact on the development of ATM payments. This finding suggests that improvements in governance or a reduction in the corruption rate can enhance confidence in the financial sector and encourage investment in the development of banking payment system infrastructure. In addition, ATM payments at the second lag are also significant with a t-statistic value of 2.33145, indicating persistence or internal dynamics in the development of ATM infrastructure. This means that an increase in the number of ATMs in the previous period tends to be followed by an increase in the subsequent period. On the other hand, credit card payments in the second lag show a negative and significant effect with a t-statistic value of -2.43755, indicating that credit expansion within the financial system may reduce reliance on ATM infrastructure. This condition is likely caused by a shift in public preference from conventional banking services toward more efficient digital financial services and non-cash payment systems.

In addition, Regulatory Quality also has a significant impact on banking credit growth, with a t-statistic of 2.12444. These results indicate that regulatory quality plays a crucial role in driving credit growth within the financial system. Strong and consistent regulations can enhance economic actors' confidence in the financial system, reduce uncertainty in economic activities, and strengthen the stability of the banking sector (Albaity et al., 2022; Fratzscher et al., 2016). With a clear and credible regulatory framework in place, financial institutions tend to be more active in extending credit to productive sectors, thereby driving broader economic growth.

Furthermore, in e-money transaction equations, the estimation results show that the e-money variable exhibits an internal persistence effect with a t-statistic of 2.03464, reflecting a pattern of sustained growth in electronic transaction usage over time. This finding indicates the presence of internal dynamics in e-money usage. In other words, an increase in electronic transaction usage in a previous period tends to drive an increase in e-money usage in the subsequent period. This phenomenon reflects the presence of a network effect in digital payment systems, where the wider the adoption of digital payment technology by the public and economic actors, the higher the level of its use will be in the future (Gong et al., 2022; Nyirenda and Chikumba, 2014; Rehncrona, 2018).

The equation describing the dynamics of the rule of law (RLI) reveals that ATM payments at the first lag have a significant effect, with a t-statistic of -2.02774. This result suggests that changes in payment system infrastructure may have implications for the dynamics of legal institutions. Furthermore, the rule of law (RLI) at the second lag is also significant with a t-statistic value of -2.10272, indicating the presence of internal dynamics within the rule of law indicator. This suggests that the quality of legal institutions is influenced not only by external factors but also by institutional conditions from the previous period (Emenalo and Gagliardi, 2020). In other words, improvements or declines in the quality of legal institutions tend to have a lasting effect over a certain period of time. In the regulatory quality equation (RQI), the first lag shows a significant effect with a t-statistic value of -2.14116. This finding indicates the persistence of regulatory policy dynamics, whereby changes in regulatory quality in the previous period influence regulatory changes in the subsequent period. This dynamic reflects the fact that

regulatory reform typically proceeds in stages and is influenced by previously implemented policies. Therefore, improving the quality of regulations generally requires a sustained and consistent institutional process.

Overall, the results of the Vector Autoregression (VAR) model indicate that the relationship between the development of the digital financial system, institutional quality, and corruption levels is dynamic and mutually influential. Several variables, such as bank credit, regulatory quality, and the use of e-money, have a significant impact on the system, suggesting a link between financial technology development and institutional governance. Furthermore, most of the significant effects emerged at the second lag, indicating that the impact of changes in the financial system and institutions does not occur immediately but takes time to affect other variables within the system. These findings confirm that strengthening regulatory quality, enhancing the transparency of the digital financial system, and developing cashless payment infrastructure are key factors in shaping the dynamics of economic governance and corruption control in the long term.

Furthermore, dynamic relationships between digital payment instruments, institutional quality, and corruption levels in the ASEAN-4 countries exhibit complex characteristics in both the short and long term. Preliminary findings from stationarity tests indicate that all variables become stationary at the first difference, suggesting that the data exhibit a long-term trend but can be analyzed dynamically after differentiation. This is consistent with the characteristics of macroeconomic and institutional variables, which are generally non-stationary at the original level but become stable after differentiation. Thus, the use of a Panel Vector Autoregression (PVAR) model is appropriate for capturing the dynamic relationships among variables within the system.

Furthermore, the results of the Johansen cointegration test indicate the presence of two cointegration relationships among the variables under study. This finding suggests that although the variables of digital payments, institutional quality, and corruption fluctuate in the short term, there is a long-term equilibrium linking these variables. Theoretically, this suggests that the transformation of digital payment systems and the quality of governance have a structural relationship with the dynamics of corruption levels in the ASEAN region. In other words, changes in digital financial systems and institutional quality not only affect corruption conditions temporarily but also shape long-term equilibrium patterns within the economic and governance systems (Cheng, 2026; Kotukov et al., 2025).

The results of Granger causality tests indicate that causal relationships among the variables are relatively limited and are mostly unidirectional. Specifically, a significant causal relationship was found between the CPI and Regulatory Quality (RQI), suggesting that changes in perceived corruption levels can influence regulatory quality in a country. These findings indicate that when corruption levels worsen, governments tend to respond by implementing regulatory reforms or policy adjustments to improve governance. Furthermore, the causal relationship between the RLI and RQI and the use of e-money suggests that the development of digital payment systems is significantly influenced by the quality of institutions and the supporting regulatory framework. In other words, the digitization of payment systems is driven not only by technological factors but also by legal stability and the effectiveness of regulations governing the financial system.

Variance Decomposition

Table 7. Root Test on First Different

Period	S.E.	D(CPI)	D(LN_ATM)	D(LN_CREDIT)	D(LN_EMONEY)	D(RLI)	D(RQI)
1	1.981321	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	2.110441	92.90560	2.473008	0.044186	2.377184	1.704444	0.495582
3	2.492607	72.53384	2.563055	8.359768	2.658153	2.169527	11.71566
4	2.649868	67.26550	7.080965	7.725241	4.247200	3.292653	10.38844
5	2.842155	60.75563	8.250450	6.715289	6.713223	6.093035	11.47238
6	2.994309	63.00944	7.723603	6.273778	6.272441	5.911624	10.80912
7	3.087853	63.09314	8.640392	6.226649	6.185831	5.675619	10.17837
8	3.242628	62.39282	8.453776	6.268059	6.852165	5.146766	10.88642
9	3.330283	61.52874	9.192426	6.160534	7.467755	4.903945	10.74659
10	3.441874	60.94844	9.882431	6.018583	7.510764	4.915838	10.72394

The results of the variance decomposition for the variable D(CPI) indicate that in the initial period (period 1), the variation in corruption scores is fully explained by internal factors, accounting for 100%. However, as the number of periods increased up to the 10th period, the contribution of this internal factor decreased to approximately 60.94%, indicating the presence of a persistence effect, where past corruption conditions remain a dominant factor in determining future corruption dynamics.

Among external factors, institutional quality specifically Regulatory Quality (D(RQI)) emerged as the most influential determinant, with a relatively stable contribution of approximately 10.72% in the 10th period, indicating that the quality of government regulation plays a significant role in influencing changes in perceptions of corruption

over the long term. Meanwhile, the Rule of Law (D(RLI)) contributes a smaller share of approximately 4.91%, indicating that the influence of law enforcement is relatively more limited compared to regulatory quality as a whole.

Institutional factors and digital payment instruments influence changes in corruption. ATM payments showed the second-largest contribution after the RQI, with a value of around 9.88% in the 10th period, indicating that basic banking digitization can influence corruption in the long term. E-Money increased by 7.51%, indicating an accumulative effect on changes in corruption. Meanwhile, credit cards contributed a stable contribution of around 6.01%, but their influence on corruption was smaller than that of ATMs and e-Money. Overall, internal factors of corruption, institutional quality, and the development of digital payment instruments contribute to the dynamics of long-term changes in corruption.

The findings from Variance Decomposition further strengthen these results by showing that most of the variation in corruption changes is still explained by factors internal to corruption itself, reflecting a persistence effect in corruption dynamics. However, the contribution of external variables such as institutional quality and digital payment systems increases over time. Specifically, Regulatory Quality is the largest external determinant in explaining long-term changes in the CPI, followed by the development of banking infrastructure such as ATMs. This suggests that policy reform and strengthening the formal financial system play a strategic role in sustainably influencing corruption dynamics.

Uji Impulse Response Function (IRF)

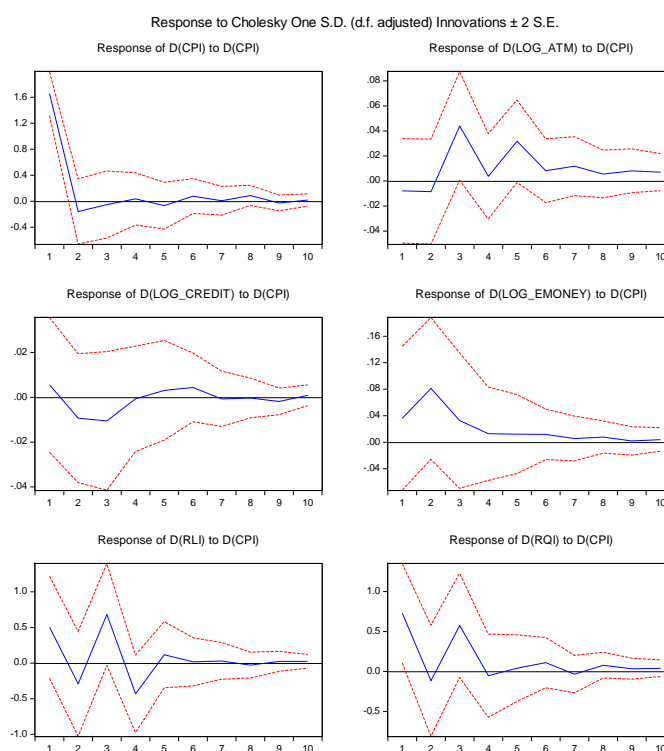


Figure 2. IRF test results

In general, responses to changes in the Corruption Perceptions Index (D(CPI)) in response to shocks from other variables exhibit a fluctuating pattern and tend to subside over the medium to long term. In the initial period, the CPI responded most strongly to shocks to itself, indicating a relatively large internal shock to the corruption system. The response to non-cash payment instruments such as ATMs and e-money was relatively small and unstable throughout the observation period. This suggests that the development of digital payment systems does not have a strong direct impact on changes in corruption levels in the short term.

Meanwhile, bank credit (D(LN_CREDIT)) showed a relatively stronger response compared to digital payment variables during the early periods, particularly around the third period. This suggests that developments in the formal financial sector have a more pronounced correlation with changes in corruption dynamics than digital payment instruments. Increased credit activity may reflect the expansion of the formal financial system, which enhances the transparency of economic transactions.

In terms of institutional quality, the CPI's response to Regulatory Quality (RQI) and Rule of Law (RLI) showed fairly pronounced fluctuations in the early period before eventually declining gradually and approaching equilibrium. This pattern suggests that shocks to institutional quality can influence perceptions of corruption in the short term, but these effects tend to be temporary and revert to stable conditions in the long term.

Overall, the results of the Impulse Response Function indicate that the dynamics of corruption in this model are more sensitive to changes in the formal financial sector and institutional quality, while the direct impact of developments in digital payment instruments is relatively limited. Furthermore, most variable responses within the system tend to converge toward an equilibrium point after the 7th to 10th periods, suggesting that the system possesses long-term stability following economic or institutional shocks.

CONCLUSION

This study aims to analyze the dynamic relationship between digital payment instruments, institutional quality, and corruption levels in ASEAN countries using the Panel Vector Autoregression (PVAR) approach. The results of the stationarity test indicate that all variables are stationary at the first difference, allowing for a valid estimation of the dynamic model. Furthermore, the results of the Johansen cointegration test indicate the presence of two cointegration relationships, suggesting that the variables of corruption, digital payment systems, and institutional quality are long-term interrelated within the economic system.

The PVAR estimation results indicate that, in the short term, only a few variables have a significant impact on changes in corruption levels. Specifically, bank credit and regulatory quality were found to have a significant impact on changes in the Corruption Perceptions Index (CPI). These findings suggest that the expansion of the formal financial system and high-quality regulation can contribute to improved perceptions of corruption levels. Furthermore, the research results also indicate that the development of payment system infrastructure such as ATMs, the dynamics of the rule of law, and the use of e-money have a dynamic relationship within the system, although they do not all have a direct impact on changes in corruption in the short term.

The results of the Granger causality test indicate a limited and largely one-way causal relationship. There is a causal relationship from the Corruption Perceptions Index (CPI) to regulatory quality, meaning that changes in corruption can drive regulatory improvements. Institutional quality, such as the rule of law and regulatory quality, facilitates the use of e-money, indicating that digital payment systems are influenced by robust regulations. Variance Decomposition Analysis indicates that in the long run, changes in corruption are more influenced by internal factors, but regulatory quality and banking infrastructure increasingly contribute over time. This suggests that policy reforms and the development of digital financial systems can influence the dynamics of corruption in the long term. The results of the Impulse Response Function (IRF) show that the CPI responds to shocks with initial fluctuations but stabilizes over time. The CPI is most responsive to its own shocks. Responses to digital payments, such as ATMs and e-money, are small and unstable, indicating a weak short-term impact, while bank credit and institutional quality show a clearer response before stabilizing.

These findings suggest that corruption in ASEAN countries is more influenced by the development of the formal financial sector and institutional quality than by the use of digital payments. This study emphasizes the importance of integrating the transformation of digital payment systems with improvements in institutional quality and regulation to enhance economic transparency and accountability. Academically, this study contributes to the understanding of the relationship between financial system digitalization, institutional quality, and corruption by using a Panel Vector Autoregression (PVAR) approach to understand the dynamics of the relationships among variables in the ASEAN context.

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