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**CRYPTOCURRENCY REGULATIONS:  
INSTITUTIONS AND FINANCIAL OPENNESS**

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**Abstract**

This study assesses how effective governance institutions and *de jure* financial openness influence the attitude of policy makers in pursuing further financial development by allowing the use of cryptocurrency. In other words, we examine the relationships between a) *de jure* openness to cryptocurrency and institutional strength and b) *de jure* openness to cryptocurrency and *de jure* capital openness. Our main method of estimation is a cross-sectional ordered probit model using institutional and macroeconomic data drawn from several sources, including the Chinn-Ito index, the World Bank's Worldwide Governance Indicators, and the World Bank's World Development Indicators, among others, over the period 2010–2018. To measure the *de jure* openness to cryptocurrency, we compose an index of 218 economies by using the current legal and regulatory status of cryptocurrency compiled in 2018. Our results show that effective governance institutions are associated with a less restrictive regulatory stance on cryptocurrency, whereas financial openness is not found to be significant. The results imply that a certain level of institutional quality may be necessary before opening up to new forms of financial technology. As cryptocurrency is recognized as a risky speculative financial instrument, its current state of many unknowns can prevent policy makers from conducting a thorough surveillance to avoid system-wide vulnerabilities.

**Keywords:** cryptocurrency, institutions, financial regulations, financial development, financial openness

**JEL Classification:** E44, F36, G18, G28

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## 1. INTRODUCTION

Cryptocurrency is currently at the frontier of financial development. It provides both opportunities and risks in financial markets and has attracted significant attention in recent years. Accordingly, the number of market players involved in the cryptocurrency business has risen (Farell 2015). The new business model provided by cryptocurrency along with the exponential increases in the prices of cryptocurrency may have enticed investors toward cryptocurrency, with many utilizing cryptocurrencies as a speculative asset to take advantage of the early gains. However, the subsequent crash in prices acted as a wake-up call to speculators dealing with cryptocurrency. Additionally, risks related to price manipulation in cryptocurrency markets are not unheard of (Gandal et al. 2018).

Although many central banks issue warnings about the use of cryptocurrency and have explicitly denied its status as a currency, only a few have banned its use as a financial asset. Policy makers are concerned about the low liquidity, the use of leverage, market risks from volatility, and the operational risks of cryptocurrency (FSB 2018). Many central banks emphasize that cryptocurrency is not legal tender and that users face the risk of unenforceability of cryptocurrency transactions. The Global Research Center (2018) compiled regulations on cryptocurrency and its report shows that, in countries where cryptocurrency is allowed, it can be legally traded as long as it follows existing rules or laws related to financial instruments. Regardless of the regulatory stance, policy makers are wary that cryptocurrency would be used for illegal activities, such as money laundering, trade in illegal or controlled substances, or terrorism finance. Policy makers are also aware of the potential lack of consumer and investor protection. Deposit insurance for holders of cryptocurrency is limited and not supplied by domestic monetary authorities. The combination of its potential benefits as well as macroeconomic risks begs the question of what determines policy openness or aversion to cryptocurrency.

Research on cryptocurrency encompasses several fields of study, from economics and finance to computer science and engineering, as well as applied mathematics. The breadth of the research field is not surprising given the nature of cryptocurrency as a financial innovation with its roots in blockchain technology and the fact that it uses cryptography intensively. Farell (2015) provides a brief historical background to cryptocurrency and discusses the security networks used by major cryptocurrency providers and the implications for the cryptocurrency industry. DeVries (2016) presents an examination of the bitcoin market and industry players using a SWOT (Strengths, Weaknesses, Opportunities, and Threats) framework, which is a common management analysis tool. Recent economic literature on cryptocurrency delves into issues such as determinants of cryptocurrency prices (Liu and Tsyvinski 2018; Corbet, Lucey, and Yarovaya 2018), cryptocurrency exchange rates (Li and Wang 2017), and persistence in the cryptocurrency market (Caporale, Gil-Alana, and Plastun 2019; Bouri et al. 2019), among other things. To date, there are no studies specifically investigating the factors influencing the policy stance on cryptocurrency.

In this study, we examine whether the presence or absence of credible surveillance and regulatory authorities influences the extent to which policy makers would allow, regulate, or take a hands-off approach to cryptocurrency. This study contributes to literature by bringing together two strands of literature—one examining cryptocurrency regulation and the other investigating financial development through legal institutions and financial openness. On the one hand, the need to balance promoting innovation while mitigating economic risks has sparked interest in the appropriate legal and regulatory framework

surrounding cryptocurrency. Marian (2015) proposes a regulatory system that imposes costs on anonymity to curtail potential illicit uses of cryptocurrency, such as tax evasion, money laundering, or financing terrorism, without disincentivizing the innovation that cryptocurrency could bring. On the other hand, previous research has provided evidence linking the quality of institutions and governance effectiveness to financial development (La Porta et al. 1998; Beck, Demirgüç-Kunt, and Levine 2001; Nee and Opper 2009). Furthermore, several research works have delved into the relationship between increased financial openness through capital account liberalization and financial development. A recent research by Ozkok (2015) shows that financial openness, along with other institutional variables, explains a large proportion of the variations in financial development across countries and over time. Meanwhile, Klein and Olivei (2008) show that the link between capital mobility and financial depth is significant in countries with high levels of institutional quality, i.e. industrialized countries. While regulation of cryptocurrency, a decentralized asset, is difficult, its potential destabilizing effects on vulnerable financial markets emphasize the need for vigilance in cryptocurrency market development.

To provide an empirical examination of the policy stance toward cryptocurrency, we begin by composing an index of *de jure* openness to cryptocurrency using the current legal and regulatory status of cryptocurrency compiled in 2018 by the Global Legal Research Center, the *Bitcoin Market Journal*, and CoinStaker. We identify three broad types of regulation system in 218 economies—fully liberalized, regulated, and banned. The policy choice of allowing the use, regulating, or prohibiting the use of cryptocurrency can represent, on the one hand, how open policy makers are to new avenues in financial development or, on the other, how prudent they are in adopting new financial technology. Then, we refer to Chinn and Ito (2006) as our baseline model to investigate empirically whether both institutional quality and a higher level of financial openness are associated with a less restrictive policy stance toward cryptocurrency. We use a cross-sectional ordered probit model and regress the *de jure* index of cryptocurrency, on the one hand, and a well-developed policy environment and *de jure* capital openness on the other. Then, we control variables representing institutional and macroeconomic factors that can affect cryptocurrency regulation. The analysis is based on data covering 124 economies.

Our results show that a well-functioning policy environment is associated with a greater likelihood of a less restrictive regulatory stance on cryptocurrency. Meanwhile, financial openness is not found to be significant. Our results are robust to alternate specifications, testing the sensitivity of the results to alternate measures of policy environment, and also the choice of year in the data used for the econometric estimation.

The paper is structured as follows. Section 2 provides a brief overview of what cryptocurrency is and its current legal and policy environment. Section 3 discusses the links between financial development, on the one hand, and financial openness and legal systems, on the other, as well as their implications for the policy stance on cryptocurrency. Section 4 presents our econometric model, describes the data, and provides descriptive statistics of the variables. In addition, we also explain our index of *de jure* openness to cryptocurrency (*cc*) in detail on the data source and the method of compilation and classification. Section 5 provides empirical results, discussion, and policy implications, particularly for emerging Asian economies. Robustness checks are also provided in this section. Section 6 concludes.

## 2. CRYPTOCURRENCY AND ITS POLICY ENVIRONMENT

Cryptocurrency is an electronic token, which originates from the need for direct peer-to-peer online payments (Peters et al. 2015). The most widely used and known cryptocurrency is bitcoin, introduced by an unknown developer or a group of developers with the pseudonym Satoshi Nakamura. It uses a decentralized public ledger to record ownership and transfers of value. The innovation behind cryptocurrency is that transactions are verified by several “miners,” who solve a complicated cryptographic problem to verify the ownership of the cryptocurrency and the subsequent transfer. The miner who solves the cryptographic problem first and validates the transaction receives cryptocurrency as remuneration. The mining process is an open-source program that can be accessed by the public. The peer-to-peer verification system bypasses typical trusted third parties such as a bank or a credit card company. Various innovations in cryptocurrency have emerged since bitcoin rose to popularity, thereby broadening the definition of cryptocurrency. While some central banks are mulling over establishing their own cryptocurrency, the industry is mainly a market-driven phenomenon.

Cryptocurrency in its current state is not considered a substitute for money. One of the largest points of contention regarding its value comes from the fact that it is not issued by any sovereign authority, thus its intrinsic value is questionable. Money has three basic features—a unit of account, a generally accepted medium of exchange, and a stable store of value. Cryptocurrency cannot take the role of a unit of account and a store of value because the market valuation of cryptocurrency is characterized by large volatility in prices. Bitcoin, the largest cryptocurrency in terms of market capitalization (Coinmarketcap.com 2017), saw its value rise in December 2017, before subsequently losing 30% of its value in December 2018 (Kollewe 2018). The unenforceable nature of cryptocurrency transactions in many countries also prevents it from becoming a common means of payment.

In its beginnings, cryptocurrency was used as a payment instrument (Farell 2015). Since cryptocurrencies use distributed ledger systems that bypass intermediaries, they can potentially reduce the cost of international transfers, including remittances. Lower transaction costs can ultimately contribute to financial development and increased financial access. Thus, while the large uncertainty over the value of cryptocurrency currently prevents it from being recognized as a currency that functions as a unit of account or a store of value, it is largely used for payment that promises anonymity and the elimination of intermediation costs.

As cryptocurrency gained more recognition in the financial sector, market players began to use it as a speculative investment asset. Similarly to other financial instruments, cryptocurrency began to be traded in cryptocurrency exchanges. Baur, Hong, and Lee (2018) found that bitcoin, holding the largest share of the cryptocurrency market, is mainly used as a speculative instrument rather than an alternative currency. Speculative trading is conducted in exchanges where consumers can buy, sell, and exchange cryptocurrencies using dollars, euros, or yen, or other cryptocurrencies. Currently, over 200 exchanges support cryptocurrency trading all over the world (Hansen 2018). The major exchanges are located in countries such as, the US, the Republic of Korea, and Samoa, among others (Hansen 2018).

Despite the recognition of policy makers of the risks of cryptocurrency, the policy stance on cryptocurrency among countries remains heterogeneous, with some countries being open to its use, silent in terms of regulation, or explicit in its prohibition. The Global Legal Research Center (2018) provides a comprehensive report on the legal and policy landscape surrounding cryptocurrency. While some countries ban cryptocurrency outright (Nepal, Pakistan, Viet Nam, etc.), most countries neither regulate nor promote it. Italy, Australia, and Japan, among other countries, require the registration and licensing of cryptocurrency operations. Meanwhile, the report shows that the Isle of Man and Mexico allow the use of cryptocurrency as a means of payment.

Uncertainty over security, the legality of its transactions, and the extent of consumer and investor protection has kept policy makers wary about its operations. Because of this, many central banks around the world try to inform the public about the difference between legal tender, which is backed by their central bank, and cryptocurrency, which is neither backed by the domestic nor other foreign monetary authorities. Furthermore, the combination of the speculative nature of cryptocurrency and its lack of supervision poses a threat to both investors and consumers. Although the cryptocurrency market itself is not large enough to pose a global risk at this time (FSB 2018), it may still pose risks to consumers and investors in smaller countries where cryptocurrencies are being used.

For countries where cryptocurrency transactions take place, policy makers also need to consider other policy or legal issues. In particular, the anonymous nature of cryptocurrency leads to concerns about using it to finance illegal activities such as trade in illegal substances, tax evasion, and financing of terrorism. Thus, particular regulations are put in place on top of existing laws on commercial activities. The Global Legal Research Center (2018) reports that the Republic of Korea, for instance, prohibits the use of anonymous bank accounts in cryptocurrency trading. The government of the Republic of Korea also requires banks to report activities deemed suspicious under the regulations in its thrust to prevent money laundering. In addition, the report shows another example of cryptocurrency regulation with the licensing requirement of Israel's Supervision of Financial Services for financial asset service providers, which includes virtual currency. While cryptocurrency operations have started to face registration and licensing requirements, they have remained outside most supervisory reach, thus they maintain that users of cryptocurrency do so at their own risk.

As opportunities and threats connected with cryptocurrencies become clearer as news about cryptocurrency operations unfolds, policy makers adopt their attitudes and policy stance toward cryptocurrency. For instance, the Global Legal Research Center (2018) reports that Japan revised its regulations on cryptocurrency to respond to the increasing speculation in the market. In April 2017, Japan revised the Payment Services Act to explicitly define cryptocurrency and to require the registration of dealers who exchange cryptocurrency with legal tender such as yen (Jiji 2018). In March 2018, Japanese regulators issued business improvement orders to cryptocurrency exchanges as a response to the incident when Coincheck, one of the biggest cryptocurrency exchanges in Japan, lost about \$400 million in cryptocurrency. From this episode, we see that regulators can be quick to respond to the threats that unfold from new financial technology.

In contrast, some policy makers decide not to regulate cryptocurrency specifically and allow existing laws on commodities or financial instruments to govern the use of cryptocurrency. The regulations compiled by the Global Legal Research Center (2018) present several examples. Austria considers cryptocurrency to be a business asset, classified under other intangible commodities. The Czech Republic similarly considers cryptocurrency to be a commodity, which explains their "liberal approach" to

cryptocurrency, essentially neither promoting nor hindering its development as they would do in other commodity trading. Australia sees cryptocurrency as assets for the purpose of capital gains tax. Anguilla treats cryptocurrency that functions as securities to be regulated under the existing securities framework. Meanwhile, some other countries, such as Bermuda and the Bahamas, currently do not have specific regulations on cryptocurrency and are in the process of exploring their regulatory or legislative options.

The risks of cryptocurrency are undisputed but the policies toward it vary widely. With its increasing presence in financial markets, cryptocurrency cannot be ignored, particularly by policy makers. Policy makers have been vocal about giving warnings but not all have been active in banning or regulating it. Even the policy choice of no regulation is a policy decision in itself in that policy makers are not prohibiting, but essentially allowing people or firms to engage in cryptocurrency transactions at their own risk. In the next section, we discuss how some policy choices or legal frameworks affect the attitudes of policy makers in permitting or regulating cryptocurrency.

### **3. FINANCIAL DEVELOPMENT, LEGAL SYSTEMS, AND POLICIES TOWARD CRYPTOCURRENCY**

In this study, we examine whether the quality of governance and the degree of financial openness contribute to the attitude of policy makers in pursuing further financial development by allowing the use of cryptocurrency.

We posit that the characteristics of government institutions can also influence the policy stance taken toward cryptocurrency. In particular, we test whether effective governance is more likely to be supportive of financial development as characterized in this paper by a less restrictive stance to a burgeoning cryptocurrency industry. Nee and Opper (2009) show that the quality of the state bureaucracy can contribute to financial market development. They argue that financial markets develop when institutions provide a stable environment where risks can be calculated. Enforcing contracts and protecting property rights can foster the confidence of economic actors. In particular, they emphasize the importance of credible, predictable, and reliable support from the public administration in facilitating the development of the securities market where control and ownership are separated.

Further, studies examining the link between legal institutions, an important component of governance, and financial development are not scarce. La Porta et al. (1998) show that differences in the legal system influence the development of financial markets. In particular, financial markets develop when legal institutions protect property rights, contracts, and the rights of owners. Beck and Levine (2003) explain that in contrast to supportive legal institutions, uncertainty in the legal environment where a central political power can usurp private capital can impede the development of financial markets by discouraging investment. In the same way, centralization of political power can stifle the progress of financial markets (Beck, Demirgüç-Kunt, and Levine 2001). Legal institutions may also vary in the degree to which they are flexible in adapting to changing times. More flexible institutions can support financial innovations that serve market gaps as shown by Beck, Demirgüç-Kunt, and Levine (2001) when they investigated the link between legal origin and financial development. Thus, in this study we conjecture that institutions and the quality of governance that supports financial development are more likely to be supportive of burgeoning cryptocurrency industries.

In addition, we investigate whether *de jure* financial openness is related to policy decision on cryptocurrency. On the one hand, countries with a more liberal capital flow policy may also be open to developments in new financial instruments to keep up with competition in international markets. Klein and Olivei (2008) discuss how capital account liberalization contributes to financial development by introducing international standards, servicing niche markets, and broadening financial services through financial innovation, among other things. With financial innovation offering new opportunities, many countries face the incentive to keep up with new financial instruments to compete internationally. In the same vein, we posit that countries that are more financially open tend to be more open to the adoption of cryptocurrency, otherwise they risk lagging behind their peers by ignoring the current financial market developments.

On the other hand, countries with a higher degree of financial openness may be more prudent in exposing themselves to risk through new financial instruments. Greater financial openness can exacerbate the risks that cryptocurrency can bring through large and volatile flows, which can destabilize the financial sector (Kaminsky and Reinhart, 1999). Cubillas and González (2014) show that financial liberalization encourages bank risk taking in both advanced and developing countries. In particular, competition in banks encourages risk taking in advanced countries, whereas the presence of opportunities to take risks increases bank risk in developing countries. Thus, an alternative hypothesis could be that the potential risk that cryptocurrency brings with it could influence policy makers in financially open economies to be more prudent and impose regulations to repress the use of cryptocurrency, especially because it is primarily used as a speculative instrument.

## 4. ECONOMETRIC FRAMEWORK

### 4.1 Model Specification

To estimate the link between *de jure* openness to cryptocurrency, on the one hand, and *de jure* capital openness and institutional strength, on the other, we use a model that estimates the determinants of financial development. Since cryptocurrency represents a new financial technology, permission for the operation of cryptocurrency can be likened to further development of the financial sector. For this purpose, we base the empirical model on Chinn and Ito's (2006) empirical specification examining the link between financial development and other policy, legal, institutional, and macroeconomic factors.

Chinn and Ito (2006)'s regression equation is the following:

$$FD_t^i - FD_{t-5}^i = \gamma_0 + \rho FD_{t-5}^i + \gamma_1 KAOPEN_{t-5}^i + \gamma_2 L^i + \gamma_3 (L^i \times KAOPEN_{t-5}^i) + X_{t-5}^i \tau + u_t^i \quad (1)$$

where FD refers to a measure of financial development; KAOPEN is a measure of financial openness;  $L^i$  represents a measure of legal and institutional development; and  $X$  is a vector of macroeconomic control variables.

As the main purpose of their research is to examine the determinants of the development of equity markets, FD represents any indicators that measure equity market development, e.g. the size of the market and the market activeness, among others. Stock market capitalization (SMKC), the total value of stocks traded (SMTV), and the stock market turnover ratio (SMTO) were used as a different proxy for FD.

In contrast, instead of equity markets, our study investigates the degree of cryptocurrency market development. Thus, we adopt a *de jure* openness to cryptocurrency (*cc*) variable as our dependent variable. The *cc* variable is described in greater detail in the data section. Our model is specified as:

$$cc^i = \delta_0 + \delta_1 KAOPEN_{t-3}^i + \delta_2 L_{t-3}^i + X_{t-3}^i \tau + v^i$$

We use the Chinn-Ito index for the financial openness variable (*ka\_open*) and Worldwide Governance Indicators' (WGI) government effectiveness (*bureau\_quality*) for a measure of legal and institutional development. The indexes are also discussed in more detail in the following section. To control for macroeconomic factors, log per capita income (*log\_gdp\_pc*), inflation rate (*inflation*), and trade openness (*trade\_open*) are incorporated in the vector *X*. As stated in Chinn and Ito's (2006) work, the rationale behind the inclusion of each control variable also applies in the case of cryptocurrency market development. For example, the inclusion of log per capita income is to capture the effect of rising income that may contribute to more sophisticated economic and financial structures that can support the development of the cryptocurrency market. The inflation rate is included in the model as high inflation may encourage the use of cryptocurrency, rather than paper money or other assets.

Due to the unavailability of multiple-year *cc* data, our main estimation method is a cross-sectional ordered probit model using the cross-sectional data from 2018. Three-year-lagged independent variables are used in the main regression since new legislation takes time to adjust. We also use four-year- and five-year-lagged independent variables to check whether our results are robust to the choice of lag period. Moreover, we estimate alternate model specifications using different definitions of legal and institutional factors to check whether our results are robust to different measures of our key variables.

Except for the dependent variable and the time dimension, we strictly follow Chinn and Ito's (2006) model specification since 1) the model offers clean and clear interpretations of its results and each variable in relation to financial development, and 2) it is also interesting to compare our results (the cryptocurrency market development) to those of different financial markets, e.g. the equity market.

## 4.2 Data

The data are originally recorded at an annual frequency over the 2010–2018 period, covering 180 economies and drawn from several sources, primarily the Chinn-Ito index, the World Bank's Worldwide Governance Indicators (WGI), and the World Bank's World Development Indicators, among others.

### 4.2.1 Index of Cryptocurrency Regulation

The index of cryptocurrency regulation (*cc*) is an index measuring an economy's degree of *de jure* openness to cryptocurrency. "*cc*" is based on the ordinal variables that codify the current legal and regulatory status of cryptocurrency in 218 economies,<sup>1</sup> using the current legal and regulatory status of cryptocurrency compiled in 2018 from the Global Legal Research Center, the *Bitcoin Market Journal*, and CoinStaker. We classified the economies based on their policy stance toward cryptocurrency as follows: first, we assign the value 0 when the economy is "banned"; 1 when "regulated"; 2 when "fully liberalized"; or "no explicit prohibitions/regulations." The higher the figure, the more liberal the

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<sup>1</sup> For a complete list of the economies, see Appendix A.

economy is toward cryptocurrency. We found that 135 economies allow the free use of cryptocurrency, 61 economies regulate its use, and 22 economies ban it.

#### 4.2.2 Measures of De Jure Capital Openness

We adopted the 2016 capital account openness index developed by Chinn and Ito [as a proxy of financial liberalization since the Chinn-Ito index (*ka\_open*) is the most widely used in the financial literature. The Chinn-Ito index was first introduced in 2006 and has been continuously updated. The index covers the time period of 1970–2016 for 182 economies. It is the first standardized principal component of the four binary dummy variables reported in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). The variables include variables indicating the presence of multiple exchange rates, restrictions on current account transactions, restrictions on capital account transactions, and the requirement to surrender export proceeds. The higher the value, the more liberal the economy is to cross-border capital transactions.

#### 4.2.3 Measures of Legal and Institutional Factors

In our main regression, we use the WGI's government effectiveness (*bureau\_quality*) to control for legal and institutional factors. Government effectiveness is one of the WGI's six aggregate indicators of governance. With an unobserved components model, it is computed from various data sources and reported in percentile rank where a higher percentile corresponds to higher quality.<sup>2</sup> The indicator of government effectiveness reflects the overall quality and credibility of the government in terms of public and civil services, legislation, and policy formation.

Similarly, *legal2* captures a broader effectiveness and quality of the government. *legal2* is the first principal component of all the WGI's six aggregate dimensions of governance, namely voice and accountability (*VA*), political stability and absence of violence (*PV*), government effectiveness (*GE*), regulatory quality (*RQ*), rule of law (*RL*), and control of corruption (*Corrupt*). The first eigenvector for *legal2* was found to be (*VA, PV, GE, RQ, RL, Corrupt*)' = (0.415, 0.337, 0.428, 0.408, 0.401, 0.452), showing that the variability of *legal2* is not driven by any particular dimensions of governance. We extend *legal2* from Chinn and Ito's (2006) *legal1*, which covers only three dimensions, namely the level of corruption, law and order, and the quality of the bureaucratic system. As *legal1* has a relatively limited definition and there is no compelling reason to omit other WGI indicators, we opt to use *legal2* in the robustness check of our main results. We normalized *legal2* in order to simplify our interpretation of the regression results.

Used for another robustness check, Polity IV's *polity2* controls for legal and institutional factors. It captures a state's level of democracy, which ranges from –10 (strongly autocratic) to +10 (strongly democratic). The *polity2* score is derived from a difference between the scores for democracy and autocracy. Both scores are evaluated from the state's elections for competitiveness and openness, the nature of political participation, and the extent of checks on executive authority. Even though *polity2* does not directly capture the quality of a legal but institutional framework, a higher level of democracy may imply more refined and sophisticated legislation (Habermas 1995; Raban 2015), which may also contribute to financial development.

We also use the Heritage Foundation's index of financial freedom (*fn\_freedom*) as a proxy of the legal and institutional factors. The index assesses the extent of government regulation and intervention in the financial sector, including openness

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<sup>2</sup> For more details on the methodology, refer to Kaufmann, Kraay, and Mastruzzi (2010).

to foreign competition, on a scale of 0 to 100. Higher values of the index indicate less government interference and thus greater financial freedom. The underlying assumption is that well-established legal and institutional frameworks such as enforcement of contractual obligations and fraud prevention, among others, would lead to greater financial freedom without further government intervention or with a very minimal level of government interference. We also normalized *fn\_freedom*.

## 5. EMPIRICAL RESULTS AND DISCUSSION

Table 1 presents the ordered probit regression result with marginal effects of the main model specification (equation (2)). It shows the effects of legal and institutional development and financial development on the degree of cryptocurrency market development. In addition, the results of different robustness checks are presented in Table 2. We test our results against alternative specifications using alternate measures of government quality and effectiveness and also the choice of year in the data used for the econometric estimation. It is worth noting that our research does not delve deeper into the actual cryptocurrency mining or exchanges but highlights the linkage between the policy environment and financial market development from the institutional perspective.

**Table 1: Ordered Probit Regression Results and Marginal Effects**

Dependent Variable: <i>De Jure</i> Openness to Cryptocurrency ( <i>cc</i> ) in 2018				
Independent Variable	Coefficient	Marginal Effects		
		Banned	Regulated	Fully Liberalized
Bureaucratic quality ( <i>bureau_quality</i> )	1.509** (0.647)	-0.264** (0.118)	-0.329** (0.155)	0.592** (0.253)
De jure capital openness ( <i>ka_open</i> )	0.262 (0.382)	-0.046 (0.067)	-0.057 (0.084)	0.103 (0.150)
GDP per capita ( <i>log_gdp_pc</i> )	-0.673*** (0.170)	0.118*** (0.033)	0.147*** (0.047)	-0.264*** (0.066)
Inflation ( <i>inflation</i> )	0.053* (0.032)	-0.009* (0.006)	-0.011 (0.007)	0.021* (0.012)
Trade openness ( <i>trade_open</i> )	0.006*** (0.003)	-0.001** (0.000)	-0.001** (0.001)	0.003*** (0.001)
Constant cut1	-5.877*** (1.347)			
Constant cut2	-4.773*** (1.325)			
Observations	124	124	124	124

Note: a) Standard errors in parentheses; \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

Source: Authors' compilation and calculation.

As shown in Table 1 and columns 1–3 of Table 2, the coefficients on bureaucratic quality are statistically significant and robust across different specifications with three-year-, four-year-, and five-year-lagged independent variables. Our result shows that one unit increase in the index of bureaucratic quality is associated with a higher chance of full cryptocurrency liberalization by 59 percentage points. In contrast, the probability of being banned and regulated is lower by 26 and 33 percentage points, respectively, when the index of bureaucratic quality rises by one unit. Therefore, the results show that the quality of legal system and institution strongly relates to the attitude of policy makers toward the cryptocurrency liberalization. In other words, cryptocurrency is less regulated when the legislation is more refined and sophisticated. On the other hand, it seems that *de jure* capital openness is not relevant in the context of cryptocurrency development as the capital openness variable is not statistically significant in all the different model specifications.

**Table 2: Ordered Probit Regression Results and Robustness Check**

Dependent Variable: <i>De Jure</i> Openness to Cryptocurrency (cc) in 2018						
	(1)	(2)	(3) *	(4)	(5)	(6)
Independent Variable	Five-year Lag	Four-year Lag		Three-year Lag		
Bureaucratic quality (bureau_quality)	1.098* (0.592)	1.194* (0.614)	1.509** (0.647)			
Level of governance (legal2_n)				1.567* (0.920)		
Level of democracy (polity2)					0.063*** (0.020)	
Financial freedom (fn_free_n)						1.378* (0.710)
De jure capital openness (ka_open)	0.241 (0.342)	0.320 (0.370)	0.262 (0.382)	0.174 (0.391)	-0.091 (0.380)	-0.142 (0.358)
GDP per capita (log_gdp_pc)	- 0.637*** (0.158)	- 0.651*** (0.165)	- 0.673*** (0.170)	- 0.612*** (0.169)	- 0.388*** (0.118)	- 0.476*** (0.124)
Inflation (inflation)	0.005 (0.019)	0.040* (0.023)	0.053* (0.032)	0.049 (0.032)	0.035 (0.027)	0.017 (0.022)
Trade openness (trade_open)	0.004* (0.002)	0.006** (0.002)	0.006*** (0.003)	0.006** (0.002)	0.007*** (0.003)	0.006** (0.002)
Constant cut1	- 6.031*** (1.258)	- 5.880*** (1.306)	- 5.877*** (1.347)	- 5.349*** (1.292)	- 3.876*** (1.037)	- 4.451*** (1.009)
Constant cut2	- 4.966*** (1.236)	- 4.798*** (1.284)	- 4.773*** (1.325)	- 4.254*** (1.268)	- 2.800*** (1.019)	- 3.430*** (0.991)
Observations	128	126	124	124	139	151

Note: a) Standard errors in parentheses; \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1.

b) All independent variables are lag variables (please refer to the title of each column).

c) \* Model (3) is the main regression specification.

Source: Authors' compilation and calculation.

We also check the robustness of our results with the alternative measures of legal and institutional frameworks, including *legal2*, *polity2*, and *fn\_freedom*. Even though legal and institutional frameworks are measured or proxied differently, our results of the robustness check (columns 4–6 of Table 2) show that our regression model is quantitatively and qualitatively robust across different specifications, except for the magnitude of *polity2*'s coefficient. As discussed in the previous section, *polity2* possibly captures only the quality of the institutional framework, and not the legal one. This may explain the reason why the coefficient of *polity2* is lower than the other alternate measures.

By considering our control variables, we observed some interesting patterns. Firstly, economic development has a negative effect on the development of cryptocurrency since a percentage change in real income per capita decreases the probability of full cryptocurrency liberalization by 26 percentage points (Table 1). In contrast, we found that trade openness positively affects a policymaker's attitude toward cryptocurrency liberalization. The result indicates that an additional unit of trade openness raises the chance of full cryptocurrency liberalization by 0.3 of a percentage point. However, the magnitude of trade openness's coefficient seems negligible compared with the effects of bureaucratic quality and real income per capita. Lastly, we did not find a relationship between inflation and the development of cryptocurrency.

The results can contribute to policy discussions on the timing of adopting financial technology in line with developing financial markets. This study reaffirms previous findings that institutional quality contributes to financial development even after taking into consideration factors such as *de jure* financial openness, economic development, inflation, and trade openness, which may also influence the decision of policy makers to be open to cryptocurrency. Putting it differently, the results imply that a certain level of institutional quality may be necessary before opening up to new forms of financial technology. Cryptocurrency in particular is recognized as a risky speculative financial instrument. Its current state of many unknowns can also prevent policy makers from conducting a thorough surveillance to avoid system-wide vulnerabilities.

Furthermore, our findings invite policy makers to consider the different pace in the development of institutions and the financial market. Financial market developments appear to outrun institutional development. In 2011, other cryptocurrencies emerged three years after the inception of bitcoin in 2008 (Farell 2015). In this short period of time, various players joined in to take advantage of the opportunities. Since then, however, several legal and security problems have also emerged. In the meantime, the pace of strengthening institutions by enhancing bureaucratic effectiveness or the credibility of legal systems may not keep up with the demands of the financial sector. Some policy makers and industry players acknowledge the gap in the institutional capacity to regulate and intervene and thus advocate a hands-off government approach to market development. Nevertheless, whether the government decides to intervene, to regulate, or to let markets be, the quality of governance gives policy makers credibility in enforcing their policy choice. Hence, improving institutions could still be a worthwhile aim moving forward even if it is outpaced by financial development.

Finally, the decentralized and international nature of the cryptocurrency industry underlies a need for international cooperation. Standing issues include avoiding potential circumvention of regulation and supervision in the international trade of cryptocurrency, particularly for preventing money laundering or terrorism finance. Policy makers also need to be wary of potential spillover effects of volatility in the cryptocurrency market. Increasing macro-financial linkages could make the real sector vulnerable to amplified adverse effects coming from new financial technology, especially if the presence of cryptocurrency continues to rise in the coming years.

## 6. CONCLUSION

In this study, we investigate how effective governance institutions and *de jure* financial openness influence the attitude of policy makers in pursuing further financial development by allowing the use of cryptocurrency. Although several sources have developed a regulatory stance on cryptocurrency (Global Legal Research Center 2018; Bitcoin Market Journal 2018; CoinStaker 2018), a systematic investigation of the policy, economic, and institutional factors influencing policy choice has not been conducted. As a first step, we compose an index of *de jure* openness to cryptocurrency in 218 economies, using the current legal and regulatory status of cryptocurrency compiled in 2018. We categorize policy stance into “banned,” “regulated,” and “permitted” and investigate its determinants using a cross-sectional ordered probit model.

The regression analysis shows that effective governance institutions are associated with a greater likelihood of a less restrictive regulatory stance on cryptocurrency. The results are robust when we use different measures of effective governance, namely bureaucratic quality, a calculated governance indicator index, democratic institutions, and financial freedom. This provides evidence that policy makers in an environment with institutions conducive to financial development are more likely to be open to cryptocurrency. Meanwhile, financial openness is not found to be significant. Thus, the results do not support the hypothesis that a higher degree of financial openness would translate to higher openness to new financial technology presented by cryptocurrency. The empirical results imply that policy and institutions associated with financial development, rather than financial openness itself, determine *de jure* openness to cryptocurrency.

The limitations of this paper can pave the way for future research. For one, the index of *de jure* openness to cryptocurrency is constructed based on the policy stance of economies toward cryptocurrency in 2018. Our index does not capture changes in the regulatory stance of government. It would be interesting to investigate the drivers of policy change over the years. Examining the policy stance vis-à-vis the size of the cryptocurrency market in an economy can also provide a more nuanced interpretation of the policy choice based on how large the cryptocurrency industry is relative to the size of the financial market or economy.

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## APPENDIX A: INDEX OF CRYPTOCURRENCY REGULATION

<b>East Asia and the Pacific</b>		Nepal	0	Comoros	2
Australia	1	Pakistan	2	Congo, Dem.	2
Brunei Darussalam	2	Sri Lanka	1	Congo, Rep.	1
Cambodia	2	<b>Other Economies</b>		Cook Islands	2
PRC	0	Abkhazia	1	Costa Rica	1
Fiji	2	Albania	2	Croatia	1
Hong Kong, China	2	Algeria	0	Cuba	2
Indonesia	0	Andorra	1	Cyprus	2
Japan	1	Angola	1	Czech Republic	2
Kiribati	2	Anguilla	2	Denmark	2
Democratic People's Republic of Korea	1	Antigua and Barbuda	2	Djibouti	2
Republic of Korea	1	Argentina	1	Dominica	2
Lao PDR	2	Armenia	2	Dominican Republic	0
Macau, China	0	Artsakh	1	Ecuador	0
Malaysia	2	Austria	1	Egypt	0
Marshall Islands	2	Azerbaijan	2	El Salvador	2
Micronesia	1	Bahamas	2	Equatorial Guinea	2
Mongolia	2	Bahrain	0	Eritrea	2
Myanmar	1	Barbados	2	Estonia	2
Nauru	2	Belarus	2	Ethiopia	2
New Zealand	2	Belgium	2	Finland	1
Palau	2	Belize	2	France	1
Papua New Guinea	1	Benin	1	Gabon	2
Philippines	1	Bermuda	2	Gambia	2
Samoa	2	Bolivia	0	Georgia	2
Singapore	2	Bosnia and Herzegovina	2	Germany	1
Solomon Islands	2	Botswana	1	Ghana	2
Taipei, China	1	Brazil	2	Gibraltar	1
Thailand	1	British Virgin Islands	2	Greece	2
Timor-Leste	2	Bulgaria	1	Grenada	2
Tonga	2	Burkina Faso	2	Guatemala	2
Tuvalu	2	Burundi	2	Guernsey	2
Vanuatu	2	Cameroon	2	Guinea	2
Viet Nam	0	Canada	1	Guinea-Bissau	2
<b>South Asia</b>		Cape Verde	1	Guyana	2
Afghanistan	1	Cayman Islands	1	Haiti	2
Bangladesh	0	Central African Republic	2	Honduras	2
Bhutan	1	Chad	2	Hungary	2
India	2	Chile	2	Iceland	1
Maldives	2	Colombia	2	Iran, Islamic Rep.	0

*continued on next page*

**Appendix A** *table continued*

Iraq	0	Morocco	0	South Africa	2
Ireland	2	Mozambique	2	Tskhinvali Region	2
Isle of Man	1	Namibia	2	South Sudan	2
Israel	1	Netherlands	2	Spain	1
Italy	1	Nicaragua	1	St. Kitts and Nevis	2
Ivory Coast	2	Niger	2	St. Lucia	2
Jamaica	2	Nigeria	2	St. Vincent and the Grenadines	2
Jersey	1	Niue	2	Sudan	2
Jordan	1	Northern Cyprus	2	Suriname	2
Kazakhstan	2	Norway	1	Swaziland	2
Kenya	2	Oman	0	Sweden	1
Kosovo	2	Palestine	2	Syrian Arab Republic	2
Kuwait	0	Panama	1	Tajikistan	2
Kyrgyz Republic	1	Paraguay	2	Tanzania	1
Latvia	1	Peru	2	Togo	2
Lebanon	1	Poland	2	Transnistria	1
Lesotho	0	Portugal	2	Trinidad and Tobago	2
Liberia	2	Puerto Rico	1	Tunisia	2
Libya	0	Qatar	0	Turkey	2
Liechtenstein	1	Romania	1	Turkmenistan	2
Lithuania	1	Russian Federation	2	Uganda	2
Luxembourg	1	Rwanda	2	Ukraine	2
Macedonia, FYR	2	Sahrawi Republic	2	United Arab Emirates	0
Madagascar	2	San Marino	2	United Kingdom	1
Malawi	2	São Tomé and Príncipe	2	United States	1
Mali	2	Saudi Arabia	0	Uruguay	1
Malta	2	Senegal	2	Uzbekistan	2
Mauritania	2	Serbia	2	Vatican City	2
Mauritius	1	Seychelles	2	Venezuela, RB	2
Mexico	2	Sierra Leone	1	Yemen, Rep.	2
Moldova	2	Slovak Republic	2	Zambia	2
Monaco	2	Slovenia	1	Zimbabwe	1
Montenegro	2	Somalia	2		
Montserrat	2	Somaliland	2		

Note: a) Economy groupings are based on the World Bank Country and Lending Groups.

b) 0 = "banned"; 1 = "regulated"; 2 = "fully liberalized."

Source: Authors' compilation and calculation.

## APPENDIX B: DESCRIPTIVE STATISTICS

Variable	Observations	Mean	Standard Deviation	Min.	Max.
De jure openness to cryptocurrency (cc)	124	1.411	0.721	0	2
Bureaucratic quality (bureau_quality)	124	0.561	0.267	0	1
De jure capital openness (ka_open)	124	0.580	0.207	0.158	0.996
GDP per capita (log_gdp_pc)	118	5.068	5.801	-10	10
Inflation	123	0.594	0.200	0.111	1
Trade openness (trade_open)	124	1.411	0.721	0	2
Level of governance (legal2_n)	124	0.561	0.267	0	1
Level of democracy (polity2)	124	0.600	0.381	0	1
Financial freedom (fn_free_n)	124	9.458	1.187	6.729	11.756

Source: Authors' compilation and calculation.