CROSS-COUNTRY CO-MOVEMENT BETWEEN BITCOIN EXCHANGES: A CULTURAL ANALYSIS

1. Introduction

Cryptocurrency markets have been growing very rapidly in recent years; they include 4600 different types of cryptocurrencies (according to coinmarketcap.com, 11 December 2019), Bitcoin being the most popular one and representing about 66.6% of the total market capitalization. However, research on the systematic variations in their return structure is relatively limited. This paper analyses the cultural drivers of co-movements between Bitcoin exchanges in 34 major countries around the world and the US (which is taken to be the global benchmark) over the period January 24, 2011 - January 7, 2019. In particular, we run IV regressions to investigate the importance of cultural factors (such as tightness, individualism, trust and risk-taking) following an earlier study by Eun et al. (2015) which had shed light on their importance to explain stock co-movement within individual countries.

Previous studies on cryptocurrencies have focused on their economic implications (e.g., Böhme et al., 2015; Dwyer, 2015; Harvey 2016; Raskin and Yermack 2016; Bariviera et al., 2017; Biais et al., 2018; Schilling and Uhlig 2018), returns and risk (e.g., Balciar et al., 2017; Liu et al., 2018), market efficiency (e.g., Urquhart, 2016; Bariviera, 2017; Nadarajah and Chu, 2017), hedging properties (e.g., Dyhrberg 2016a, 2016b; Baur et al., 2018; Bouri et al., 2017a, 2017b, 2017c), illegal activities (Foley et al., 2018, Li et al., 2018; Gandal et al., 2018; Griffin and Shams, 2018), initial coin offerings (Kostovetsky and Benedetti. 2018; Howell et al., 2018; Lee et al., 2018b; Li and Mann, 2018; Malinova and Park, 2017) and so on. More recently, a few papers have analysed cryptocurrency co-movement (or connectedness). In particular, Corbet et al. (2018) and Lee et al. (2018a) find weak linkages between cryptocurrencies and other traditional assets, which implies that the former may offer diversification benefits to investors, especially in the short run. Ciaian et al. (2017) report that the prices of Bitcoin and other cryptocurrencies are

independent of each other. Using a bivariate diagonal BEKK model, Katsiampa (2019) finds that volatility co-movements between Bitcoin and Ether are significant and responsive to major news. Manhattan distance between the share of trading volumes of cryptocurrencies across different exchanges to explain their co-movements. However, none of the extant literature investigates the effects of cultural variables on the co-movements between Bitcoin exchanges internationally. To the best of our knowledge, this paper is

cross-country stock market correlation. Thus, we expect countries with a higher degree of trust to exhibit more co-movement vis-à-vis the US, our global benchmark. Moreover, risk-averse Bitcoin investors should be more inclined to trade on domestic exchanges for which it is easier to gain access and relevant information, whilst risk-loving investors should trade Bitcoin on the basis of the US Bitcoin price rather than the domestic ones; consequently, more co-movement should occur in the latter case.

We also expect the underlying culture to affect Bitcoin exchange shutdowns. As already mentioned, tightness is an external constraint on individual behaviour requiring agents to follow social norms and is characterised by lower tolerance for deviant behaviour (Gelfand et al., 2006); a Bitcoin exchange shutdown could be regarded as an example of the latter since it can cause significant disruption to financial markets. Therefore, we expect Bitcoin shutdowns to be less likely in the case of countries with a tighter culture. As for the impact of individualism, this being an internal attribute of a person who is more likely to exhibit stronger analytic skills (Choi and Nisbett, 2000; Nisbett et al., 2001; Eun et al., 2015), this should result in a lower probability of shutdowns since individualist agents should be more eager to trade on the Bitcoin markets and more likely to understand the chaos shutdowns could bring about. Further, in countries with a trusting culture investors should be more vulnerable to Bitcoin trading which is highly speculative, and therefore shutdowns should be more likely. Finally, they should occur more frequently in more risk-taking cultures (with the possibility of massive losses resulting from speculation).

Our results suggest that indeed markets in tighter, more individualistic, trustful and risk-taking societies are more tightly linked to the US one. In particular, it appears that, in

opposed to looser) culture, investor behaviour leads to cross-country Bitcoin trading co-movement (the US being the global benchmark), consistently with

on the effects of a tight culture on stock co-movements. Interestingly, whilst individualism (as opposed to collectivism) had been found by Eun et al. (2015) to decrease stock co-movement within a country, we find that it has a positive impact on cross-country co-movement vis-à-vis the US, with investors following the US Bitcoin markets which are considered more reliable for the reasons already mentioned. We also find that investors in countries with a more trusting culture follow the US market (the global benchmark) despite its being a foreign one

Bitcoin trading caused by an increase in trust. Further, more risk-taking behaviour increases Bitcoin exchange shutdowns to prevent further speculative losses for investors.

The layout of the paper is as follows. Section 2 outlines the methodology. Section 3 describes the data and presents the empirical findings. Section 4 offers some concluding remarks.

2. Methodology

We use the from the expanded market model by Morck et al. (2000) and Jin and Myers (2006) to measure Bitcoin price co-movement across countries. The specification is the following:

week t across the Bitcoin exchanges. Therefore, unlike Morck et al. (2000) and Jin and Myers (2006), we analyse price co-movements across countries but not within each country. More specifically, we do not include the weekly market return of country i in week t as in their model since we only consider one Bitcoin return for each country.

We examine the relationship between culture and Bitcoin price co-movement across countries using a similar set of variables to Morek et al. (2000), Jin and Myers (2006) and Eun et al. (2015). We also add country-specific variables including Bitcoin returns ( ), trading volumes ( ), geometric capital distance between a country and the US, and international Internet bandwidth (kb/s) per Internet user (bandwidth), as well as economic control variables, specifically GDP per capita (GDP) and GDP growth volatility (GDP_gvol), which are lagged one year to avoid hindsight bias. Finally, we include the global hash rate of blockchain (Hash_rate). Note that we take the natural logarithm (ln) of the Bit_V, GDP, GDP_gvol and Hash_rate variables to deal with the scaling issue.

We then run an instrumental variable (IV) regression with Tight, Indiv and Trust as endogenous variables and country-specific indices for corruption (Corrupt), inefficient government bureaucracy (Govbur) and religion (Religion) as instruments. Since the number of endogenous variables and instruments is the same, the IV regression is just identified. It takes the following form:

(2)

where the variables are defined as specified above and the subscript i indicates a country. (the goodness-of-fit from equation (1)) is our co-movement measure. Since it is bounded within the interval [0,1], following Morck et al. (2000) and Eun et al. (2015) we also use the log-transformed R^2 as a robustness check:

Log-transformed —— (3)

We then extend the analysis to examine the effects of the cultural variables on the Bitcoin exchange shutdowns; specifically, we estimate IV logit regressions with a Bitcoin exchange shutdown binary variable (Shut_down) which is equal to one if a country shuts down its Bitcoin exchanges within our sample period and zero otherwise.

(4)

for country i. In equation (4), Tight, Indiv and Trust are the endogenous variables and Corrupt, Govbur and Religion the respective instruments (the same as in the IV regression given by equation (2)). We also include our co-movement measure in the IV logit regression, and replace it with as a robustness check. In addition, the maths education level of a country (Mathedu) is also included as an explanatory variable.

3. Data and empirical results

3.1. Data description

The data on weekly Bitcoin prices and trading volumes are obtained from https://data.bitcoinity.org. The sample period goes from January 24, 2011 to January 7, 2019. R^2 is the co-movement measure we use following Morck et al. (2000) and Jin and Myers (2006). $Tr(R^2)$ is the logistic transformation applied to R^2 following Morck, Yeung, and Yu (2000).

Tight is the country-specific tightness-looseness score from Gelfand e A tight (loose) culture in a country has strong (weak) social norms and low (high) tolerance for deviant behaviour (Gelfand et al., 2011; Eun et al., 2015). Indiv is the country-specific individualism-collectivism score collected f It is based on the extent to which people are integrated into groups and the degree to which they focus on their internal attributes to differentiate themselves from others (Hofstede, 1980, 2001; Eun et al., 2015). Thus, people from individualistic culture tend to have more analytic skills and use logic to ur (Choi and Nisbett, 2000; Nisbett et al., 2001; Eun et al., 2015). Trust and Risk_taking are country-specific trust and risk-taking behaviour measures, respectively, collected from the World Values Survey (WVS). Higher values for Trust and Risk_taking indicate a more trustworthy environment and more risk-taking behaviour, respectively. The four cultural variables Tight, Indiv, Trust and Risk_taking are the main one

Indiv

bureaucracy is a social organisation formed to manage effectively large populations by following uniform rules and procedures by means of a hierarchical system (Schiller, M). Therefore, the degree of (in)efficiency of a government bureaucracy (Govbur) can endogenously affect the individualism-collectivism culture of a country. ln(GDP) and GDP_gvol are the natural

3.2.1. Cultural effects on cross-country co-movement between Bitcoin returns

Finally, there is also a positive effect of risk-taking on co-movement. In other words, more risk-taking Bitcoin investors follow the global benchmark rather than domestic prices despite the latter being more easily accessible for them.

Bitcoin investment is a highly speculative activity, the co-movement between Bitcoin exchanges being high most of the time (the mean of R^2 is 0.9 in Table 1). This suggests that risk-loving Bitcoin investors tend to increase their speculative activities following movements in US Bitcoin prices. Similarly, the average Bitcoin price co-movement being relatively high across the globe, US Bitcoin price movements lead to higher trading volumes (ln(Bit_V)).

Concerning the other variables, we find that wealthier (ln(GDP)) and more stable (GDP_gvol) countries tend to have greater Bitcoin price co-movement vis-à-vis the US than less developed ones whose investors exhibit home bias

[Insert Table 3 Here]

3.2.2. Cultural effects on Bitcoin exchange shutdowns

excessive risk-taking activities. Risk-taking behaviour (Risk_taking) is found in fact to increase Bitcoin speculative activities and thus the probability of Bitcoin exchange shutdowns.

As for the impact of ln(GDP)and GDP_gvol, higher and more volatile economic growth

In brief, we find that cryptocurrency markets in tighter, more individualistic, trustful and risk-taking societies are more likely to co-move with the US one. Moreover, countries with looser, collectivistic, trustful and risk-taking cultures are more likely to shut down their Bitcoin exchanges. These results confirm our theoretical priors.

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Table 1. Summary statistics

The following table shows the summary statistics of our variables. R^2 is our measure of Bitcoin price co-movement across countries using an expanded version of the market model by Morck et al. (2000) and Jin and Myers (2006). In Panel A, we show the data

Japan	JPY/XBT
Luxembourg	EUR/XBT
Mexico	MXN/XBT
Netherlands	EUR/XBT
New Zealand	NZD/XBT
Norway	NOK/XBT
Poland	PLN/XBT
Portugal	EUR/XBT
Republic of Korea	KRW/XBT
Russian Federation	RUB/XBT
Singapore	SGD/XBT
Spain	EUR/XBT
Sweden	SEK/XBT
Switzerland	CHF/XBT
Thailand	THB/XBT
Ukraine	UAH/XBT
United Kingdom	GBP/XBT
United States of America	USD/XBT

Table 2. Variable correlations

[a] stands for significance at the 1% level, [b] at the 5% significance level and [c] at the 10% level.

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)	(s)
R^2 (a)	1[a]																		
$Tr(R^2)$ (b)	0.95[a]	1[a]																	
Bit_R (c)	0	0	1[a]																
ln(Bit_V) (d)	0.16																		

Table 4. Cultural analysis of Bitcoin exchange shutdowns

The following table reports the results from IV logistic regressions to analyze the impact of the cultural variables on Bitcoin shutdowns. The dependent variable is shutdown in both cases. We use two types of comovement regressors, R^2 and $Tr(R^2)$ in regressions (1) and (2), respectively. We report the p-values for the instrument relevance and Wu-Hausman endogeneity tests, and also the Wald test and R^2 as for our goodness-of-fit measures. N is the total number of observations reflecting missing values in our regressions. *** stands for significance at the 1% level, ** at the 5% level and * at the 10% level.

	(1)	(2)
Intercept	**2.952*** (24.866)**	**1.324*** (14.185)**
R^2	**-2.295*** (-29.94)**	
$Tr(R^2)$		**-0.229*** (-23.204)**

Mathedu	**-0.233*** (-32.414)**	**-0.24*** (-30.4)**
	1512.72*	**1690.76***
R^2	0.28	0.09
Instrument Relevance (P-value): Trust	0	0
Instrument Relevance (P-value): Tight	0	0
Instrument Relevance (P-value): Indiv	0	0
Wu-Hausman (P-value)	1	1
N	3538	3538