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Cryptocurrencies Bandwagon…Fad wave or Investment Asset? Firm Level Analysis of Panel Data in Egypt

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Contents

Abstract:

The crypto market is growing rapidly and gaining momentum globally. The current study is tackling the impact of the crypto exchanges on the stock market in Egypt. The author consolidated firm level data from DataStream and Cryptocurrency data from CoinDesk to conduct this study over the period 2014-2020. The methodology is based on Fixed Effect and IV-GMM models to study the differential impact across sectors and firm attributes.

Our main findings can be highlighted as follows: (a) cryptocurrencies are substitutes to stocks. (b)Two periods are highlighted in the analysis: 2016 post currency devaluation and COVID-19 pandemic, where the adoption was found to increase. (c) There was a sectoral differential aspect, where stocks of sectors exhibiting the highest risk and return were more prone to be substituted by crypto assets (for instance IT and Telecom) as opposed to stable and low risk sectors (for instance Pharma and Healthcare). (d) Finally, from an attributes perspective the most impacted firms are new entrants, largest firms, the ones with high debt financing (especially long-term debt) and with high leverage as well as the most profitable ones.

This study provides three main contributions to the current literature. First, it extends the literature of the Firm theory by introducing crypto market variables as an essential determinant for the firm stock prices and market value trends. Second, the study highlights the differential impact across sector attributes and firm inherent characteristics. Finally, the results of the study show that cryptocurrency market plays a significant role in investors' portfolio decisions, even in developing countries like Egypt.

Keywords: cryptocurrencies, Egypt, complements, substitutes, stock market, firm level

JEL Classification Codes: E0, E7, G0, G4

Introduction:

"Elon Musk supports cryptocurrency", "price of Bitcoin soars", "price of Bitcoin plummets", "new companies accepting cryptocurrency payments globally," are some of the common news that could be read about cryptocurrency updates and its persistent and excessive volatility (Macheel, 2021, p.1; McEvoy, 2021, p.1). Financial Technology (Fin Tech) and Decentralized Finance (DeFi) are new creative innovations introduced in the financial markets. There is a debate on whether the new fintech revolutions are considered a fad wave or they substitute the real economy in the long run. Blockchain technology is an innovation that allowed for the introduction of many opportunities in the sharing economy, mainly peer to peer (P2P) systems. This technology was utilized to develop cryptocurrencies after the global financial crisis of 2008. People started to question the power of centralized authorities and the crypto market was developed (C. Nelms, 2018).

Overview of Crypto Markets:

There are almost 11,912 cryptocurrencies with a total market capitalization value amounting $ 1.94 Trillion in September 2021. Bitcoin is the most known cryptocurrency since it is ranked first in terms of market capitalization, accounting for almost 50% of total crypto market capitalization (CoinDesk, 2021). There are three main characteristics of cryptocurrencies. First, they are decentralized systems that allow for direct P2P transactions without having an authority or a financial intermediary. So, they are unregulated platforms. Second, the transactions recorded on the chain are anonymous because people can hide their identity and involvement in certain transactions. Nonetheless, the transactions are secured as the blockchain technology backs them up and all activity is recorded. Lastly, cryptocurrencies do not have any guarantees. This flows from the previous two characteristics (Saksonova, 2019).

The Bitcoin is a young market but witnessed very rapid and constant growth. Its price increased from $ 123 in 2014 to $ 10,700 in 2020. To add, year to date, Bitcoin prices increased by 59.5% compared to 22.9% for gold prices (CoinDesk, 2020 and Gold prices, 2020). This shows the strength of Bitcoin and its stable growth. To add, this year witnessed the most significant bear market condition, with the COVID-19 pandemic, which is considered one the biggest shocks in Bitcoin history. To understand the role of Bitcoin and its evolution, we first have to analyze the global and regional adoption motivations.

Cryptocurrency Global Adoption:

The adoption of cryptocurrencies is different across the globe. The Global Crypto Adoption Index ranks 154 countries by measuring the activity level (both in trade volume and value) per country normalized for the economy size and population. The activity level is calculated across four different metrics. All measures are weighted by the PPP per capita to assess the cryptocurrency activity relative to the income and wealth per individual: The cryptocurrency P2P value received, on-chain retail value transferred, cryptocurrency deposits relative to total internet users in each country, and flow of trade volume (Chainanalysis, 2020). In 2021 report, the metric concerning deposits relative to total internet users in each country was discarded from the methodology, only considering the other three metrics: on-chain cryptocurrency value received, on-chain retail value received, both weighted by PPP per capita, and P2P exchange trade volume weighted by both the PPP per capita and number of internet users (Chainanalysis, 2021). It was removed since it skewed the results towards transactions to centralized authority and this is a protocol different from DeFi. The report highlights that the global cryptocurrency adoption is on the rise. It increased by 2300% compared to Q3 2019 and by 881% in the last year (Chainanalysis, 2021). The main motivations for this increase differ per region. For emerging markets, users resort

to cryptocurrency adoption to counter devaluation risks and maintain the value of their savings. To add, traders use cryptocurrency to transfer money internationally mainly remittances. Some emerging markets imply limits on the amount of money to be transferred. Thus, cryptocurrency allows to bypass this restriction and transfer the amount they need. Another main use case in emerging markets is the completion of business transactions. However, this is not the case for developed countries where adoption is skewed towards institutional investment.

Countries differ in their crypto usage and adoption. The top countries in 2020 rankings were Ukraine, Russia, Venezuela, China, Kenya and the US. Ukraine and Russia top the list. Some of the main reasons might be lack of trust in their government and distrust in financial institutions, since corruption in government services is common in those countries. Also, e-payment has a high adoption rate which might have eased the adoption of cryptocurrencies. To add, remittances transfer was another motivation relevant to those countries. For Venezuela, the main motivation is to hedge against the local inflation (Chainanalysis, 2020 and 2021).

In the "2021 geography of cryptocurrency report", other countries topped the list with Vietnam, India, Pakistan and Ukraine as highest ranked countries (Chainanalysis, 2021).

Deep Dive in MENA crypto adoption:

In this study, we will focus on the MENA region; although it is currently a small region in crypto adoption, it has boundless potential and is among the highest growing regions globally. In 2021, adoption increased by 1500% compared to a year ago (Chainanalysis, 2021). In 2020, Turkey had the highest adoption in the region (ranking 29th) followed by Iran (ranked 52nd) and Egypt (ranked 64th). In 2021, Egypt ranked higher at 59th. The most common use case is local currency volatility, which could lead people to resort to cryptocurrency as another means for

savings and to preserve the value of their current savings. Also, remittance transfers constitute a significant motivation and are a driver of the trend increase (Chainanalysis, 2020 and 2021). Countries in the Middle East have economic instability and often face difficulties maintaining their local currency values. Cryptocurrency acts as a hedge against those turbulences, thus being a vital area for research. Also, MENA accounts for a big share of global remittances, amounting $ 59 Billion in 2018, since it hosts a lot of expats (World Bank, 2021). So, labor mobility in the MENA region is high, which could create demand for cryptocurrencies to transfer funds. To add, with the current COVID-19 pandemic and travel restrictions, the demand for cryptocurrency for global remittances might have become more relevant. Since Egypt is the country being studied in this paper, personal remittances are a very relevant context. According to the World Bank (2020), Egypt is considered the highest recipient of remittances in MENA and one of the top 10 remittances receivers on a global scale. Personal remittances as % of GDP were on an increasing trend since 2000, reaching 8.8% in 2019. In 2020, with the outbreak of the pandemic and the travel restrictions, remittances inflows to Egypt were countercyclical as workers abroad transferred their funds to their families in Egypt. According to the Central Bank of Egypt, remittances increased by 8.5% from July 2020 to March 2021, amounting $ 23.4 Billion. This is a high record considering the COVID-19 context. Also, the cost of transferring remittances increased compared to 2019 (World Bank, 2020). Thus, cryptocurrency might be useful to transfer remittances at lower transaction costs.

Cryptocurrency Trading: Clandestine Activity in Egypt

The cryptocurrency market in Egypt is characterized by being a clandestine activity due to Egypt's legal stance on its trading and exchange. It is considered illegal and prohibited since it is regarded as a threat to national security. Some people were arrested before for mining

cryptocurrency. So, despite legal rejection of digital currencies and cryptocurrency activity, there is an existing informal cryptocurrency market, specifically on social networks, that is in some cases compared to the black market of the US dollar in the years leading up to the devaluation of the Egyptian Pound. On the authority trading market releases, there is a growing cryptocurrency adoption in Egypt (Diaa, 2018). According to Local Bitcoins, a cryptocurrency trading platform, new user registrations increased by 100% between the period from 2019 to 2020. Moreover, the cryptocurrency traders in Egypt were said to be from the millennial young generation that are looking for incremental sources of income and resort to cryptocurrency markets with this end objective in mind (Sanadali, 2021). On another note, in 2019, the CBE announced a project about launching the country's digital currency. Nonetheless, this project did not see the light until now.

The objective of the study is to assess to what extent is the crypto market soaking credit from the stock market. The focus is to assess whether cryptocurrencies are considered complements or substitutes to the stock market in Egypt. There are three main contributions to the literature on cryptocurrency adoption globally. On one side, the study is focusing on Egypt and as per our knowledge no study in the literature focused on investor behavior regarding crypto exchanges in Egypt. On the other side, we are using micro level data covering firm specific variables. This will allow us to assess differential impact across sectors and firms' attributes. The study extends the application of portfolio management and diversification theories using a Fixed Effect and IV-GMM models to correct from endogeneity. Also, we showcase that crypto market dynamics are important determinants of firm stock prices and market value.

The major finding of the study is that the crypto market is considered a prominent substitute to stocks in Egypt from an investment standpoint. The relationship differs across the years. The

negative relationship was highlighted in 2016 (devaluation year) and 2019 (COVID-19 pandemic outbreak). Another finding of the study is that there is a heterogeneous impact of crypto market across firms. Firms exhibiting high risk and return (for instance "IT and Telecom") are more prone to be substituted by crypto assets than the less risky assets (for instance "Pharma and Healthcare" sector stocks). Finally, we conclude that new entrants, largest and most profitable firms (high market value, ROA and ROE) are more impacted by the crypto market as well as the ones relying on debt in their financial structure (for instance, high leverage, high long-term debt).

The next sections of the study will be organized as follows. First, we will analyze conceptual framework of the main theories that will be a foundation of the analysis. Then, we will conduct an empirical literature reviewing the results of the existing studies in the literature on the relationship at hand. Afterwards, we will shift to showcase the data sources and collection. In the following sections, we will display the data descriptive, trends and methodology. Finally, we will discuss the regression results and will conclude with the main outcomes and the possible policy implication aspects.

Conceptual Framework:

Technological Innovations:

Rogers (1983) outlined different criteria determining the adoption of an innovation, specifically technological ones, in his theory "Diffusion of Innovation." He summarizes five adoption determinants: relative advantage, compatibility, complexity, trialability and observability. Relative advantage, compatibility, trialability and observability have positive impacts on innovation adoption. On the other hand, complexity has a negative impact on adoption. It could slow it down or even prevent the consideration of adoption. First, relative advantage encompasses any increase in benefits or reduction in costs. Some examples could be reduction in transaction costs, time, effort, or an enhanced security and efficiency. Transaction cost quantification is one of the areas that were deeply tackled in the literature to assess innovation adoption (Kim, 2017). Second, compatibility refers to the level of coherence between the innovation and the market. Third, complexity refers to how people perceive the difficulty of technology. The easier and less time-consuming technology is to integrate, and understand, the higher the rate of adoption. Another determinant of adoption is trialability. This relates to the ability of people to try and experiment the innovation before fully adopting it. Finally, observability is an important indicator since it shows the visibility of the product or service.

Nonetheless, innovations may be different from one sector to another. Niehan (1983) focused on innovations in the financial and banking sectors. He explained that transaction cost is the main innovation determinant. He tackles the banking sector as a specific field since banking functions and products remain the same across time and geographies. They revolve around transferring and exchanging funds, paying and saving money as well as bringing parties together. Niehan (1983)

describes financial products as being "immutable." Thus, he outlines two main types of banking sector innovations: "adaptive innovation", and "technological innovation".

Adaptive innovation is a new way of bundling the existing products. It is a "reactive' innovation as it arises due to changing needs in the market. Also, they are "reversible", so when the market conditions; that led to the appearance of this innovation; change, the innovation will fade with time. The second innovation type prevailing in the financial sector is "technological innovations". The latter are based on "relative advantage" in terms of transaction costs. They could have cost advantages over the current system as well as being more secure and efficient (Niehan, 1983).

Portfolio Management Theories:

Another strand of research focuses on the investment aspect of cryptocurrencies. Many of the researchers in this field hammer on portfolio management theories (Gil-Alana et al., 2020; Jareño et al., 2020; Sapuric et al., 2020; Syed Zwick et al., 2019). The basis of this literature is that investors diversify their portfolio by combining different assets that exhibit different return, risk and volatility patterns. The rationale is to reduce the downside risk of all the portfolio and to secure downward swings in the portfolio returns. In cryptocurrency modern literature, many tackle the role of diversifier, hedge and safe-haven of assets (Syed Zwick et al., 2019). First, a diversifier is defined as an asset that is not perfectly correlated with other components of a portfolio. The low correlation creates a diversification advantage. Second, an asset that acts as a hedge could be uncorrelated or negatively correlated with the average assets in a portfolio. Finally, the safe-haven asset is even a safer investment option since it acts as a hedge in market downturn conditions. In bear market conditions (periods when the stocks are decreasing in value), the more uncorrelated an asset is to others in a portfolio, the more it qualifies to become a safe-haven for investors. This implies that its behavior will be independent from other assets, and it could better function as a

hedge against the risks and volatility affecting other assets (Bouri et al., 2017). Apart from the asset role in a portfolio, the market structure impacts investor behavior.

Efficient Market Hypothesis (EMH) and Random Walk Paths:

Discussion about the efficient market hypothesis, by Fama (1970, 1991), emerged when the scholars started applying probability mathematics to stock market performance. It was assumed that stock prices follow a random walk path independent from past trends. The main source of randomness is the new information that comes into play every day in the stock exchange for instance: new company announcement, new economic laws, or regulations, be it positive or negative, or others. That news is reflected in the share prices ensuring that stocks are always traded at their fair price. Therefore, this theory postulates that the stock market is efficient in reflecting the available information in new price trends. It is assumed that efficient market functioning guarantees a fair market operation because investors cannot outperform the market dynamics. There are no overvalued nor undervalued stocks, each stock price reflects its intrinsic value given the free and available information. This theory was highly criticized for many reasons. One of the crucial ones being the impact of economic behavior and investor psychology in the price trends (Malkiel, 2003). Many scholars presume that the cryptocurrency market is inefficient due to its high volatility relative to other asset classes. The prices do not follow a random walk path, this could be attributed to some cryptocurrency traders' behavior driven from behavioral economics theories (Kakinaha, 2021).

From Random Walk to "Bandwagon Effects":

Cryptocurrency research relies on behavioral finance theories to explain the different attitudes of investors in stock markets and cryptocurrency markets. Research showed that the nature of investors is different in the stock market as opposed to the cryptocurrency market. Most

of stock market investors are institutional entities that use advanced valuation techniques, and this guides their trading behavior. Thus, changes in stock market returns are mainly driven by changes in macroeconomic fundamentals, for instance, inflation and interest rate. On the other hand, investors in the crypto market are retail investors, which means they are non-professional and non-expert individuals in the domain of investment analysis (Burggraf et al., 2020). Thus, they are affected by microeconomics, for instance wage rate and unemployment, more than changes in macroeconomics. Since most crypto market actors are retail investors, this market showcased herd behavior (Ballis et al., 2020). Herd behavior refers to the fact that investors "follow the crowd" (Burggraf et al., 2020). This means that they are driven by their sentiment more than changes in macroeconomic fundamentals. There is a "FOMO" (Fear of Missing Out) attitude, where they rush and buy cryptocurrencies when its prices soar in order not to miss out on the opportunity of gains, and vice versa when the prices of crypto assets fall. Herd behavior is also referred to as "bandwagon effect", where trades are influenced by others and their behavior is driven by political, economic as well as social aspects (Malkiel, 2003). This herd behavior is sometimes concluded to be one of the crucial factors behind the huge swings and volatility in crypto currencies prices and could also lead to irrational behavior of investors. It is overall a nascent market that is driven by non-sophisticated investors that follow each other and are emotionally more than rationally driven. Different studies conducted empirical models in order to analyze the role of crypto markets, their behavior as well as their impact on the economy.

Empirical Literature:

The main areas of literature tackle the investment properties of cryptocurrencies, their liquidity and the competition with the conventional market.

Cryptocurrencies New Asset Class: Investment Tool:

Several recent studies analyzed the property of cryptocurrencies as investment vehicles and assessed their role within a portfolio investment framework. Table 1 summarizes the methodology and findings of those studies.

The hypothesis of cryptocurrencies acting as a diversifier, hedge and safe-haven assets has been tested. Also, more focus has been attributed to Bitcoin, since it is the cryptocurrency with the highest market cap value. There is a belief that Bitcoin could act as the new gold, "digital gold" (Syed Zwick et al., 2019, p.2518). The nexus and connections between gold and Bitcoin have been analyzed in a cross-sectional context using threshold regression. It was found that gold could be an accurate predictor for Bitcoin, showing the similarities and connections between both. Nonetheless, they discovered that the relationship is nonlinear, implying that the perception of Bitcoin by investors evolved during the period studied. Initially, Bitcoin was mostly treated as a speculative asset and was not used for diversification, hedge nor safe-haven properties. However, there was a change in the stance of Bitcoin as more countries started to adopt it and its performance witnessed high returns. Bitcoin started to behave more like gold and the demand for it began to rise, especially in times of increasing uncertainty (Syed Zwick et al., 2019).

Moreover, Bitcoin was studied within a financial management context by Jareño et al. (2020) whereas they tackle the sensitivity of Bitcoin returns relative to gold, stock returns, as well as other financial and macro variables (interest rate, VIX, oil and financial stress) using Quantile Regression and NARDL. Their results confirm the findings of Syed Zwick et al. (2019) as they

depict a positive relationship between gold and Bitcoin, showing that investors treat them the same way within an investment portfolio. This positive correlation was mostly highlighted in periods of volatility and uncertainty within the sample period studied. Also, they found that Bitcoin sensitivity has a negative relationship with the financial stress index, which implies that Bitcoin acts as a safe-haven in bear market condition.

The diversification property of cryptocurrencies was studied to gain a deeper understanding of the relationship between cryptocurrencies' returns and stocks. Gil-Alana et al. (2020) used fractional integration and cointegration to model short run and long run relationships. They studied six major cryptocurrencies and found very low connection between crypto market and stock returns, which confirms the results of previous studies showing the diversification benefits of the crypto market. Accordingly, the literature confirmed the benefits of crypto assets in investment portfolio management. Moreover, Sapuric et al. (2020) revealed an asymmetric response of volatility in the crypto market. Investors respond more significantly to “good news” relative to “bad news”.

Nonetheless, the cryptocurrency market is a nascent market; hence it has not been through rough market turbulences. COVID-19 pandemic was analyzed as the major stress test for cryptocurrency investment properties. Many publications in the recent literature studied their performance under the pandemic circumstances and their resistance to the shock (Conlon et al., 2020; Demir et al., 2020). There is no consensus on whether cryptocurrencies passed the COVID-19 test or not. On the one hand, Conlon et al. (2020) questioned the role of Bitcoin in bear markets. On the other hand, Demir et al. (2020) found that the behavior of Bitcoin was nonlinear and evolved over the progression of the pandemic. It started with a negative relationship then turned into positive, suggesting that Bitcoin started to become a safe-haven.

Table 1: Crypto currencies as Investment Vehicle

Main Finding: *Crypto currencies are appropriate Investment Instruments and BTC behaves as the new "Digital Gold"*				
	(Syed Zwick et al., 2019)	***(Jareño et al., 2020)***	***(Sapuric et al., 2020)***	***(Gil-Alana et al., 2020)***
Objective	Connections between Gold and BTC	Study sensitivity of BTC relative to: -Gold returns -US market returns -Interest rate -Oil -VIX -FSI	Study price volatility of BTC	Study the connection between 6 CCs and other different asset classes
Model	-Threshold regression to model non linearity -Cross Sectional data from 2010 to 2018	-Quantile Regression from 2010 to 2018. Before 2014: higher volatility After 2014: more stability -NARDL	Study returns, volume and volatility versus 6 major currencies through EGARCH	Fractional integration and cointegration
Empirical Results	Noted change in the perception and properties of BTC: -Before 2017, it was only viewed as speculative asset -After 2017: Similar Behavior as Gold (Diversifier and hedge)	-Negative relationship with FSI (safe-haven properties of BTC) -Positive Connection between BTC and gold to confirm safe haven property	-Volume and volatility have positive relationship -Asymmetry in volatility: Investors respond more to "good news" than "bad news"	-Very low connection between CC and other asset classes, confirming its diversification benefits

Cryptocurrency Market Conditions:

Market Liquidity:

Another topic that was studied is liquidity. Cryptocurrencies liquidity is highly important since it was first introduced as a medium of exchange (Table 2). However, cryptocurrencies evolved to be used as investment assets. So, liquidity is crucial to assess its digital currency and investment asset properties. Kim (2017) focused on studying the role of Bitcoin in the international foreign exchange market. The author compares the bid-ask spread of Bitcoin, the Dollar and Euro and concludes that Bitcoin has a cost advantage. Thus, it can be used for transferring funds. This is an important conclusion, especially for the MENA region, since Bitcoin can be used to transfer remittances through less costly alternatives relative to the banking system. The advantages of cryptocurrencies that allow them to have a cost advantage are that the system is available online and does not go through a market power intermediary. However, Dimphfl et al. (2020) reached another conclusion by studying the Kraken market, a cryptocurrency exchange market. They concluded that Bitcoin is a dry market. It is less liquid relative to both foreign exchange and stock markets. Therefore, there is no consensus in the literature as to the liquidity of the crypto market. Another study conducted by Brauneis et al. (2020) identified the liquidity determinants of the cryptocurrency market and concluded that they are independent of other asset classes and forex markets. They depend on specific characteristics of the crypto market for instance volatility and trading activity.

Table 2: Crypto market liquidity

	BTC has cost advantage in FX transfer *(Kim, 2017)*	***BTC is dryer in liquidity terms, does not compete in FX market*** *(Dimpfl et al., 2020)*	***Determinants of CCs Liquidity*** *(Brauneis et al., 2020)*
Objective	Compare BTC to international FX	Focus on liquidity of a trading exchange platform, Kraken Liquidity Determinants of BTC	Analyse the liquidity of 4 CCs from 2015 to 2019
Model	Compare Bid-Ask Spread to USD and EUR to calculate the cost (dis)advantage of BTC in transfer of international currencies	Liquidity model and bid ask spread calculations	Bid-ask spread measures to assess the liquidity of the markets
Empirical Results	For transfer of international currencies: -BTC exhibits the lowest transaction cost, resulting in cost advantage compared to FX markets -Traders could choose to transfer funds using BTC as intermediary instead of financial institutions	FX Market: -Trading BTC for FX exchange is dryer and less liquid than converting fiat currencies relative to each other -BTC market is dryer (less liquid) compared to FX exchange and stock market	-BTC is most liquid among the 4 CCs studied -Liquidity determinants of CCs are independent from financial and FX markets. -It is related to CCs characteristics for instance trading and volatility

Cryptocurrency Market Volatility:

The cryptocurrency market is usually characterized by high and persistent volatility. This has significant implications regarding the efficiency of cryptocurrency exchanges (Table 3). Some scholars describe cryptocurrency market as being highly inefficient due to the huge swings in volatility and returns. Also, volatility has crucial implications regarding the role of assets, be it a digital currency, an investment asset or barely a speculative tool. Walther et al. (2019) studied the drivers of cryptocurrency volatility by investigating seventeen economic and financial measures. They adopted a variation of the GARCH model, GARD-MIDAS to capture short run as well as long run determinants. They concluded that cryptocurrency market volatility is complex and is determined by global indicators (both economic and financial variables) rather than country-specific factors. For instance, the Global Real Economic Activity was one of the most significant determinants of cryptocurrency volatility. Other scholars focused on the implications of Bitcoin volatility on its role in an investment portfolio (Lopez-Cabarcos et al., 2021). It was concluded that Bitcoin could act as a safe-haven in periods where its volatility is controlled relative to other securities, as would be suggested by portfolio management theories. Nonetheless, their role shifts to speculation when its volatility soars. They also suggest that Bitcoin traders are highly technological. Therefore, their sentiment and behavior could be determined by social network sentiment more than other exchanges trends.

Table 3: Cryptocurrency volatility

	Drivers of Cryptocurrency Volatility *(Walther et al., 2019)*	**Bitcoin volatility behavior** *(Lopez-Cabarcos ´ et al., 2021)*
Objective	The main exogenous determinants, both macroeconomic and financial, of the volatility for the 5 leading cryptocurrencies in terms of market capitalization	Determine the nexus between Bitcoin volatility, returns and investor behavior
Model	GARCH-MIDAS (Mixed Data Sampling) allowing for the differentiation of short run and long run volatility drivers	Using GARCH and EGARCH models to estimate Bitcoin market volatility
Empirical Results	Drivers of cryptocurrency volatility cannot be attributed to one country specific indicators but could be linked to global trends (financial and economic indicators)	Bitcoin volatility is impacted by financial markets and social sentiment. Bitcoin investors rely on technological information more than traditional data.

Competition with conventional market in MENA region:

A different strand of the literature focuses on the impact of cryptocurrencies on different fields. The modern literature attempted to study the impact of cryptocurrency, on the real sectors in the economy. The main areas being investigated are the impact of the crypto market on the stock market (Sami et al., 2020) and on the banking sector (Othman et al., 2020) (Table 4).

The crypto market is competing with the stock market since it is considered an alternative asset class. Sami et al. (2020) studied the relationship by testing whether they are considered complements or substitutes in the Gulf countries. They included crypto returns as a determinant of stock returns and found that the relationship is negative and significant, implying that investors consider crypto assets as substitutes for stocks. Consequently, they concluded that the crypto

market is soaking credit from the stock market and represents a threat. The authors extended their study in another publication by comparing this impact amongst GCC and non-GCC countries. The rationale is that GCC countries adopt Islamic Sharia in their legislation and non-GCC countries could be more flexible in their legislation approach. In GCC, the cryptocurrency was banned since they view it impermissible in their law because it is based on a virtual intangible and non-real asset and, speculation is unauthorized. Therefore, they examined whether the legislation approach will impact the nature of the relationship between crypto and stock returns. The results showed that for non-GCC countries, crypto assets are considered complements; there was a positive relationship between crypto returns and stock returns, which contradicts the findings for GCC countries. Nonetheless, there was evidence of cointegration and long-run relationship for both country groups (GCC and non-GCC). They recommended that countries in MENA should be more flexible in legalizing cryptocurrencies since this will lead to higher return on investors' portfolio and thus higher economic growth (Sami et al., 2020).

Another study conducted by Othman et al. (2020) tackled the impact of the crypto market on the banking sector; more specifically, they investigated the relationship between bank deposits variability and market capitalization of the crypto market in GCC markets. They found a negative long run relationship between the banking sector deposit variability and the crypto market capitalization. This confirms the findings of Sami et al. (2020) with regards to the impact of crypto assets since they constitute a threat and are soaking credit from both the stock market (Sami et al., 2020) and the banking sector (Othamn et al., 2020). However, this negative relationship was mainly depicted for GCC countries.

Table 4: Impact of Cryptocurrencies in MENA region

	Impact of CCs on Stock Markets in GCC (Sami et al., 2020)	**Comparison of Impact in GCC and Non-GCC countries** (Sami et al., 2020)	**Impact of CCs on the banking sector in GCC** (Othman et al., 2020)
Objective	Stock market and virtual money markets are substitutes for investors	Extend previous paper to compare Gulf and non-Gulf countries in MENA	Impact of CCs on bank deposits variability in GCC (6 countries)
Model	Stock market returns are driven by 4 main factors: -Fundamental Macroeconomics -News and Media -Anomalies and cycle fluctuations -Contribution of the paper is to add virtual money market as a determinant	Cointegration and Granger causality test Same model but with 2 runs. - GCC countries following Islamic Sharia - Non GCC countries with more flexibility in their regulations	Johansen cointegration VECM Engel Granger Granger causality test
Empirical Findings	CCs returns are substitutes to stock returns in GCC (negative relationship)	<u>Gulf:</u> Substitutes <u>Non-Gulf:</u> Complements	Negative relationship Need innovation in banking sector

Hence, the modern literature has studied the investment aspect of cryptocurrencies, their liquidity, volatility, and impact on real economic sectors, such as banking and stock markets. To our knowledge, no research was conducted on the crypto exchanges impact in Egypt. Furthermore, current literature focuses on the macro impact on either the banking sector or the stock market. Nonetheless, no study tackled the micro-level impact on firm-level. In this regard, our contribution to the literature is threefold. First, we will extend the portfolio management theory to include cryptocurrency index as a determinant of stock trends. Second, we will focus on Egypt as a case study since many of the drivers of crypto adoption could be relevant to Egypt: inflation (years leading up to the devaluation of the Egyptian pound and after the flotation decision was implemented), political and economic instability (after the revolution), high unemployment and young population looking for extra sources of income. Third, we will focus on micro-level analysis of crypto adoption impact in Egypt by using micro-level data about listed firms' characteristics and attributes.

Methodology and Expected Results:

Since we are dealing with firm level data, we employed a Fixed Effect regression model following So Im & al. (1999). This methodology was utilized since it accounts for sector level and firm level differentials, so it is more suitable for the purpose of our study. It also allowed for incorporating fixed effects for the year as well as panel regressions according to different firm level characteristics at hand. So, it was useful for control for heterogeneity effects across firms and identify firm varying relationships.

The general regression framework can be summarized as per the below:

$$SR_{i,t} = \alpha + \beta Crypt\_return_{i,t} + \lambda Z_d + \theta_i + \gamma_t + \mu_{id} \qquad (1)$$

Where $SR_{i,t}$ referring to stock returns for firm i at time t, α is a constant term, $Crypt\_return_{i,t}$ is the main explanatory variable referring to crypto market returns at time t, Z_d is a vector of other explanatory variables of stock returns namely interest rate or GDP per capita (used interchangeably because they are highly correlated) market value and inflation rate. θ_i is the firm fixed effects, γ_t is year fixed effects (employed in some regressions variations) and μ_{id} is the error term assumed to be independently identically distributed (IID).

Other variations of this general regression framework included prices instead of returns, and market value for firms with market capitalization of crypto market. Below are the variations employed:

$$Stock\ Prices_{i,t} = \alpha + \beta Crypt\ Prices_{i,t} + \lambda Z_d + \theta_i + \gamma_t + \mu_{id} \qquad (2)$$

$$Firm\ Market\ Value_{i,t} = \alpha + \beta Crypt\ Market\ Cap_{i,t} + \lambda Z_d + \theta_i + \gamma_t + \mu_{id} \qquad (3)$$

Since we are studying the impact of crypto market on the stock market, the β coefficient is the main regression output to analyze:

- If β takes a positive and statistically significant value, then it implies that the stock exchanges and crypto markets are considered complements for investors. Both are increasing or decreasing in conjunction.
- If β assumes a negative statistically significant value, then crypto assets and stock securities are considered substitutes from an investment standpoint. So, when investment in crypto assets increases, stock market counterpart decreases.

According to the literature, we are hypothesizing that the relationship would be negative and that both assets would be considered substitutes. Nonetheless, we expect a differential effect across the years and the firms.

Data Used and Sources:

Our data collection consists in consolidating different data categories. First, we collected macro level data regarding inflation rates, interest rates and GDP per capita. This data category was used since they are important determinants of stock market prices and returns and will be used as explanatory variables in the model to avoid omitted variable bias.

Table 5: Macroeconomic Variables

Variable	Description
Inflation rate (in decimal)	Monthly headline inflation rates were extracted from Central Bank of Egypt, time series database. It is calculated as month over month growth of CPI.
GDP per capita (in USD)	It is extracted from World bank as an annual time series data.
Interest Rate (in decimal)	Monthly average loan rates to corporates for loans less than 1 year. It was extracted from Central Bank of Egypt, time series database. The rates are calculated as weighted averages for a sample of banks whose deposits account for nearly 80% of the total deposits and calculated on a monthly basis.

Other variables were collected for the crypto market exchanges. The data were extracted from CoinDesk, which is the main source of data for cryptocurrency trading globally. Since there is no data available about crypto trading per country, the global crypto indicators were used. The top 5 cryptocurrencies in terms of market cap leadership from 2013 till 2021 were selected: Bitcoin, Ethereum, XRP, Litecoin and Bitcoin cash. They account for more than 80% of the total crypto exchange market capitalization. For each of those currencies, the below data were collected daily from 2013 till 2021. They were computed as the mean of the top 5 crypto currencies.

Table 6: Cryptocurrency Variables

Variable	Description
Market Capitalization (in USD)	It is a financial indicator representing the value of assets being traded. For crypto market capitalization, it is computed as the volume of token traded multiplied by their market prices. So, the market capitalization accounts for both the size and value of the security at hand.
Price (in USD)	It represents the price of each coin traded. The average and median prices were computed for the top 5 crypto coins.

Firm level data were extracted from Eikon Reuters DataStream. It includes data from 254 companies across different sectors. Data include quarterly variables from 1991 to 2021 in USD. Firms were grouped in 9 sectors as per the below:

Table 7: Firms' Sectoral Classification

Sector	Description	Number of firms
1	Automobile	4
2	Banks, Investment Firms, Capital Markets, EGX	48
3	Real Estate, Construction, Machinery	70
4	Textile, consumer products, food & beverages, tobacco	47
5	IT, Telecom	10
6	Pharma & Healthcare	18
7	Hotel, Entertainment, Utilities	21
8	Retail, transportation & distribution	20
9	Chemicals	16

The variables in Table 8 were extracted for each firm in each sector at hand.

Table 8: Firm Level Data

Asset Categories: ***It is important to conduct panel regressions according to firms' asset sizing***
- Total Capital - Net Property, Land and Equipment - Total Assets
Liabilities Categories: ***It is an important measure since it indicates the firms' debt choice and the relative weight of long term and short term liabilities. This also gives an indication about firms' crisis management.***
- Long Term Debt - Short Term and Current Debt - Total Debt - Total Liabilities
Shareholders' Equity Category: ***It indicates the share of equity in the firms' financial statement profile.***
- Common Shareholders' Equity
Profitability Indicators: ***This indicates the overall profitability of the firm and its financial performance in the market.***
- Net Sales or Revenue - Operating Income

Trading Indicators: ***It measures the price, and the market value considering volume and value of the traded security***
- Daily Stock Prices - Market Value
Firm Characteristics
- Firm date of incorporation to account for experienced/established firms versus new entrants - Number of employees

Some variables and financial ratios were computed in order use them in the modeling and to better understand the firm level behavior.

Table 9: Computed Variables

Variable	**Description**
Returns for both stock markets and crypto (in decimals)	Computed as the difference between prices and their lagged terms $\left[\frac{Price_t}{Price_{t-1}}\right] - 1$
sreturns	This was computed by removing the outliers from the returns series. The top 1% and least 1% outliers were excluded to avoid having extreme values that are unrelated to the relationship studied at hand.
sprices	The top 1% and least 1% of the prices series were excluded as well to avoid outlier skewness.

Debt Financing Ratios	
Leverage	Computed to account for a firm's debt financing decisions. $\frac{Debt}{Shareholders'Equity}$
Long term to short term debt	Computed to assess time frame of debt financing. $\frac{Long\ Term\ Debt}{Short\ Term\ Debt}$
Profitability Ratios	
Return on Equity (ROE)	This is an important ratio to investors since it shows the return to shareholders' equity. It will be used to conduct panel regressions. $\frac{Net\ sales}{Equity}$
Return on Assets (ROA)	This is another profitability ratio out of assets instead of equity. $\frac{Net\ sales}{Assets}$

We had to compile the data through reshaping and merging. Some variables had collinearity higher than 0.5, so they were not used in conjunction in the same regression mainly:

- interest rate and GDP per capita
- Net sales or revenue, market value, operating income, shareholders' equity

Table 10: Correlation Matrix

	Stock Prices	Crypt Prices	Inflation	GDP Per Capita	Interest Rate
Stock Prices	1				
Crypt Prices	-0.02	1			
Inflation	0.00	-0.37	1		
GDP Per Capita	-0.00	-0.21	-0.00	1	
Interest Rate	-0.00	0.09	0.12	-0.88	1

Note(s): Extracted from stata output

Data Descriptive:

Return Distribution Shapes

Table 11 below summarizes the descriptive statistics for the main financial variables. The prices and returns are corrected from the least and top 1% outliers to exclude extreme changes that are not the focus of our study. The crypto price and return distributions exhibit significantly higher mean and standard deviation from the stock prices and their returns. This corroborates with the main characteristic of crypto assets. They showcase higher returns but are also subject to higher volatility and dispersion, which implies higher risk. This differential in mean and standard deviation is also present between firms' market value and crypto market cap. With regards to distribution symmetry, crypto returns exhibit higher skewness than stock returns. This shows that the crypto return distribution is relatively more positively skewed, it is more likely to increase than decrease in the future. As for the shape of the distribution, the kurtosis indicates heavier tails for the crypto returns compared to the stock returns. This could be visually highlighted in the shape of both distributions in Graph 1.

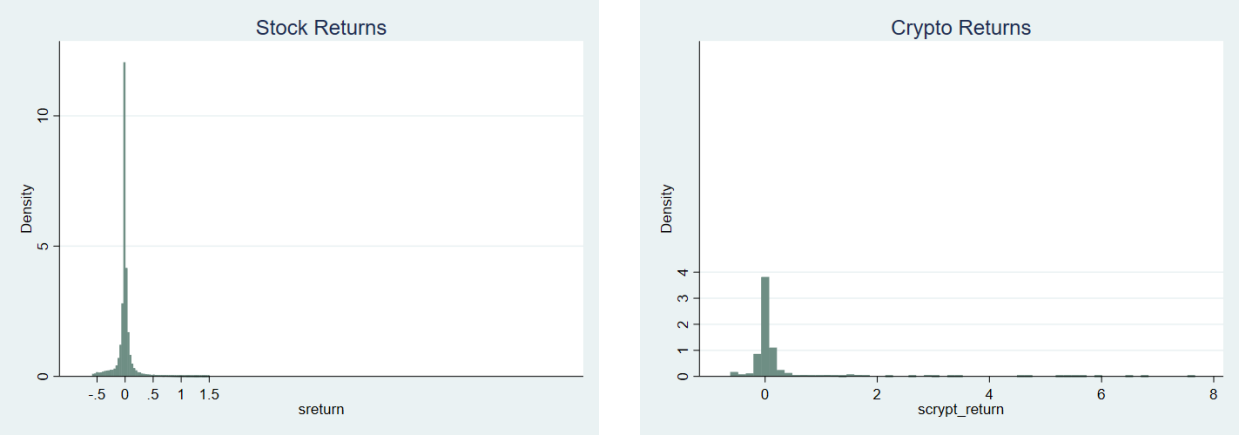
Table 11: Financial Variable Descriptive

	Stock Price	**Crypt Price**	**Crypt Return**	**Stock Return**	**Market Value**	**Crypto Market cap**
mean	2.64	1016.82	.27	.002	240.22	1.22e+11
sd	5.94	1234.58	1.03	.19	698.66	1.78e+11
min	.01	20.85	-.62	-.59	.01	9.80e+08
max	69.59	7681.54	7.67	1.51	17357.2	1.20e+12
skewness	6.02	2.16	4.53	2.51	8.86	2.94
kurtosis	49.78	9.96	25.16	19.35	133.53	14.91

Note(s): Extracted from stata output

SD: Stands for Standard Deviation

Graph1: Histogram of stock returns (to the left) and crypto returns (to the right)



Note(s): Graph generated from stata

Data for stock prices extracted from DataStream and data for crypto prices from CoinDesk

Macro Variables Descriptive

Table 12 below shows the main descriptive statistics for the macro variables that will be employed in the regressions. The inflation rate mean is 0.8% with the maximum value recorded at 4% after the devaluation of the Egyptian Pound in 2016. Interest rate has a mean of 13%. Inflation distribution exhibits heavy tails shown by extreme kurtosis of 5.

Table 12: Macro Variables Descriptive

	Inflation	Interest rate	GDP Per Capita
mean	.01	.13	2665.24
sd	.01	.03	757.84
min	-.03	.095	1186.39
max	.05	.199	3562.93
skewness	.19	.93	-.53
kurtosis	5.04	2.51	2.08

Note(s): Extracted from stata output

Crypto and Stock Markets Differentials:

We collapsed the data for the stock returns to have the mean per year for all sectors. Graph 2 highlights the differential return trends between the stocks and the crypto assets. This illustrates the investment opportunity in crypto assets since they offer significantly higher returns. Also, the volatility differential is visible from the graph. Crypto returns are highly volatile and are subject to extreme swings while stock returns trend experience moderate dispersion. Another difference to note is the growth rate differentials. From 2014 till 2021, crypto and stock returns increased by 159% and 89% respectively. This shows that crypto market is growing exponentially compared to stock market exchanges.

To add, for most of the years, both trends seem to be moving in the same direction except for 2 periods:

- In 2016, when the crypto returns continued to rise while the stock returns decreased. This will be highlighted more in the discussion of the regression results. This could be linked to the devaluation of the Egyptian pound that negatively impacted the stock returns but had no impact on crypto exchanges.
- Another period where there is a divergence in the directional trend is 2019 onwards, where the crypto increased significantly higher than the stock returns. This could be linked to COVID-19 pandemic and the bull market condition in those years.

Graph 2: Return Trends for both crypto and stocks

f

Note(s): Graph generated from stata

Data on stock prices from DataStream and crypto prices from CoinDesk

Returns are calculated and top and least 1% outliers are excluded

Firm Level Descriptive:

The automobile sector exhibits negative mean returns. It is a relatively a new entrant sector (youngest sector in the fields at hand) with average date of incorporation in 2003. It is relatively a large sized company with average number of employees around 3.7K. The leverage is high compared to other sectors, but they do not adopt long term debt financing. The data suggests that their debt consists mostly of short term liability dues.

Table 13: Automobile Sector

	Return	ROA	ROE	Leverage	Long to Short term debt	Number of employees	Date of incorporation
mean	-.003	.18	.64	1.48	0	3714.26	2003
sd	.194	.17	.71	1.24	0	1164.695	6.38
min	-.58	0	0	-3.08	0	2392	1998
max	1.5	0.65	3.77	3.82	0	5210	2012
skewness	2.13	0.62	1.04	-.08	.	.23	.69
kurtosis	18.78	2.57	4.34	3.88	.	1.49	1.5

Note(s): Extracted from stata

SD: Stands for Standard Deviation

The financial sector exhibits relatively higher and positive returns than the remaining sectors (higher than the consolidated mean of all firms combined). It is relatively a new entrant sector with average date of incorporation in 1991. Their profitability ratios (ROA & ROE) are relatively lower than the rest of the sectors. The main important characteristic is that they rely on long term debt in their financing shown by a high long term to short term debt ratio with mean 66.

Table 14: Banks, Investment Firms, Capital Markets

	Return	ROA	ROE	Leverage	Long to Short term debt	Number of employees	Date of incorporation
mean	.003	.04	.22	.64	66.26	2473.96	1991.49
sd	.18	.07	.69	6.197	553.68	1814.92	14.496
min	-.59	-0.16	-15.83	-86.59	0	10	1948
max	1.51	0.72	13.52	225.56	10137.83	7071	2015
skewness	2.67	5.62	-.87	24.499	16.62	1.28	-.41
kurtosis	20.75	44.14	244.19	977.98	300.14	3.39	2.99

Note(s): Extracted from stata

SD: Stands for Standard Deviation

The real estate sector is relatively experienced and bigger in size. On average, half of their equity is financed through debt obligations with long term debt 27 times higher than the short term debt.

Table 15: Real Estate, Construction and Machinery

stats	Return	ROA	ROE	Leverage	Long to Short term debt	Number of employees	Date of incorporation
mean	.002	.13	.32	.546	27.714	2505.01	1980.93
sd	.199	0.14	1.123	3.699	258.187	3144.95	20.86
min	-.59	-0.15	-27.305	-96.12	0	124	1904
max	1.50	1.15	13.63	73.18	4424.38	13256	2007
skewness	2.46	2.52	-10.42	-6.06	13.80	1.94	-1.51
kurtosis	18.28	13.45	316.801	325.89	206.87	5.85	5.55

Note(s): Extracted from stata

SD: Stands for Standard Deviation

The textile and food sector is characterized by negative mean returns. It is an experienced sector with average date of incorporation in 1979. It is the largest sector with highest average of number of employees. They rely on long term debt in their financing but a relative low leverage, at 0.12 on average.

Table 16: Textile, consumer products, food & beverages, tobacco

stats	Return	ROA	ROE	Leverage	Long to Short term debt	Number of employees	Date of incorporation
mean	-.00004	.25	.71	.13	18.15	3972.83	1979.84
sd	.189	0.26	3.69	16.87	172.14	3449.07	17.29
min	-.59	-0.16	-93.77	-732.44	0	125	1938
max	1.51	2.16	62.66	76.58	3847.62	13859	2000
skewness	2.48	2.5	-5.04	-41.87	20.16	1.77	-.77
kurtosis	19.33	11.88	343.93	1821.24	441.43	5.64	2.68

Note(s): Extracted from stata

SD: Stands for Standard Deviation

IT and Telecom is considered to be one of the most digital and technologically advanced sectors. So, it is important to differentiate the impact of crypto assets on this sector. It is relatively a new entrant sector than its counterparts with smaller size. It exhibits positive returns with the highest average returns amongst the sectors studied, with relatively high leverage.

Table 17: IT & Telecom

stats	Return	ROA	ROE	Leverage	Long to Short term debt	Number of employees	Date of incorporation
mean	.02	.11	.34	.78	.25	14720.48	1997.25
sd	.199	.06	1.37	6.08	1.49	18288.98	.83
min	-.59	0	-14.45	-62.08	0	300	1996
max	1.5	0.26	6.61	28.87	10.75	53332	1998
skewness	2.6	0.22	-4.95	-4.95	6.89	1.34	-.49
kurtosis	17.58	2.42	60.68	59.66	48.53	3.39	1.63

Note(s): Extracted from stata

SD: Stands for Standard Deviation

The pharma sector is considered to be a stable sector, with the second highest average returns from the sectors at hand. It is relatively an experienced sector with medium sized firms operating in the market.

Table 18: Pharma and Healthcare

stats	Return	ROA	ROE	Leverage	Long to Short term debt	Number of employees	Date of incorporation
mean	.007	.22	.42	.26	10.41	1853.31	1979.18
sd	.17	.08	.67	.65	14.67	596.12	18.67
min	-.59	-0.04	-5.45	-5.18	0	625	1940
max	1.49	0.71	13.18	5.497	51.58	2874	2005
skewness	2.63	1.18	9.63	2.39	1.33	.08	-.59
kurtosis	20.78	7.95	219.16	29.72	3.61	2.49	2.43

Note(s): Extracted from stata

SD: Stands for Standard Deviation

The hotel and entertainment industry is relatively a volatile sector since it is highly prone to external shocks. It has one of the highest average number of employees implying large operating firms in this field. Their average returns are low and negative at around 0%. There is high reliance on long term debt financing (highest ratio amongst the sectors studied) and high leverage.

Table 19: Hotel, Entertainment and Utilities

stats	Return	ROA	ROE	Leverage	Long to Short term debt	Number of employees	Date of incorporation
mean	-.00001	.48	.86	.58	536.27	3002.26	1986.84
sd	.18	1.55	3.10	.84	1656.82	1909.77	15.01
min	-.587	-.24	-.31	0	0	88	1954
max	1.5	10.61	25.13	8.75	14504.67	5515	2007
skewness	2.68	4.48	5.65	4.41	4.99	-.28	-.93
kurtosis	21.81	23.78	36.76	32.65	33.200	1.69	3.07

Note(s): Extracted from stata

SD: Stands for Standard Deviation

The retail and transportation sectors are one of the average performing sectors in terms of stocks returns with average returns of 0.15%. It is considered a conservative sector in terms of leverage and long term financing.

Table 20: Retail, Transportation and Distribution

stats	Return	ROA	ROE	Leverage	Long to Short term debt	Number of employees	Date of incorporation
mean	.002	.18	.41	.46	22.18	1577.52	1985.63
sd	.18	0.17	1.16	5.12	131.26	1264.39	13.65
min	-.59	-0.44	-19.88	-60.53	0	18	1958
max	1.5	1.05	16.01	102.33	1695.33	3500	2006
skewness	2.22	1.50	-2.45	7.77	11.14	.14	-.40
kurtosis	18.27	6.81	170.32	242.37	137.37	1.37	2.18

Note(s): Extracted from stata

SD: Stands for Standard Deviation

The chemicals industry exhibits return higher than the average of all consolidated firms. The average ROE is 0.36%. It is an experienced sector with relatively small companies in terms of number of employees. Their leverage and long term debt financing are moderate.

Table 21: Chemicals

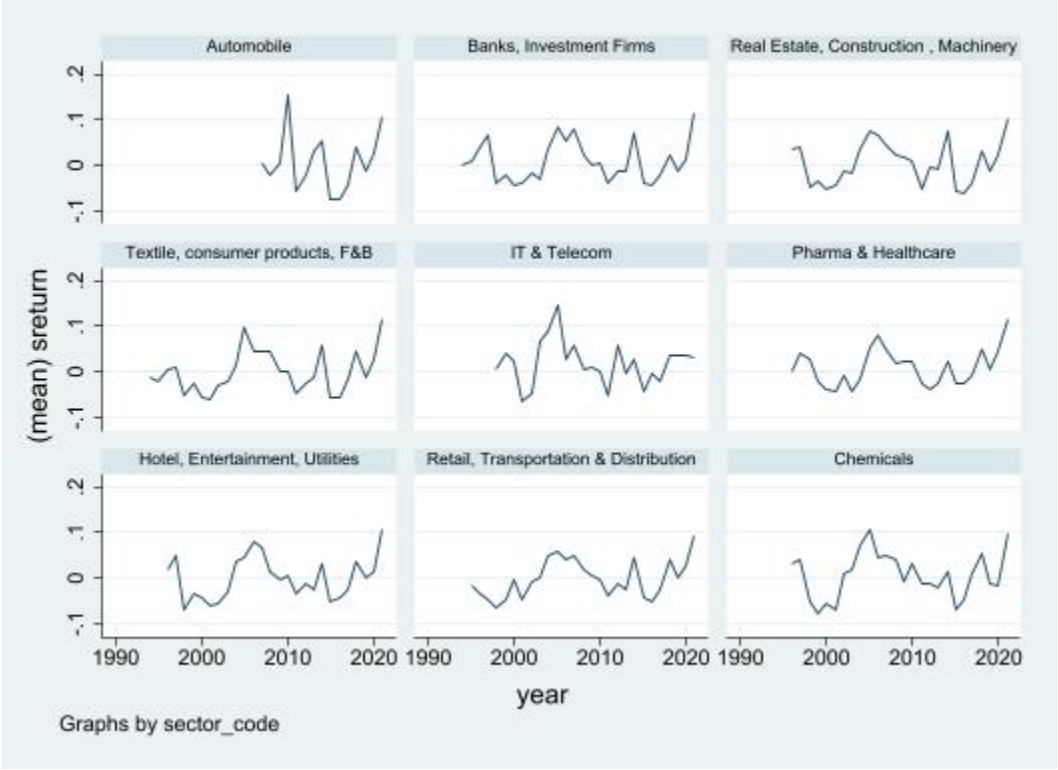
stats	Return	ROA	ROE	Leverage	Long to Short term debt	Number of employees	Date of incorporation
mean	.004	.21	.3598	.35	12.14	1561.01	1979.31
sd	.19	.17	.28	.45	41.83	892.364	21.47
min	-.59	-.03	-.03	0	0	710	1929
max	1.5	0.97	2.38	3.47	506.83	3321	1999
skewness	2.44	1.73	2.11	2.39	9.84	.84	-.97
kurtosis	18.05	6.52	10.43	12.07	114.72	1.96	2.80

Note(s): Extracted from stata

SD: Stands for Standard Deviation

Graph 3 summarizes the return trends by sector. “IT and telecom” followed by “real estate, construction and machinery” sectors exhibit the highest return standard deviation as shown from the volatility of the line graph. “Pharma and Healthcare” sector has the most stable returns shown by relatively low to very moderate swings in the return pattern.

Graph 3: Return Trends by sector



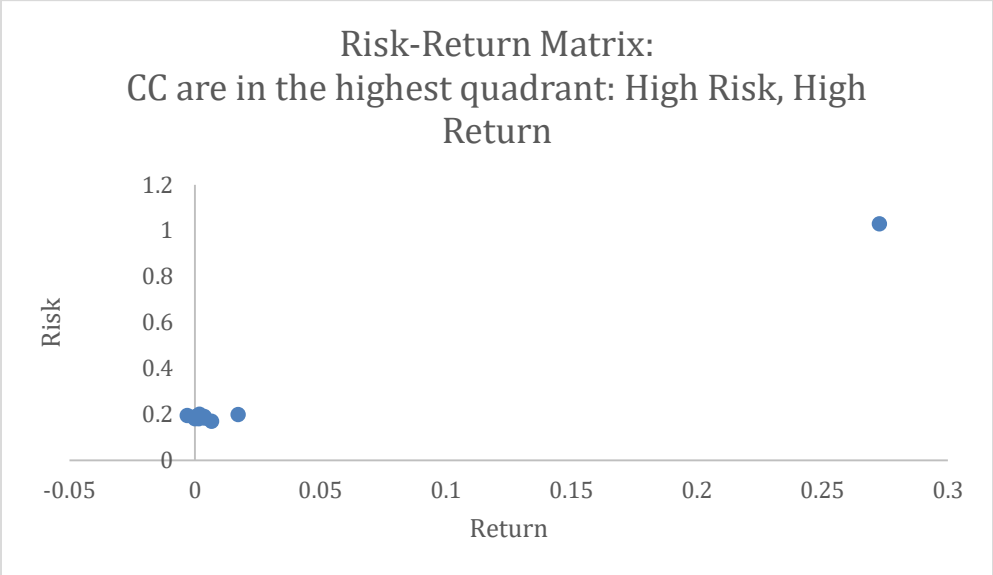
Note(s): Graph generated from stata

Stock prices extracted from DataStream

Returns were calculated and outliers (top and least 1%) excluded

To further illustrate sector differentials with regards to return patterns, graph 4 summarizes the risk versus return behavior of all sectors at hand compared to the crypto market. The return was graphed as the main stock returns corrected from outliers, and the risk was inferred to from the standard deviation of the return distribution. As shown on the graph, the crypto market is characterized by significantly higher risk and higher return than all other sectors.

Graph 4: Risk-Return Matrix



Note(s): Developed by author

Stock prices extracted from DataStream

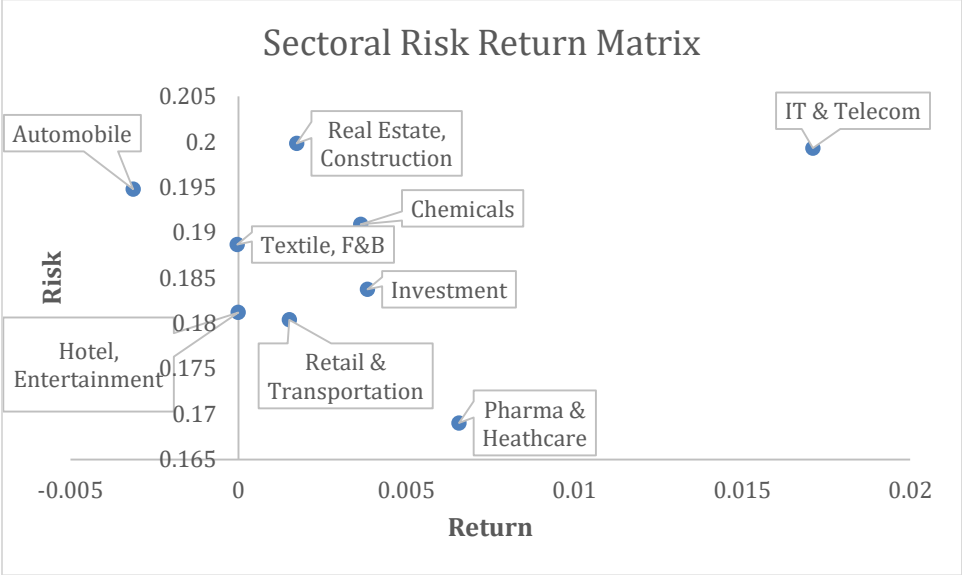
Returns were calculated and outliers (top and least 1%) excluded

Risk proxied for by the author from standard deviation of the returns

Focusing on the sectoral risk-return matrix, we can see a differential behavior across firms in Graph 5. IT and Telecom sector exhibits high risk and high return behavior compared to the rest of the industries. Other sectors with comparable risk levels but lower returns are real estate, construction

machinery, chemicals and textile/Food and Beverages. Pharma and healthcare sector has the lowest risk with moderate returns.

Graph 5: Sectoral Risk Return Matrix



Note(s): Developed by author

Stock prices extracted from DataStream

Returns were calculated and outliers (top and least 1%) excluded

Risk proxied for by the author from standard deviation of the returns

Empirical Results:[1]

General Regressions:

Table 22 below summarizes the results of the general regressions having stock prices (after removing the outliers) as a dependent variable. From model 1 and 2 (OLS regressions), we can depict a negative and significant relationship between stock and crypto prices. Columns 3 and 4 replicate the same models as OLS while using a FE model to account for firm endogenous heterogeneity. We can see that the results remain the same with a negative and significant relationship between both assets. This implies that their role in portfolio management is substitutes and not complements, since prices tend to move in opposite directions. So, this creates a diversification advantages for investors since both asset types act as complements.

Table 22: Results for OLS and FE

Dependent Variable: Stock Prices

VARIABLES	(1) OLS	(2) OLS	(3) FE	(4) FE
Crypt Prices	-0.1397***	-0.1940***	-0.1983***	-0.2691***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Inflation	-4.3534***	-5.9087***	-4.3750***	-6.3453***
	(1.5578)	(1.5551)	(0.6006)	(0.5968)
Interest Rate	-2.4967***		-5.0640***	
	(0.6276)		(0.2438)	
Market Value	0.7316***	0.7357***	2.2417***	2.2538***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
GDP Per Capita		-0.0083		0.1559***
		(0.0000)		(0.0000)
Constant	2.1413***	1.8728***	2.2594***	1.1223***
	(0.0894)	(0.1543)	(0.0364)	(0.0597)
Observations	92,962	91,727	92,962	91,727
R-squared	0.0063	0.0064	0.0546	0.0544
chi2	.	.	.	.
Number of compcode			248	248

[1] For all regressions, the below explanatory variables were scaled and approximated as follows:
- Crypt prices, market value, net sales or revenues (divided by 10 to the power of 3)
- Crypto Market Cap (divided by 10 to the power of 9)

Fixed Effect	YES	YES

Note(s): Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In the table below (Table 23), the same regressions were conducted for stock and crypt returns instead of prices. The coefficient for crypt returns is positive. Nonetheless, the Year Fixed effect observation show time differentials. For years from 2015 to 2017, the FE year coefficient is negative and significant. So, from a returns standpoint, the stock and crypt returns acted as substitutes in the devaluation year and the years leading up to the devaluation. This is consistent with the motivations depicted in the literature covering the top reasons when investors resort to crypto assets. Moreover, this is consistent with the findings of the descriptive statistics section (Graph 2), where a directional divergence was depicted for the years leading up to the devaluation of the Egyptian pound. Thus, to counter uncertainty, inflation as well as devaluation risks and preserve the value of their savings, investors could have resorted to crypto assets given the arbitrage condition it offered them.

Table 23: Dependent Variable: Stock Returns

VARIABLES	(1) OLS	(2) FE	(3) FE	(4) FE
Crypt Return	0.0297***	0.0298***	0.0282***	0.0280***
	(0.0006)	(0.0006)	(0.0006)	(0.0006)
Inflation	-1.0214***	-0.9934***	-0.2329***	-0.2740***
	(0.0471)	(0.0469)	(0.0497)	(0.0553)
Interest Rate	-0.1940***	-0.1731***	-0.4589***	-0.4164***
	(0.0193)	(0.0193)	(0.0551)	(0.0566)
Market Value	0.0104***	0.0677***	0.0635***	0.0639***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Constant	0.0233***	0.0085***	0.0485***	0.0384***
	(0.0027)	(0.0029)	(0.0071)	(0.0079)
2015.year			-0.0558***	-0.0544***
			(0.0027)	(0.0028)

2016.year			-0.0483***	-0.0473***
			(0.0029)	(0.0029)
2017.year			-0.0239***	-0.0246***
			(0.0042)	(0.0043)
2018.year			0.0438***	0.0423***
			(0.0042)	(0.0043)
2019.year			0.0081**	0.0076**
			(0.0034)	(0.0034)
2020.year			0.0095***	0.0110***
			(0.0027)	(0.0028)
2021.year			0.0585***	0.0633***
			(0.0044)	(0.0049)
2.month				0.0046
				(0.0028)
3.month				-0.0071**
				(0.0028)
4.month				0.0093***
				(0.0027)
5.month				0.0003
				(0.0028)
6.month				-0.0047*
				(0.0028)
7.month				0.0078***
				(0.0026)
8.month				0.0026
				(0.0028)
9.month				0.0110***
				(0.0026)
10.month				0.0077***
				(0.0028)
11.month				0.0055**
				(0.0028)
12.month				0.0064**
				(0.0028)
Observations	90,744	90,744	90,744	90,744
R-squared	0.0351	0.0388	0.0708	0.0716
chi2	.	.	.	.
Number of compcode		249	249	249
Fixed Effect		YES	YES	YES
Year FE			YES	YES
Month Fixed Effect				YES

Note(s): Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

To further study the investment trends between crypto and stock assets, another round of regressions was implemented with firms' market value as dependent variable and average crypto market cap as explanatory variable along with determinants such as inflation and interest rate. The conclusion remains the same. For models 1 (OLS) and 2 (FE), the relationship is negative and significant corroborating the substitution properties of both assets.

Table 24: Dependent Variable: Firms' Market Value

VARIABLES	(1) OLS	(2) FE
Average Crypto Market Cap	-0.0001***	-0.0619***
	(0.0000)	(0.0000)
Inflation	-448.4556***	-435.8182***
	(145.3104)	(47.2500)
Interest Rate	-423.5761***	-413.3838***
	(57.6141)	(18.7952)
Constant	273.2216***	272.1025***
	(8.2658)	(2.6988)
Observations	97,220	97,220
R-squared	0.0011	0.0102
chi2	.	.
Number of compcode		249
Fixed Effect		YES

Note(s): Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Year Differentials:

Since year effects play an important role in the relationship studied, table 25 summarizes the results of the FE regressions for the stock prices for different year periods. We can see that the overall relationship is negative, and it is negative for years after 2014 and 2015. This could be related to the monetary and exchange rate changes at those times with the EGP devaluation. Crypto prices could have been used as a hedge against inflation. Also, year 2019 exhibits a negative sign for the relationship between stock and crypto prices. This could be mapped against the COVID-

19 pandemic and the instability and uncertainty it entailed. The use of crypto assets could be highlighted here against the literature concluding that their adoption rises in times of uncertainty and inflation.

Table 25: Dependent Variable: Stock Prices

VARIABLES	(1) Overall	(2) Year>2014	(3) Year>2015	(4) Year>2016	(5) Year>2017	(6) Year>2018	(7) Year>2019	(8) Year=2019
Crypt Prices	-0.1938***	-0.1052***	-0.0144***	0.0750***	0.0570***	0.0432***	0.0613***	-0.0316***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Net sales or revenue	0.0039***	0.0038***	0.0060***	0.0042***	0.0037***	0.0030***	-0.0003*	0.0080***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Inflation	-5.1710***	-3.1791***	-1.1928***	0.2730	2.0666***	1.5915***	3.5260***	-0.0523
	(0.5121)	(0.4130)	(0.3516)	(0.2918)	(0.2946)	(0.5740)	(0.7439)	(0.6253)
Interest Rate	-6.5182***	-2.9006***	0.8053***	3.1227***	3.4202***	2.1861***	-0.3720	3.8764***
	(0.2229)	(0.1698)	(0.1507)	(0.1271)	(0.1279)	(0.1703)	(0.3425)	(0.4143)
Constant	2.4784***	1.7026***	0.7994***	0.3256***	0.3665***	0.5851***	0.9913***	0.1913**
	(0.0338)	(0.0280)	(0.0272)	(0.0252)	(0.0261)	(0.0313)	(0.0480)	(0.0756)
Observations	73,533	58,328	48,602	39,422	29,661	19,565	9,400	10,165
R-squared	0.0439	0.0254	0.0258	0.0377	0.0416	0.0266	0.0295	0.0781
Number of compcode	210	205	205	204	204	201	200	198
Fixed Effect	YES	YES	YES	YES	YES	YES	YES	YES

Note(s): Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

To test the annual differentials, annual FE regressions were studied with firm market value as the dependent variable and crypto market cap as the explanatory variable. Years 2014 and 2015 were found to exhibit negative relationship between both assets.

Table 26: Dependent Variable: Firm Market Value

VARIABLES	(1) Overall	(2) Year=2014	(3) Year=2015	(4) Year=2016	(5) Year=2017	(6) Year=2018	(7) Year=2019
Average Crypto Market Cap	-0.0619***	-3.1981***	-19.2332***	1.2929	0.0738***	0.0928***	0.0055
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Inflation	-435.8182***	303.6253***	-343.2755***	-509.9865***	182.0456***	372.9923***	117.7967
	(47.2500)	(70.0059)	(101.6765)	(118.2117)	(67.2430)	(37.6706)	(74.8844)
Interest rate	-413.3838***	3,774.0678***	4,934.2697***	-1,304.7487***	450.0041***	599.8143***	329.2464***
	(18.7952)	(443.3633)	(1,325.8622)	(220.2135)	(58.7950)	(141.5329)	(47.7574)
Constant	272.1025***	-139.4753***	-258.5531*	351.0232***	70.9922***	64.3093***	137.3072***
	(2.6988)	(52.2798)	(151.2701)	(20.4788)	(10.6998)	(23.8537)	(8.3806)
Observations	97,220	11,713	12,125	11,541	12,466	12,919	13,052
R-squared	0.0102	0.0129	0.0233	0.0474	0.0375	0.0459	0.0068
Number of compcode	249	224	231	238	241	246	247
Fixed Effect	YES	YES	YES	YES	YES	YES	YES

Note(s): Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

For the returns annual differentials, the negative relationship is depicted for years 2016 and 2017 as per table 27.

Table 27: Dependent Variable: Stock Return

VARIABLES	(1) Overall	(2) Year=2014	(3) Year=2015	(4) Year=2016	(5) Year=2017	(6) Year=2018	(7) Year=2019
Crypt Return	0.0298***	0.0538***	0.3594***	-0.1384***	-0.0220***	0.0801***	0.0562***
	(0.0006)	(0.0009)	(0.0054)	(0.0036)	(0.0010)	(0.0016)	(0.0044)
Inflation	-0.9934***	-0.3283***	0.1744	-1.3440***	-0.1828	-0.0458	0.4458***
	(0.0469)	(0.1170)	(0.1209)	(0.1578)	(0.1863)	(0.0861)	(0.1723)
Interest Rate	-0.1731***	0.2994	-3.3411**	0.8677***	2.1010***	-0.3303*	-0.5156***
	(0.0193)	(0.8260)	(1.3730)	(0.1568)	(0.1565)	(0.1939)	(0.1039)

Market Value	0.0677***	0.1088***	0.1162***	0.0760***	0.1355***	0.1051***	0.1272***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Constant	0.0085***	-0.0547	0.3426**	-0.1339***	-0.4152***	0.0455	0.0484***
	(0.0029)	(0.0963)	(0.1602)	(0.0201)	(0.0303)	(0.0351)	(0.0166)
Observations	90,744	10,452	11,587	11,294	11,824	12,030	12,475
R-squared	0.0388	0.2500	0.2851	0.1305	0.0601	0.1851	0.0211
Number of compcode	249	224	231	238	241	246	247
Fixed Effect	YES	YES	YES	YES	YES	YES	YES

Note(s): Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Sector Specific Regressions:

The price regressions conducted in the sections above were replicated for each sector to assess the differential impact of crypto assets on each industry and relate them to the industry characteristics and attributes. The relationship is negative for all sectors except for Sector 6 (Pharma and Healthcare). The negative coefficient is the highest for Sector 5 (IT and Telecom), Sector 3 (Real Estate, Construction, Machinery) and Sector 2 (Banks and Investment Firms).

Table 28: Dependent Variable: Stock Prices

VARIABLES	(1) Overall	(2) Sector 1	(3) Sector 2	(4) Sector 3	(5) Sector 4	(6) Sector 5	(7) Sector 6	(8) Sector 7	(9) Sector 8	(10) Sector 9
Crypt Prices	-0.1938***	-0.0868***	-0.2655***	-0.3794***	-0.0536***	-0.5728***	0.0024	-0.1089***	-0.0909***	-0.1343***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Net sales or revenue	0.0039***	0.0006***	0.0029***	0.0147***	0.0006***	0.0040***	0.0418***	0.0001	0.0005	0.0012***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Inflation	-5.1710***	-1.9466***	-4.0506***	-7.0059***	-4.0530***	-2.7520	-4.7235***	-4.8773***	-3.5109***	-4.9899***
	(0.5121)	(0.4985)	(0.8000)	(1.7146)	(0.3633)	(2.3465)	(1.3042)	(0.7978)	(0.4874)	(0.5963)
Interest rate	-6.5182***	-2.5228***	-3.2446***	-14.7648***	-2.1820***	-5.8333***	-8.5233***	-4.7451***	-3.6784***	-2.9145***
	(0.2229)	(0.2328)	(0.3445)	(0.7644)	(0.1566)	(1.2796)	(0.6317)	(0.3736)	(0.2114)	(0.2505)

Constant	2.4784***	0.6394***	1.9985***	3.9514***	1.5165***	0.8235***	3.3535***	1.8582***	1.3892***	1.5343***
	(0.0338)	(0.0397)	(0.0522)	(0.1086)	(0.0253)	(0.2639)	(0.1409)	(0.0577)	(0.0358)	(0.0380)
Observations	73,533	1,108	14,616	19,662	15,138	2,035	4,565	5,457	5,865	5,087
R-squared	0.0439	0.3428	0.0733	0.0708	0.0440	0.1424	0.1292	0.0829	0.1255	0.1421
Number of compcode	210	3	44	57	39	6	14	16	17	14
Fixed Effect	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Note(s): Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Following the same approach of sectoral analysis, the regressions were implemented for firm market value as dependent variable against average crypt market cap as independent variable as well as inflation and GDP per capita. The relationship was negative and of same magnitude for all sectors except for Sectors 4 (Textile, consumer products, F&B), 7(Hotel, Entertainment and Utilities) and 8 (Retail, Transportation and Distribution), which exhibited positive relationship.

Table 29: Dependent Variable: Firm Market Value

VARIABLES	(1) Overall	(2) Sector 1	(3) Sector 2	(4) Sector 3	(5) Sector 4	(6) Sector 5	(7) Sector 6	(8) Sector 7	(9) Sector 8	(10) Sector 9
Average Crypt Market Cap	-0.1018***	-0.1870***	-0.0311**	-0.2127***	0.0097	-0.8951***	-0.0134**	0.0342***	0.0533***	-0.1184***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Inflation	-602.4330***	-762.5451***	-368.9666***	-543.2301***	-270.8088***	-4,462.3105***	-95.5061	-662.1205***	161.7980*	-1,646.0868***
	(47.5919)	(175.2337)	(124.4293)	(69.5071)	(66.4591)	(727.2422)	(74.6851)	(122.0718)	(88.5651)	(216.1209)
GDP per Capita	0.0155***	0.0225***	0.0283***	0.0120***	-0.0014	0.1933***	0.0080***	0.0060*	-0.0117***	-0.0118*
	(0.0014)	(0.0052)	(0.0037)	(0.0020)	(0.0020)	(0.0215)	(0.0022)	(0.0036)	(0.0026)	(0.0063)

Constant	169.8361*** (4.7777)	51.0582*** (17.7639)	246.8518*** (12.4628)	134.2339*** (6.9696)	97.0268*** (6.7097)	359.5043*** (73.2214)	58.6692*** (7.4297)	176.9484*** (12.3318)	120.1786*** (8.9090)	409.0822*** (21.4695)
Observations	94,730	1,608	17,730	26,406	18,371	3,542	5,904	7,553	7,552	6,064
R-squared	0.0089	0.0991	0.0055	0.0398	0.0013	0.0892	0.0040	0.0065	0.0102	0.0112
Number of compcode	249	4	48	68	47	9	18	19	20	16
Fixed Effect	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Note(s): Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Linking those findings to the firm characteristics outlined in the descriptive section, we can see that the sector that is most negatively impacted by the crypto presence is IT and Telecom. It is the sector exhibiting the highest risk and return amongst the sectors studied (Graph 5). It is concluded that investors in this sector are risk takers and consider crypto assets as substitutes rather than complements. So, this sector is more prone to be negatively impacted by the crypto assets. Risk taker investors in those sectors see opportunity in the market crypto market with its high volatility and risk that are compensated by the higher returns.

On the other hand, the sectors that are marginally or unaffected by the crypto exchanges are: (Pharma and Healthcare), (Textile, consumer products, F&B), (Hotel, Entertainment and Utilities) and (Retail, Transportation and Distribution). Those are the sectors with the lowest risk and return patterns on the risk-return matrix. This could imply that investors buying stocks in those sectors are more conservative and risk averse and thus do not consider crypto assets as substitutes. They only view them as complements to their safe and stable stock investments in those sectors.

Panel Regressions:

In this section, different panel regressions were conducted to assess the direction and magnitude of the relationship depending on micro level firm characteristics. For each variable, the top and least 25% were assessed.

Table 30 below shows the differential impact of crypto assets on stock assets based on firm experience. Date of incorporation variable was used as a proxy for firm experience. The top and least 25% firms were included in regressions (1) and (2). The beta coefficient for crypto prices has a higher negative magnitude for new entrant firms. This shows that crypto assets are more likely to become substitutes for stocks of new entrant firms. This could be related to firm experience through existence and operation in the market. The older the firm, the more experience it has and the more likely it is to be established and stable facing technological changes that appear in the market. Cryptocurrencies compete with new entrant firms more than the established and experienced firms in the market.

Table 30: Dependent Variable: Stock Prices

VARIABLES	(1) New Entrants	(2) Experienced Firms
Crypt Prices	-0.1219***	-0.0403***
	(0.0000)	(0.0000)
Net Sales or revenue	0.0013***	0.0018***
	(0.0000)	(0.0000)
Inflation	-4.3370***	-4.7991***
	(0.3609)	(0.4267)
Interest Rate	-3.1230***	-3.9164***
	(0.1599)	(0.1803)
Constant	1.4261***	1.8501***
	(0.0244)	(0.0270)
Observations	18,296	16,008
R-squared	0.0978	0.0595

Number of compcode	60	42
Fixed Effect	YES	YES

Note(s): Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Firm size was estimated using the (number of employees) variable. From the below regressions, it could be concluded that largest firms are more negatively impacted by crypto assets.

Table 31: Dependent Variable: Stock Prices

VARIABLES	(1) High number of employees	(2) Low number of employees
Crypt Prices	-0.1957***	0.0990***
	(0.0000)	(0.0000)
Net sales or revenue	0.0038***	-0.0025**
	(0.0000)	(0.0000)
Inflation	-5.1419***	-4.1561***
	(0.5417)	(1.1688)
Interest rate	-6.7193***	-5.2678***
	(0.2356)	(0.9904)
Constant	2.5286***	2.4817***
	(0.0357)	(0.1301)
Observations	69,196	724
R-squared	0.0428	0.0813
Number of compcode	206	8
Fixed Effect	YES	YES

Note(s): Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Firm financial size (proxied by market value) is another metric of interest. The same results hold, where firms with highest market value are more negatively impacted than the smaller ones. This is consistent with the previous results. Crypto assets act as substitutes for firms with high market value and the ones exhibiting high return trends.

Table 32: Dependent Variable: Stock Prices

VARIABLES	(1) High Market Value	(2) Low Market Value
Crypt Prices	-0.1808***	-0.0991***
	(0.0000)	(0.0000)
Net sales or revenue	0.0048***	0.0008
	(0.0000)	(0.0000)
Inflation	-5.1758***	-3.5999***
	(1.3276)	(0.3873)
Interest rate	-3.3903***	-5.6529***
	(0.6002)	(0.1831)
Constant	2.4745***	1.6464***
	(0.0993)	(0.0270)
Observations	20,461	16,152
R-squared	0.0235	0.1089
Number of compcode	81	78
Fixed Effect	YES	YES

Note(s): Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Another financial variable to proxy for firm size is ln (Total Assets). The results displayed in Table 33 show that firms with higher assets values are more negatively impacted by the presence of crypto exchanges than the smaller firms.

Table 33: Dependent Variable: Stock Prices

VARIABLES	(1) High ln(Total Assets)	(2) Low ln(Total Assets)
Crypt Prices	-0.1896***	-0.0997***
	(0.0203)	(0.0059)
Inflation	-6.2683***	-4.7042***
	(1.4792)	(0.4265)
leverage	0.0003	0.0064**
	(0.0022)	(0.0030)
gdppercapita	-0.0000	0.0002***
	(0.0000)	(0.0000)
Market Value	1.5413***	27.0186***

	(0.0507)	(0.6929)
Constant	1.4040***	0.0705
	(0.1596)	(0.0453)
Observations	17,272	14,728
Number of compcode	64	81
R-squared	0.0597	0.1468

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Debt management is another important firm attribute that investors assess when comparing different firms, since it is a measure of firm risk and crisis management as well. Firms with high debt could be considered riskier than the ones holding low debt levels. From the below regressions in Table 34, highest debt firms are more negatively impacted by crypto exchanges.

Table 34: Dependent Variable: Stock Prices

	(1)	(2)
VARIABLES	High Debt	Low Debt
Crypt Prices	-0.2363***	-0.0279***
	(0.0000)	(0.0000)
Net sales or revenue	0.0046***	0.0146***
	(0.0000)	(0.0000)
Inflation	-7.1731***	-2.7645***
	(1.1697)	(0.4854)
Interest rate	-5.6915***	-3.3554***
	(0.5071)	(0.2461)
Constant	2.7043***	1.7491***
	(0.0803)	(0.0364)
Observations	26,932	12,966
R-squared	0.0298	0.0776
Number of compcode	146	103
Fixed Effect	YES	YES

Note(s): Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Not only the debt amount is important, but its structure is crucial to assess. Some firms adopt strategies focused on holding long term debt and others prefer to keep their debt's terms of payment short with more current than long term liabilities. The higher the long term debt, the higher the risk since there is higher uncertainty involved in longer time horizons. From the regression output, it could be inferred that firms holding highest long term debt are more prone to become substituted by crypto exchanges.

Table 35: Dependent Variable: Stock Prices

VARIABLES	(1) High long term Debt	(2) Low long term Debt
Crypt prices	-0.2156***	-0.1184***
	(0.0000)	(0.0000)
Net sales or revenue	0.0045***	-0.0032***
	(0.0000)	(0.0000)
Inflation	-5.1732***	-2.7440***
	(0.6497)	(0.8842)
Interest rate	-6.7691***	-6.3288***
	(0.2860)	(0.4338)
Constant	2.5817***	2.5806***
	(0.0434)	(0.0712)
Observations	55,450	8,002
R-squared	0.0406	0.0488
Number of compcode	206	61
Fixed Effect	YES	YES

Note(s): Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Looking at the same regression from a relative perspective, we can see that firms having higher long term debt relative to short term debt are more negatively impacted by crypto assets.

Table 36: Dependent Variable: Stock Prices

VARIABLES	(1) High Long Term : Short Term Debt	(2) Low Long Term : Short Term Debt
Crypt Prices	-0.2091***	-0.0234**
	(0.0000)	(0.0000)
Net sales or revenue	0.0047***	-0.0017***
	(0.0000)	(0.0000)
Inflation	-5.3827***	-2.7559***
	(0.6076)	(0.6754)
Interest rate	-7.2549***	-1.8240***
	(0.2659)	(0.3459)
Constant	2.6599***	1.6127***
	(0.0401)	(0.0573)
Observations	60,910	5,216
R-squared	0.0437	0.0138
Number of compcode	210	45
Fixed Effect	YES	YES

Note(s): Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 37 below splits the dataset in the top and least 25% groups according to the $\frac{Liability}{Asset}$ ratio. The results confirm that firms holding higher liabilities relative to their assets are more impacted by the crypto market. Those firms tend to be riskier in their financial structure since higher debt goes accompanied by higher risk.

Table 37: Dependent Variable: Stock Prices

VARIABLES	(1) High Liability:Asset	(2) Low Liability:Asset
Crypt Prices	-0.2517***	-0.1501***
	(0.0000)	(0.0000)
Net sales or revenue	0.0059***	0.0062***
	(0.0000)	(0.0000)
Inflation	-3.8750***	-3.3507***
	(1.1926)	(0.5369)

Interest rate	-3.2310***	-5.6054***
	(0.5261)	(0.2569)
Constant	2.1846***	1.9293***
	(0.0855)	(0.0360)
Observations	21,405	17,240
R-squared	0.0296	0.0877
Number of compcode	115	89
Fixed Effect	YES	YES

Note(s): Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The leverage was computed and the results corroborate the findings of previous regressions. Firms with higher leverage levels are more negatively impacted by the crypto market existence. From the finance literature, there is a high correlation between leverage and profitability and risks. So, firms that hold higher leverage are usually considered to be riskier firms. This creates a risk premium for this type of investment since it increases the systematic risk (Hill et al., 1980).

Table 38: Dependent Variable: Stock Prices

VARIABLES	(1) High Leverage	(2) Low Leverage
Crypt Prices	-0.2646***	-0.1169***
	(0.0000)	(0.0000)
Net sales or revenue	0.0086***	0.0021***
	(0.0000)	(0.0000)
Inflation	-6.6745***	-3.3302***
	(1.2537)	(0.5251)
Interest rate	-11.1676***	-5.2954***
	(0.5516)	(0.2596)
Constant	3.4280***	2.2036***
	(0.0860)	(0.0388)
Observations	26,747	13,740
R-squared	0.0454	0.0715
Number of compcode	166	111
Fixed Effect	YES	YES

Note(s): Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Apart from the debt management, a firms' profitability indicators matter for investment decisions. The outputs imply that high income firms are more likely to be substituted by crypto assets. The same rationale applied for firms' sales. The ones with higher total sales are more negatively impacted. So, crypto markets compete more with firms exhibiting high returns showcased by high sales/incomes.

Table 39: Dependent Variable: Stock Prices

VARIABLES	(1) High Income	(2) Low Income
Crypt Prices	-0.2666***	-0.1631***
	(0.0000)	(0.0000)
Net sales or revenue	0.0056***	0.0010***
	(0.0000)	(0.0000)
Inflation	-6.6792***	-2.8548***
	(1.3657)	(0.8219)
Interest rate	-4.4493***	-4.7835***
	(0.6246)	(0.3707)
Constant	2.5315***	1.8317***
	(0.1078)	(0.0529)
Observations	18,115	19,805
R-squared	0.0388	0.0282
Number of compcode	96	153
Fixed Effect	YES	YES

Note(s): Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 40: Dependent Variable: Stock Prices

VARIABLES	(1) High Total Sales	(2) Low Total Sales
Crypt Prices	-0.2489***	-0.1029***
	(0.0000)	(0.0000)
Net sales or revenue	0.0042***	0.0695***
	(0.0000)	(0.0000)
Inflation	-6.4373***	-3.1092***
	(1.4019)	(0.4330)
Interest rate	-3.3940***	-6.0394***
	(0.6433)	(0.1890)
Constant	2.2378***	1.6220***
	(0.1123)	(0.0275)
Observations	19,157	19,318
R-squared	0.0267	0.1034
Number of compcode	78	87
Fixed Effect	YES	YES

Note(s): Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Some important financial profitability ratios confirm the results. Firms with higher ROE are more negatively impacted. For ROA, the magnitude of the negative coefficient is almost the same for both high and low ROA firms.

Table 41: Dependent Variable: Stock Prices

VARIABLES	(1) High ROE	(2) Low ROE
Crypt Prices	-0.1588***	-0.1145***
	(0.0000)	(0.0000)
Net sales or revenue	0.0072***	-0.0001
	(0.0000)	(0.0000)
Inflation	-8.1000***	-2.2033***
	(1.3456)	(0.4358)
Interest rate	-9.6317***	-5.3761***

	(0.6276)	(0.1946)
Constant	3.1581***	1.7189***
	(0.1050)	(0.0272)
Observations	19,894	19,504
R-squared	0.0402	0.0845
Number of compcode	138	98
Fixed Effect	YES	YES

Note(s): Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 42: Dependent Variable: Stock Prices

VARIABLES	(1) High ROA	(2) Low ROA
Crypt Prices	-0.1136***	-0.1424***
	(0.0133)	(0.0062)
Net sales or revenue	0.0039***	0.0026***
	(0.0005)	(0.0003)
Inflation	-6.6458***	-1.9269***
	(1.0144)	(0.4902)
Interest rate	-8.1638***	-3.9581***
	(0.4742)	(0.2182)
Constant	2.8800***	1.6399***
	(0.0824)	(0.0313)
Observations	19,222	17,325
R-squared	128	100
Number of compcode	0.0376	0.0724
Fixed Effect	.	YES

Note(s): Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Additional Tests:

Correlation Tests

In order to further study the relationship between stock market and crypto exchanges, some tests were implemented. Table 42 displays the results of cointegration tests following the methodologies of Pedroni (1999), Kao (1999) and Westerlund (2005). To address serial autocorrelation, the tests employed Bartlett kernel with four to five lags, as noted by Newey and West (1987).

All three methods test the below hypothesis formulation:

$$H_0: No\ cointegration\ between\ both\ markets$$

$$H_a: Cointegration\ is\ present\ between\ both\ markets$$

All test results reject the null hypothesis, thus concluding that there exists a long run relationship between prices for both stocks and crypto assets.

Table 43: Cointegration tests

Kao Test	Modified Dickey-Fuller t	-1.2e+02*** (0.0000)
	Dickey-Fuller t	-54.8859*** (0.0000)
	Augmented Dickey-Fuller t	-61.2243*** (0.0000)
	Unadjusted modified Dickey-Fuller	-1.6e+02*** (0.0000)
	Unadjusted Dickey-Fuller t	-58.8652*** (0.0000)

Pedroni Test	Modified Phillips-Perron t	-136.4186***(0.0000)
	Phillips-Perron t	-83.9813***(0.0000)
	Augmented Dickey-Fuller t	-85.1855***(0.0000)

Westerlund Test	Variance ratio	-15.3758***(0.000)

Note(s): ***p < 0.01, **p < 0.05, *p < 0.1. The p-value is reported between brackets while the statistic value is reported outside the brackets

Causality Tests

Following Juodis, Karavias, and Sarafidis, (2021), we tested for granger non causality for heterogeneous panel datasets. The null hypothesis being assessed is that crypt prices do not granger cause stock prices. The test was conducted once with 1 lag and another specification with 4 lags as recommended by BIC. For all results, the p-value is significant concluding that we reject the null hypothesis and suggesting that crypto market granger causes the stock prices.

This is aligned with the results that we got in previous regressions and tests.

Table 44: Causality Tests

Null Hypothesis	Statistic	
Crypt Prices do not Granger cause Stock Prices	Half Panel Jackknife Estimator	0.0000764***(0.000)
Crypt Prices do not Granger cause Stock Prices (4 lags recommended by BIC)	Half Panel Jackknife Estimator	L1. 0.0000724***(0.000)
		L2. -0.0000218***(0.001)
		L3. 0.0000142***(0.032)
		L4. 0.0000376***(0.000)

Note(s): ***p < 0.01, **p < 0.05, *p < 0.1. The p-value is reported between brackets while the statistic value is reported outside the brackets.

Robustness Check

In order to control for any biasness that might be caused by endogeneity, we estimated IV-GMM model as a robustness check. The crypto prices were instrumented for, using its lagged realizations denoted by Z in the below regression equation:

$$\widehat{K} = \theta + \sum_{l=t-1}^{L} Z_{t-1} + v_t \quad (4)$$

$\widehat{K}$ is the crypto prices (the instrumented variable) from first stage regression, Z_{t-1} are the instruments employed in the regression represented by the lagged crypto prices. v_t is the error term.

Equation (2) and (3) was re-estimated using the first stage regression for crypto prices from Equation (4).

In order to ensure the validity of the instruments employed, we used the Hansen J statistic for the over-identification test of the instruments, and Kleibergen– Paap LM statistic for the under-identification tests.

The p-value of the Hansen J statistic is statistically insignificant ensuring that the instruments are not overidentified. However, the Kleibergen– Paap LM statistic is significant assuming that the instruments are not weak, exogenous and do not have high correlation with the error terms.

The results discussed in the FE models are re-estimated and the results of IV-GMM models are presented in the following sections.

Stock and crypto Markets are substitutes

Table 45 summarizes the relationship between crypto and stock prices. The results imply that crypto assets are substitutes to stocks and this finding is robust to both models: IV-GMM and FE.

The magnitude of the negative relationship is higher for IV-GMM model than FE. This is due to the correction from endogeneity in IV-GMM model.

Table 45: Dependent Variable: Stock Prices
Results for FE & IV-GMM

VARIABLES	(1) IV-GMM	(2) FE
Crypt Prices	-0.2795***	-0.2214***
	(0.0000)	(0.0000)
D.Stock Prices	0.3099***	
	(0.0417)	
Inflation	-8.0943***	-6.3724***
	(0.6246)	(0.5406)
L.Inflation	-2.4584***	
	(0.6838)	
L2.Inflation	4.4238***	
	(0.5582)	
leverage	0.0024***	-0.0005
	(0.0008)	(0.0013)
GDP per capita	0.00002*	0.0002***
	(0.0000)	(0.0000)
Market Value	1.2858***	1.8940***
	(0.0001)	(0.0000)
L.Market Value	0.5296***	
	(0.0001)	
Constant		0.5994***
		(0.0571)
Observations	44,504	64,691
R-squared	0.0569	0.0753
Number of compcode	203	208
Hansen J Statistic (p-value)	0.4047	
Kleibergen–Paap LM statistic (p-value)	0.0000***	

Note(s): Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
IV-GMM uses the lag cryptocurrency in order to instrument the current prices. All instruments are exogenous and valid as seen by the tests

Panel Regressions

High Debt Firms

As conducted in the FE model, we estimated panel regressions with the IV-GMM model using different firm characteristics in order to confirm the attributes making a firm more prone to be substituted by the crypto prices. Table 46 splits the data in the top and least 25% firms according to long term to short term debt ratio. The results are consistent between FE and IV-GMM. Firms with high long term to short term debt ratio are more negatively impacted by crypto markets. For each 1% increase in crypt prices, stock prices decrease by 0.2% for high debt firms (column (2)) and 0.1% for low debt firms (column (4)). The coefficients for FE model are consistent with this trend and magnitude differentials. For each 1% increase in crypt prices, stock prices decrease by 0.2% for high debt firms (column (1)) and 0.03% for low debt firms (column (3)). So, overall high debt firms and especially the ones with highest long term debt structure in their liabilities face more uncertainties and thus are more negatively impacted by crypto exchanges.

Table 46: Dependent Variable: Stock Prices

	(1)	(2)	(3)	(4)
	High		*Low*	
	Long Term: Short Term Debt		*Long Term :Short Term Debt*	
VARIABLES	FE	IV-GMM	FE	IV-GMM
Crypt Prices	-0.2372***	-0.2929***	-0.0357***	-0.1236***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
D.Stock prices		0.3087***		0.3842***
		(0.0427)		(0.0766)
Inflation	-6.5377***	-8.5115***	-3.0405***	-2.1030**
	(0.6557)	(0.7457)	(0.6358)	(1.0525)
L.inflation		-2.3904***		-2.4888*
		(0.8168)		(1.3368)
L2.inflation		4.5555***		1.5601
		(0.6723)		(1.0556)
leverage	-0.0016	0.0020**	0.0024***	0.0016***
	(0.0016)	(0.0010)	(0.0009)	(0.0005)
gdppercapita	0.0003***	.00004***	-.00004*	-0.0001***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
marketvalue	2.4982***	1.5895***	0.6940***	0.4625***
	(0.0000)	(0.0001)	(0.0000)	(0.0001)
L.marketvalue		0.7306***		0.2363***
		(0.0001)		(0.0001)
Constant	0.5389***		1.2087***	
	(0.0700)		(0.0733)	
Observations	52,024	35,999	5,246	3,115
R-squared	0.0829	0.0661	0.0861	0.0646
Number of compcode	206	200	44	40
Hansen J Statistic (p-value)		0.6758		0.7092
Kleibergen–Paap LM statistic (p-value)		0.0000***		0.0000***

Note(s): Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
IV-GMM uses the lag cryptocurrency in order to instrument the current prices. All instruments are exogenous and valid as seen by the tests

High Profitability Firms

Another differential variable that was used in the panel regressions of the FE models is the profitability performance of the firms (Sami & Eldomiaty, 2020; Sami and ElBedawy, 2019). Below the estimations for the top and least 25% of firms in ROE is presented for both IV-GMM and FE models. According to IV-GMM methodology, for each 1% increase in crypt prices, stock prices decrease by 0.15% for high ROE firms and 0.07% for low ROE firms. This is the same trend shown in FE model specification, but the differential is more pronounced and corrected for from endogeneity with IV-GMM.

Table 47: Dependent Variable: Stock Prices

	High ROE		***Low ROE***	
	(1)	**(2)**	**(3)**	**(4)**
VARIABLES	**FE**	**IV-GMM**	**FE**	**IV-GMM**
Crypt Prices	-0.1282***	-0.1508***	-0.0967***	-0.0729***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
D.Stock Prices		0.3231***		0.0474
		(0.0530)		(0.0708)
Inflation	-5.9921***	-6.3089***	-2.4988***	-1.7788***
	(1.2517)	(1.2536)	(0.3900)	(0.3758)
L.Inflation		-3.0788**		-0.5174
		(1.5020)		(0.4327)
L2.Inflation		3.0684**		1.2699***
		(1.2232)		(0.3517)
leverage	0.0004	0.0032***	-0.0065***	0.0020***
	(0.0022)	(0.0009)	(0.0010)	(0.0003)
gdppercapita	0.0003***	0.00003	0.0001***	0.0001***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
marketvalue	7.6831***	3.6318***	0.4482***	0.6128***
	(0.0001)	(0.0003)	(0.0000)	(0.0000)
L.marketvalue		1.4534***		0.0787**
		(0.0002)		(0.0000)
Constant	0.1195		0.3339***	
	(0.1356)		(0.0426)	
Observations	18,729	13,849	14,681	9,869
R-squared	0.1818	0.1601	0.0690	0.0493

Number of compcode	126	116	94	89
Hansen J Statistic (p-value)		0.5838		0.4975
Kleibergen–Paap LM statistic (p-value)		0.0000***		0.0000***

Note(s): Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
IV-GMM uses the lag cryptocurrency in order to instrument the current prices. All instruments are exogenous and valid as seen by the tests

Another profitability indicator is ROA. As displayed in Table 48, firms with high ROA (columns 1 for FE and 2 for IV-GMM) are less prone to become substituted by crypto assets than low ROA firms (columns 3 for FE and 4 for IV-GMM).

Table 48: Dependent Variable: Stock prices

	High ROA		***Low ROA***	
VARIABLES	**(1) FE**	**(2) IV-GMM**	**(3) FE**	**(4) IV-GMM**
Crypt Prices	-0.09***	-0.1117***	-0.1481***	-0.1585***
	(0.0142)	(0.0198)	(0.0068)	(0.0152)
D.Stock prices		0.4167***		0.6214***
		(0.0432)		(0.0898)
Inflation	-5.5872***	-4.1753***	-3.1727***	-3.3581***
	(0.9999)	(1.0044)	(0.5066)	(0.6514)
L.Inflation		-3.1143***		-1.5092**
		(1.1207)		(0.6665)
L2.Inflation		2.1420**		1.4802***
		(0.8979)		(0.5490)
leverage	-0.1471***	-0.0016	-0.0141***	-0.0005
	(0.0041)	(0.0022)	(0.0025)	(0.0025)
gdppercapita	0.0003***	0.0000	0.0001***	-0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
marketvalue	5.7759***	1.6349***	0.6693***	0.2931***
	(0.1116)	(0.1644)	(0.0295)	(0.0637)
L.marketvalue		1.1450***		0.4024***
		(0.1424)		(0.0617)
Constant	0.1752		0.8171***	

	(0.1083)		(0.0561)	
Observations	17,748	12,663	13,188	8,209
R-squared	0.1538	0.1382	0.0817	0.0792
Number of compcode	116	108	97	92
Hansen J Statistic (p-value)		0.0480		0.8830
Kleibergen–Paap LM statistic (p-value)		0.0000***		0.0000***

Note(s): Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
IV-GMM uses the lag cryptocurrency in order to instrument the current prices. All instruments are exogenous and valid as seen by the tests

Sectoral Differentials

In order to assess the differential impact of crypto market across firms, we employ the below methodology. We group sectors into 4 categories according to the risk-return matrix quadrants from the return distributions. Return is estimated as the mean of the stock returns after being corrected from outliers. Risk is proxied for by the standard deviation of the return, the higher the standard deviation of the return distribution, the more dispersed the distribution is and thus the higher the risk. According to the descriptive statistics, for all firms the mean return is 0.002 and the standard deviation is 0.18. We use these aggregated values to classify the sectors in the below quadrants.

Low Return-High Risk (LH) - Automobile - Real estate, construction, machinery	***High Return-High Risk (HH)*** - Chemicals - IT & Telecom
Low Return-Low Risk (LL) - Retail, transportation & distribution - Hotel, Entertainment, Utilities - Textile, consumer products, food & beverages	***High Return-Low Risk (HL)*** - Bank and Investment Firms - Pharma & Healthcare

Table 49 summarizes the results as per the below:

- As per the IV-GMM specification, highest negatively impacted firms by the crypto markets are:
    - HH followed by HL, LH and then LL is the lowest impacted sector
- For the FE specification, we can see that the impact is highest for LH, LH and HL. The impact is least pronounced for the LL sectors.

This differential impact is consistent across both model specifications and corroborate the findings of the FE model regressions in the sections above. We can conclude that sectors exhibiting either high risk, high return or both are most prone to be substituted by crypto markets. This is due to the crypto assets' characteristics discussed in the descriptive statistics. They exhibit high return as well as high volatility implying high investment risk. On the other hand, the sectors with low risk or return are less impacted by the crypto market. This could be because investors in these sector types are risk averse and prefer moderate returns with controlled risks over risky assets.

Table 49: Dependent Variable: Stock Prices

	HH		***LL***		***HL***		***LH***	
VARIABLES	**(1) FE**	**(2) IV-GMM**	**(3) FE**	**(4) IV-GMM**	**(5) FE**	**(6) IV-GMM**	**(7) FE**	**(8) IV-GMM**
Crypt Prices	-0.1799***	-0.3797***	-0.1064***	-0.1291***	-0.1987***	-0.3474***	-0.3031***	-0.2007***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
D.Stock Prices		0.3685***		0.4186***		0.5033***		0.2545***
		(0.0778)		(0.0324)		(0.0359)		(0.0497)
Inflation	-3.9184***	-8.8706***	-4.5667***	-4.1517***	-5.7121***	-9.2284***	-9.6847***	-6.4242***
	(0.7410)	(1.3116)	(0.2919)	(0.4135)	(0.6863)	(0.9659)	(1.7280)	(1.8106)
L.Inflation		-3.3831**		-2.5589***		-3.1228***		-2.6093
		(1.3787)		(0.5065)		(0.9949)		(1.9783)
L2.Inflation		6.3268***		2.5924***		5.6107***		2.5971
		(1.1340)		(0.4189)		(0.8500)		(1.6186)
leverage	-0.0039**	-0.0106***	-0.0011	-0.0001	0.0019	0.0009**	-0.0068	0.0070**
	(0.0019)	(0.0013)	(0.0009)	(0.0004)	(0.0012)	(0.0004)	(0.0044)	(0.0029)
gdppercapita	0.0001***	-.0000135	0.0001***	-.0000104	0.0001***	-.00004**	0.0004***	0.0002***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0000)
marketvalue	0.6572***	0.8257***	0.91807***	0.6204***	1.2189***	0.8181***	5.8227***	4.6228***
	(0.0000)	(0.0001)	(0.0000)	(0.0001)	(0.0000)	(0.0001)	(0.0001)	(0.0004)
L.marketvalue		0.2888***		0.1183**		0.6495***		0.8953***
		(0.0001)		(0.0001)		(0.0001)		(0.0003)
Constant	0.6717***		0.6147***		1.1627***		0.0265	
	(0.0774)		(0.0312)		(0.0719)		(0.1840)	
Observations	6,290	4,393	23,690	15,942	16,623	11,829	18,088	12,340
R-squared	0.1897	0.0755	0.0942	0.0406	0.0928	0.0479	0.1372	0.1289
Number of compcode	20	20	71	70	58	56	59	57
Hansen J Statistic (p-value)		0.2407		0.7213		0.2160		0.8604
Kleibergen–Paap LM statistic (p-value)		0.0000***		0.0000***		0.0000***		0.0000***

Note(s): Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

IV-GMM uses the lag cryptocurrency in order to instrument the current prices. All instruments are exogenous and valid as seen by the tests

Conclusion and Policy Recommendations:

Concluding remarks:

To conclude, there remain debates around the role and definition of cryptocurrencies, and whether they are a bubble, fad, or a fintech revolution that will disrupt the financial landscape. The crypto market has recorded a high growth rate since its inception and its perception evolved from being a speculative asset to an appropriate investment asset class. Due to the technology they are hammering on, cryptocurrencies are more efficient and allow for lower transaction costs. So, they could have advantages over the forex market, stock market, and banking sectors. This paper contributed to the literature by studying the impact of the crypto market on stock exchanges in Egypt. The paper gave insights on answering the research question regarding whether crypto and stock assets are considered complements or substitutes from an investment standpoint. Other originality aspects of the paper are extending the portfolio management theory by including crypto market index as well as depicting the differential impact across different sectors and firms depending on their inherent attributes. We employed FE and IV-GMM models and the regression results could be summarized as per the below:

- Crypto assets are considered substitutes to stock assets.
- Years 2016 and 2019 onwards show the highest magnitude of the negative relationship implying that the devaluation year and the COVID-19 pandemic increased the adoption of crypto assets relative to stock assets. This corroborates the literature findings since the main motivations of crypto adoption are countering the risks of both inflation and devaluation as well as preserving the value of the savings.
- Sectors with the highest risk and return patterns (namely IT and Telecom) are more prone to be substituted by crypto assets since investors in those sectors are risk takers and seek

the highest returns. Those investors embrace the risks and volatility of the crypto market since they aim to be compensated by high returns.

- More stable sectors (e.g., Pharma and Healthcare) are not impacted by crypto assets. This could be because this sector exhibits moderate to low risk and return. Thus, investors are mostly risk-averse and do not consider crypto-asset exchanges. Those investors are conservative and do not pursue investments in risky assets.
- The most impacted firms are new entrants, largest firms, the ones with high debt financing (especially long term debt) and with high leverage as well as the most profitable ones (with highest income and ROE). This shows that firm experience plays a crucial role in the relationship studied. Established and experienced firms are more resilient to the cryptocurrency innovation as opposed to new entrants that are more likely to become substituted by it. Since crypto assets exhibit high return and risk, they compete with sectors of similar market nature for both return and systematic risks and attract risk taker investors. So, firms with high profitably metrics as well as the riskier ones are more prone to become substituted by crypto asset investments.

Study Limitations:

The main limitation of the study is that there is no data available on the crypto trading per country. Therefore, the market capitalization and prices used were the global ones available on Coindesk. If country specific data were available for the trading in Egypt specifically, it would be insightful to test the relationship to confirm our results. This study could be extended to other countries in the MENA region and other developing countries to assess the differential impact across countries from the same region and income group. Also, the analysis could cover other countries from differential income and development levels for comparison purposes.

Another area of improvement for the study is to enhance the explanatory power of the models studied by working on increasing the R-squared. The regression in Table 23 was estimated using the Random Effect model and the Hansen test was conducted. It yielded a significant p-value implying that the appropriate model to study this relationship is the Fixed Effect. For the other regressions at hand, Hansen test was conducted, for some of them the p-value was insignificant. Nonetheless, the R-squared changes only marginally. Thus, there is a need to add other independent explanatory variables to the model in order to improve the R-squared, namely financial variables for instance the beta performance for each firm.

Policy Recommendations: "Fighting fire with fire"

Below we will present some policy recommendations that will focus on both local policies and international cooperation.

Role of monetary authority:

One of the most common motivations behind the adoption of the crypto assets is local inflation and distrust in government and financial authorities (Chainalaysis, 2020). Therefore, the monetary authorities should focus on transparency in communicating their strategies and objectives to the public through regular communications and targets that are both measurable and quantifiable. For instance, Egypt is shifting towards the adoption of inflation targeting, thus the CBE needs to be transparent in communicating an inflation target and be accountable for deviations from this target. This will help in building trust with the public.

Local and international legislation:

It is important for countries not to ignore cryptocurrencies and to tackle them in their legislation. The local legislation is advised to define cryptocurrency clearly and accurately, and to acknowledge its benefits and risks. It is recommended for countries not to ban cryptocurrencies since they present many investment advantages for investors, and in order for investors not to consider them as substitutes (Othman et al., 2020). However, literature shows that there are some misuses of cryptocurrencies, for instance, money laundering, tax evasion and funding terrorism. This is mostly referred to as "the dark side of crypto market" or crypto crime. The International Monetary Fund (IMF) addressed that there should be international cooperation to be able to control this aspect. Christine Largarde (2018) mentioned that we should fight "fire with fire" by using blockchain technology to fight those crypto crimes. Blockchain technology could be used to design distributed ledgers that are shared among legislators and regulators. They could include consumer

data with their digital signatures. Also, the use of biometrics, artificial intelligence and cryptography could be developed across countries in a multinational manner to detect illicit transactions and achieve digital security (IMF, 2018). Another article focused on the Liechtenstein blockchain act as a case study that could be scaled up to become legislation for international standards for blockchain misuses and risks (Teichmann et al., 2020). It is the first country to adopt an act against the token economy. The main advantage of this act is that it includes legal regulations to control crimes caused by blockchain in general and not only cryptocurrencies. In this sense, it is comprehensive and forward-looking.

Use Cases:

Adopting blockchain technology in the banking sector:

The stock market and banking sectors need to constantly be updated with innovations and technologies to reduce transaction costs and stand firm in the face of new fintech revolutions like crypto markets. They might think about incorporating financial technologies and revamping their structure to be able to always compete with financial innovation and coexist with them instead of being substituted or being vulnerable and threatened by them. Also, countries should decrease bureaucracy in their regulations to adopt new technologies in a timely manner without having significant policy lags.

Linking those policy discussions to current central bank directions. In Egypt, the CBE is undertaking strong policies to accelerate digital growth in the banking sector. They are limiting on-ground bank expansions; to urge banks to grow digitally. This is part of their financial innovation plans. Nonetheless, this falls under FinTech 1.0, revolving around internet banking and internet finance businesses. Blockchain technologies have opened the room for more innovative tools, which is referred to as FinTech 2.0, building on using Blockchain technologies in banking

services and operations (Guo et al., 2016). In Egypt, there are no initiatives taken until now to incorporate blockchain technologies in the banking industry. However, in the US for example, many banks started implementing blockchain technology. Also, the Fed is closely monitoring changes in the financial innovations and incorporating them, for instance, in 2015 the stock market Nasdaq announced that it conducted securities transactions using blockchain. To add, banks are experimenting with incorporating blockchain in their operations. Moreover, there is a very trending topic in Fed's Innovation Hour in 2020, where they announced that they have been experimenting and exploring using Distributed Ledger Technologies (DLT) to introduce a digital dollar, as central bank digital currencies (CBDCs). This topic is still under study and exploration (Governor Lael Brainard, 2020).

So, after exploring the current roadmap, we recommend Egypt accelerate its exploration of FinTech 2.0 implementation. From the literature, we can see different use cases of blockchain in the banking sector that will lead it to become more efficient and reduce costs (transaction, operational, administrative and others). It can be incorporated in processing payments, which would reduce operational risk and admin costs in the sense that the technology is transparent and immutable. So, there will be real-time processing, being less prone to errors and fraud. Also, those benefits would be accentuated if the technology is employed for cross border payments and global remittances transfers. To add, another use case of blockchain could be through storing customer data. This info could also be available to different banks through shared blockchains between different entities. This would reduce "Know Your Customer" (KYC) costs considerably, as well as enhance the service to the customers by reducing the processing time to serve them. As the technology has benefits, there are barriers and challenges to implement it (Osmani et al., 2020). Some of those barriers include governance, legislation and regulation, technological skills, energy

consumption, business model flexibility and interoperability of current systems to incorporate new technologies (Kawasmi et al., 2019).

So, as a policy recommendation, CBE needs to design a roadmap while considering those risks and challenges. Hence, there are prerequisites to incorporating blockchain technologies in Egypt. Infrastructure should be built to pave the way for blockchain implementation. This infrastructure should cover the legal, technical, and physical fronts. The legal aspect covers the regulations including Standard Operating Procedures (SOPs) to design the operational framework. The technical aspect includes the storage, technical and energy requirements to implement this solution. Finally, the physical infrastructure includes the entities that will undertake this roadmap on ground. Hence, CBE needs to study this plan to be able to innovate in its banking sector operations to keep it strong and resilient in facing any fintech revolutions.

Adopting blockchain technology in the stock market:

Other studies focused on application of the blockchain technology to stock exchanges (Shekhar, 2018). This could transform and revamp the entire ecosystem by changing the current operations of the exchanges and allowing for: higher security, lower costs and faster processing time, clearance, and settlement. All of which would make the stock market operations more up to date with the new technology and would add value for investors, brokers, and regulators. The operational process would be enhanced through automation and decentralization of the systems. It could also be employed in the post-trade activities adopting smart contracts and allowing for a more digital and faster infrastructure. Market surveillance and security could be more closely monitored and tackled through blockchain technology. However, challenges regarding governance, regulations and scalability remain open issues (Manning, 2017).

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