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Developing A Sharīʿah-Compliant Precious Metal Backed Cryptocurrency

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ABSTRACT. Under the fiat standard, money is no longer backed by any assets, but rather it is backed by debt. The implication of such a system is the emergence of many socio-economic problems. Restoring the value of money has long been a controversial topic, hampered in part by the lack of theoretical and empirical evidences. Therefore, this research aims to develop a Sharīʿah-compliant precious metal backed crypto-currency (PMBC) mechanism. To achieve this, a general product development process is adopted, which consists of four phases involving planning, concept development, system-level design, and testing. In addition, Sharīʿah scholars and financial experts were interviewed to validate the mechanism theoretically. The result of this research was to introduce a Sharīʿah-compliant PMBC where the description and the modus operandi of the PMBC were presented. This research defined PMBC as a digital currency, backed by precious metals that uses strong cryptography. It is designed to fulfill all the functions of money in accordance with Sharīʿah while operating as a peer-to-peer payment system. Overall, it was found that all the resources needed to develop and implement PMBC are already available. The scholars and experts interviewed supported the implementation of PMBC, but there are a variety of challenges and reservations.

KEYWORDS: Sharīʿah-compliant, precious metal, cryptocurrency.

JEL CLASSIFICATION: E42, L61

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1. Introduction

The global monetary system, undoubtedly, has gone through tremendous evolutions, from the use of primitive monies, to precious metals, and then descending to unbacked fiat currency (Meera & Larbani, 2006a, p. 18). Fiat currency refers to a system of money that a government in a particular country has declared to be legal tender, and it is not backed by a physical commodity (Grubb, 2006, p. 10). In fact, money is no longer backed by any assets. On the contrary, it is backed by nothing, or even worse, it is backed by debt obligation. The absence of real asset backed money implies that money is being created out of thin air (McLeay, Radia, & Thomas, 2014, p. 16).

The implication of such a system is an excess of money supply as a result of aggregate deposit and loan interest in relation to demand. The effect is a decline in the value of money which leads to an exponential increase in prices over the long term. Hence, inflation is a monetary phenomenon (Abdullah, 2015, p. 205; Meera, 2002, p. 57). For example, with regard to the Malaysian Ringgit (MYR), the value of MYR 1.00 in 1970 has fallen to 2.08[(1)] cents in 2018. Accordingly, by losing 4,702[(2)] per cent of the purchasing power of the MYR, the Malaysian currency has confirmed its inefficiency in storing value, which will affect the other functions of money as well in the long term.

These limitations of unbacked money have given rise to the development of alternative methods of transferring value that are decentralized, and trust less currency (Maurer, Nelms, & Swartz, 2013, p. 265; Mullan, 2014, p. 94). Therefore, Satoshi Nakamoto in 2009 introduced the world's first cryptocurrency, Bitcoin (Nakamoto, 2008). However, even cryptocurrencies were not free from limitations and were a favorite target for speculators, manipulators, and illegal businesses, which led to significant fluctuations in its value (Corradi & Höfner, 2018, pp. 195-199; Janze, 2017). For instance, the value of one Bitcoin has dramatically dropped from USD 19,298, to USD 13,206 within 6 days from 18 to 23 December 2017 (https://coinmarketcap. com/). At the time of writing this paper (April 3, 2019), Bitcoin was traded at USD 4,953 which reveals massive fluctuations in Bitcoin value that was mainly caused by the fact that Bitcoin is not backed by any real assets or real value and the absence of regulations (Meera, 2002, p. 107; Wegdell & Andersson, 2014, p. 15). In addition, many Sharīʿah issues have also been raised against cryptocurrencies and some countries have even prohibited them (al-Qaradaghi, 2018, p. 4; Islamic Economic Forum, 2018, p. 25).

Meanwhile, the opposite of unbacked money is, of course, real money, money that has intrinsic value which cannot be created out of thin air like fiat money and cryptocurrencies (Meera & Larbani, 2006b, p. 86). Precious metal has always preserved its value (as proven by history), remained stable, and has always been trusted by the economy (Abdullah, 2016b, p. 40). Precious metal backed money will prevent the creation of money out of thin air. Precious metal would be able to be a trustworthy store of value, which qualifies precious metal to reliably perform as a medium of exchange, a standard of deferred payments, and a common measure of value.

Accordingly, the Holy Qur'ān and the Sunnah of the Prophet (may the peace and blessings of Allah be upon him) also suggest gold and silver as money. Consider the following verse for example:

> And there are those who hoard gold and silver and spend it not in the Way of Allah, announce unto them a most grievous chastisement (Qur'ān, 9:34)

It is clear that in the above verse Allah Almighty is referring to gold and silver as money to be spent in His path. As for Sharīʿah rulings, there is a hadith reported in Ibn Majah which prohibits the destruction of the monetary system of Muslims (interpreted as gold and silver) (Haneef & Barakat, 2006, p. 27):

> Alqama bin Abdullah reported on the authority of his father (may Allah be pleased with him) that Allah's Messenger (may the peace and blessings of Allah be upon him) forbade from destroying the coins in vogue among the Muslims without any necessity. (Ibn Majah, 2009, 3:370, *ḥadīth* no. 2263; Abu Dawood, 2009, 5:320, *ḥadīth* no. 3449)

(1) The value of one Ringgit 2017 $= \frac{\text{RM110\oz}}{\text{RM5282.57\oz}} = 0.0208$

(2) The change in Ringgit Purchase Power $= \frac{5282.57-110}{110} = 4702\%$

Also consider the following *ḥadīth*:

> The Holy Prophet (may the peace and blessings of Allah be upon him) said: A time is certainly coming over mankind in which there will be nothing (left) which will be of use (or benefit) save a Dīnār and a Dirham. (Ibn Hanbal, 2001, 28:433, *ḥadīth* no. 17201)

The above verses of the Qur'ān and *hadith* demonstrate that gold and silver were created by Allah, and that such value would survive this mundane world to be retained in the next world as well. The verses also demonstrate that Allah created gold and silver to be used as money. The above tradition strengthens our contention that gold is to play the role of money (Meera & Larbani, 2006b, p. 89).

However, physical precious metal is argued to be an inefficient medium of exchange but efficient store of value while cryptocurrency is found to be an efficient medium of exchange but inefficient store of value (Kiviat, 2015, pp. 582-585). In this research, the advantages of cryptocurrency and precious metals will be combined to develop a precious metal backed cryptocurrency (PMBC). Therefore, the main objecttive of this research is to develop a Sharīʿah-compliant PMBC to enable researchers to study this phenomenon in a deeper and broader way.

2. Literature Review

2.1 Islamic Monetary Theory of Value (IMTV)

The discussion of money is certainly as old as the economics discipline itself. However, the outlook of money has changed, and the issue of what money is and what money should be is a controversial one among scholars and economists. The early Muslim scholars emphasized that money is an instrument of transfer only, while contemporary Islamic economists and scholars appear to have implicitly accepted the current interest-based fiat monetary system with some reservations. On the other hand, conventional economists re-defined money as a commodity that comes at a price (Abdullah, 2016b, p. 244; Haneef & Barakat, 2006, p. 22). In other words, contemporary Islamic scholars and conventional economists agreed that money is not necessarily to be backed by assets and that it is not limited to gold and silver.

Over the years, the consequences of the absence of assets-backed money evolved which preoccupied economists either by neoclassical or Keynesian theories. The contemporary monetary theories attempt to solve the consequences of the problem (inflation) instead of focusing on the problem itself which is the absence of assets-backed money. Thus, Keynesians focused on managing the supply of money by targeting the interest rate, while, neoclassicals focused on managing the supply of money by targeting the quantity of money. However, both failed in achieving economic security and stability in money value (Abdullah, 2015, p. 212).

Therefore, the Islamic Monetary Theory of Value (IMTV) developed by Abdullah (2016a, pp. 137-142, 2016b, p. 237) will be adopted in this research. The IMTV highlights the importance of restoring precious metal money or real money to ensure a stable measure and store of value, a stable standard of deferred payment which would involve a stable medium of exchange that would be trusted at domestic and international levels (Abdullah, 2016b, p. 242).

According to Abdullah (2015, p. 207), in order to obtain a price stability, monetary authorities should pay attention to a stable value of money rather than focusing on the quantity of money, interest rate, or even target prices. Abdullah empirically established that a high value of money (the cause) meant low prices (the effect) over the long term, or a low value of money (such as fiat money) would involve high prices. Therefore, money should be redefined as an instrument of transfer rather than a commodity, which means that gold and silver are no longer commodities; they are money. In fact, they stratify IMTV to the medium of exchange so that quality and quantity of money are both required to maintain the function and stability of money.

The IMTV has not discussed the practical aspects for restoring precious metal money or real money, but somehow this theory is supporting the philosophical framework that is needed for restoring precious metal backed money. Since the IMTV depends heavily on the precious metal system, it retains the store value function of money that is linked to Sharīʿah-compliance. Although, this is an exploratory research in a new area of precious metal money, the IMTV is convincing when discussing some of the issues in this research.

2.2 Electronic Payment and Cryptocurrencies

Electronic payment (E-payment) has transformed payment mechanisms profoundly and has become a popular mean for conducting daily transactions. This is not confined to new currencies or speedier payment techniques, but an entire rethinking of transfers of "value" and how these are undertaken (BNY Mellon, 2015). Nowadays, electronic mechanisms are well equipped with functionalities that surpass daily needs, and which inspire the use of technology as access devices and electronic commerce in general.

E-payment refers to the transfer of value electronically (Teoh, Chong, Lin, & Chua, 2013, p. 467; Wondwossen & Kidan, 2005, p. 3) which includes the internet (accessed via multiple devices, including personal computers, mobile phones, and tablets) and mobile phone networks (Economist Intelligence Unit, 2018, p. 6). This value could be driven from any assets, commodities or any other type of value that has general acceptance. For example, digital currency (digital money, electronic money, or electronic currency) is a digital representation of value for either virtual currency (non-fiat backed) or e-money (fiat-national currency), which is issued by a central authority (Financial Action Task Force, 2014, p. 4).

Thus, virtual currency is a digital representation of value that can be digitally traded and functions as (1) a medium of exchange; and/or (2) a unit of account; and/or (3) a store of value but does not have legal tender status. It is distinct from e-money, which is a digital representation of fiat currency used to electronically transfer value denominated in fiat currency. E-money is a digital transfer mechanism for fiat currency, i.e., it electronically transfers value that has legal tender status (Financial Action Task Force, 2014, p. 4).

As such, cryptocurrency is a digital currency but also a type of virtual currency based on cryptographic algorithms. Cryptocurrency is defined as a virtual asset designed to work as a medium of exchange that uses strong cryptography to secure financial transactions, control the creation of additional units, and verify the transfer of assets (Tkachyk & Tulchak, 2018, p. 1). This definition reveals cryptocurrencies main characteristics which are: firstly, cryptocurrency is a virtual asset that exists in a binary format without a physical presence. Secondly, it is a decentralized system that does not implement central authority control. Thirdly, it is a peer-to-peer transaction which facilitates direct transactions between parties. Finally, it uses cryptography technology which ensures high degree of security (Baur, Bühler, Bick, & Bonorden, 2015, p. 67; Spenkelink, 2014, p. 8).

2.3 Digital Precious Metal Currency

Most previous studies mainly discussed the conceptual and theoretical aspects of fiat money. They discussed fiat money as the main causes of socio-economic problems and urged to revert back to the gold and silver standard (see, Abdullah, 2015, 2016b; Askari & Krichene, 2016; Billah, 2014; Lee, 2011; Meera & Abdul Aziz, 2004; Meera & Larbani, 2004, 2006a, 2006b, Meera, 2002, 2004, 2011; Ramo & Bajram, 2012; Schwartz, 1987; Shapiee & Zahid, 2014; White, 2012). On the other hand, other studies discussed and examined the stability of gold and silver and focused on the features of precious metals and their role in solving the problems raised by fiat money. Some of these studies engorge to revert back to the commodity standard to ensure stability of money (see, Abdullah, 2013a, 2013b, 2013c, 2015; Bordo, Dittmar, & Gavin, 2007; Bordo, 2005; Erb & Harvey, 2013; Ibrahim, 2006; Ramo & Bajram, 2012; Rolnick & Weber, 1997; Schwartz, 1987; White, 2012).

Some theoretical studies provide a mechanism for gold-backed currencies but these studies failed in providing a sufficient precious metal based mechanism combining both theoretical and practical issues that meet Sharīʿah and financial requirements. Meera (2002, p. 92), for example, proposed the usage of electronic gold for domestic transactions similar to the current practice of e-money. Further, Meera (2004, p. 95) suggested the implementation of gold in bilateral trade. Muhayiddin, Abdullah, Che-Rahim, and Raja-Omar (2015, p. 125), and Muhayiddin, Ahmed, and Ismail (2011a, p. 295) encouraged using electronic gold dinar especially for traveling which can eliminate the exposure of foreign exchange risk. Similarly, Omerčević (2013, p. 17) recommended the introduction of a monetary model which is built on a commodity-based information system that can be easily implemented using today's existing information and communication technology.

At the practical level, some digital precious metal companies have been introduced since early 1990, but unfortunately there isn't much reliable literature available on such matters. Several companies were established between 1996 and 2018 such as E-gold, OSGold, E-Bullion, IntGold, Precious Metal Storage Account, E-dinar, and GoldMoney (Herpel, 2011, p. 26; Mullan, 2014, p. 6).

Basically, the idea of digital precious metal currency (DPMC) is simply an electronic representtation of physical precious metal held offline in a secure vault, while users are circulating the electronic units. Fundamentally, it offers secure and efficient online methods to buy, sale, hold, earn, spend, send, and redeem gold and silver (https://bit.ly/2ubuOqp; Mohamed & Ali, 2018, p. 85). The value of the DPMC is always tied to the daily spot prices of gold and silver. Consequently, the value of DPMC as expressed in terms of national currency will fluctuate based on change in the spot price of the gold and silver (Mullan, 2016, p. 97). However, users are always able to cash-out their DPMC by converting it to national currency or redeem the physical gold and silver at the company itself or at any third-party exchange agent (Mullan, 2016, p. 18 & p. 198).

Some of these companies were characterized by offering a distinguished service. For instance, E-gold offers its users the flexibility to spend from their account using US Dollar or weight of gold with a cost effective and non-repudiable transaction. A client could pay 1 gram of gold or $39.51 (https://goldprice.com/; Mullan, 2016, pp. 18-28). An important development in DPMC industry involves E-Bullion and OSGold, which introduced the world's first debit card linked to gold account (Mullan, 2016, p. 141 & p. 220). IntGold and GoldMoney have given the debit card a push forward by cooperating with the MasterCard network which enables its holders to withdraw cash from ATMs, make online purchases, and pay retail merchants (Mullan, 2016, p. 199). DPMC companies such as GoldMoney also allow their users to withdraw cash in nine currencies without exposing them to foreign exchange risks or fees (https://bit.ly/2SHKRXb) .

In the years before, E-gold emerged, when DPMC companies were not subject to financial institutions' regulations (Mullan, 2016, p. 74). Therefore, some companies have voluntarily followed the financial regulations such as GoldMoney (Mullan, 2016, p. 133), while other companies took advantage of the lack of regulation of fraud and money laundering such as E-gold, E-Bullion, OSGold (FBI, 2009; Mullan, 2016, p. 219). However, some experiences which still operate till today such as Precious Metal Storage Account, E-dinar, and GoldMoney do ensure a high rate of transparency by providing comprehensive audited reports (https://bit.ly/2st63FL; Herpel, 2011, p. 32; Mullan, 2016, p. 133).

Nowadays, with blockchain technology established as a secure accounting method, a new age of precious metal-backed cryptocurrency is emerging. In the crypto world, there is proverbial (and literal) gold rush happening now, and some countries are seriously considering the introduction of gold-based cryptocurrency (Clark, 2019). The feature that distinguishes between precious metal-backed cryptocurrency and digital precious metal currency is the usage of cryptographic algorithms. The cryptographic algorithms are the means of altering data from a readable form (also known as plaintext) to a protected form (also known as ciphertext), and back to the readable form which is used in cryptocurrencies (Vyakaranal & Kengond, 2018).

The blockchain ledger records every transaction from the beginning to the end, whether it is thousands of transactions or a single transaction. As each transaction occurs, it is recorded in blocks, and each block is linked to the previous and next block. This made blockchain ideal for recording the mining, refining, and distribution of precious metal (Dorothal, 2017). The blockchain ledger keeps a record of every touchpoint along the precious metal journey. It can track a precious metal path from mining all the way to the users' or consumers' hands with transparency and exceptional security. It holds certificate of authenticity, real time records of every payment transaction as well as products details such as karat and serial numbers. At the end of the transactions cycle, there is a complete auditable and indisputable record of information about the precious metal journey (Dorothal, 2017).

So far, there are more than 37 gold-backed cryptocurrency companies in operation (Clark, 2019). Interestingly, some of these companies are approved

as Sharīʿah-compliant such as HelloGold and One-Gram Coin (https://bit.ly/2QDfquj; Mohamed & Ali, 2018; Clancy, 2018). However, to the best of the authors' knowledge, there is no reliable resource that presents HelloGold and OneGram Coin. So far, what is available is a collection of information from different web pages on the internet and *fatāwá* statements which both do not specify the working mechanism of these models.

3. Methodological Development Process

A development process is the sequence of steps or activities which an enterprise employs to conceive, design and commercialize a product. Many of these activities and steps are organizational and intellectual rather than physical (Ulrich & Eppinger, 2000, p. 14). According to Ulrich and Eppinger (2000, p. 15), in general, a product development process consists of six phases which are planning, concept development, system-level design, detail design, testing and refinement, and production tamp-up. On the other hand, Yang and el-Haik (2008, p. 34) introduced the process life cycle and six sigma approach in developing products which contains ideation, concept development, process design, process routine operation, and process improvement. However, both methodologies are similar in nature. Therefore, both are adopted in developing a Sharīʿah-compliant PMBC. However, because of the research limitations, only four phases are executed: planning and ideation, concept development, system-level design, and testing respectively. The remaining phases are related to the physical development or final design of the product which is beyond the objectives addressed in this research.

The first phase is planning. This phase is often described as "phase zero". The output of this stage is the mission statement which determines the goals, key assumptions, and limitations (Ulrich & Eppinger, 2000, p. 17). It also includes identifying the project scope, customers, suppliers, and customer needs (Yang & el-Haik, 2008, p. 35). Thus, the product scope is to develop a Sharīʿah-compliant PMBC where this cryptocurrency can be used in any local community. In addition, the main supplier for PMBC is the precious metal market where exchange operations are smoothly facilitated (Mullan, 2016, p. 21). Therefore, the mission statement for this research is to develop a Sharīʿah-compliant PMBC to restore the value of money.

The second phase is concept development. In this phase, the alternative product concepts are generated and evaluated and then one or more concepts are selected for development (Ulrich & Eppinger, 2000, p. 17). Also, at this stage, more details on user needs are developed and documented. Many ideas are generated for concepts that fit these user needs. One or more of these concepts are selected for future development. According to Yang and el-Haik, (2008, p. 35), in this stage, developers are required to ensure the new process concept to come up with the right functional requirements which satisfy customer needs in a sound system design, free of design vulnerabilities.

The third phase is system-level design. In this phase, the definition of product architecture and the decomposition of the product into subsystems and components are addressed. The outputs of this phase usually include functional specification of each subsystem in the product and the preliminary process flow diagram for final assembly process (Ulrich & Eppinger, 2000, p. 17). The selected concepts are divided into sub-systems and components that can be more easily developed during the detail design phase. Breaking products into components helps create division of labor (Smith, 2012, p. 30).

The concept development and system-level design in this research is carried out by generating the literature review conducted on electronic payment and cryptocurrency mechanisms, electronic precious metal mechanisms, and gold-backed cryptocurrency. The studies and information available were then evaluated to determine which concepts are going to be used in developing PMBC. Thus, over four months, the selected concepts were processed and adjusted to fit the mechanism; these concepts became the components of the mechanism. Each concept was given a definition that is commensurate with its role in the mechanism. Then, a task description for each concept was also developed to achieve the customers' need. The developed concept is carefully explained in section 4.1, while the subsystem design is illustrated in section 4.2.

The final phase is testing and refinement. This phase involves construction and evaluation of the product. However, due to practical constraints, constructing PMBC physically was not possible. However, Sharīʿah scholars and financial experts were

interviewed to test and validate the mechanism (see the results of the interview in section 4.3). The interview with Sharīʿah scholars and financial experts was mainly adopted because Sharīʿah scholars' opinion is very important to ensure that the mechanisms are in line with Sharīʿah law, and to ensure that the objective of developing a Sharīʿah-compliant PMBC is achieved. Financial experts' opinion was taken to ensure the viability of the mechanism and to ensure that it can fulfill customers' needs. Interviews are the most common and powerful instrument in providing narrative data that gives the researchers opportunity to explore people's point view in greater depth (al-Shenqeeti, 2014, p. 39).

Importantly, the general product development process was adopted because it is harmonized with the designed research objectives, and it is suitable for developing mechanisms, tools or simulation, and for exploring or testing it theoretically.

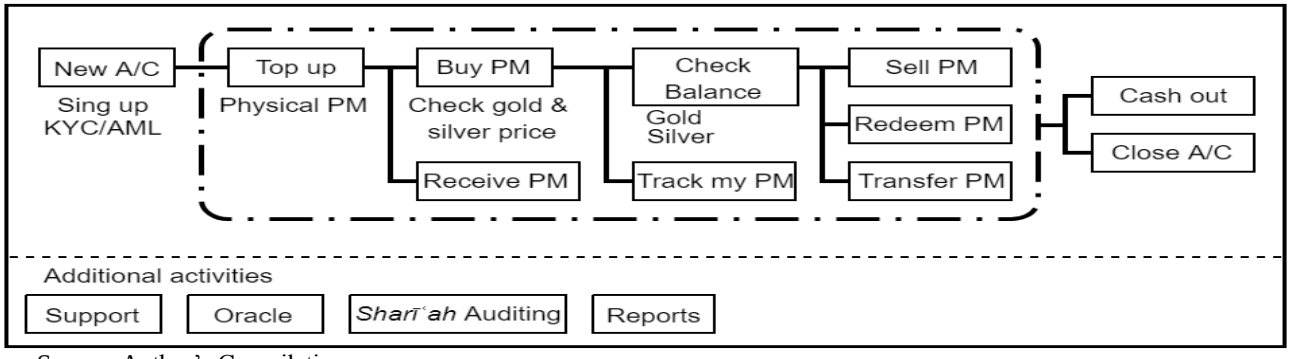
4. Results and Discussion

4.1 Background of Precious Metal Backed Cryptocurrency

PMBC is defined as a digital currency backed by precious metal that uses strong cryptography which is developed to fulfill all the functions of money in accordance with Sharīʿah while operating as a peer-to-peer payment system (Nakamoto, 2008, p. 1; Tkachyk & Tulchak, 2018, p. 1). This mechanism offers an efficient and secure online method to buy, sale, hold, earn, spend, send, and redeem precious metal (https://bit.ly/36gewKR). In addition, this mechanism allows to circulate gold and silver through electronic mechanism such as PCs, tablets, smartphones, magnetic cards, and wearable devices (Mullan, 2016, p. 255). The value of the PMBC is always tied to the daily spot prices of gold and silver. Consequently, the value of PMBC as expressed in terms of national currency will fluctuate based on the change in the spot price of gold and silver (Mullan, 2016, p. 97).

Accordingly, PMBC increases the efficiency and security of the payment system by creating a class of digital transaction system whose unit of account is assets, as opposed to all other current electronic money whose units of account are nothing, or even worse, are debt liabilities. Thereby, it eliminates socio-economic problems in the current interest-based financial system (Meera, 2002, p. 57). Figure 1 summarizes the core product or system of PMBC.

Figure (1) The Core System of Precious Metal Backed Cryptocurrency



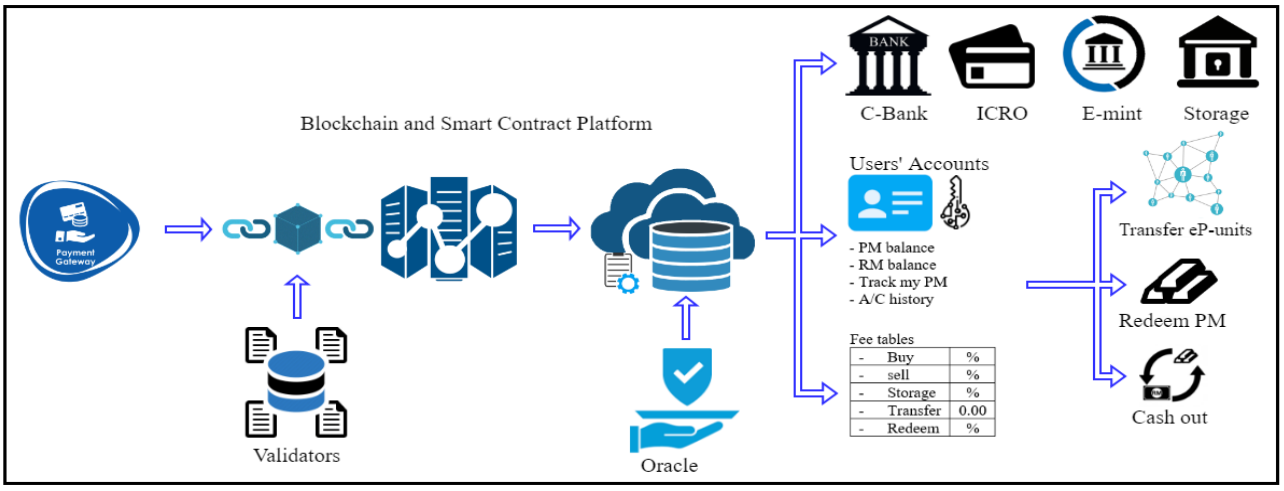
Source: Author's Compilation.

4.2 Description of Precious Metal Backed Cryptocurrency

In accordance with the embodiment of the mechanism, a PMBC comprises of:

(1) Operator of the cryptocurrency, (2) Communication network, (3) Blockchain and smart contract platform, (4) At least one secure storage site either off-shore or in-shore, (5) An inventory of gold and silver stored at a secure storage site, (6) Means for transmitting the PM-Cryptocurrency to the payee, (7) Means for receiving the PM-Cryptocurrency from a payer, (8) Validators to verify transactions and to mint or forge the blocks, (9) Commercial bank, (10) Mediator for payment, (11) Third-party financial auditing of precious metal stocks which are called Oracle, and (12) Third-party Sharīʿah auditing of operations. Figure 2, summarizes the PMBC mechanism.

Figure (2) Precious Metal-Backed Cryptocurrency Mechanism



Source: Author's Compilation.

A summary and clarification of the terms used in PMBC is provided hereafter:

"The user" is a person or entity who opens an account with the mechanism (U.S. Patent No. 2003/0191708 A1, 2003). Every user is required to provide identity authentication, and then will become a participant in the system network (AAOIFI, 2017, p. 952; HelloGold, 2017, p. 17). The account opening is confirmed when users:

(1) Convert their own physical precious metal to PM-Cryptocurrency, (2) Convert national currency to PM-Cryptocurrency, and (3) Receive PM-Cryptocurrency from any user in the mechanism (U.S. Patent No. 2003/0191708 A1, 2003).

"E-mint" is considered as the operator of the mechanism. The key role of E-mint is to manage and coordinate the operations in the mechanism (U.S. Patent No. 2007/0244812 A1, 2007). The E-mint is expected to perform multiple tasks such as:

(1) Establishing a relationship with users, (2) Establishing a coordination relationship with the storage site, (3) Establishing a coordination relationship with the blockchain platform, (4) Issuing payment platform and applications for PCs, tablets, smartphones, magnetic cards, and wearable devices, (5) Enabling the account holders to send PM-Cryptocurrency and to be immediately informed that PM-Cryptocurrency has been debited from their accounts, (6) Enabling the account holders to receive PM-Cryptocurrency and to be immediately informed that PM-Cryptocurrency has been credited into their accounts, (7) Performing an intermediary role in settling payments of national currency between parties, (8) Conducting netting-off process between parties, (9) Providing a corresponding account calculator that shows the weight of an account and its value denominated in a specific currency, (10) Charging and collecting transaction fee from users, and (11) Following the financial regulations that govern the digital currencies (see HelloGold, 2017, p. 19; Mullan, 2016, p. 28 & p. 234; U.S. Patent No. 2003/0191708 A1, 2003, U.S. Patent No. 2007/0244812 A1, 2007).

"Communication Network" is a network that provides information and links all parties that participate in the mechanism. In a typical implementation of the mechanism, the interactive communication network is the internet (Baur et al., 2015, p. 67).

"Blockchain and smart contracts Platform" is the platform that offers the benefits of the blockchain technology with a powerful system of smart contracts. In addition, smart contract plays an essential role in the mechanism. It is a self-executed contract once it receives the information from parties (HelloGold, 2017, pp. 18-20). For PMBC, a private blockchain system is suitable for use (Ducas & Wilner, 2017, p. 545). The blockchain platform is expected to perform multiple tasks such as:

(1) Recording transactions between parties, and (2) Protecting users' information. On the other hand, the main tasks for smart contracts platform are: (1) Providing a range of contracts to fulfill the mechanism needs, and (2) Executing orders according to information received from parties (HelloGold, 2017, p. 20).

"Storage Site" is a secure facility (e.g. a vault) where the gold and silver are held for safekeeping. The storage sites are preferably placed in a politically stable country where there is minimal risk of confiscation of the precious metal by private or government entities. It is also preferable to have several storages sits especially inshore locations (Mullan, 2016, p. 21). In addition, the storage site also offers exchange of PM-Cryptocurrency to physical precious metal, and vice versa for users. The precious metal repository is expected to perform multiple tasks such as:

(1) Storing precious metal in a secure place and ensuring its safety, (2) Maintaining the quantity and the quality of the precious metal stored and providing reports, (3) Providing special script for each parcel of the precious metal stored, (4) Periodically updating the quantity of precious metal stocked to the smart contract, (5) Minting special coins and ounces for the mechanism, and (6) Redeeming physical precious metal in return for PM-Cryptocurrency (Mullan, 2016, p. 21; U.S. Patent No. 2003/0191708 A1, 2003).

"Allocated Precious Metal" is the commodity used in the mechanism. It must be non-perishable and most preferably has a high ratio of value to weight and volume. In a preferred embodiment, the commodity comprises of precious metal such as gold and silver of a specified purity (Mullan, 2016, p. 235; U.S. Patent No. 2003/0191708 A1, 2003). Gold and silver are chosen because of their special characteristics such as: having intrinsic value, divisible, homogenous, mobile, durable, and are rare and do not have much industrial or seasonal demand. The precious metal is owned outright by clients and is stored under a safekeeping custody arrangement, at a secure vault facility (Meera, 2017, p. 10).

"Validators" is the process by which transactions are verified and added to the public ledger, known as the blockchain. Such process is also called proof-of-stake. The main function of validators is to ensure that the transactions can be combined with the results of previous transactions to provide audible consistent results (Watanabe et al., 2016, p. 467).

"Commercial bank" is a type of financial institution that accepts deposits, offers checking account services, makes various loans, and offers basic financial products. The commercial bank is expected to perform a main task which is facilitating the exchange outside the system which refers to sending and receiving value from those who do not have an account in E-mint system (Mullan, 2016, p. 28).

"Mediator for Payment" is a mediator to process payments between the merchants' banks and card issuing banks which is generally the International Cards Regulatory Organization (ICRO) such as Mastercard, Visa, and MEPS in Malaysia (Mullan, 2016, p. 199). The ICRO itself does not issue cards. It only processes and facilitates the card transactions. The mediator for payment is expected to perform multiple tasks such as:

(1) Facilitating withdrawal process using automated teller machine (ATM), and (2) Verifying authenticity of transactions (UniBul's Money Blog, 2017).

"Third-Party Financial Auditing – Oracle" is the process of checking the stocks of precious metal and financial operations to make certain they are correct and compliant with the financial regulations, and then providing this information in an official report. The financial auditing is expected to perform multiple tasks such as:

(1) Maintaining the quantity and the quality of the precious metal stored and providing reports, (2) Updating periodically the quantity of precious metal stocked to the smart contract, and (3) Monitoring the transactions and financial operation according to digital currencies regulations (Mullan, 2016, p. 234; Swan, 2015, p. 17).

"Third-Party Sharīʿah Auditing" is the process of examining the compatibility of PMBC with the Sharīʿah rules in all its activities. This examination contains transactions, products, policies, agreements, contracts, financial statements, circulars, reports, memorandum and articles of association, etc. (AAOIFI, 2018, p. 43; Sultan, 2007, p. 6). The objective of a Sharīʿah review is to ensure that the activities carried out do not contravene the Sharīʿah.

4.3 Advantages and Obstacles of Precious Metal Backed Cryptocurrency

The above precious metal backed cryptocurrency has many economic benefits and enhances the principles of Islamic economy. Firstly, PMBC restores the value for the medium of exchange. This vale ensures a stable "measure of value" that is important for fair and just economic exchange (Meera, 2017, p. 18). According to al-Sadr, (1982, p. 286) attaining the social justice and wealth distribution is the third basic component of an Islamic economy. This justice can be achieved in PMBC by preserving the wealth and value of money for a long-term to a certain extent. It has been proven by history that the precious metal protects people's wealth, while this wealth is violated by the current interest-based financial system (Abdullah, 2015, p. 242; Askari & Krichene, 2016, p. 40; Meera & Larbani, 2006a, p. 29).

In addition, protecting the ownership is the first principle of Islamic economics (al-Sadr, 1982, p. 279). According to Meera and Larbani, (2009, p. 101) money creation through fractional reserve banking is the creation of purchasing power out of nothing which brings about unjust ownership transfer of assets, from the economy to the bank, effectively paid for by the whole economy through inflation. This violates the ownership principles in Islam and is tantamount to theft. Thus, by designing a system that is free from creating money out of thin air, such as PMBC, the ownership is protected.

Secondly, cost effectiveness is the major advantage of implementing PMBC. Transactions inside the system are executed directly between parties involved without requiring third-party intermediaries. Therefore, transactions are completed in the split of a second which means instant payment and settlement (Mullan, 2016, p. 231). Lastly, PMBC allows small investors to bypass the roadblocks that usually keep them out of the precious metal market such as minimum investment levels, trading costs, and market research which enable micro investments in precious metal. For instance, users in PMBC can buy and sell an amount as minor as 0.0001 gram of gold or silver.

On the other hand, PMBC is expected to face some obstacles and risks. Firstly, operational risk could be raised in PMBC because of lack of management experiences in precious metal and/or cryptocurrency, scams, and money laundering. This is mainly due to the lack of regulations and training courses that organize the internal operations of precious metal backed cryptocurrency companies (Mullan, 2016, p. 133).

Secondly, market risk also could be found because of the decrease in precious metal prices due to many reasons such as monetary policies of the dollar, new discoveries of precious metals, and new technologies in the precious metals industry. In fact, the monetary policies of the dollar play a vital role in suppressing precious metal prices throughout selling and lending activities by the federal reserve bank (Abdullah & Bakar, 2015, p. 190; Hecht & Smith, 2013, p. 135)

Thirdly, political risk is the risk arising from government decisions and regulations related to precious metals such as confiscation of precious metals by the government, preventing circulation of precious metals, preventing pricing things in precious metals, and restrictions on precious metal export and import. According to Meera (personal communication, March 21, 2018), political risk is the greatest risk that faces electronic precious metal money. On the other hand, political support for implementing precious metal backed cryptocurrency would contribute significantly to the success of the system.

Fourthly, reputation risk in precious metal backed cryptocurrency is the risk arising from a negative perception that affects the mechanism's ability to provide payment services. For instance, awareness of the public and trust in the mechanism could be a reputation risk that the mechanism faces.

The last point is security of the physical precious metal and protecting the electronic system. The precious metal should be stored in a secure facility and the system should be protected from hackers and cyber-attacks (A.K.M. Meera, personal communication, March 21, 2018).

4.4 Testing and Validating of Precious Metal Backed Cryptocurrency

In this research, in-depth interview is adopted to test and validate the Sharīʿah compliant precious metal backed cryptocurrency mechanism theoretically by Sharīʿah scholars and financial experts. The 6 interviews sessions (three for Sharīʿah scholars and three

for financial experts) took an average duration of 30 minutes per session. Interview transcripts were examined and analyzed using the study research objectives and research questions as basic guidelines, bearing in mind that the main objective of the qualitative analysis is to test and validate the concepts and salient features related to Sharīʿah-compliant PMBC.

Each interviewee's quotation is numbered as (S1 to S3) for Sharīʿah scholars, and as (F1 to F3) for financial experts for ease of reference to the informants' profile. Demographic profile of Sharīʿah scholars and financial experts showed that they hold different positions. Four of them have PhD degrees while the rest have master's degree in various specializations such as *uṣūl al-fiqh*, Islamic transaction, Islamic finance, and finance. They have working experience between 5 to 26 years.

Sharīʿah scholars and financial experts were asked about their opinion regarding the concept and the salient features of PMBC. Obviously, there is general agreement on the concept of electronic representation of precious metal as long as the system is interconnected, which means the cryptocurrency issued is backed by 100 percent of assets, and these assets are Sharīʿah-compliant, and there is proper auditing for the stocks and transactions (AAOIFI, 2017, pp. 74-75; Kamali, 2007, p. 2). One of the financial experts (F3) explained that:

> There is no problem with electronic representation of precious metal, as long as the design of the system and the assets used are Sharīʿah-compliant, and the cryptocurrency is 100% backed by precious metal, and position and ownership are there, and basically you can transact with that precious metal.

Accordingly, PMBC can be classified as the second type of money that is allowed in Islam where the physical precious metal remains somewhere, and electronic units move as money, but it is redeemable like gold standard, as long as the ownership of precious metal is recorded properly and there is a unified standard for precious metal known by all. One of the financial experts (F1) further added:

> This cryptocurrency is the second type of money acceptable in Islam where the information is passed around as money that is redeemable for actual precious metal. So, people are actually transferring the actual precious metal because that cryptocurrency represents the precious metal. If anyone has the record, he can come and claim it, and it is allocated precious metal that tells exactly which precious metal it is because it has a serial number.

This is in line with the historical Sharīʿah scholars' opinion where they defined payment systems as four types. In the case of PMBC, precious metal remains somewhere, and users circulate the cryptocurrency which is considered as the second type of money that is accepted in Sharīʿah as stated by Nyazee, (2016, p. 118).

One of the financial experts (F1) further stressed the importance of separating tasks between the operator (E-mint) and the storage site to prevent the over-issuance of precious metal, which also requires auditing:

> Having two different companies; E-mint and storage site, is a good thing which prevents cheating as there may be no precious metal, but they issue PM-Cryptocurrency, so we reduce the possibility of cheating by separating this, and also providing external auditors or some regulators like the central bank. These are meant to make sure the amount circulated matches the actual precious metal deposited. The storage site also could be auditor by itself if it is an independent entity.

According to a senior researcher and professor (S2), further elaboration in the system must be interconnected at all stages:

> From a Sharīʿah perspective, there should be no problem since the PM-Cryptocurrency exactly matches the physical precious metal deposited and its price is linked to actual gold or silver price and it fluctuates based on that price. In addition, it needs governance, monitoring, auditing, and reviewing all functions by Sharīʿah auditors. However, since blockchain technology is used, the issue of auditing and documentation becomes more effective.

The usage of blockchain technology in PMBC makes it possible to have a high level of transparency as stated by Nguyen, (2016, p. 51) and Rodrigo, (2019, p. 30). Blockchain is a technology that is distinctly capable of performing many functions in the transaction cycle such as record keeping, monitoring, and auditing. They simply facilitate the transfer of value (Kiviat, 2015, p. 585). Therefore, the system is naturally interconnected. Thus, there is no place for over-issuance or frauds. In addition, the price of PM-Cryptocurrency is derived from the actual gold and

fluctuates based on the market price. Any change in the gram price will change the value of PM-Cryptocurrency, not the opposite. This is similar to previous experiences such as E-dinar, GoldMoney, HelloGold, and OneGram.

Sharīʿah advisor (S1) affirmed the necessity of ensuring that the users are able to swap between PM-Cryptocurrency and physical precious metal without any issues or delay:

> As long as the system will record my ownership of that metal and whenever I want the metal, I can have it without any restrictions, there will be no Sharīʿah issues.

Another expert (F2) further pointed out that users should be able to convert their PM-Cryptocurrency to national currency easily and smoothly using debit cards and ATM machines which makes the entire system more convenient for them. However, the issue of price that is going to be used in the converting process should be clear to all parties:

> Such a need may arise because nations are using fiat money as money. The only issue I see is that the price of gold should be clear to all parties. They have to use spot price, and in weekends they can use the last closing price.

For any digital currency to be adopted widely, there is a need for a good fluid movement between national money and digital currency (Mullan, 2016, p. 37). Any gold-backed digital currency platform that ensures easy and smooth convertibility between digital gold and national currency would be popular and adopted widely, especially if it allows its users to convert their digital gold using debit card at any ATM (Mullan, 2016, p. 197). In addition, the value of the PMBC is always tied to the daily spot prices of gold and silver. Consequently, the value of PMBC as expressed in terms of national currency will fluctuate based on the change in the spot price of the gold and silver (Mullan, 2016, p. 97).

Since the precious metal is not playing the role of money yet, the rules of *ṣarf* contract (currency exchange) must be considered. One of the financial experts (F1) further added:

> In the present world, precious metal is not playing the role of money yet. All of us are still using paper money as money. Therefore, all the rules of *ribā* and *ṣarf* are applicable here.

The currency exchange contract (*ṣarf*) refers to the exchange of money for money (Bakar, 2003, p. 10). Interestingly, according to Bakar, Islamic law has put some restrictions on currency exchange contracts in order to prevent the existence of *ribā*. In this regard, there are two concepts that must be clarified. Firstly, in Sharīʿah law, exchanging homogeneous money (gold for gold and silver for silver) is allowed only when two conditions are strictly adhered to. These are (a) the two countervalues must be in quantity and (b) the exchange must be hand-to-hand (on spot basis). Secondly, exchanging inhomogeneous money (gold for silver, fiat money for gold, fiat money for silver) is allowed in Sharīʿah law only when one condition is strictly adhered to which is that the exchange must be hand-to-hand (on spot basis) (Hassan & Ishak, 2008, p. 12).

Another expert (F1) supports the concept of PMBC especially with current generation lifestyle (Muhayiddin et al., 2011b, 9). However, he did not hide his concerns about the security and redeeming issues:

> Definitely, I would support PMBC because the current ways of transaction are all going fintech and are using mobile payment system in almost all payments. So, it is very appropriate for the current generation. But the main issues are the security of transactions, the precious metal itself, and the system... and redemption of precious metal should be easy and secure.

The majority of the Sharīʿah scholars and financial experts (5 out of 6) found PMBC a potential viable alternative but it is still a theoretical proposal of payment mechanism. It is a new currency with a new era of exchanging value. It must be carefully studied from all perspectives such as information technology, system developer, data basis, and accounting and financial perspective. (S1) stated that:

> This is not a matter of Sharīʿah expert working alone. Sharīʿah has to work with IT system, data basis, accounting and finance experts. So that the system recognizes this, it must be backed by research.

Overall, it is found that implementing PMBC is not a challenge especially that all the requirements of the system are already available as discussed above. The only challenge is the political will. (F1) stated that:

> Precious metal money can be slightly political, so we can justify it historically, economically, scientifically. But today it is very difficult to justify it politically. So, the greatest challenge in implementing the PMBC is politics.

All in all, many studies support the argument that cryptocurrencies have a significant future that will threaten the typical electronic payment mechanisms as stated by Bourgeois (2010) and Wegdell and Andersson (2014, p. 31). Cryptocurrencies create a revolutionary payment method for micropayments that change the stereotype of money (Grinberg, 2012, p. 170). This is in line with the current generation needs who are seeking new safe and convenient ways for conducting payments that saves cost and time. However, cryptocurrencies in general and PMBC in particular still need appropriate regulatory and legal frameworks alongside scientific research to overcome the current threats and risks that stand in front of the future development of cryptocurrencies (Descôteaux, 2014, p. 4).

5. Conclusion

The main objective of this research was to develop a Sharīʿah-compliant precious metal backed cryptocurrency. PMBC offers an efficient and secure online method to buy, sale, hold, earn, spend, send, and redeem precious metal. In addition, this mechanism allows the circulation of precious metal in encrypted manner using any electronic means. According to Abdullah (2015, p. 226), to be a credible medium of exchange, measure of value, and a standard of deferred payment, a currency has to retain its store of value function and preserve its purchasing power. Accordingly, by restoring the gold and silver to the unit of account, the efficiency in the medium of exchange will be restored in the long-term.

Overall, it is found that all the resources needed to develop and implement PMBC are already available. However, the greatest challenge in implementing PMBC is political will. The results of this study impose practical implications at governmental level where the governments are required to formulate appropriate strategies for monetary restructuring and financial reforms to support the implementation of PMBC. The implications of the precious metal system would ensure restoring metal backed money. The benefits include a long-term stability in the monetary system, excellent medium of exchange, justice in the monetary system, enhanced transparency, and reduction in some social problems.

This research contributes to the existing knowledge-base and benefits researchers, proponents and practitioners of Islamic economics, banking, and finance. This is because in the era of cryptocurrency, it is important to offer a Sharīʿah-compliant cryptocurrency and understand the Sharīʿah treatment of the proposed cryptocurrency model. In addition, Islamic finances are focused on real assets and real economy (Farooq & Selim, 2019, p. 686). Therefore, this cryptocurrency would contribute in this manner.

The most important limitation of this research lies in the fact that this research develops a Sharīʿah-compliant PMBC conceptually. Therefore, further work is required to develop a Sharīʿah-compliant PMBC physically and technically especially from information technology and data basis. In addition, the PMBC mechanism was developed to work domestically. Therefore, further research should be done to develop the mechanism internationally and regionally. On the other hand, the introduction of PMBC is perceived to be an innovation among the world's payment systems (Yusuf, Meera, Ghani, Manap, & Larbani, 2015, p. 124). Therefore, it is recommended to investigate further factors influencing consumers' intention to adopt PMBC.

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تصميم عملة رقمية مشفرة مدعومة بالمعادن الثمينة متو افقة مع الشريعة الإسلامية

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المستخلص: لم تعد النقود مغطاة بأصول حقيقية في ظل النظام النقدي والمالي المعاصر، بل على العكس من ذلك، أصبحت مدعومة بمجرد ديون. وقد ولّد هذا النظام العديد من المشاكل الاقتصادية والاجتماعية. ولهذا أصبح موضوع استعادة قيمة النقود مجالا رحباً للآراء المختلفة التي تفتقر في الغالب إلى أدلة نظرية وتجريبية. ويهدف هذا البحث إلى تصميم عملة رقمية مشفرة مدعومة بالمعادن الثمينة ومتوافقة مع الشريعة. ولتحقيق هذا الهدف اعتمدت الدراسة على منهجية لتطوير المنتجات تتكون من أربع مراحل هي: التخطيط، تطوير الفكرة، تصميم نظام العمل، وأخيراً الاختبار. وتم بعد ذلك عرض الفكرة وتقييمها من علماء متخصصون في الشريعة وخبراء ماليين. وقد تضمنت نتائج الدراسة عرضاً للإطار العام والوظائف الأساسية لهذه العملة التي تتميز بأنها مدعومة بالمعادن الثمينة ومتوافقة مع الشريعة الإسلامية، ومحمية بمستوى قوي من التشفير بما يمكنها من القيام بجميع وظائف النقود والعمل في الوقت نفسه كنظام للمدفوعات بين مستخدميها مباشرة دون الحاجة لأي وسيط. كما توصلت الدراسة إلى أن جميع الموارد المطلوبة لطرح هذه العملة المشفرة متوفرة، وأن علماء الشريعة والخبراء الماليين يؤيدون طرح هذه العملة بعد مراعاة مجموعة من التحديات والتحفظات.

الكلمات الدَّالة: متوافق مع الشريعة، المعادن الثمينة، العملات المشفرة.

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