

## V. Special Topics

### V.1 Do the Interactions Between the BIST Banking Index and BIST Corporate Sector Indices Intensify in Times of Financial Stress?

#### V.1.1 Introduction

The literature on financial contagion investigates the transmission of shocks during periods of financial stress (Corsetti, Pericoli and Sbracia, 2011). In times of financial stress, the spillover of a shock that would normally affect only a single firm, sector or country to other firms, sectors or countries is an evidence of the presence of contagion. Such changes that may occur in shock transmission can be explained by the air of panic or the herd behavior observed in times of stress as well as by more structural factors. In fact, according to the financial accelerator mechanism introduced by Bernanke, Gertler and Gilchrist (1996) and theoretically framed by Kiyotaki and Moore (1997), shocks may further spread during financial turbulence periods due to balance sheet structures of firms and banks. Accordingly, the impairment in balance sheets caused by the fall in asset prices in times of stress creates a feedback loop between the banking sector and the corporate sector, thus amplifying the impact of shocks. This study aims to test whether such a feedback loop also exists in times of financial stress in Turkey.<sup>1</sup>

The main reason for the feedback loop cited in the related literature is that market conditions at a given time can change balance sheet aggregates. In times of high financial market volatility, a fall in the value of debtor firms' collaterals and other assets will lead to a contraction in the supply of bank loans and an increase in loan rates. Consequently, balance sheet structures of firms borrowing at higher costs will further deteriorate, causing them to have more difficulty in rolling over their debt. This will trigger a disruption in trade receivables, and the cash flow in the market will be affected, causing some firms to fail to find alternative sources to repay their debt and go bankrupt. Such developments may also negatively affect the balance sheets of banks, leading to a decline in bank capitals. In particular, banks with capital adequacy ratios close to legal limits will further tighten their loan standards, raise their loan rates to relatively higher levels, and the balance sheet structures of firms borrowing under these terms will deteriorate even more. As loan rates increase, firms' repayment ability will also be increasingly questioned, and banks may prefer credit rationing if this cycle persists.<sup>2</sup>

The above-cited conventional financial accelerator mechanism and feedback loop that have been designed for closed economies get stronger in the presence of liability dollarization. This is because the deterioration in the balance sheets of firms with high net FX indebtedness may be deeper due to increases in both the interest rates and the exchange rates, in times of stress. In a small open economy, foreign investors who see the increased riskiness of banks and firms may prefer to cut their positions in that country, which may lead to an FX liquidity shortage in countries with an FX short position. Countries in which capital markets have not fully developed and financial hedging is limited may be affected more by financial volatilities. In short, liability dollarization may increase the severity of the feedback loop experienced in times of financial stress.

Policymakers are trying to reduce the severity of such loops through the measures they introduce in periods of increased financial market volatility. They provide FX and domestic currency liquidity to the markets, and make decisions that will enhance the soundness of the balance sheet structures of banks and firms or that will reduce their costs. Getting a better insight into the interaction channels between the financial and corporate sectors is crucial in terms of devising these policy measures.

<sup>1</sup> This study summarizes some of the findings of the ongoing study by Kara, Hacıhasanoğlu and Ünalmiş (2018).

<sup>2</sup> Credit rationing refers to the unwillingness of banks to extend loans to risky firms in terms of payment ability, even at higher interest rates.

## V.1.2 Model and Methodology

This study applies the contagion analysis put forward by Gravelle, Kichian and Morley (2006) and developed in the study by Flavin, Panapoulou and Ünalmış (2008), to sectoral indices formulated based on firms listed in BIST. To cover as many stress periods as possible, BIST return indices have been included in the analysis as of their starting dates (the year 1997 for most indices).<sup>3</sup> All data have been taken from the BIST database at weekly frequency and returns have been calculated as the logarithmic change over the previous week.

Following the study by Gravelle, Kichian and Morley (2006), the model explains the asset returns of two different indices (1. banking and 2. corporate sector) ( $r_{it}$ ) with constant term ( $\mu_i$ ), common shock ( $z_{ct}$ ) and idiosyncratic shock ( $z_{it}$ ) as shown in Equation 1. Expected values and correlations of all shocks are zero. Therefore, the constant term can also be called the expected return.

$$r_{it} = \mu_{it} + \sigma_{cit}z_{ct} + \sigma_{it}z_{it}, i = 1,2 \quad (1)$$

Shock variances have been normalized to 1. Therefore,  $\sigma_{cit}$  and  $\sigma_{it}$  can be interpreted as the standard deviations of shocks, which increase during high volatility periods. The shift in these coefficients between stress periods and normal periods is determined via a Markov switching model, which is demonstrated in Equations 2 and 3.

$$\sigma_{cit} = \sigma_{ci}(1 - S_{ct}) + \sigma_{ci}^*S_{ct}, i = 1,2 \quad (2)$$

$$\sigma_{it} = \sigma_i(1 - S_{it}) + \sigma_i^*S_{it}, i = 1,2 \quad (3)$$

The state variable ( $S_{kt} = \{0,1\}$ ,  $k = 1,2, c$ ) takes the value of zero in normal times and one in times of volatility when the related shock is large. Coefficients marked with an asterisk represent the standard deviations in the high-volatility regimes ( $\sigma_{ci}^* > \sigma_{ci}$  and  $\sigma_i^* > \sigma_i$ ). The model also allows the expected return to change over time depending on the regime of the common shock. For example, expected returns may be affected by changes in the country risk premium depending on the level of volatility.

$$\mu_{it} = \mu_i(1 - S_{ct}) + \mu_i^*S_{ct}, i = 1,2 \quad (4)$$

Markov switching regime paths are endogenously determined in the model. The conditional probabilities of remaining in the same state are defined as follows:

$$\Pr[S_{it} = 0 | S_{it} = 0] = q_i, i = 1,2, c$$

$$\Pr[S_{it} = 1 | S_{it} = 1] = p_i, i = 1,2, c$$

Finally, following the study by Flavin, Panapoulou and Ünalmış (2008), transmission of idiosyncratic shocks is also allowed during high-volatility periods. For example, when all shocks in the model are in the high-volatility period, returns on the BIST banking index and the corporate sector indices are determined as follows:

$$r_{1t} = \mu_1^* + \sigma_{c1}^*z_{ct} + \sigma_1^*z_{1t} + \delta_1\sigma_2^*z_{2t} \quad (5)$$

$$r_{2t} = \mu_2^* + \sigma_{c2}^*z_{ct} + \sigma_2^*z_{2t} + \delta_2\sigma_1^*z_{1t} \quad (6)$$

Here,  $\delta_1$  (effects of corporate sector-specific shocks on the banking sector) and  $\delta_2$  (effects of banking sector-specific shocks on the corporate sector) measure the magnitude of the additional interaction between returns during financial stress periods. The above-cited feedback loop is valid in cases where both of these transmission mechanisms are positive and statistically significant. The Markov switching model is estimated by employing the maximum likelihood method.

<sup>3</sup> SME index data is available as of December 2013, technology and communication indices data as of July 2000, and data for other BIST return indices employed in the study as of January 1997.

### V.1.3 Findings

In this study, stress periods are determined endogenously by the model, and periods with high probability of switching to the volatility regime are identified as stress periods. Table V.1.1 demonstrates the estimates and standard errors of  $\delta_1$  and  $\delta_2$  coefficients on which our study focuses. The table also reports the results of the likelihood ratio (LR) test where the effects of sector-specific shocks are investigated together (null hypothesis:  $\delta_1 = \delta_2 = 0$ ), i.e., the bi-directional contagion test.

**Table V.1.1: Additional Interaction between BIST Banking and Corporate Sector Indices during Periods of Stress**

	Effects of Corporate Sector-Specific Shocks on Banks		Effects of Bank-Specific Shocks on Corporate Sector		Bi-Directional Contagion Test
	$\delta_1$	(Std. Err.)	$\delta_2$	(Std. Err.)	LR-Test
<b>Industrial</b>	<b>0.616***</b>	<b>(0.075)</b>	<b>0.115*</b>	<b>(0.067)</b>	<b>27.552***</b>
Food	0.642***	(0.055)	0.230***	(0.053)	141.131***
Chemicals	0.157	(0.099)	0.041*	(0.022)	2.268
Mining	0.063	(0.041)	0.933***	(0.162)	21.138***
Basic Metal	0.154**	(0.069)	0.242**	(0.111)	5.688**
Metal Goods	0.445***	(0.084)	0.062	(0.061)	19.457***
Textiles	0.643***	(0.061)	-0.203**	(0.095)	21.295***
<b>Services</b>	<b>0.348***</b>	<b>(0.080)</b>	<b>0.161**</b>	<b>(0.067)</b>	<b>10.500***</b>
Electricity	0.194***	(0.052)	0.397***	(0.049)	85.451***
Communication	0.337***	(0.077)	0.204***	(0.063)	21.257***
Trade	0.648***	(0.074)	-0.209	(0.134)	2.128***
Tourism	0.351***	(0.048)	-0.532**	(0.246)	27.853***
Transportation	0.036	(0.053)	0.077	(0.280)	0.752
<b>Technology</b>	<b>0.336***</b>	<b>(0.070)</b>	<b>0.492***</b>	<b>(0.053)</b>	<b>45.653***</b>
<b>SME</b>	<b>0.187**</b>	<b>(0.082)</b>	<b>0.421***</b>	<b>(0.126)</b>	<b>17.527***</b>

Note: \*\*\*, \*\*, and \* refer to a significance level at 1%, 5% and 10%, respectively. Standard errors are displayed in parentheses in the column on the right of the coefficient.

Estimation and test results indicate a significant feedback loop for many sector indices. In high-volatility periods, there are statistically significant mechanisms that amplify the interaction between aggregate corporate sector indices (industrial, services and technology) and the banking index. The same applies to small and medium-size enterprises (SMEs). Although a more heterogeneous structure is at play across sub-indices, in periods of high volatility, there is a strong feedback loop between the banking sector and the food, basic metals and communication sectors that have high financial indebtedness and largely trade in the domestic market. The electrical energy sector, highly indebted to the financial sector due to its high-volume investments, is exposed to a feedback loop in periods of stress as it borrows mostly from domestic banks in foreign currency and operates in the domestic market.<sup>4</sup> The fact that one pillar of the transmission is negative for the textiles and tourism sectors, i.e. they are not adversely affected by the shocks affecting the banking sector, can be explained by the fact that the competitiveness of goods and services-exporting sectors in foreign markets increases during times of financial volatility due to the depreciation in exchange rates and the fact that they are not affected as much by the tightening in credit conditions in such periods. We find that the stress periods in mining and chemicals sectors with low

<sup>4</sup> Yılmaz and Çolak (2017) reveal that the net FX open position of the energy sector is higher than other sectors.

financial indebtedness have no additional negative effect on banks. The transportation sector index composed heavily of airline companies also does not have any additional interaction with the domestic banking sector during stress periods due to its high external integration.

#### V.1.4 Conclusion

Understanding the transmission channels during financial market stress periods is important for policy makers. This study shows that the interaction between the banking and corporate sectors changes during high-volatility periods in Turkey. The findings differ across sub-sectors, and it would be useful if the future studies examined these interactions by decomposing them on a firm basis and/or into the characteristics of firms. For instance, specifically for some firms, identifying whether the additional interaction during times of stress results from conventional financial accelerator mechanisms or from FX balance sheet mismatch is deemed crucial to understand the dynamics of the feedback loop. This is believed to contribute to policy design both on a macro basis and a sectoral basis.

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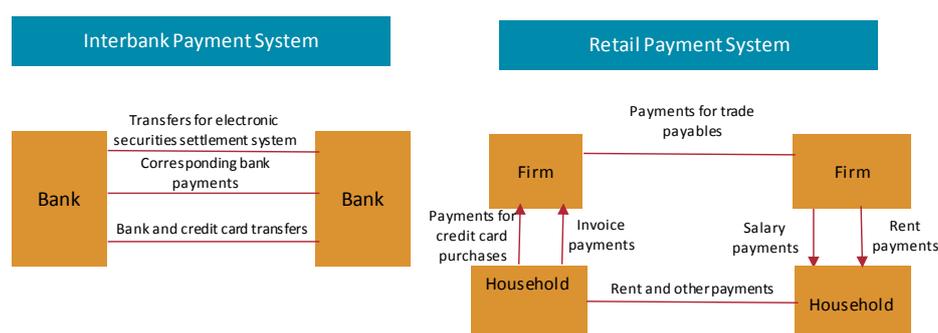
## V.2 Alternative Financial Indicators That Can Lead Business Cycles and the Maturity Factor of Trade Payables

Setting indicators that can lead the movement of the GDP series is crucial as the GDP data are released at a quarterly frequency with a time lag of approximately 2.5 months. This Special Topic presents an analysis of the predictability of cyclical movements of the GDP series through financial indicators released at a higher frequency with a shorter lag. Accordingly, business cycles are compared with cyclical characteristics of the capital movement data and the volume of cheques and payment systems that were not previously considered in the related literature to be a financial indicator having the capacity to lead the business cycle. The loan data series is also included in the analysis for comparison as it has the strongest relationship with business cycles among the financial indicators analyzed in the study by Binici et al. (2016).

To identify the business or financial cycles, the method of turning point identification developed by Bry-Boschan (1971) is used. In this method, employing criteria so that expansion and contraction phases are at least  $n$  quarters long and the full cycle (contraction + expansion) is at least  $m$  quarters long, peaks and troughs are determined. Following Claessens (2012) and Binici et al. (2016), two-quarter values are used for  $n$  and five-quarter values for  $m$ . After the peaks and troughs of related series are determined, the length of cycles of series and the degree of the co-movement of different series can be examined.

Payment system volume data have been available daily on the Electronic Data Delivery System (EVDS) of the CBRT since 1 April 1992. The types of money transfers constituting the payment system volume are summarized in Figure V.2.1. These transfers can be categorized under two main headings: the transfers among customers (Retail Payment System - RPS) and the transfers among banks (Interbank Payment System- IPS). As of the recent period, 18% of the total transaction volume of the payment system is composed of RPS transactions. Data with a breakdown by RPS transactions and IPS transactions have been available only since after 2012 while the RPS volume in the previous periods is reported under the IPS volume. Therefore, to ensure integrity of the series, the sum of the two amounts is used to refer to the payment system volume. This study employs the real GDP series while data on loans, payment systems and cheque volume are deflated by the CPI.

Figure V.2.1: Payment Systems



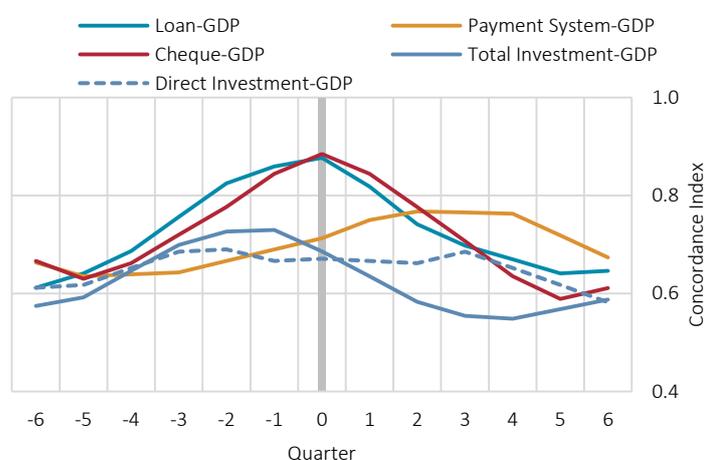
An analysis of the cyclical characteristics of series based on the Bry-Boschan method reveals that the total cycle length (expansion + contraction) of the GDP series (business cycle) is 18 quarters, and the total cycle length of capital movement data is shorter than that of other financial indicators. Moreover, the slope coefficient of capital flows in the form of direct investment is higher during contraction periods. In other words, the change in this series is greater during a one-quarter period of contraction (Table V.2.1).

**Table V.2.1: Cyclical Characteristics of the Series**

		GDP	Loan	Payment System	Cheque	Total Investment	Direct Investment
Duration (Number of Quarters)	Expansion	14.3	15.5	13.8	14.0	10.3	7.3
Amplitude (% Change)		21.7	62.6	68.5	24.3	41.0	60.7
Slope (% Change/Time)		1.5	4.0	4.9	1.7	4.0	8.3
Duration (Number of Quarters)	Contraction	3.7	4.8	3.6	5.5	4.8	3.7
Amplitude (% Change)		-3.2	-19.9	-14.5	-14.5	-10.2	-17.5
Slope (% Change/Time)		-0.9	-4.1	-4.0	-2.6	-2.1	-4.8
Duration (Number of Quarters)	Expansion + Contraction	18	20.3	17.4	19.5	15.1	11
Beginning Periods for Data Series		1987Q4	1987Q4	1993Q1	1998Q4	1996Q4	2000Q1

Note: For payment system, cheque and capital flow data (total investment and direct investment), the yearly averages of real monthly levels which are calculated using the CPI are used. For loan data, the related period's real term data calculated using the CPI is used. Total investment and direct investment series are gathered from the International Investment Position data. Total investment is the sum of direct investment, portfolio investment and other investment. The International Investment Position Data was published in a yearly frequency before 2005Q4, so these series are turned into quarterly frequency via interpolation. Duration denotes the number of quarters spent in a phase, amplitude denotes the percentage change in the value recorded at a given peak (trough) point compared to the previous trough (peak) point, slope coefficient is the ratio of amplitude to time.

To compare business cycles with financial cycles calculated from different financial indicators, the concordance index for these series is calculated for different lag periods. In cases of co-movement of the two series, i.e. if one of the series moves from the peak to the trough or vice versa, so does the other, the concordance index takes the value of 1 while it takes the value of 0 in other cases. Consequently, the highest concordance index value is calculated as 0.89 for the cheque volume and 0.88 for loans simultaneously. Although they do not lead the GDP, it is believed that these data may still help in following the cyclical movements of the GDP as they are released with a shorter lag. On the other hand, the concordance index for direct and total investments and the GDP reaches the peak before  $t=0$ , which means that changes in capital movements lead the GDP. Finally, the concordance index for the payment system volume reaches the peak at  $t=2$ , indicating that GDP developments lead the payment system volume (Chart V.2.1).

**Chart V.2.1: Concordance Index for Business Cycles**

Source: CBRT, BRSA, TURKSTAT

To confirm the findings, the relation between these series is also analyzed via the *Granger causality* method. We find that, similar to the turning point analysis, the relation between loan and GDP is simultaneous, the changes in capital movements lead the GDP, and GDP developments lead the payment system volume. While the turning point analysis reveals a simultaneous relation between the cheque volume and the GDP, the *Granger causality* method demonstrates that the cheque volume follows economic activity with a time lag. The differentiation between the two methods is attributed to the fact that the cycle concordance cannot be fully identified since the GDP series are always found to be in the expansion phase after 2009 and the cheque data cannot be traced back to very early dates in the turning point analysis. It is believed that the maturity of trade payables may have a role in the lagged relation of the payment system and the cheque volume with the GDP. For example, while a sales transaction between two firms at time  $t$  affects the GDP also at time  $t$ , payment of this transaction with a cheque affects the cheque volume if the cheque is submitted to the bank at  $t+1$  or at a later date. Likewise, if the debtor firm pays the creditor firm via payment system later than time  $t$ , the payment system volume is affected after the GDP.<sup>1</sup>

Figure V.2.1 reveals that the payment system volume is actually composed of the sum of very different money transfers. While the maturity factor is important in money transfers for forward sales between firms and in credit card payments with installments, both of which are categorized under the RPS transactions, it can be more easily ignored in other transactions. On the other hand, money transfers against government domestic debt securities (GDDS) account for approximately 17% of the IPS transactions among banks, and these are very short-term transactions that are sensitive to liquidity conditions in the market.

To test the maturity hypothesis through a more detailed analysis of payment system volume data, this study focuses on the period as of end-2012 since when this series has been available in a breakdown by RPS and IPS. The IPS series is also examined under two headings as the amount of money transfers against the GDDS under the IPS heading is also publicly available. To increase the number of observations, monthly GDP series estimated by the CBRT and the payment transactions volume are included in the analysis for the November 2013-May 2018 period.

Accordingly, it is observed that the GDP leads the RPS transactions in which the share of forward transactions is relatively larger. One factor that is effective in this result is the maturity channel in trade payables while bank accounts and money transfers that increase in line with the revival in economic activity constitute another factor. Meanwhile, although they are affected by factors such as the liquidity conditions in the market and intraday liquidity management strategies of banks, money transfers against the GDDS lead the GDP. It is found that the relation of total payment transactions volume or IPS volume with the GDP is not crystal clear due to different components of these items (Table V.2.2).

To conclude, capital movements can be used to predict the cyclical movements of the GDP series as the GDP series are released either with a time lag or at a quarterly frequency, and the loan data can be used to predict the cyclical movements of the GDP series as they are released at a higher frequency. The GDP leads the cheque volume due to the maturity factor. On the other hand, because the payment system volume is composed of the sum of items with different maturity structures, its relation with the GDP series is not very clear.

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<sup>1</sup> In sales transactions, although a certain amount is paid by the debtor firm to the creditor firm during the transaction, the maturity factor is still at play as the actual total payment is made in the following periods.

**Table V.2.2: Leading Relations of the Data Series with GDP**

	Start of the Data Series	Finding
Interbank payment system + retail payment system (payment system volume)	12.1998	GDP is leading for this series
<b>For the period where retail payment system data breakdown is available</b>		
Interbank payment system + retail payment system (payment system volume)	11.2013	*
Interbank payment system (a+b)	11.2013	*
a) Transfers for electronic securities settlement system	11.2013	This series is leading GDP
b) Other interbank payment system	11.2013	Simultaneous with GDP
Retail payment system	11.2013	GDP is leading for this series

Note: The table shows the results at 10% significance level. Payment system volume is published in a daily frequency, and moving yearly averages are used for seasonal adjustment. The series are mean trended by the taking logarithmic difference.

\*Leading relations are different when different information criteria are used to determine the optimal lag number.

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## V.3 Central Banks and Digital Currencies

### V.3.1 Introduction

According to the economic theory, money has three core functions: medium of exchange, unit of value and store of value. In today's world, the concept of money generally refers to fiat money issued by central banks that are not based on gold or silver. In addition, the majority of money is held in banks as deposits, and a large portion of payments is conducted in the electronic environment.<sup>1</sup> Due to recent technological developments, it seems possible that money, one of the most important elements of the economy, can assume a new digital form. Central banks, in line with their various duties and powers to provide the money that the economy needs and develop payment systems, have also increased their research in this field. During this process, they closely monitor crypto assets such as Bitcoin as well as the technology used by these assets.

Currently, considering that crypto assets do not fulfill the three core functions of money and are not an alternative to legal currencies, the term *crypto asset* is preferred over the term *crypto currency*.<sup>2</sup> International organizations, such as the International Monetary Fund (IMF), the Committee on Payments and Market Infrastructures (CPMI) and the Financial Stability Board (FSB), and some central banks emphasize that crypto assets should be closely monitored because they have complex management structures, create capacity problems due to their high energy-demanding working principles, their technological development is still in progress, are traded anonymously, and their values are highly volatile.<sup>3</sup> A public warning has also been issued in Turkey regarding the risks that crypto assets may create.<sup>4</sup>

On the other hand, it is assessed that the *Distributed Ledger Technology* (DLT) and its special application the blockchain technology used by crypto assets, will allow for a secure exchange of digital assets with no need for a central counterparty just like the case in exchange of cash, which may significantly contribute to the digitalization of currency.

### V.3.2 Central Bank Digital Currency and Its Taxonomy

The central bank digital currency (CBDC) is defined as a new form of central bank money. Accordingly, it is a central bank liability denominated in an existing unit of account that serves both as a medium of exchange and a store of value.

CBDC as a new digital form of central bank money is distinguished from reserves or settlement balances held by commercial banks and some financial corporations at central banks.

#### *The Money Flower*

To get a clearer insight into the forms of money, it would be useful to compare different forms of money with each other. Figure V.3.1 presents a taxonomy called the money flower.<sup>5</sup> The Money Flower classifies the money according to four key properties: issuer (central bank or other), form (digital or physical), accessibility (widely or restricted), and technology (account- or token-based).

<sup>1</sup> As of end-October 2018, the amount of currency in circulation is TRY 135.1 billion in Turkey while the M1 and M2 money supplies amount to TRY 523.0 billion and TRY 1,984.5 billion, respectively. Although the volume and amount of cash payments are not known for sure, the average daily transaction volume is around 2.5 million transactions in the EFT system, 10 million transactions in cards, and 50 thousand transactions in checks. The average daily value of payments in the EFT system is alone TRY 400 billion.

<sup>2</sup> [www.fsb.org/wp-content/uploads/P101018.pdf](http://www.fsb.org/wp-content/uploads/P101018.pdf)

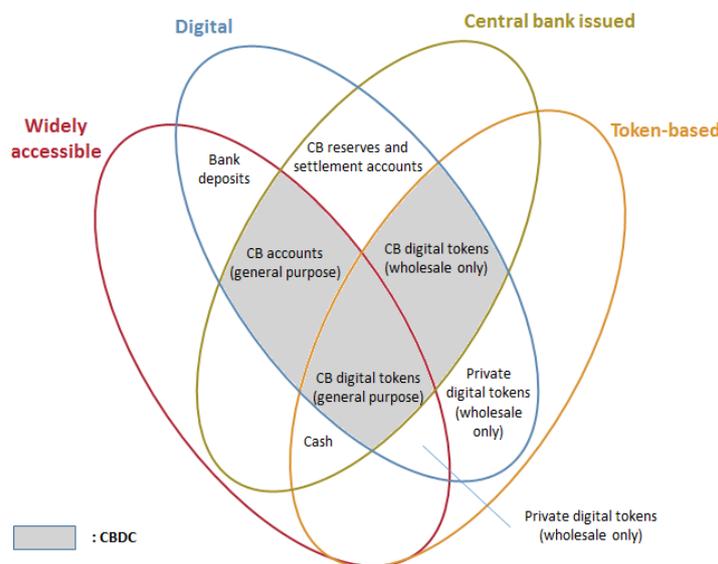
<sup>3</sup> [www.fsb.org/2018/07/crypto-assets-report-to-the-g20-on-the-work-of-the-fsb-and-standard-setting-bodies/](http://www.fsb.org/2018/07/crypto-assets-report-to-the-g20-on-the-work-of-the-fsb-and-standard-setting-bodies/)

<sup>4</sup> <https://www.treasury.gov.tr/File/Index?id=b22897c3-0f09-4886-9f24-62f9023b337e>

<sup>5</sup> [www.bis.org/cpmi/publ/d174.pdf](http://www.bis.org/cpmi/publ/d174.pdf)

CBDC is placed at the center of this taxonomy in three different forms. *The general-purpose CBDC* is a widely accessible payment instrument that is used in retail payments while the *wholesale-only CBDC* is a payment and settlement instrument that is used in large-value payments and is generally accessible only by financial corporations. On the other hand, the *account-based CBDC* envisages central banks providing accounts to individuals and institutions.

Figure V.3.1 The Money Flower: A Taxonomy of Money<sup>6</sup>



### Design Features

In addition to the four core properties on which the Money Flower taxonomy is based, central bank digital currencies may also display other features (Table V.3.1).

Table V.3.1 Design Features of the Central Bank Digital Currency

	Existing central bank money		Central bank digital currencies		
	Cash	Reserves and settlement balances	General purpose		Wholesale only token
			token	accounts	
7/24 availability	✓	X	✓	(✓)	(✓)
Anonymity vis-à-vis central bank	✓	X	(✓)	X	(✓)
Peer-to-peer transfer	✓	X	(✓)	X	(✓)
Interest-bearing	X	(✓)	(✓)	(✓)	(✓)
Limits or caps	X	X	(✓)	(✓)	(✓)
✓ = existing or likely feature, (✓) = possible feature, X = not typical or possible feature					

### 7/24 Availability

Currently, access to non-cash central bank reserves and settlement accounts is available only within working hours. CBDC can be available 7/24 or during specified times depending on the design.

<sup>6</sup> Tokens function as the visible or tangible representation of a value such as a financial asset or liability. For example, cash is a physical token-based form of money that represents the central bank liability. Token-based systems differ from account-based systems in that the transferred value is not stored in a central form but in a distributed form. In bank deposits, the most well-known example of account-based systems, banks acting in their capacity as a central authority store information about their customers' account balances and update the balances of related parties following the transfers. Conversely, in token-based systems such as crypto assets, the token values of assets of parties that change following the transactions between the parties are stored in a distributed manner.

### Anonymity

Anonymity means that the real identities of the parties of a transaction cannot become known. While anonymity is not possible in account-based systems, *token-based CBDC* can be designed in a way to achieve anonymity at various levels. Depending on the design and the technology used, it is possible to devise a cash-like digital currency which ensures identity checks during access to the system, track of identities of transacting parties by authorized institutions or full anonymity of transactions.

### Peer-to-peer transfer

The transfer of the *token-based CBDC* takes place among peers similar to cash transfers while the *account-based CBDC* can be transferred by the central bank.

### Interest-bearing

As is the case for other digital central bank liabilities, it is technically feasible for both token- and *account-based CBDCs* to bear positive or negative interest.

### Limits / Caps

Limits or caps can be set on CBDC transactions and holdings of assets. These limits or caps may be instrumental in controlling potentially undesired implications or steering usage in a certain direction.

## V.3.3 Studies by Central Banks

Issuing digital currency has recently been on the agenda of central banks. Motivations for central banks' studies on this field vary depending on country-specific circumstances while the focus of such studies differs according to the structure of the money they work on. Accordingly, these studies highlight different benefits and risks.

Many central banks including those of Russia, Estonia, Italy, the Netherlands, Iran and Malaysia have announced they are working on digital currencies. The People's Bank of China has accelerated its digital currency research by establishing the Digital Currency Research Lab in 2017. Some central banks such as those of the UK, Canada, Denmark, Norway and Sweden have released detailed reports on this subject.

The Central Bank of Ecuador became the first central bank to define a kind of *account-based CBDC* by opening accounts for its citizens in 2015 and enabling transfers via a mobile application. However, it was not adopted by the people and officially abolished in December 2017 as the system for access to accounts could not fulfill the function of money as a medium of exchange because it failed to fully integrate with the existing payment systems and was not accepted in all payments.

Under a six-month pilot project it launched in November 2017, the Central Bank of Uruguay produced a limited number of banknote-like tokens (e-peso) based on a central platform developed by an international firm, distributed these tokens via a financial institution, enabled their transfer via mobile phones, and took them back after the six-month period. This project is deemed to be successful in technological terms and the related work on the potential costs, implications and risks of the country-wide CBDC continues.

Meanwhile, the government of Venezuela announced in 2018 that it was planning to issue a token-based digital currency backed by the country's precious mineral reserves, particularly oil.

### Wholesale-Only CBDC

The key motivation for using CBDC for wholesale payments is to facilitate financial corporations' access to central bank money. It is argued that the use of CBDC may reduce the operational costs and transaction durations particularly in cross-border payments, in integration of different payment systems, and in expansion of delivery versus payment transactions via the use of smart contracts.

It is expected that a digital currency to be used only by financial corporations will improve competitiveness and innovative approaches in the field of payments, and contribute to developing cost-effective and flexible systems. Moreover, it will also boost the operational resilience of the country's payment systems infrastructure by introducing an alternative to existing payment systems, and contribute to financial stability by reducing operational risks.

The Bank of Canada<sup>7</sup>, the Monetary Authority of Singapore<sup>8</sup>, the Central Bank of Brazil<sup>9</sup> and the South African Reserve Bank<sup>10</sup> have tested the feasibility of the use of central bank digital currency in wholesale payments via proof of concept studies. The studies have confirmed the adequacy of technology and presented findings that new structures do not offer a significant advantage over existing payment systems but they may provide some benefits in cross-border and securities systems transactions.

### General-Purpose CBDC

Several central banks are known to be conducting different studies on issuing of a cash-like digital currency based on the needs and circumstances of their countries.

For some countries, the need to formulate a policy response for crypto assets and other private payment instruments is an important motivation. In Sweden, the decline in cash use has led the Sveriges Riksbank to consider issuing a digital currency (e-krona) that will be an alternative to and complement cash.

The motivation for digital currency studies of the People's Bank of China mainly arises from the probability that non-central bank crypto assets may reduce the effectiveness of the central bank if they become widespread.

The Bank of Canada and central banks of some European countries analyzed the effects of an interest-bearing digital currency on monetary and fiscal policies. The analyses have highlighted certain benefits of a central bank digital currency such as increasing the flexibility of monetary policy in countries implementing negative interest rate policy, reinforcing monetary policy through direct effect of interest rates on consumers, and facilitating the distribution of money to the public as a tool to stimulate the economy, which is also called the *helicopter money*.

Issuing, printing, distributing and renewing cash are all very costly processes that involve operational burdens and security risks. CBDC is likely to make the money issuance processes faster, safer and more cost-effective. Digital currency issuance will enable central banks to control the money supply more easily and to take measures against the loss of seigniorage that may occur due to developments such as the spread of crypto assets in the future.

In addition, the general-purpose CBDC is expected to bring the following benefits:

- Reduce the use of cash and facilitate the transition to cashless economy,
- Improve financial inclusion,
- Contribute to preventing criminal activities as transfers will be tracked by authorities,
- Ensure transparency in data such as the velocity of money,
- Increase competitiveness in payment services,
- Reinforce operational resilience by creating an alternative to retail payment systems and payment instruments,
- Facilitate cross-border payments.

<sup>7</sup> [https://www.payments.ca/sites/default/files/29-Sep-17/jasper\\_report\\_eng.pdf](https://www.payments.ca/sites/default/files/29-Sep-17/jasper_report_eng.pdf)

<sup>8</sup> <http://www.mas.gov.sg/Singapore-Financial-Centre/Smart-Financial-Centre/Project-Ubin.aspx>

<sup>9</sup> [https://www.bcb.gov.br/htms/public/microcredito/Distributed\\_ledger\\_technical\\_research\\_in\\_Central\\_Bank\\_of\\_Brazil.pdf](https://www.bcb.gov.br/htms/public/microcredito/Distributed_ledger_technical_research_in_Central_Bank_of_Brazil.pdf)

<sup>10</sup> [https://www.resbank.co.za/Lists/News%20and%20Publications/Attachments/8491/SARB\\_ProjectKhokha%2020180605.pdf](https://www.resbank.co.za/Lists/News%20and%20Publications/Attachments/8491/SARB_ProjectKhokha%2020180605.pdf)

On the other hand, it is noted that the issuance of a digital currency by central banks also involves some risks such as the following:

- It may be used as a tool that may accelerate deposit run from the banking system particularly in times of financial fragility,
- It may lead to an impairment in banks' balance sheets and lending capacities if there is a shift to digital currency from bank deposits due to widespread use and demand,
- It is vulnerable to cyber risks in the absence of necessary measures, and it may cause loss of assets when the digital wallet is lost or out of service,
- It may pose political and reputational risks to the central bank if the system fails to work, inefficiently functions or is not widely accepted by the public,
- Depending on the degree of anonymity, it may be used to skip controls and conduct illicit transactions,
- It may cause difficulties in issues regarding compliance with regulations on anti-money laundering and countering the financing of terrorism,
- It may create additional operational risks for the central bank,
- It requires high costs of investment,
- Still raw technology may create problems regarding scalability and confidentiality,
- It involves challenges for interoperability with existing payment systems,
- It involves legal ambiguity.

### *Current Situation*

Current statements made in line with CBDC-related research as well as impact and risk analyses of central banks include different evaluations:

- In its latest report on the e-krona project, the Sveriges Riksbank proposes that the Bank start developing a technical solution to test which of the possible solutions are applicable and feasible for an e-krona that will be the alternative of cash, work on necessary legislative amendments to the central bank law to clarify the legal status of an e-krona, and continue its research on the financial effects of an e-krona.
- The Swiss National Bank has stated that the distributed ledger technology is not an appropriate or adequate technology for CBDC.
- The People's Bank of China has emphasized that the development of digital currency as the future form of money is technologically inevitable, and announced that the Digital Currency Research Lab has expanded its activities to prevent crypto currencies from causing substantial and irreparable damages to the economy.
- Investigating CBDC rather in the context of wholesale payments, the Hong Kong Monetary Authority has asserted that the distributed ledger technology is not clearly superior to conventional payment system infrastructures, that the existing retail payment systems are very efficient and effective, and that accordingly, it does not consider issuing a CBDC in the near future.
- The Bank of Japan has stressed that the demand for cash has accelerated and a cash-equivalent CBDC may have substantially negative impacts on the existing two-tier currency system and private banks' financial intermediation. It has declared that it does not plan to issue a CBDC in the near future.
- The European Central Bank has stated that currently there is no concrete need to issue a CBDC and the cash demand continues to grow. It has also announced that it has no plan to issue a CBDC in the near future but it is carefully analyzing the potential consequences of issuing a CBDC as a complement to cash.

- The Bank of Canada has noted that there is currently no adequate need for a CBDC notwithstanding its potential benefits, and that the effects of a CBDC should be analyzed in detail before it is issued.
- The Iranian government has confirmed that it is working on an experimental model of a domestic cryptocurrency. However, no detailed information is available on this experimental cryptocurrency.
- The Monetary Authority of Singapore has stated that a CBDC can be used effectively and efficiently in wholesale payments but its general-purpose use will damage the banking system and is not feasible for now.
- The Bank of England which has published many articles on this subject has mentioned the potential benefits of a CBDC but also warned that there will be an outflow of bank deposits towards CBDCs particularly in times of financial uncertainties, which may negatively affect the banking system and financial stability.
- The Reserve Bank of India has particularly highlighted the cost of printing, distributing and ensuring the physical security of cash, and announced that an inter-departmental working group at the Bank is investigating the potential benefits and risks of a CBDC. Accordingly, it has also noted that the rapid change particularly in the sphere of payments and the rise in private crypto assets are carefully monitored.
- The Reserve Bank of Australia has stated that it is not convinced of the need for a CBDC despite its frequently mentioned benefits and that it is not clear what kind of additional advantages the use of a distributed ledger technology-based fiducial digital currency instead of effectively and efficiently working existing payment systems would bring.

### V.3.4 Conclusion

In today's world where many financial market transactions and assets are getting digitalized, central banks have also included the digital currency topic in their agenda in relation to their main duties such as achieving price stability and increasing the effectiveness of payment systems. In this process, the DLT has become prominent as the technology used by crypto assets. Central banks' studies today largely focus on the integration of wholesale CBDC with cross-border payments and securities settlement and payment systems. On the other hand, studies on a publicly available CBDC are rather at the analysis stage, and there is currently no example of a cash-like CBDC in use in real life.

The CBRT is also closely monitoring and analyzing domestic and global developments regarding innovative financial technologies (particularly the DLT), crypto assets and digital currencies. Accordingly, it actively engages in and contributes to international work carried out by the CPMI, FSB and G20. The CPMI Digital Innovations Working Group, to which the CBRT also contributes, carries out detailed work on potential effects of wholesale-only CBDC.

Through its analyses on the need for a cash-like CBDC based on Turkey's conditions, the CBRT investigates CBDC in terms of its:

- Business requirements and possible features,
- Effects on the central bank, banks, persons and the general economy,
- Potential advantages and disadvantages,
- Potential areas of use,
- Legal requirements.

Results to be obtained from these studies will serve as a guide to building a vision and strategies for the future.