Stuck in the Middle: Observations from intermediaries in cross-border payments for CBDC design

Jesse Leigh Maniff (Federal Reserve Bank of Kansas City) and Paul Wong (Federal Reserve Board)[1]
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Introduction

Growth in trade, e-commerce, and remittances has created an essential role for cross-border payments.[2] Despite the importance of cross-border payments to the global economy, they remain expensive and slow due in large part to the number of intermediaries involved in completing a payment.[3] Cross-border payments may require multiple intermediaries on both sides, such as commercial banks, money service businesses and fintech firms, and international and domestic payment systems. Adding to this complexity are potential jurisdictional differences in legal structures, market structures, and payment infrastructures. Although new business models and technologies have promised to reduce reliance on a complex set of intermediaries to speed up transactions, lower costs, and enhance transparency, significant market changes have thus far been elusive.

More recent discussions have raised the possibility that a general-purpose central bank digital currency (CBDC) could help address these cross-border payment challenges. This note looks at the role intermediaries play today in cross-border payments, the role they may play in potential future CBDC designs, and the potential overall implications of a CBDC for cross-border payments. An initial analysis suggests that the introduction of a CBDC alone is unlikely to change the role of intermediaries significantly; further improvement to cross-border payments may require additional policy and technology changes.

Basic Mechanics of Cross-Border Payments

Cross-border payments are usually complicated by legal, technological, and social differences between countries. Even payments that do not involve an exchange of one currency for another face challenges. Broadly, cross-border transactions involve two types of intermediaries: a front-end intermediary that interfaces with an end user and a back-end intermediary for exchange and settlement of funds. Front-end intermediaries, such as commercial banks, money transfer operators, or other payments service providers (PSPs), are used by consumers to initiate or receive cross-border transactions. These consumer interfaces may be digital (for example, a mobile app or website) or in-person (such as an agent at a bank branch or an automated teller machine).

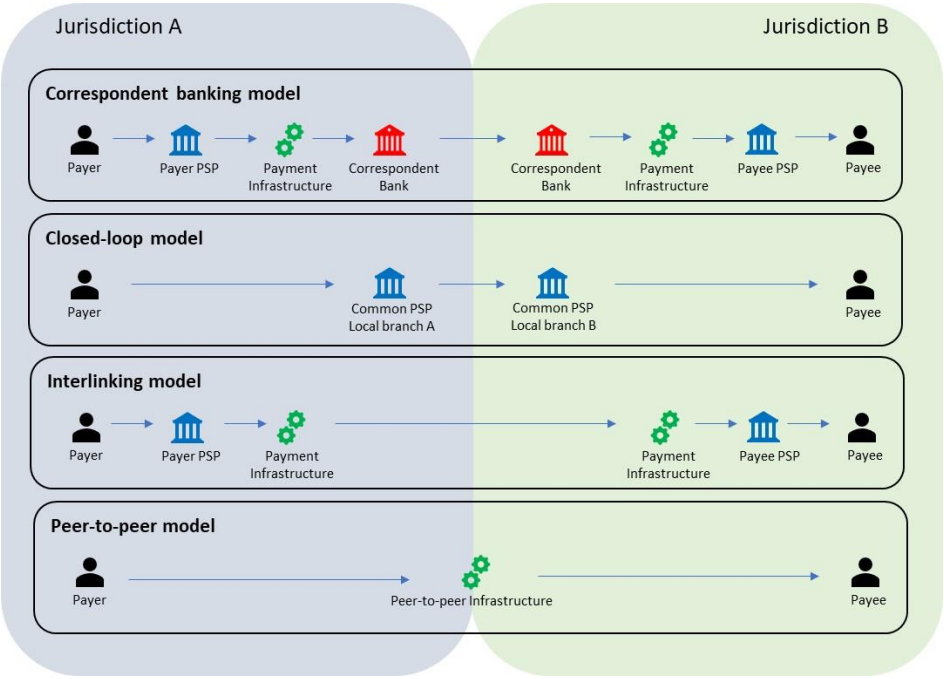
[1] The views expressed in this note are solely the responsibility of the authors and should not be interpreted as reflecting the views of the Board of Governors of the Federal Reserve System, the Federal Reserve Bank of Kansas City, or anyone else in the Federal Reserve System. The authors would like to thank Jacqueline Cremos and Dave Mills of the Federal Reserve Board, Angela Lawson of the Federal Reserve Bank of Minneapolis, and Liz Willoughby of the Federal Reserve Bank of Kansas City for their helpful comments and Zachary Proom of the Federal Reserve Board who provided research assistance for this note.

[2] Cross-border payments can be broadly defined as funds transfers for which the sender and the recipient are located in different jurisdictions. See FSB (2020).

[3] Existing cross-border arrangements have four main challenges: cost, speed, access, and transparency. These challenges arise from seven frictions: fragmented and truncated data formats, complex processing of compliance checks, limited operating hours, legacy technology platforms, funding costs, long transaction chains, and weak competition. See FSB (2020).

Front-end providers typically rely on back-end service providers for the clearing and settlement of transactions. Back-end intermediaries operate through several different models, which have been broadly classified as correspondent banking, interlinking of payment infrastructures, closed-loop, and peer-to-peer (see Figure 1). Correspondent banking, in which one bank (the correspondent) holds deposits owned by other banks (the respondents) and provides them with payment and other services, has traditionally been the predominant model. The correspondent banking model often involves the payer's PSP, a payment system in the payer's country, a correspondent bank in the payer's country, a correspondent bank in the payee's country, a payment system in the payee's country, and the payee's PSP. The closed-loop model is commonly found in remittance transactions, such as MoneyGram and Western Union.

Figure 1: Stylized traditional back-end models



Source: Authors' modification of CPMI (2018)

The Role of Intermediaries in Cross-Border Payments

Intermediaries in cross-border payments initially arose out of necessity, fulfilling vital roles in the steps to complete a transaction, often called the transaction chain. In the Middle Ages, intermediaries developed paper bills of exchange to allow for more convenient and efficient trade when merchants left their local markets. Over time, these intermediaries evolved into financial intermediaries that provide a range of cross-border payment, settlement, and clearing services today. These services have been immensely beneficial to consumers and businesses; the average daily value of foreign exchange transactions moving through global payment infrastructures exceeds $5.5 trillion.[4]

Although intermediaries have made many improvements to facilitate payments, their presence nonetheless represents an additional layer in cross-border transactions. The more intermediaries in a transaction, the longer the transaction chain. As a result, more intermediaries may lead to increased

[4] Statistic as of July 2021, based on CLS (2021).

opportunities for operational error, greater need for compliance checks, and higher processing costs.[5] Intermediaries also may impact the timing of clearing and settlement, causing additional delays due to non-overlapping operating hours across jurisdictions. These delays, in turn, may increase costs for intermediaries who keep balances in prefunded accounts as part of their liquidity management. For example, a payment to Frankfurt initiated in New York at 2 p.m. eastern time would likely not settle until the following day when the European business day opens. Uncertainty about when the transaction would settle may lead to an intermediary setting aside too much capital for the transaction.

The use of intermediaries in a cross-border transaction varies based on how the payment is processed. Since intermediaries are prevalent in the most common type of back-end model, the correspondent banking model, simplifying such a complex structure could improve the speed, cost, and transparency of cross-border payments.

The Role of Back-End Intermediaries in a CBDC Transaction Chain

One possible solution for enhancing cross-border payments may be a CBDC. This notion stems, in part, from the idea that a CBDC could operate as a digitized version of paper money where a payer would effectively "hand over" digital currency to a payee. With this in mind, a cross-border payments model using CBDC might look more like a peer-to-peer arrangement, in which a payer and payee are connected through a peer-to-peer payment system, than a correspondent banking arrangement. As a result, a CBDC could remove intermediaries and simplify the settlement of cross-border payments. Whether a CBDC could make cross-border payments more efficient may therefore depend on central banks choosing designs that minimize the number of intermediaries in a cross-border transaction while preserving the benefits that intermediaries provide to consumers and businesses.[6]

General-purpose CBDC models exist in multiple designs with several different combinations of features. For discussion purposes, this note looks at three stylized CBDC back-end models: a cash equivalent model in which a CBDC is designed as a bearer instrument, an account CBDC model in which a central bank offers accounts to the public, and a hybrid CBDC model in which a CBDC is distributed through third parties, such as banks or PSPs.[7,8] For reference, these models are compared with the correspondent banking model. In addition, this note considers three CBDC access/user scenarios: in the first, anyone can hold a CBDC; in the second, only individuals in a CBDC's jurisdiction can hold it; and in the third, only individuals in a CBDC's jurisdiction can hold it and the payer and payee use different currencies. The back-end models are agnostic as to what technology is used for the CBDCs.

In the first scenario, a central bank will let anyone hold its CBDC, regardless of residency. In this scenario, the payer and the payee reside in different jurisdictions and agree to transact in a specific currency with no need for a currency exchange. Figure 2 shows under this scenario, all three CBDC models would have fewer intermediaries than in the correspondent banking model. The cash-equivalent model mimics the peer-to-peer model and does not have any intermediaries. The account CBDC model relies on one intermediary, a central bank ledger for clearing and settling the transaction. And the hybrid CBDC model requires at least one PSP to process the payment and may require two if the payer and payee have different PSPs.

[5] FSB (2020).

[6] Since intermediaries often benefit end users, it is highly unlikely that intermediaries will be removed entirely from the transaction.

[7] See Wong and Maniff (2020).

[8] Figure 2, Figure 3, and Figure 4 are stylized for simplicity and are meant to depict the minimum intermediaries required for each model. It is likely that additional intermediaries may appear in all three scenarios.

Figure 2: Anyone Can Hold the CBDC, Regardless of Residency

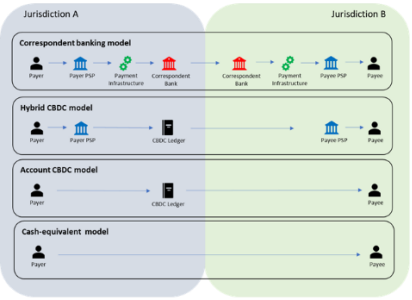


Figure 3: Only Individuals in a Jurisdiction Can Hold the Jurisdiction's CBDC

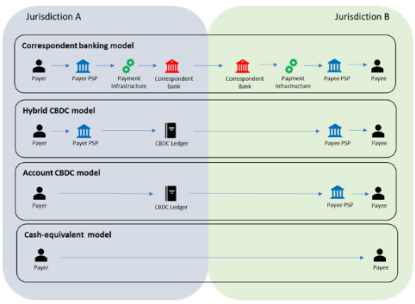
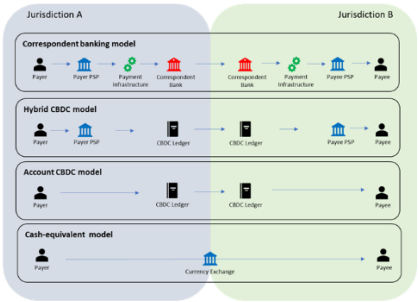


Figure 4.Payer and Payee Use Different Currencies



These figures are stylized for simplicity and are meant to depict the minimum intermediaries required for each model. Additional intermediaries may appear in all three scenarios.

In the second scenario, a central bank limits who can hold its CBDC to only individuals in its jurisdiction. A payee in a different jurisdiction may need a PSP to hold the CBDC, even if the payer and payee use the same currency.[9] Figure 3 shows that this scenario increases the number of intermediaries for the account CBDC model because the payee in jurisdiction B would not have direct access to the central bank ledger in jurisdiction A.[10] To execute the transaction, one or more intermediaries would have to facilitate the transaction between payer and payee. The hybrid model would not require an additional intermediary beyond the PSPs from the first scenario. Whether the cash-equivalent model would require an additional intermediary depends on whether the central bank imposes a technical or a legal limitation on use (for example, limiting transactions within a geographic area).

In the third scenario, which expands on the second, only individuals in a jurisdiction can hold the jurisdiction's CBDC and the payer and payee use different currencies. Figure 4 shows that under this scenario, all three CBDC models would likely require one or more intermediaries. The introduction of a currency exchange would add a new dimension to the cross-border transaction chain, either necessitating another intermediary or requiring the central bank to offer a currency exchange mechanism, as demonstrated in the account-based and hybrid models. In this scenario, the cash-equivalent model would likely require an intermediary for the currency exchange as well.

The Reduction of Intermediaries and Challenges in Cross-Border Payments

Although Figures 2 through 4 show that CBDCs could reduce intermediaries under certain circumstances, would this reduction lead to efficiency and cost improvements? Currently, no CBDCs are being used for cross-border payments, making their speed and cost difficult to observe. However, we can analyze speed and cost data for the correspondent banking model and closed-loop model to assess whether there is evidence to suggest that reducing the number of intermediaries in a transaction chain leads to improved cross-border payments. If intermediaries are, in fact, a material cause of unnecessary frictions in the cross-border payments market, we may expect to see improvements in cost or speed as one moves across the spectrum from correspondent banking to peer-to-peer models.

[9] This would be no different than what happens today, where funds don't technically transfer in and out of a jurisdiction.

[10] This also may be no different than what happens today, where certain jurisdictions require entities connecting to their infrastructure to have a local branch. In Figure 3, this means that the payee PSP would need to have a branch in jurisdiction A.

Data are inconclusive as to whether fewer intermediaries result in cheaper cross-border payments. Table 1 shows that fewer intermediaries are indeed associated with lower costs in an example that considers the cost of transferring 200 U.S. dollars between the United States and Germany. Here, bank transfers represent the correspondent banking model, money transfer operators represent the traditional closed-loop model, and fintech firms are considered, as per the literature, to be closed-loop.[11] The data suggests that the cost of the transaction is more expensive for bank transfers, somewhat less expensive for money transfer operators, and cheapest for fintech firms. This example is consistent with the hypothesis that suggests reducing intermediaries may reduce costs.

Table 1. Rough costs and speed of sending 200 USD from United States to Germany

Speed	Bank	Money Transfer Operator	Fintech
Within minutes		$ 8.50	$ 5.00
Within 1 day	$8-$15		$ 3.50
Within 1-3 days	$25.00	$ 1.99	$ 1.80

Source: Authors' calculations based on top three providers in each category

However, a broader analysis suggests that this may not always be the case and we should not make any conclusions about whether it is cheaper to send a cross-border payment through a model with fewer intermediaries. Table 2 looks at the average cost of sending 200 U.S. dollars from the United States to about forty different jurisdictions. The data highlights that there is significant variability in cross-border payment costs. For example, the cost of a bank transaction that takes an hour to complete is less than that of money transfer operators and fintech firms. Yet the cost of a 3-5 day bank transaction is almost four times the cost of a bank transaction that takes an hour or less to complete, and may be cheaper at a money transfer operator or a fintech firm. The data indicates that transaction costs are often dependent on a number of factors, including how the transaction was made (in-person versus online), funding source (bank account or credit card), specific currency corridor, and the size and reach of the PSP.

Table 2. Rough costs and speed of sending 200 USD from the United States (forty currency corridors)

Speed	Bank	Money Transfer Operator	Fintech
Less Than 1 Hour	$ 9.84	$12.78	$10.66
Same Day	$ 7.27	$ 9.32	$ 9.89
Next Day	$12.04	$ 9.69	$ 9.25
3-5 Days	$38.93	$ 9.83	$ 8.13

Source: Authors' calculations based on World Bank (2021) Q2 2016-Q3 2020

It is also possible that assumptions made about the number of intermediaries involved in bank, money transfer operator, and fintech firm transactions were oversimplifications. While they have traditionally been categorized as closed-loop systems, many money transfer operators and fintech firms still rely on banking services for their cross-border activity. It is possible that certain money transfer operators and fintech firms should no longer be classified as being closed loop. Moreover, in some cases, fintech firms have opted to become licensed financial institutions or even banks, further blurring the distinction between bank and fintech.

[11] See, for example, Beck and Hancock (2020).

Several additional factors unrelated to the length of the transaction chain might also explain the cost differential between the different types of providers. Banks, money transfer operators, and fintechs, for example, are all subject to different regulatory frameworks, which may result in different consumer protection and other compliance requirements, leading to different operating costs. Consumer deposits at banks are typically insured, whereas consumer deposits at money transfer operators and fintechs are not directly insured. In addition, intermediaries may have different customer focuses or service offerings, resulting in different business models. Fintech firms typically have smaller, focused operations and operate virtually. Banks typically offer a range of services and maintain a significant physical presence. Intermediaries may also use different technologies and newer technologies may allow fintech firms to operate more efficiently than banks or money transfer operators that are burdened by legacy systems.

New technology may also enable the shortest possible transaction chain, the peer-to-peer model. Bitcoin, for example, has been touted for its ability to allow users to conduct peer-to-peer transactions without a central intermediary (though in practice, it is mostly used for speculation rather than for payments). In its simplest form, bitcoin can be sent by payers to payees using self-managed wallets—about as close to a peer-to-peer model as possible.[12] Although transactions do not require an intermediary, payers still pay fees to have their transactions recorded on the ledger, called the blockchain. These fees are not based on value, but on the size of the data in the transaction.[13] As more payers execute transactions, network congestion can lead to an increase in fees and a slowdown in confirmation time. Additionally, most bitcoin holders use intermediaries (such as exchanges) to buy, hold, and transfer bitcoins for convenience. Although a decentralized system has the potential to reduce intermediaries, lower costs, and speed up transactions, this potential has not been realized yet.

Observations for Designing a CBDC for Cross-Border Payments

In theory, a CBDC could decrease the number of intermediaries in a cross-border payment. In practice, it is not clear whether reducing the number of intermediaries will have any practical effect on efficiency and cost. The inconclusive cost comparisons suggest that alternatives to correspondent banking have not fully alleviated the frictions in cross-border payments, despite removing some intermediaries. In some cases, efficiency and costs were lower even with added layers. In addition, the introduction of new technology, such as blockchain, has not eliminated intermediaries outright. In light of these experiences, we conclude this note with three observations about intermediaries and CBDC design.

Jurisdictions can support intermediaries by supporting straight-through processing.

If shortening the length of the transaction chain does not necessarily improve costs and efficiencies, other solutions, such as supporting straight-through processing, may. Straight-through processing refers to the automated processing found in electronic financial transfers and its absence often results in delays and increased costs for both the transaction and reconciliation process. Central banks may choose to support straight-through processing in existing systems and in any potential CBDC implementation. For a CBDC to improve straight-through processing, it will need to have some degree of interoperability with existing payment systems.

A comprehensive approach is needed to reduce frictions that materially affect efficiency and cost.

[12] Having a custodian host a wallet will likely add an intermediary to the transaction.

[13] Since the protocol uses unspent transaction output (UTXO), the composition of UTXOs required to complete a transaction is more important than the value associated with the UTXO. It would be similar to the cost of a cash transaction being dependent on how many dollar bills you use rather than the value of the bills.

The scenario exercise in this note highlights that policy decisions may dictate whether CBDCs will be able to reduce intermediaries in the cross-border transaction chain. Who can access a jurisdiction's CBDC and what roles banks and other PSPs play in the ecosystem will have significant implications for how cross-border payments might evolve. However, as the data shows, the removal of intermediaries alone may not result in reduced frictions such as costs. Other policy decisions may be more effective in improving cross-border payments, such as expanding operating hours of the financial ecosystem and improving interoperability among core systems.[14]

A peer-to-peer model may only be feasible with physical cash or a fully decentralized system.

Despite having the shortest CBDC transaction chain, the peer-to-peer model may only be possible with cash and fully decentralized systems where everyone can access a CBDC, making the model unrealistic for CBDC designs. Digital systems need entities to process and confirm transactions, even in decentralized environments, prevent payers from double spending. These validators are in practice intermediaries, even though they operate in a decentralized accounting system. Payers rely on them, as third parties, to confirm transactions. Validators incur costs that have to be passed on to someone and ultimately take the form of transaction costs. Thus, despite trying to replicate an instant, low-cost, intermediary-less cash transaction in a digital environment, current systems have yet to achieve that goal. A cash-equivalent CBDC will still need to be processed and confirmed by something, somewhere— and policy decisions will likely dictate who bears the cost.

Conclusions

For central banks seeking to use CBDCs to improve cross-border payments, merely changing the back-end model of the transaction may not lead to the desired efficiencies. Moreover, seeking to reduce intermediaries may overlook how intermediaries could provide value-added services for CBDC. Instead, CBDC designs may have to factor in other attributes, such as access and operating hours, to improve cross-border transactions. Although CBDC systems may offer some enhancements over existing cross-border payments models, it is important to consider how the current complexity of cross-border payments might translate in a potentially new CBDC environment. If not fully accounted for, then CBDC for purposes of cross-border payments may inherit some of the same unnecessary frictions that exist today.

References

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[14] It is important to remember that a new central bank liability does not inherently alleviate frictions such as limited operating hours, which is a policy choice. All three back-end CBDC designs, and likely the legacy correspondent banking model, would be an improvement over the existing structure if they operated 24 hours, 7 days a week, and 365 days a year.

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