Master Thesis : Currency Substitution Due to Cross-border CBDC and Its Implications in Financial Stabilities

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Abstract

This paper considers the risk on bank run as cross-border central bank digital currency (CBDC) enters an emerging country. Bank run is a main consideration on the literatures of CBDC, as interest bearing CBDC might compete with demand deposits offered by commercial bank. Means can be legislated to prevent the risk, but cross-border CBDC, especially that coming from a highly developed country, which is overwhelmingly popular as a global means of payment, might be difficult to regulate as the technology of CBDC is digitalized, hence exacerbating the emergence of a bank run. In this paper, an agent-based model is used to approach this issue to simulate the dynamic currency substitution episode, as well as the emergence of a bank run episode.

1 Introduction

During the outbreaks of Covid-19, physical cash and coins are considered to be one of the possibilities of invisible route of transmission, and more and more individuals choose to pay with digital payments. (introduction of CBDC) One major consideration is its risk of financial disintermediation[cite]. As it allows people to hold an "account" directly in the central bank, people used to digital payment have incentives to transfer their cash and deposit into holding CBDC if it offers the same interest rate[cite], since CBDC is by definition backed by central bank, and typically has no risk of run. The withdrawal might cause commercial banks to shrink their balance sheet, hence increasing their leverage on credits. The signal of high leverage and low money holding further causes withdrawal from non-digital payment users, and the economy enters a bank-run episode.

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As mentioned by Diamond and Dybvig (1983), measures like deposit insurance can be used to alleviate the fear of a bank run, hence preventing bank runs to happen. However, this will fail to be the solution if the CBDC that is held widely in the current country is issued by a foreign country. When the foreign currency is also a potential candidate of a global means of payment, this currency substitution effect will be especially difficult to prevent. For potential agents about to withdraw, deposit insurance is no longer a convincing solution, since central banks may also run out of foreign reserves.

As dreadful as it looks, currency substitution might not necessarily happen. Decisions of means of payment is a global coordination game through a self-fulfilling process[cite].

2 Model

2.1 Basis Flow and Structure

The model is composed of two open economies and three sectors — buyers/sellers banks, and government. Each country issues its own currency, but all buyers have the freedom to decide what means of payment (hereafter MoP) to use. There is an alternation of roles between buyers and sellers, with each transitioning to the other role once a successful trade is conducted. This setting is to assure that agents have the incentives to adjust its portfolio of MoP, conceptually similar to the idea given in Trejos and Wright (1995). For each period, buyers decide how much to consume and save, and base on the consumption budget, buyers meet with sellers during a search and matching process.

MoP is then decided under each trade. Both buyers and sellers observe the popularity of each Mop, hence deciding the optimal portfolio of MoP to hold. [1] For every trade and portfolio reallocation that involves altering the banks' ledger, it is immediately recorded, and this in turn causes the leverage of the bank to alter. The leverage of the bank is globally visible to all agents, signalling the soundness of the financial environment. Sensitive agents are then urged to withdraw any premature assets from the bank (in this model I consider only the deposit) if they sense a signal of instability, and through a herding behavior tha bank is thus exposed to a risk of run. This herding behavior can be modeled through introducing an imitation rule (Santos and Nakane, 2021). For simplicity, the bank has an exogenous credit level. Doing so allows the result to be focused on the effect of cross-border CBDC, instead of other financial acceleration coming from the capital market (Bernanke et al., 1996).

Central banks interest rates are temporarily set exogenously.

[1] Under rational expectations, a representative agent looks forward and chooses the optimal mean of payment that provides one the largest lifetime utility. In the absence of perfect coordination and perfect foresight, however, an agent might possibly hold a depreciating currency solely due to the fact that it is the only means of payment widely used regionally.

2.2 Consumption Decision

Following Dawid and Delli Gatti (2018), consumption decision for a buyer is separated into two steps: consumption budget and consumption bundle.

Definition 1 (General Rule of Consumption Decision)**.** For each buyer $b \in \mathcal{B}^t$, given the history of the individual states S_b^t and one's surrounding state $\mathbf{S}^t$, the agent's consumption decision can be denoted as $(C, \{q_j\}_{\forall j \in \mathcal{G}_b})$, where $C \in \mathbb{R}$ denotes the real consumption budget, $\mathcal{G}_b$ denotes the goods seller in contact with buyer b, and q_j denotes the quantity of goods b bought from seller j.

References

Bernanke, B., Gertler, M., and Gilchrist, S. (1996). The financial accelerator and the flight to quality. *The Review of Economics and Statistics*, 78(1):1–15.

Dawid, H. and Delli Gatti, D. (2018). Chapter 2 - agent-based macroeconomics. In Hommes, C. and LeBaron, B., editors, *Handbook of Computational Economics*, volume 4 of *Handbook of Computational Economics*, pages 63–156. Elsevier.

Diamond, D. W. and Dybvig, P. H. (1983). Bank runs, deposit insurance, and liquidity. *Journal of political economy*, 91(3):401–419.

Santos, T. R. E. d. and Nakane, M. I. (2021). Dynamic bank runs: an agent-based approach. *Journal of Economic Interaction and Coordination*, 16(3):675–703.

Trejos, A. and Wright, R. (1995). Search, bargaining, money, and prices. *Journal of Political Economy*, 103(1):118–141.