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Liquidity uncertainty and intermediation

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ABSTRACT

The paper performs a welfare comparison between demand deposit and equity contracts in the presence of intrinsic aggregate uncertainty. In this framework, the welfare dominance of deposit contracts emerges under corner preferences. It is shown that aggregate uncertainty creates high price volatility of ex-dividend equity claims traded in a secondary market and the resulting consumption allocations offer less risk-sharing opportunities to risk-averse consumers than tailor-made deposit contracts. The contingency of early payoffs on depositors' withdrawal order reinforces the welfare performance of deposit contracts, whereas costly liquidation of productive long-term investments deteriorates their welfare performance relative to equity contracts.

1. Introduction

Financial crises are an important reminder that fractional reserve banking systems are prone to liquidity problems that can lead to periods of financial instability. Recently, central banks and governments alike worldwide have followed both conventional and unconventional policies to enhance banks' liquidity in order to restore public confidence.[1] In performing the asset transformation function, depository intermediaries raise funds by issuing debt contracts which provide their holders the option to terminate the contract on demand at a pre-determined return, in order to finance high yielding yet illiquid long-term investments. Due to the liquidity mismatch in their balance sheet, depository intermediaries are prone to liquidity problems which could lead to insolvency.[2] This has raised questions regarding the performance of demand deposit contracts in liquidity provision against alternative contractual forms.

It is well-established in the literature pioneered by Bryant (1980) and Diamond and Dybvig (1983) that demand deposit contracts improve on the competitive outcome by providing risk-sharing opportunities against consumers' private consumption contingencies, but the resulting illiquidity of banks' asset portfolio renders them vulnerable to runs.[3] The present paper investigates the welfare performance of deposit contracts against the default-free equity contracts introduced by Jacklin (1987). Examining the characteristics of the two contractual arrangements in the presence of intrinsic aggregate uncertainty about the demand for liquidity, the paper identifies cases where this friction imposes tighter constraints in the design of optimal equity contracts which therefore can be dominated by a deposit banking structure.

The vulnerability of banks to default has attracted the attention of a strand of literature focusing on the design of deposit contracts that eliminate the bank run equilibrium when depositors are assumed to be sequentially served.[4] An alternative run-proof contractual arrangement is developed by Jacklin (1987) where intermediaries are entirely financed by issuing equity rather than debt and permit the interim trading of equity claims. In a Diamond–Dybvig setting where consumers have corner preferences such that they consume only once in their lifetime, tradable equity contracts are welfare dominant as they provide consumers with optimal risk-sharing opportunities against idiosyncratic consumption shocks without the possibility of default. However, when preferences are assumed to be smooth over time such that different types of consumers have

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[1] See Gertler and Kiyotaki (2010).

[2] For a comprehensive literature survey on the effects of liquidity shortages, see Tirole (2011).

[3] Policies that prevent or mitigate the effects of bank runs have been widely discussed in the literature. For a review of the literature, see Gorton and Winton (2002).

[4] See Cooper and Ross (1998), McCulloch and Yu (1998), Green and Lin (2003), Peck and Shell (2003), Andolfatto et al. (2007), Ennis and Keister (2009), Nosal and Wallace (2009), and Ennis and Keister (2011).

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different valuation of consumption at different dates, the restriction that characterises the design of equity contracts which imposes the same wealth to consumers prior to trade in the secondary market, results in a welfare loss in comparison to tailor-made deposit contracts' allocations.[5] Hence, the assumption of smooth preferences has been widely adopted to justify the evident prominence of depository intermediaries in liquidity provision relative to alternative arrangements.

The model developed in this paper highlights the role of intrinsic aggregate liquidity uncertainty in the design of optimal financial contracts. Contrary to existing literature that relies on the smooth preferences assumption to show the welfare dominance of deposit contracts, the model demonstrates that when the aggregate demand for liquidity is not ex ante known, deposit contracts can dominate in terms of welfare even under a more restrictive preference structure such as corner preferences since they offer more liquidity insurance to risk-averse consumers. This assumption on preferences is adopted to simplify the analysis. A more general preference structure will only reinforce the welfare dominance of deposit contracts in the presence of liquidity uncertainty.

In particular, it is assumed that the fraction of agents that want to consume early in their lifespan is random, so that intermediaries can only make conjectures about the actual realisation of the aggregate demand for liquidity from a known distribution when contracts are offered. Therefore, contracts are incomplete as their interim payoffs are independent of the prevailing state of the world and only second-best allocations are attainable. Specifically, deposit contracts are liquidated on demand, providing consumers with the option to receive a pre-determined interim payoff. In contrast, equity contracts provide a stream of payoffs and intermediaries are restricted ex ante to commit to a level of investment in the underlying technologies as specified by the contracts' terms. Thus, equity contracts have a positive worth at the interim date that facilitates trade among different types of consumers in an ex post secondary market. Market clearing ensures that the equilibrium market price reveals the state of the world so that interim consumption is contingent on the realised demand for liquidity. Depending on the prevailing state and the primitives of the model, two possible equilibrium configurations that can arise in the ex post secondary market are identified.

The findings suggest that when liquidation of investment in the productive technology is costless relative to storage, equity contracts could result in a greater welfare loss than deposit contracts because they offer less liquidity insurance in the state of the world that is mostly wanted by risk-averse consumers, and more liquidity insurance when it is least desirable. To facilitate the comparison with the literature that sees bank fragility emanating from extrinsic uncertainty when depositors are sequentially served, contingency of the deposit contracts' interim payoff on depositors' withdrawal order reinforces their welfare dominance. However, when investment in the productive technology is costly to liquidate, equity contracts can become welfare dominant as equilibrium consumption allocations are independent of the liquidation costs.

Although the paper focuses on the welfare analysis of financial intermediaries with different capital structure, the results can also be extended to welfare comparison between alternative channels of liquidity provision. The contractual arrangements considered in the paper can be interpreted as depository intermediaries with mutual ownership that raise funds by issuing deposit contracts, and non-depository intermediaries that issue tradable equity claims such as mutual funds. In contrast to the welfare evaluation in Qi (2003) who distinguishes between monitoring banks and non-monitoring mutual funds in the presence of borrowers' moral hazard, the present paper does not impose any qualitative differences between these two types of intermediaries.[6] Alternatively, it can be viewed that liquidity is supplied in the economy indirectly through depository intermediaries, or directly by trading of firms' shares that have a pre-determined dividend policy and access to the productive investments in the economy. As such, the results of the paper provide a welfare evaluation of consumption allocations attainable under different configurations of the financial system of an economy.[7]

The rest of the paper is structured as follows. Section 2 describes the model and the benchmark case of full information. Section 3 analyses the optimal form of the demand deposit and equity contracts. The welfare comparison of these two contracts is described in Section 4, and conclusions are presented in Section 5. Proofs are provided in the Appendix.

2. The model

The banking environment in this model is based on Allen and Gale (2005) framework that introduces uncertainty about consumers' demand for liquidity in the Diamond and Dybvig (1983) setup.

There is a single homogeneous commodity in the economy that can be used for consumption and investment, and three dates indexed by $t = 0, 1, 2$. There is a continuum of measure one of ex ante identical consumers born at date 0 with an endowment of one unit of the commodity, and nothing thereafter. Consumers receive a privately observed liquidity shock at date 1 and may become either impatient with probability $\pi \in (0,1)$, or patient with probability $1-\pi$. Consumers are assumed to have corner preferences such that impatient consumers derive utility only from the consumption of the commodity at date 1, whereas patient consumers only from consumption at date 2. Expected utility is given by

$$V(C_1, C_2; \pi) = \pi U(C_1) + (1-\pi)U(C_2), \tag{1}$$

where C_t denotes consumption at date $t = 1, 2$. The utility function $U(C_t)$ is twice continuously differentiable with $U''(C_t) < 0 < U'(C_t)$ and satisfies the Inada conditions.

Aggregate uncertainty is modelled by assuming that the preference shock π is a random variable that takes two possible values $0 < \pi^L < \pi^H < 1$ with respective probabilities $q \in [0,1]$ and $1-q$. The distribution of the liquidity shock is common knowledge at date 0 and uncertainty is resolved after consumption decisions have been made at date 1. The liquidity shock is independently and identically distributed across consumers so that, from the law of large numbers, π also represents the proportion of impatient consumers in the economy. Therefore, there is ex ante uncertainty about the aggregate demand for liquidity as the fraction of consumers who turn out to be either type is random.

There are two risk-free technologies available to all consumers in the economy. There is a storage technology with a return of 1 unit at date $t+1$ for every unit of the commodity invested at date $t = 0, 1$, and a long-term technology with a certain return of $R > 1$ units for every unit of the commodity invested at date 0. If the

[5] See Jacklin (1987), Jacklin and Bhattacharya (1988), Haubrich and King (1990), and Alonso (1996).

[6] Departing from the welfare comparison between the two contractual forms, Gorton and Pennacchi (1990) focus on intermediaries with mixed capital structure where both types of contracts are issued by the same intermediary (i.e. commercial banks). They demonstrate that, in equilibrium, informed consumers hold equity whereas uninformed consumers hold debt as deposit contracts provide a mechanism to protect the latter from being exploited in the secondary market by coalitions of the informed consumers.

[7] For more information, see Allen and Gale (1995, 2000).