## Review of Literature

### Interest rate swap pricing

Formal swap agreements were first seen in financial markets in 1981/1982. Smith et. al. (1988) present two models of pricing swaps. One model replicates the payoff of a swap through a portfolio of forward or futures contracts. The other model replicates the payoff through a portfolio of floating rate and fixed rate corporate bonds. Smith notes that for a portfolio of bonds, there is an exchange of the principal at the end of the bond term, while for an interest rate swap the principal is usually notional and not exchanged. Thus, the impact of a default is greater for a corporate bond default than for an interest rate swap. Futures contracts on the other-hand are exchange-traded and settled daily and the risk of loss due to counterparty default is close to zero. For forwards, the contract value is realized only at the end of the contract period and has greater potential for counterparty default than for futures. An interest rate swap is somewhere in-between: it is periodically settled (on the payment dates).

Minton (1997) examines these valuation models. He finds that the fixed rate of the interest rate swap is discounted by ~4 bps compared to a replicating portfolio of Eurodollar futures (Eurostrips) and that movements in swap rates and Eurodollar futures rates are highly correlated. When evaluating the portfolio of bonds model, he finds that actual swap rates fall between the rate derived from a portfolio of corporate bonds and the rate derived from Eurodollar futures. The risks of a counterparty default are much more severe in the case of bonds and nearly non-existent in the case of swaps. Proxies for counterparty credit quality also had significant explanatory power, suggesting counterparty risk is a factor in observed swaps pricing.

### Liquidity

Biais (1993) proposes a model for a dealer intermediated market and derives the optimal bid-ask spreads quoted by a dealer with constant absolute risk aversion. In this model, the reservation prices for dealers (that is the price at which the dealer is indifferent between trading and holding on to his portfolio) is proportional to the variance of the price and the size of the liquidity shock (market order) relative to the dealer’s inventory.

### Price Volatility

### Systemic Risk and Contagion

Jackson and Pernoud (2021) outline two main avenues of contagion (that is financial distress at one institution spreading throughout the financial system): firstly, through defaults and firesales of assets that diminish the value of interconnected financial institutions (the network channel) and secondly, through feedback effects such as bank runs and credit freezes. For the first avenue, consider the case when a large financial institution fails. The value of other institutions that do business with them is also diminished and can cause a cascading series of failures. Each failure leads to additional bankruptcy costs and the final cost to the system can greatly exceed the initial shock. Such models are explored by Rochet & Tirole (1996) and Allen & Gale (2000). Another way that financial institutions are interconnected are through the assets they trade. That is, even though two financial institutions might not directly do business with each other, they might own assets that are highly correlated. When a bank becomes insolvent, it often must sell assets at distressed prices. Such sales can also depress prices of related assets and drive institutions that hold those assets to insolvency. This type of models are explored by Kiyotaki & Moore (1997), Cifuentes et al. (2005), Gai & Kapadia (2010), Capponi & Larsson (2015) and Greenwood et al. (2015).

Besides the network avenue, contagion can also occur through feedback loops and multiple equilibria. The classic Diamond and Dybvig (1983) model illustrates how multiple equilibria can lead to panic and bank runs. Banks lend out money long term and take in deposits for short terms. If enough depositors demand to withdraw their funds at once, the bank cannot repay all of them. In fact, if depositors believe a bank is insolvent (or even that others believe that the bank is insolvent), they have an incentive to be the first in line to pull their funds out. Thus, a change in belief about the solvency of a bank can lead to a self-fulfilling insolvency, without any decrease in the value of the bank’s actual portfolio of loans. Similarly, banks beliefs about the creditworthiness of their counterparties can lead them to pull back their lending, leading to the very adverse credit condition and defaults that they were anticipating. This chain of defaults can cast doubts about the solvency of other banks, eventually leading to a systemwide freeze where banks stop lending to each other. This type of models are explored by Bebchuk & Goldstein (2011), Brunnermeier (2009) and Diamond and Rajan (2011).

### Central Clearing

The policy and market implications of a central clearing mandate are discussed extensively by Pirrong (2011). Per Pirrong, CCPs should clear liquid, standardized products, as illiquid products can pose substantial risks to the CCP. They can reduce the disruptive effect of defaults by drawing on additional sources of capital and facilitating orderly liquidation of positions. However, they could also increase systemic risk by requiring additional margin during periods of financial stress. In addition, by mutualizing the risk of default, they can induce market participants to take more risk (moral hazard and selection issues). CCPs are also subject to economies of scale and scope (that is, the market will converge to one or few large CCPs that can economize over costs of warehousing and multiproduct netting).

Benos et al. (2019) explores the issue of economies of scale/scope. Regulators in Europe and United States have required “local” CCPs under their jurisdiction. Benos et al. find that the same contract trades at different prices when cleared through different clearinghouses (London Clearinghouse and Chicago Mercantile Exchange Clearing) and suggest that this basis arises due to increased collateral costs when clearing is fragmented. Duffie and Zhu (2011) also show that theoretically concentrating clearing to one CCP can economize on collateral.

Bernstein et al. (2019) look at the impact of central clearing on equities pricing by examining the prices of the same stocks traded on New York Stock Exchange (NYSE) and Consolidated Stock Exchange (CSE). The NYSE established a clearinghouse in 1892 while the CSE did not. Bernstein et al. find that the same stocks on the NYSE traded for 90-173 premium over the CSE price.