2017 Marjolin Prize
« Traditional and Shadow Banks During the Crisis »
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Non-technical summary

"Shadow banks" now account for about a quarter of total financial intermediation worldwide (IMF, 2014).[1] They are market-based institutions ranging from money market funds to asset-backed securities issuers, supplying credit through more or less complex intermediation chains outside of the traditional regulated banking system. By most accounts, the emergence of shadow banking has been largely motivated by regulatory arbitrage (Acharya et al., 2013; Gorton and Metrick, 2011), i.e. an attempt to bypass the cost associated with the regulations traditional banks must comply with, enabled by financial innovation allowing many of the services provided by traditional banks to be sustained by other types of banks (see e.g. Merton, 1995; Rajan, 1998a).

Following the failures of financial regulation revealed by the crisis of 2007, the need for regulatory reforms emerged a consensus (Duffie, 2016). However, while the collapse of shadow banking was at the heart of the crisis, the ongoing tightening of banking regulation applies to traditional banks, not shadow banks. Some debates about the effectiveness of banking regulation thus center on their effects on shadow banks, with concerns that financial intermediation may migrate away from traditional banks and towards shadow banks (Hanson et al., 2011; Buchak et al., 2017). Yet, more complex interactions between both sectors, beyond regulatory arbitrage, are suggested by evidence that during the crisis large amounts of assets and liabilities were transferred from shadow to traditional banks. To gauge the effects of traditional banks' regulation on shadow banks, one needs to understand these interactions, and in particular why traditional and shadow banks coexist.

We propose a theory of the coexistence of traditional and shadow banks. In our model, bankers must choose to set up a traditional or a shadow bank: Shadow banks escape the costly regulation traditional banks must comply with, but forgo deposit insurance, which traditional banks can rely upon in a crisis. Thus, in a crisis, shadow banks repay their creditors by selling assets at fire-sale prices to traditional banks, which fund these purchases with insured deposits. The larger the relative size of the traditional banking sector, the higher these asset prices, and thus the higher a banker's incentive to set up a shadow bank in the first place. We show that in equilibrium traditional and shadow banks coexist. The analysis implies that an increase in deposit insurance leads to a *decrease* in the relative size of the traditional banking sector, and that in equilibrium, the shadow banking sector is larger than socially optimal. Our model is consistent with several facts from the 2007 financial crisis: some assets and (deposit-like) liabilities migrated from shadow banks to traditional banks, and shadow bank assets were sold to traditional banks at fire sale prices.

Specifically, we consider a model with three dates 0, 1, 2, and two groups of agents: bankers and households. At date 0, each banker can set up a traditional bank or a shadow bank. The banker invests his endowment, which constitutes the banks' only equity. Banks can also issue

[1] This estimate is in terms of credit intermediation (see IMF, 2014). For descriptions of shadow banking, see Pozsar et al. (2013) for the United States, ESRB (2016) for the European Union, IMF (2014) and FSB (2015) for global estimates. Globally, shadow banks' assets were worth $80 trillion in 2014, up from $26 trillion more than a decade earlier (FSB (2015)).

claims to households, which we assume must be money-like claims, i.e., riskless short-term debt (henceforth "short-term debt").[2] With these funds, banks invest in risky assets which pay off at date 2. At date 1, two states are possible: Either a crisis occurs, in which case date-2 asset returns are low and uncertain, or no crisis occurs and date-2 asset returns are high and certain.

We assume two differences between traditional and shadow banks. On the one hand, traditional banks incur a cost associated with the regulation they must comply with, which shadow banks evade. This assumption captures the idea that shadow banking is largely motivated by regulatory arbitrage (Hanson et al., 2011; Buchak et al., 2017). On the other hand, traditional banks can, up to a limit, issue claims backed by deposit insurance, which shadow banks cannot. Therefore in a crisis at date 1, despite uncertain asset returns, deposit insurance enables traditional banks to issue the riskless claims households demand, but not shadow banks. We assume that deposit insurance is actuarially fairly priced and limited, i.e. each bank can issue riskless debt only up to a fixed dollar amount. In practice, deposit insurance only guarantees a limited level of deposits. In the U.S., this limit holds per depositor, per FDIC-insured bank.[3] It follows that only part of households' wealth can be invested in insured deposits, so that as we assume in our model, each bank is *de facto* limited in the total dollar amount of riskless debt it can issue using deposit insurance. This limit may stem, for instance, from fiscal costs (see Davila and Goldstein, 2016), or ex-ante distortions in banks' behavior (Calomiris and Kahn, 1991; Diamond and Rajan, 2001).

If at date 1 there is no crisis, asset returns are high and certain. Thus all banks can issue riskless debt, which they do to refinance their assets with short-term debt. Instead, in a crisis, shadow banks are unable to roll over their short-term debt because their assets are risky and households demand riskless debt. Hence, shadow banks must liquidate assets to repay their existing debt. We assume that only traditional banks can buy shadow banks' assets in a crisis. They can finance these purchases by issuing short-term debt backed by deposit insurance. Because of limited deposit insurance, traditional banks have limited debt capacity and therefore shadow banks' assets trade at a discount.

At date 0, when bankers choose to set up a traditional or a shadow bank, they trade off the costs and benefits associated with each type of bank, i.e. low regulation costs but need to sell assets at a discount in a crisis versus high regulation cost but ability to buy assets at a discount in a crisis. The trade-off depends on the asset discount anticipated in a crisis, itself a function of the relative size of the two banking sectors. The larger the relative size of the traditional (shadow) banking sector, the higher (lower) asset prices in a crisis, and the higher bankers' incentive to set up a shadow (traditional) bank in the first place. In that sense, traditional and shadow banks form an ecosystem. In equilibrium, bankers must be indifferent between setting up a traditional or a shadow bank. This pins down asset prices in a crisis and thus the relative size of the traditional and shadow banking sectors in equilibrium.

[2] When households are infinitely risk-averse, short-term debt arises naturally as the optimal contract between the households and the bank. For instance, in Gennaioli et al. (2013) households have an infinite risk-aversion utility function, and in Caballero and Farhi (2016) they have Epstein-Zin preferences with infinite relative risk aversion and infinite intertemporal elasticity of substitution.

[3] Since the FDIC creation in 1934, this limit has increased from $2.5k per depositor per bank, to $250k.

Our analysis is consistent with several facts from the 2007 financial crisis.

First, in our model, shadow banks must liquidate assets in a crisis to repay their existing debt. This is consistent with the wide run on the shadow banking system that occurred in the crisis (Gorton and Metrick, 2011). Instead, in our model, traditional banks are able to issue short-term debt in a crisis. This is consistent with the evidence that during the crisis, almost $600 billion of deposits went into the largest traditional banks in less than a month, following the bankruptcy of Lehman Brothers in 2008q3 (see Acharya and Mora, 2015, for a discussion).

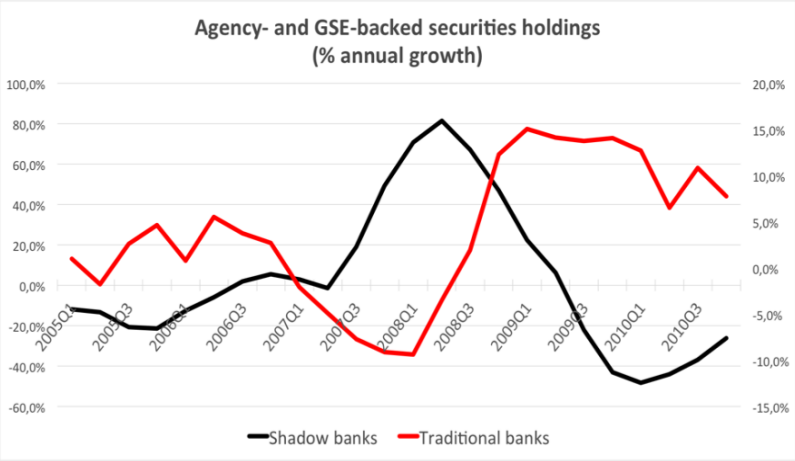

Figure: Traditional and shadow banks' asset flows
Source: Financial Accounts of the United States

Second, in our model, traditional banks purchase shadow banks' assets in a crisis. This is consistent with the evidence that in the crisis, about $800 billion assets flew out of shadow banks, out of which $550 billion flew into traditional banks from 2007q4 to 2009q1.[4] The corresponding asset flows are shown in the above figure, using the Financial Accounts of the United States data. In our model, traditional banks finance these purchases by issuing riskless debt backed by deposit insurance. Using Call Report data, we regress traditional banks' asset purchases on deposit changes. We find evidence that traditional banks purchased assets sold by shadow banks by issuing *insured* deposits. Finally, consistent with our assumption that deposit insurance is limited, there is evidence that in the crisis, mortgage-backed government-agency securities traded at spreads well above historical norms (Merrill et al., 2012; Gagnon et al., 2011). Such high spreads for a security with no credit risk points to the scarcity of asset buyers' arbitrage capital.

Third, in our model, asset fire sales arise a crisis. Gorton and Metrick (2011) provide evidence that in the crisis, certain higher-rate bonds traded at a higher spread than lower-rate bonds of the same category and maturity. So many higher-rated bonds were sold that their price fell to

[4] The reason why these numbers do not exactly add up is twofold. First, traditional banks have used depost inflows in the crisis for other purpose than asset purchases (for instance, to meet credit line drawdawns, as shown in Ivashina and Scharfstein, 2010). Second, the documented figures come from balance sheets data and it need not be that, for a given volume, assets switching from one bank to the other keep a constant value. Indeed, it can be that assets trade at a discount, in which case the asset seller's balance sheets contraction is greater than the buyer's balance sheets expansion. Abbassi et al. (2015) also find banks played an important role in providing price support to the distressed securities markets by buying fire-sold securities.

attract buyers. This negative spread thus provides anecdotal evidence of fire sale of assets. Other evidence of asset fire sales is documented in Krishnamurthy (2008) and Chernenko et al. (2014). Arbitrage of regulatory costs has been an important feature of the banking industry since the first Basel accords of 1988. Some debates about the effectiveness of banking regulation thus center on regulatory arbitrage by shadow banks (Hanson et al., 2011), whereby shadow banks emerge in response to high regulatory costs for traditional banks. Yet, this view does not capture the interactions between both sectors that we document, nor their coexistence. For instance, if traditional banks face higher regulatory costs and no advantage, why not all bankers set up shadow banks? In our model, we assume that traditional banks can, up to a limit, issue claims backed by deposit insurance, which shadow banks cannot. We study how, in our model, the level of deposit insurance affects the relative size of traditional and shadow banks. We find two competing effects.[5]

On the one hand, traditional banks' increased debt capacity allows them to operate on a larger scale. This effect increases bankers' incentives to set up a traditional bank. On the other hand, traditional banks use their increased debt capacity to bid for shadow banks' assets in a crisis, which leads to higher asset prices. In turn, higher asset prices in a crisis increases shadow banks' initial debt capacity, which allows them to operate on a larger scale. This second effect increases bankers' incentives to set up a shadow bank.

We show that the latter effect dominates the former. To gain intuition about this result, recall that asset prices are pinned down in equilibrium so that traditional banks' regulatory costs are offset by their purchases of shadow banks' assets. Everything else equal, when deposit insurance expands, traditional banks use their increased debt capacity to bid for shadow banks' assets in a crisis, which leads to higher asset prices. This increases bankers' incentives to set up a shadow bank. Therefore, for traditional and shadow banks to coexist when deposit insurance expands, asset prices must decrease to realign bankers' incentives to set up either type of bank. For asset prices to decrease in a crisis, the economy moves to an equilibrium with a relatively higher size of shadow banks. Overall, we find that expanding support to traditional banks in a crisis *increases* the relative size of shadow banks.

Last, we consider the normative implications of our analysis, comparing the equilibrium size of both sectors to their socially optimal size. We find that asset fire sales involve a pecuniary externality. When operating a shadow bank, bankers take as given the asset purchases from traditional banks in a crisis. At the margin, they fail to internalize that operating a shadow bank instead of a traditional bank reduces the support from traditional to shadow banks in a crisis. In turn, shadow banks' ability to issue riskless debt initially depends on the collateral value of their assets in a crisis. This involves a pecuniary externality whereby too many bankers operate a shadow bank in equilibrium, reducing other shadow banks' profitability. We show that in equilibrium, a social planner would choose to have relatively less bankers operating shadow banks, i.e. a smaller relative size of shadow banks.

[5] We study *small* changes in traditional banks' support in a crisis because large changes in traditional banks' support in a crisis wipe out either type of bank from the market, which is an effect already emphasized in existing models of shadow banking as regulatory arbitrage (see e.g. Plantin (2015), Ordonez (2013), Harris et al. (2015)).

This paper relates to several strands of the literature.

Merton (1995) and Rajan (1998a,b) are early discussions of the future of traditional banks in light of increased competition from other types of banks.[6] More recently, Hanson et al. (2011) show concerns that ongoing banking reforms fail to fully come to grips with shadow banks. Given the level of financial competition, they argue that tightened regulation applying to traditional banks will drive a larger share of intermediation into shadow banks. In this paper, we find that despite higher regulatory costs, traditional are complements to shadow banks. In line with the regulatory arbitrage view, we find that absent regulatory costs for traditional banks, traditional and shadow banks would not coexist. Bankers would only set up one bank type.

Some papers study banking regulation in the presence of shadow banks, i.e. capturing the regulatory arbitrage mechanism. Plantin (2015) studies optimal bank capital regulation in the presence of shadow banks, and finds that the optimal regulation needs not be in line with current regulatory reforms. In Ordonez (2013), regulation provides a commitment device for traditional banks to avoid excessive risk taking. He finds that an optimal policy is to tax shadow banks and subsidize traditional banks, allowing banks to self-select into the traditional and shadow banking sectors depending on their investment opportunities. In the existing literature, shadow banks emerge in response to tightened regulation of traditional banks, failing to explain the coexistence of traditional and shadow banks that we observe in reality. This is the aim of this paper. We propose a theory of the coexistence of traditional and shadow banks based on their interactions in a crisis, consistent with documented stylized facts.

A second group of theories assume the coexistence of traditional and shadow banks. Luck and Schempp (2016) study the conditions for runs in the shadow banking sector to spread to traditional banks. Hanson et al. (2015) are interested in which assets are held by traditional versus shadow banks.

Our model is in line with theories of banks as issuers of riskless claims. A seminal paper is Gorton and Pennacchi (1990).[7] Our model is based on Stein (2012), however we consider two types of banks, traditional and shadow banks.

Finally, some papers study the coexistence of traditional and shadow banks. In LeRoy and Singhania (2017), deposit insurance subsidizes traditional banks, benefitting shadow banks through different channels depending on how deposit insurance is priced. The relative size of the traditional banking sector then depends on the size of the insurance subsidy. Gornicka (2016) develops a model where shadow banking stems from regulatory arbitrage by traditional banks, and traditional banks provide exogenous guarantees to shadow banks that render both bank types complements. To the best of our knowledge, our paper is the first to provide a theory of the coexistence of traditional and shadow banks based on their interaction in a crisis, that is consistent with stylized facts from the financial crisis.

[6] Other examples include Boyd and Gertler (1994) and James and Houston (1996).
[7] Other recent papers include DeAngelo and Stulz (2015), Plantin (2015), and Gennaioli et al. (2013).

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