



## The real consequences of financial stress



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### ABSTRACT

We introduce a dynamic banking-macro model, which abstains from conventional mean-reversion assumptions and in which—similar to Brunnermeier and Sannikov (2010)—adverse asset-price movements and their impact on risk premia and credit spreads can induce instabilities in the banking sector. To assess such phenomena empirically, we employ a multi-regime vector autoregression (MRVAR) approach rather than conventional linear vector autoregressions. We conduct bivariate empirical analyses, using country-specific financial-stress indices and industrial production, for the U.S., the UK and the four large euro-area countries. Our MRVAR-based impulse-response studies demonstrate that, compared to a linear specification, response profiles are dependent on the current state of the economy as well as the sign and size of shocks. Previous multi-regime-based studies, focusing solely on the regime-dependence of responses, conclude that, during a high-stress period, stress-increasing shocks have more dramatic consequences for economic activity than during low stress. Conducting size-dependent response analysis, we find that this holds only for small shocks and reverses when shocks become sufficiently large to induce immediate regime switches. Our findings also suggest that, in states of high financial stress, large negative shocks to financial-stress have sizeable positive effects on real activity and support the idea of “unconventional” monetary policy measures in cases of extreme financial stress.

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### 1. Introduction

The banking system played a central role in the 2007–08 financial meltdown in the U.S. This is, as Reinhart and Rogoff (2009) and Gorton (2009, 2010) underscore, an all too common phenomenon in financial crises that—regardless of the underlying causes—tend to exacerbate and amplify economic downturns. Gorton (2010) points out that whereas in the past loan losses and bank runs have been the conventional mechanisms by which crises were triggered, more recently, banking crises seem to be strongly related to adverse shocks to asset-values and to financial stress. In the aftermath of the recent “great recession,” a number of studies have investigated the relationships between banking crisis, financial stress and economic output. He and Krishnamurthy (2008), Brunnermeier (2009), Adrian et al. (2010), Davig and Hakio (2010) and Hubrich and Tetlow (2011) conduct empirical analyses for the U.S. economy. Monnin and Jokipii (2010) consider several OECD countries; Mallick and Sousa (2011) and Hollo et al. (2012) look at the euro area; and van Roye (2012) focuses on Germany.

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Theoretical analyses of the recent meltdown have largely used the financial accelerator to model the linkage between the financial and the real sector. This approach is not without problems. Brunnermeier and Sannikov (2010/2011,2013)<sup>1</sup> point out that the destabilizing dynamics are not adequately captured in such a setting. Furthermore, the financial-accelerator theory has been mainly applied to firms and households, so far. Bernanke et al. (1999) show that financial markets can have amplifying effects. In the DSGE tradition, however, there are only locally magnifying effect, namely, through collaterals. Collateral values rise at a high level of economic activity, making more and less expensive credit available; and the reverse happens at low levels of economic activity.

From a technical viewpoint, DSGE-type models suffer from the facts that they are typically solved via linearization about a unique and stable steady state, and that amplifying effects occur only with respect to deviations from the steady state. Moreover, they generally do not track debt dynamics.<sup>2</sup> Departures from the steady state are eventually mean reverting. Although the economy might accelerate, ultimately, it will revert back to the steady state. Related empirical analyses are often conducted by means of linear vector autoregressions (VARs) as in Gilchrist et al. (2009), Gilchrist and Zakrajšek (2012), Christensen and Dib (2008) and Del Negro et al. (2011).

As the recent meltdown has, however, demonstrated, shocks to banks seem to be destabilizing rather than mean reverting.<sup>3</sup> Eminent empirical contributions in this context are Brunnermeier (2009) and Brunnermeier and Pedersen (2009), who show that financial intermediaries<sup>4</sup> often have to liquidate their capital, when asset prices fall and margin requirements rise. This forces financial intermediaries to take a haircut and to further de-lever, which depresses asset prices even further and, thus, reinforces the downward spiral.

Models attempting to capture such mechanisms often stress that falling asset prices, possibly accompanied by a fire sale of assets, have external effects on the financial sector. The possibility of a downward spiral, then, comes from interconnectedness, interlinkages and contagion. Investigations along these lines began with Greenwald and Stiglitz (1993) and continue with Geanakoplos and Farmer (2009), Adrian et al. (2010), Gorton (2010), Geanakoplos (2010) and Brunnermeier and Sannikov (2010/2011,2013). These studies argue that such dynamics create an endogenously generated jump in risk that is usually triggered by large changes in asset-price movements.

Recent research suggests that this process primarily works through the banks' balance sheets. In the first instance, banks may have loan losses arising from defaults of firms or households, the foreign sector, or from sovereign debt. On the other hand, large shocks to asset prices and financial stress affect the asset and liability sides of banks' balance sheets, reducing the availability of credit. As financial stress rises, so will risk premia, repo rates, TED spreads and other credit spreads. These spillovers to other intermediaries (as well as to firms and households) create what Brunnermeier and Sannikov (2010/2012,2013) refer to as endogenous risk. In this context, they refer to a form of "corridor stability," implying that small shocks have little impacts but large ones may have severe consequences.

In this paper, we investigate theoretically and empirically the question of how a crisis of financial intermediaries and financial stress spill over to the real economy. Specifically, we study theoretically what destabilizing mechanisms might be at work on the side of the financial markets that can spill over to the real sector.<sup>5</sup> Looking at the U.S. and five EU countries, namely, the UK and the four largest euro-zone economies Germany, France, Italy and Spain, we examine to what extent such linkages can be detected and quantified empirically. To do so, we use country-specific financial-stress indices constructed by the IMF and discussed in Cardarelli et al. (2011).

Rather than emphasizing—as done in Brunnermeier and Sannikov (2010/2011,2013)—the role of asset prices and asset-price volatility in downward destabilization, our approach focuses on movements in risk premia and credit spreads. This is motivated by theoretical and empirical studies, which show that factors, such as large drops in asset prices, rising volatility, higher risk premia, and runs into liquidity, are highly correlated with movements in the discount rate.<sup>6</sup> Yet, as we will show, triggering of downward instability also depends on the constraints imposed on the banking industry, such as on the growth of capital assets (through borrowing) and on payouts, affecting banks' risk taking, equity formation and leveraging. Higher payouts, for instance, may induce more risk taking and risk transfer and, thus, generate higher aggregate risk and risk premia to be paid by all. We will explore the dynamic behavior for different constraints on banks' decision variables.

Our model is in the spirit of Brunnermeier and Sannikov (2010/2011), who specify capital assets and the evolution of debt as state variables. We introduce model variants, where amplifying mechanisms may be strong or weak. In a version with

<sup>1</sup> There are only a slight differences between Brunnermeier and Sannikov (2010, 2011) and, below, we will refer to those as the (2010/2011) model. Brunnermeier and Sannikov (2010/2011) model define two state variables, whereas the (2013) version uses only one state variable. Qualitatively, both models yield, however, more or less the same properties. We will only occasionally refer to the (2013) version.

<sup>2</sup> Empirically, the debt-to-asset ratio is predicted to fall in booms and to rise in recessions (cf. Gilchrist et al., 2009). Yet, as Geanakoplos (2010) mentions, the empirical measure is distorted through the way the debt-to-asset ratio is measured.

<sup>3</sup> Scholars of the great depression maintain that credit and the banking sector had quite strong destabilizing effects. Minsky (1975, 1982) and Kindleberger and Aliber (2005), for example, regard the credit sector as a significantly amplifying force. Kindleberger and Aliber view the instability of credit and Minsky the way financing becomes de-linked from collaterals as contributing factors to a downward spiral, once large real or financial shocks occur. This important tradition captures many aspects of the banking-macro link.

<sup>4</sup> This may include what Gorton (2010) calls the shadow banking system, i.e., investment firms, brokers and money-market dealers, that has grown sizable in the last 15–20 years.

<sup>5</sup> Note that the model proposed here does not detail the interaction of the financial and real sectors—as is done in Chen and Semmler (2012)—and refer broadly to destabilizing mechanisms arising from financial intermediaries.

<sup>6</sup> The different factors driving discount rates—and, through that, asset prices—are extensively discussed in Cochrane (2011).

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