Research Agenda: On Financial Crises and Prudential Policies

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A long-standing literature in macroeconomics has been concerned with understanding the origins of financial crises. Crises often have devastating economic and social consequences, raising the question of what role government policies should play in helping prevent them. In my research, I develop analytical frameworks to understand theoretically and quantitatively the driving forces behind financial crises and take a normative approach to evaluate what macroeconomic policies are desirable.

In this research overview, I provide a summary of my work in this agenda. I classify my papers in three broad sections: (i) macroprudential policy; (ii) banks and financial intermediation; and (iii) sovereign debt crises. I conclude by outlining what I view as interesting avenues for future research. The work I review reflects collaborations with Manuel Amador, Fernando Arce, Julien Bengui, Saki Bigio, Luigi Bocola, Emine Boz, Louphou Coulibaly, Charles Engel, Juan Carlos Hatchondo, Guido Lorenzoni, Leonardo Martinez, Enrique Mendoza, Pablo Ottonello, Jorge Mondragon, Fabrizio Perri, Ignacio Presno, and Cesar Sosa-Padilla.

1. Macroprudential Policy

An extensive empirical literature has documented that financial crises are typically preceded by credit booms (Reinhart and Rogoff, 2009; Schularick and Taylor, 2012; Mendoza and Terrones, 2014). This observation raises the question of whether expansions in credit are socially efficient or whether they are a symptom of overborrowing by private agents. To evaluate the need for regulation or lack thereof requires understanding the relevant externalities in financial markets.

A central theme in my work has been the development of theoretical foundations for macroprudential policy, prudential government interventions in financial markets with a macro perspective. I have approached the problem of macroprudential regulation from a

constrained-efficiency perspective, examining the problem of a social planner that chooses financial decisions subject to the same frictions as private agents and internalizes the general equilibrium effects. Using non-linear solution methods, my work has established that optimal macroprudential policy can deliver a substantial reduction in financial fragility.

In what follows, I describe selected papers in this line of work.

1.1 Pecuniary externalities

In Bianchi (2011), I develop a theory of overborrowing due to a pecuniary externality that emerges from an occasionally binding financial constraint linked to market prices. Households' borrowing is constrained by their income, which depends on the relative price of non-tradable goods. When aggregate borrowing contracts, the relative price of non-tradables falls, leading to a tightening of households' borrowing constraints. Households do not internalize the general equilibrium effects of their borrowing decisions on prices and how they affect other agents' constraints. I consider the problem of a social planner that chooses borrowing on behalf of the households and is constrained by the same financial constraint. By reducing the amount of borrowing ex ante, a social planner mitigates the decrease in demand for consumption during crises, and doing so mitigates the real exchange rate depreciation and prevents a further tightening of financial constraints, making everyone better off.

The quantitative comparison between the competitive and constrained-efficient equilibrium is conducted by solving the model non-linearly and calibrating the former to match long-run properties of an emerging market economy. The main lesson is that compared to the constrained-efficient equilibrium, the competitive equilibrium exhibits substantially higher probability and severity of financial crises. While the social planner does not find it optimal to reduce the average debt level by significant amounts, the planner does reduce debt levels enough to make financial crises a much lower-probability event. These results complement other theoretical work on inefficient credit booms (e.g., Caballero and Krishnamurthy, 2003; Lorenzoni, 2008; Stein, 2012) as well as the literature on the amplification and propagation effects of financial frictions (e.g., Bernanke and Gertler, 1989; Kiyotaki and Moore, 1997; Mendoza, 2010).

The theory delivers an analytical formula for an optimal state contingent Pigouvian tax on private debt, which induces agents to internalize the systemic impact of their financial decisions and thus provide a rationale for macroprudential policy. The formula establishes that when there is a positive probability that households' borrowing constraint will be binding, a strictly positive tax on debt is required. Moreover, the tax is increasing in the severity with

which the constraint is expected to bind (and therefore the expected severity of the crisis). In addition to taxes on debt, the government can implement the constrained-efficient allocations with state contingent reserve requirements, capital controls, capital requirements or debt-to-income constraints. As it turns out, a constant tax on debt is also shown to achieve about half of the gains from the optimal state contingent tax, but a tightening of the debt-to-income constraint in a non-state contingent fashion is welfare reducing.

Financial crises are often associated with fire sales of assets by agents facing margin constraints, and the resulting financial disruption leads to contractions in economic activity. In work with Enrique Mendoza (Bianchi and Mendoza, 2018), we consider a model in which agents pledge assets as collateral and face working capital constraints. The financial constraint introduces a Fisherian deflation by which deleveraging and contractions in output and asset prices mutually reinforce each other. From a normative point of view, this feedback loop creates a pecuniary fire-sale externality. However, we also identify a time inconsistency problem in macroprudential policy, emerging from the forward-looking nature of asset prices. A policy that raises consumption in a given period helps increase asset prices and push up the collateral value, but it also reduces asset prices in a previous period by lowering the marginal value of the asset payoffs. The optimal policy becomes significantly more complex.

In a calibration to the US economy, the optimal time-consistent policy still delivers overall welfare gains, but now simple policy rules dependent on credit or output may easily backfire. We also show that macroprudential policy has significant effects on asset pricing. The direct effect of a tax on borrowing is to raise the opportunity cost of purchasing assets and therefore reduce asset prices, but by making sharp contractions in consumption less likely, the tax also indirectly increases asset prices by reducing risk premia.

In follow-up work (Bianchi and Mendoza, 2020, RED 2020 special issue to celebrate the 25 anniversary of "Frontiers of Business Cycle Research") we develop a financial stability-growth frontier. The financial stability-growth frontier dictates the combinations of long-run probabilities of crises and output levels that a fixed tax on borrowing can achieve. A tax on borrowing raises the required return on capital and leads to a reduction in investment while it also reduces debt levels and makes financial crises less likely. From a normative point of view, we find that the optimal tax is strictly positive, implying a reduction in both long-run output and the probability of crises.

The work discussed above was conducted under a full information rational expectation paradigm. However, there is a long tradition that dates back to Fisher (1933) and Minsky (1986) that argues that changes in beliefs can play a key role in the dynamics of credit and

crises. In work with Emine Boz and Enrique Mendoza, we explore a setup in which agents and the planner learn in a Bayesian fashion about the persistence of the financial environment (Bianchi, Boz and Mendoza, 2012). We consider several configurations of optimism and pessimism with potential asymmetries between the planner and households. Under one behavioral configuration, in which agents and the planner are very optimistic that loan-to-value ratios will remain high, the planner finds it optimal to ride the credit boom, which precipitates a large crash if financial conditions reverse. When the planner is assumed to be more informed (and less optimistic) than private agents, the optimal tax now features a paternalistic component, in addition to a pecuniary fire-sale externality component and an interaction between the two.

In practice, regulation is often circumvented. In a paper with Julien Bengui, we ask how capital flow management policies should be designed when a fraction of agents can avoid the regulation (Bengui and Bianchi, 2018). Our analysis underscores two effects. First, there is a "leakage" effect. Tighter regulation reduces borrowing by unregulated agents and induces—through the lower need of precautionary savings—higher borrowing by unregulated agents, undermining the effectiveness and the desirability of regulation. Second, there is a "squeezing" effect. Given that some agents cannot be regulated, a reduction in overall fragility requires tightening further the regulation of those agents that cannot circumvent. Overall, the quantitative simulations show that despite moderate levels of leakages, the optimal macroprudential policy remains successful at mitigating the vulnerability to financial crises.

The issue of circumvention also raises the question of what other instruments governments can deploy with a macroprudential objective. In Arce, Bengui and Bianchi (2019), we establish that the accumulation of international reserves by a central bank can serve a similar purpose as capital controls and, under the conditions identified, implement the same allocations. We also show that our macroprudential theory of foreign reserve accumulation can go a long way in accounting for the buildup of international reserves while being consistent with salient cross-sectional patterns of capital flows across middle-income countries.

The lessons from the macroprudential policy literature have rapidly permeated into the policy arena. Within the last decade, macroprudential policy has gone from being a term encountered almost exclusively in Bank for International Settlements (BIS) reports on the implementation of Basel regulation—I myself ran into these reports while working at the Central Bank of Uruguay before starting my Ph.D.—to becoming one of the pillars of macroeconomic policy together with monetary and fiscal policy. Central banks have macroprudential committees or divisions, which depending on the precise institutional setup, are in charge of deploying countercyclical capital buffers/loan-to-value ratios, macroprudential stress tests,

restricting equity payouts, and taxes on foreign capital inflows, among other instruments. In the international setting, the International Monetary Fund (IMF) has drastically changed the views on capital flow management policies, specifically capital controls. What was deemed unacceptable is now part of the accepted policy toolbox. See for example the latest review on IMF's institutional view on the liberalization and management of capital flows (IMF, 2022).

The increased use of macroprudential policies is also becoming fertile ground for empirical work directed at assessing their effects. A snapshot of this literature is provided in a handbook chapter I prepared with Guido Lorenzoni (Bianchi and Lorenzoni, 2021).

1.2 Aggregate Demand Externalities

A related macroeconomic externality emerges when there are nominal rigidities and monetary policy faces constraints—for example, because of a fixed exchange rate (Schmitt-Grohe and Uribe, 2016 and Farhi and Werning, 2016). The key idea is that households do not internalize that saving more during expansions contributes to an increase in aggregate demand during recessions, which helps mitigate the fall in employment.

In Bianchi and Lorenzoni (2021), we provide a simple framework to analyze the role of prudential capital controls and foreign currency reserves. We construct an environment where the central bank faces costs from exchange rate fluctuations, and this hinders the ability of monetary policy to stabilize macroeconomic fluctuations. Using this setup, we show how capital flow management policies can help to ease monetary policy tradeoffs during a capital flight. We argue that trying to stimulate capital inflows during a capital flight may be counterproductive. While stimulating inflows raises aggregate demand, it also increases the interest rate that foreign intermediaries earn from lending to domestic households. On the other hand, restricting capital inflows during economic expansions has a double benefit: it lowers the interest rate paid to foreign intermediaries and shifts aggregate demand towards the future, when the economy may face a recession.

In much of the literature, it is taken as given that central banks face a cost from exchange rate fluctuations (or a preference for stable exchange rates). However, standard open economies with nominal rigidities predict that a floating exchange rate regime is optimal. By letting the currency float, the exchange rate acts as a shock absorber, as in the classic Mundell-Fleming paradigm. However, many central banks classified as flexible exchange rate regimes are reluctant to let the exchange rate fluctuate, a phenomenon dubbed "fear of floating " by Calvo and Reinhart (2002). In work with Louphou Coulibaly, we present an environment in which fear of floating emerges as an optimal policy in the presence of a general equilibrium

feedback between aggregate demand and credit conditions (Bianchi and Coulibaly, 2022). We establish that a nominal exchange rate depreciation can be contractionary, and letting the exchange rate float can expose the economy to a self-fulfilling financial crisis driven by households' deleveraging.

Following the Global Financial Crisis, low interest rates became a major feature of the international monetary system, and the problem of the zero lower bound became a major constraint for monetary policy. Moreover, as countries were individually trying to deal with the risk of liquidity traps, concerns about currency and capital control wars emerged in international policy debates. Research by Fornaro and Romei (2019) suggested indeed that a global paradox of thrift was a real possibility.

In Bianchi and Coulibaly (2021) we present an open economy model with an occasionally binding zero lower bound constraint on the nominal interest rate. We use the model to study the interaction between monetary and macroprudential policy and evaluate the implications for international spillovers and global welfare. To shed light on the interactions between monetary and macroprudential policies, we start our analysis by providing an analytical decomposition that separates the effects of these policies in expenditure switching, intertemporal substitution and aggregate income. A calibration of the model underscores that expenditure switching plays a prominent role for monetary policy, while macroprudential policy operates almost entirely through intertemporal substitution.

We then turn to the normative analysis. We first show that the risk of a liquidity trap generates a monetary policy tradeoff between stabilizing current output and reducing capital flows to lower the likelihood of a future recession. However, leaning against the wind by raising interest rates is not necessarily optimal, even in the absence of capital controls. This is because the resulting contraction in output may lead to higher capital inflows and leave the economy more vulnerable to a liquidity trap. On the other hand, when the government can use capital controls, monetary policy stabilizes output to the extent that the zero lower bound is not binding. As emphasized in Korinek and Simsek (2016), macroprudential policy is preferable to monetary policy to deal with the possibility of a liquidity trap.

Finally, Louphou Coulibaly and I show that in our environment, capital controls are not beggar-thy-neighbor and can enhance global macroeconomic stability. In fact, by using capital controls, individual countries can remain insulated from foreign spillovers and help prevent the outbreak of a currency war. Furthermore, we show that while there may be a role for coordination for capital controls, it is desirable only during a liquidity trap, and it stimulates flows rather than preventing them.

Facing a zero lower bound constraint, many central banks in advanced economies have resorted to more unconventional policies in an attempt to prevent an appreciation of the currency. Notably, between 2010 and 2016, the Swiss National Bank (SNB) increased its holdings of reserves from roughly 10% of GDP to more than 100% of GDP. During this time, the Swiss franc experienced a sizable deviation from covered interest parity (CIP). Specifically, Swiss franc denominated assets delivered a higher rate of return than euro and dollar denominated assets after hedging the exchange rate risk.

In work with Manuel Amador, Luigi Bocola, and Fabrizio Perri, we develop a model that can help understand these facts (Amador, Bianchi, Bocola and Perri, 2020). We present an environment in which the small open economy trades financial assets with intermediaries facing potentially binding financial constraints, as in Gabaix and Maggiori (2015). The monetary authority has an exchange rate objective, which can be implemented with conventional monetary policy as long as it is consistent with the interest parity condition under a non-negative nominal interest rate. When there is no non-negative interest rate consistent with parity, however, the exchange rate policy implies that domestic currency assets become attractive for foreign intermediaries, generating capital inflows to the small open economy. These inflows can be large, but limited by intermediaries financial constraints, thus breaking Mundell's Trilemma that dictates the impossibility of setting both exchange rates and interest rates under free capital mobility.

We then show that implementing the exchange rate policy requires the monetary authority to absorb these flows by accumulating foreign reserves. We also argue that this foreign exchange intervention is costly not only for the monetary authority but also for the small open economy (see also Fanelli and Straub, 2021) and derive a simple measurable formula for these costs: they are proportional to deviations from CIP and the amount of accumulated foreign reserves. These costs can be substantial. Around January 2015, CIP deviations of the franc with respect to the euro reached a monthly average of 85 basis points, and foreign reserves reached close to 80% of GDP. These two observations imply an estimate loss on the order of 0.6% of monthly GDP.

The SNB's decision in January 2015 to abandon the currency floor took many observers by surprise. The prevalent view was that it was feasible for the SNB to maintain the floor with the euro by printing Swiss francs to keep up with the demand. Our work provides a different perspective by uncovering the costs associated with Switzerland's exchange rate policy and the accumulation of reserves.

InAmador, Bianchi, Bocola and Perri (2016), we explore an alternative but complementary

theory of the SNB's abandonment of the currency floor, which hinges on an explicit separation between the monetary and fiscal authority. The key element is that the monetary authority faces a cap on the size of transfers it can receive from the fiscal authority. Faced with a larger demand for Swiss francs (e.g., because of lower euro interest rates), the monetary authority must expand monetary liabilities and acquire foreign reserves. To the extent that it faces a currency mismatch in its portfolio, the increase in the balance sheet opens the door to large potential losses. As we show in the paper, this implies that there is a point at which abandonment becomes inevitable. In the standard speculative attack model, the central bank runs out of foreign reserves and increases the depreciation rate, whereas in our model, the central bank is unable to keep expanding its balance sheet and must appreciate the currency, leading to a *reverse speculative attack.*

1.3 Bailouts and moral hazard

A role for macroprudential policies can also emerge in the context of moral hazard generated by bailouts that occur during financial crises. If the government cannot commit, firms take excessive leverage, anticipating they will be bailed out in a financial crisis. Imposing borrowing limits in this context can eliminate this time inconsistency problem. Two notable studies in this vein are Farhi and Tirole (2012) and Chari and Kehoe (2016).

In Bianchi (2016), I provide a quantitative analysis of the moral hazard effects of bailouts on financial fragility. I present an environment in which binding constraints on equity financing generate a pecuniary externality. A policy that restricts the demand for labor helps to boost profits, relax equity constraints and increase investment. I then consider several bailout configurations in the form of debt relief financed with payroll taxes. The main lesson is that bailouts have very different moral hazard implications depending on whether they are contingent on idiosyncratic or systemic factors. I find that moral hazard effects are limited if bailouts are systemic and broad-based. The logic is that if an individual firm becomes financially constrained, it is not granted a bailout unless the rest of the economy is also financially constrained. In contrast, if bailouts are idiosyncratic and targeted, the firm directly internalizes how financial decisions affect the amount of debt relief they perceive, and it significantly raises leverage to take advantage of bailouts. Ultimately, this makes the economy significantly more exposed to financial crises. This result is suggestive about the perils of "too big to fail." Dávila and Walther (2020) explicitly show that moral hazard concerns are larger when there are big agents in the economy and bailouts are contingent on systemic factors.

When there are limitations in private credit markets, a complete restriction on liquidity support by the government may not be optimal. In Bengui, Bianchi and Coulibaly (2019),

we ask whether it is optimal to restrict ex ante the set of investors that can receive public liquidity support ex post. We show that if the government lacks commitment, it is optimal to have a limited but positive subset of investors in the safety net. Covering all agents is inefficient because it leads investors to overaccumulate illiquid assets, which in turn leads to an interest rate that is too high for risk sharing.

2. Banking and Financial Intermediation

Banks are often at the epicenter of financial crises. What makes banks especially vulnerable is that they carry short-term debt and are exposed to runs (Diamond and Dybvig, 1983). Typically, runs happen in many banks simultaneously and coincide with weak aggregate fundamentals. This observation suggests that general equilibrium feedbacks are potentially important for understanding why financial crises involve bank runs and call for a macroeconomic model of bank runs. Despite recent progress in the literature, we have few macroeconomic models of bank runs (see Gertler and Kiyotaki, 2015).

In Amador and Bianchi (2021), we develop a dynamic macroeconomic model of self-fulfilling bank runs. Banks face limited commitment and default strategically on their bonds. As in micro models of bank runs, a run is the outcome of a coordination failure that occurs between creditors of an individual bank. Namely, an individual bank is vulnerable to a run when it is optimal for investors to withdraw because they anticipate that all other investors will also withdraw and prompt the bank to default on its obligations. Banks' franchise value depend on asset prices, which creates a link between fundamentals and fragility. In general equilibrium, we show that runs can be partial or complete depending on the aggregate level of leverage.

Our main normative exercise regards the analysis of government asset purchases ("credit easing"), which has unequivocally become a key policy within central banks' toolkit. Our analysis offers a more nuanced view of its desirability. Namely, we argue that credit easing is desirable when a crisis is triggered by self-fulfilling runs but can backfire when a crisis is triggered by fundamentals. The key idea is that repaying banks are net buyers of assets during a crisis triggered by fundamentals but are net sellers when they face a run. Therefore, when a crisis is triggered by fundamentals, credit easing leaves repaying banks worse off—as they now have to acquire assets from defaulting banks at higher prices. The result is that more banks default in equilibrium. Moreover, under the plausible assumption that the return on assets held by the central bank is not higher than the one obtained by investors, we demonstrate that credit easing unambiguously reduces welfare. When a crisis is driven by self-fulfilling

runs instead, credit easing is successful at reducing financial fragility. By raising asset prices, credit easing in effect provides liquidity to a bank facing a run. In equilibrium, investors have fewer incentives to run, because they anticipate that the bank will not default even if it faces a run.

Banks also play a crucial role in the implementation and transmission of monetary policy. In practice, the central bank sets a target for the short-term nominal interest rate in the interbank market and uses open market operations and rates on lending facilities and interest on reserves to achieve this target, with the ultimate goal of affecting macro-aggregates. However, for the most part, macroeconomic models abstract from the frictions in this transmission mechanism and effectively assume that the central bank controls the interest rate faced by households and firms. As a matter of fact, issues of "plumbing" of monetary policy have been analyzed almost exclusively within partial equilibrium models (see the literature building on Poole, 1968).

In work with Saki Bigio, we develop a unified framework to study the implementation and transmission of monetary policy (Bianchi and Bigio, 2022). From a methodological standpoint, we embed an over-the-counter (OTC) interbank market into a tractable dynamic general equilibrium model of the banking system. The OTC market is modeled after Afonso and Lagos (2015) and Atkeson, Eisfeldt and Weill (2015). In our model, banks issue deposits on demand and thus face the risk of sudden outflows of deposits. If a bank ends up short of liquid assets to settle those flows, it needs to find a counterparty in interbank market. The frictions in the interbank market imply that there is a liquidity premium from holding central bank reserves, and thus in effect make lending a costly activity. Monetary policy affects the supply of credit precisely by affecting the bank's risk-return tradeoff, giving rise to a credit channel of monetary policy. One of the insights that emerges is that different configurations of open market operations and corridor rates that achieve the same interbank market generate different volumes of banks' lending. Moreover, the pass-through from the interest on reserves to credit is potentially non-monotonic and depends critically on the interaction with capital requirements. In a quantitative application, we also conduct a decomposition underlying the collapse in bank lending during the 2008 financial crisis. Our analysis underscores the importance of disruptions in the interbank market at the height of the crisis.

The role of financial intermediation in the monetary transmission is the subject of an active research agenda. For other recent contributions, see for example, Brunnermeier and Koby, 2019; Eggertsson, Juelsrud, Summers and Wold, 2019; Piazzesi and Schneider, 2021 and De Fiore, Hoerova and Uhlig, 2021.

In an international setting, Saki Bigio, Charles Engel and I develop a theory of exchange rate fluctuations arising from financial institutions' demand for dollar liquid assets (Bianchi, Bigio and Engel, 2021). The model builds upon the observation that dollar funding risk is especially volatile in financial markets and shows how increase in funding risk or an interbank market freezing may leave banks scrambling for dollars and lead to an appreciation of the dollar. A contribution of the paper is to provide a theory of the dollar convenience yield, which has proved central to rationalizing many important empirical observations, including the exchange rate disconnect (Obstfeld and Rogoff, 2000) and the "safe haven" status of the US dollar (Gourinchas and Rey, 2007).

3. Sovereign Debt Crises

In the work I have described so far, it is private financial decisions that lead to financial crises. As we saw recently during the Eurozone crisis and in many emerging market crises, governments may also be at the epicenter of crises. Building on the workhorse model of sovereign default (Eaton and Gersovitz, 1981; Aguiar and Gopinath, 2006; Arellano, 2008), my work in this area has centered on the role of monetary factors in shaping sovereign debt crises.

Inspired by the austerity versus stimulus debate, Bianchi, Ottonello and Presno (2019) evaluate the desirability of conducting a fiscal stimulus under sovereign risk. Using a sovereign default model extended with nominal rigidities and a fixed exchange rate, we ask: Should the government apply a stimulus to mitigate a recession at the expense of higher sovereign spreads, or should it practice austerity to reduce the probability of a debt crisis—even if doing so induces a more severe recession?

We show how the effects of government spending in this environment can be understood through a modified Samuelson rule that balances the traditional public finance forces with stimulus and austerity considerations. The key tradeoff the government faces in a recession is that debt-financed spending lowers unemployment, but it raises sovereign spreads. Calibrating this model for the Spanish economy shows that optimal fiscal policy is overall procyclical (whereas it would be strongly procyclical if the government could commit to repay the debt). At the same time, the optimal policy displays a strong state dependence, calling for stimulus if the economy is in a recession and government debt is low. An important implication of this state dependence is that recessions turn out to be more severe when preceded by high levels of debt, as occurs in the data (Romer and Romer, 2019). We also show empirically that countries with higher default risk exhibit more procyclical government spending over the

cycle than countries with low default risk, consistent with our model.

In Bianchi and Mondragon (2022), we argue that the lack of monetary autonomy can make a government more vulnerable to a rollover crisis. The idea is as follows. When creditors fear others will stop rolling over, the government is forced to tighten fiscal policy. In the absence of monetary autonomy, a recession unfolds and defaulting becomes more tempting. The equilibrium is that creditors become more prone to run.

One feature of our model is that debt is real, and so the inability to inflate away the debt is not a relevant consideration. This perspective is thus quite different from the notable arguments raised by De Grauwe and Krugman that Southern Europe was more vulnerable to a rollover crisis because they lacked the ability to print their own currency and inflate away their debt.

The quantitative analysis reveals that the exchange rate regime plays a crucial role in determining the vulnerability to rollover crises. Under a flexible exchange rate regime, only 1% of the defaults are triggered by rollover crises. Under a fixed exchange rate, it is about 11%. When we simulate the Spanish economy, we find that the economy hits the Cole-Kehoe crisis zone, precisely around the time of turmoil in sovereign debt markets in 2012. A counterfactual reveals that if Spain had exited the Eurozone, it would have remained immune to a rollover crisis. The takeaway, however, is not that being part of a monetary union is undesirable but that a substantial cost of giving up monetary independence is a higher vulnerability to rollover crises. A key policy implication is that the presence of a lender of last resort can significantly reduce the temptation to exit a monetary union. Consistent with our theory, after Mario Draghi pledged to do "whatever it takes to preserve the euro," spreads fell immediately, and Spain ultimately did not default on the debt or exit the monetary union.

One of the most notable developments in the international monetary system has been the accumulation of foreign reserves by governments in emerging economies. This increase has been particularly important for countries with exchange rate pegs or limited exchange rate flexibility. Accounting for the observed levels of reserves has proven quite challenging. One key hurdle is that governments in emerging markets pay an interest rate on their bonds that is high compared with the interest rate on their reserves, typically US Treasury bonds.

In Bianchi and Sosa-Padilla (2020), we explore how the interaction between sovereign risk and aggregate demand amplification can generate a macro-stabilization hedging motive for international reserves and show how this motive can account for the observed levels of reserves in the data. The model extends Bianchi, Hatchondo and Martinez (2018) with nominal rigidities and different exchange rate regimes. Our key mechanism is that when the govern-

ment issues long-term debt to accumulate reserves, this allows the government under limited exchange rate flexibility to face less severe recessions in the future. This is because recessions are times when it becomes more costly to roll over the debt, and so having reserves allows the government to deploy more resources to reduce unemployment during a recession. Consistent with the model, we show that in the data, governments that have higher levels of reserves during crises, experience a lower depreciation of the exchange rate.

Finally, let me highlight other recent work that has been concerned with monetary factors and sovereign risk considerations, which includes Aguiar, Amador, Farhi and Gopinath (2015), Na, Schmitt-Grohé, Uribe and Yue (2018), and Arellano, Bai and Mihalache (2020). Going forward, there are many open questions in this literature.

4. Avenues for future research

Much work remains to be done to improve our understanding of the origins of financial crises and how government policies can help prevent them. One fruitful area may be allowing for richer heterogeneity across households, firms, and financial institutions. For example, financial regulation may have different impacts depending on the relevant distributions, and in turn, regulation may have different implications for different segments of the population. Moreover, there is a question of whether regulation should be calibrated differently across agents. Another area where more work is needed is on the link between financial crises, inequality, and growth. Indeed, financial crises often have long-lasting effects on growth and disproportionately adverse effects on the poor. Furthermore, political economy frictions and time inconsistency issues are also relevant to understanding actual government decisions and how they may differ from those that are socially optimal.

Finally, while many open questions are conceptual, ultimately the literature must strive to provide quantitative policy guidance. Overcoming the challenges ahead will surely require advances in computational methods, measurement, and empirical work.

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