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Introduction to International Financial Markets and Banking Systems Crises

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Abstract: *This note introduces to the literature streams explored in the special section on international financial markets and banking systems crises. All topics tackled are related to the Great Recession. A brief overview of the research questions and related literatures is provided.*

Keywords: *Financial frictions, Financial instability, International transmission, Credit crunch, Banking and sovereign debt crisis*

The Great Recession was initiated by the bursting of the housing bubble in the US in 2007, which was later followed by the financial crisis triggered by the bankruptcy of Lehman Brothers in 2008. While initially concentrated in the US, the recession have spread all over the world through the global financial markets integration. Most countries, in particular in Europe, have been affected, suffering in particular from large asset prices' fluctuations, liquidity crises and more generally from a deep and persistent macroeconomic instability. This special section is devoted to the analysis of a few key aspects of this major episode, some generic and other specific.

A fundamental inherent question is the transmission and amplification mechanisms linking the (international) financial markets and the real economy. Traditional models and methodologies along the line of the standard real business cycles literature can hardly explain extreme volatility spikes (see Kocherlakota [30] for an early illuminating empirical study). A new modelling and methodology are under way, and the first paper of this special section, Klimenko et al [29] presents a kind of minimal setting allowing to generate, via endogenous risk mechanisms, the persistence and volatility outcomes imperfectly replicated by the standard real business cycles methodology. The second paper, Fabbri [20], addresses some specific aspects of international borrowing under capital collateral constraints. In particular, it highlights the fact that investment commitment (induced by capital collateral constraints) is hardly credible in an international context because there is no such thing as an international law court to which lenders can resort in case promised investment does not materialize. Starting with this observation, another financial friction is added (no-commitment) and its implications for macroeconomic instability are studied within a stochastic continuous-time model with some peculiar (and therefore nontrivial) features. The third contribution to the special section, Clain-Chamosset-Yvrard and Kamihigashi [12], focuses on the international transmission of sunspot fluctuations. Although there exists an early literature analyzing the role of globalization and market integration in crisis contagion phenomena, including the spread of waves of pessimistic expectations as in the last Great recession, there is no piece of work shedding light on the consequences of the bursting of an asset bubble in one country on the financial markets in other countries. The latter job is done in the third paper of this special section. The two last contributions tackle, with novel theoretical models, two

specific issues arising from the Great Recession: the credit crunch studied in Li and Wigniolle [33] and the twin banking and sovereign debt crisis in Europe analyzed in Cheng, Dai and Dufourt [11] respectively.

Financial frictions, Endogenous risk and economic crises

The role of financial frictions in the amplification of macroeconomic shocks has been the subject of a highly influential literature in the late 90s, with notably the seminal papers of Kiyotaki and Moore [28] and Bernanke, Gertler and Gilchrist [2]. A fundamental mechanism works through the net worth of levered agents: because the latter takes time to rebuild, transitory shocks may have a persistent impact on the macroeconomy since they typically affect the financial constraints faced by economic agents. Another critical amplification mechanism works trough asset prices: when net worth of levered individuals drops, the prices of assets they hold also go down, which further depresses their net worth. The above mentioned literature has managed to evaluate quantitatively these mechanisms, typically within the discrete time dynamic stochastic general equilibrium frame. In particular, as in the traditional real business cycles methodology, the analysis is restricted to the (local) dynamics generated by (small) shocks to isolated deterministic steady states.

The macrofinance literature has very recently experienced a major methodological switch due to the works of Brunnermeier and Sannikov [9] and He and Krishnamurthy ([25],[26]). Precisely, the use of stochastic **continuous time** modelling in the recent stream of papers has permitted two advancements. First of all, the scope for at least partial analytical solution is much increased with the latter modelling, especially if some linearity is introduced in addition to the traditional Brownian stochastic specifications.[1] Second and much more importantly, the new methodology departs from the local approach (around deterministic steady states) implemented in the early macrofinance literature (see for example, Bernanke, Gertler and Gilchrist [2]): by construction, it allows to study dynamics outside the neighborhoods of steady states, which ultimately gives the necessary flexibility to characterize crisis times in terms of time length and magnitude of slumps.

Klimenko, Pfeil and Rochet [29] is a contribution to this new trend in the macrofinance literature. The model proposed can be indeed viewed as a

[1]For example, Brunnermeier and Sannikov [9] use AK production functions.

kind of **minimal** model within this literature. It is minimal for two reasons. First, it includes extreme financial frictions: no access to financial markets and no insurance against shocks. Second, in contrast to Brunnermeier and Sannikov [9], there are no assets sales. Indeed, much in the spirit of Kyotaki and Moore, Klimenko et al consider two classes of agents, risk-neutral landlords and risk-averse farmers; farmers do not own land (and henceforth they cannot sell it) but they rent it from landlords. As a result, the minimal model is free of the mechanism playing through the downward pressure on asset prices outlined above. Indeed, the transmission mechanism is Klimenko et al's model is quite different from Brunnermeier and Sannikov's: because (in particular) farmers cannot borrow and have no collateral, the unique way for them to avoid defaulting is to adjust their activity to the level of their reserves (savings). Hence, macrodynamics do not arise as a result of shocks to notably the financial constraints faced by firms as in Brunnermeier and Sannikov [9] but as mere responses to productivity shocks in the absence of collateral and even to access to financial markets.

This very simple structure (in addition to other appropriate specifications) allows Klimenko et al [29] to derive in closed-form the whole equilibrium dynamics while Brunnermeier and Sannikov only obtain a few partial analytical results and resort to numerical simulation. Moreover and more importantly, one of the nice results of the paper is that despite extreme frictions and the resulting elementary transmission mechanisms compared to Brunnermeier and Sannikov, the minimal model is still able to deliver the key generic dynamics outcomes that arise in the latter seminal work, in particular the paradox of volatility and the persistence of exogenous shocks. This is made possible because in both a specific endogenous risk engine is at work. This explains why in this class of models a lower exogenous risk can lead to the more extreme volatility spikes, the so-called paradox of volatility outlined by Kocherlakota [30]. Klimenko et al [29] make clear in their contribution why and how endogenous risk is working in their model and in which respects it differs from those isolated by Brunnermeier and Sannikov [9] and He and Krishnamurty ([25],[26]). Interestingly enough, they also show that the property of persistence of exogenous shocks may show up into the form of poverty traps in their model (low levels of savings and rental prices).

International borrowing without commitment and instability

Modelling borrowing constraints at the international level is tricky: in particular, the issues of collateral definition, seizability and commitment are noticeable (see Cohen and Sachs [14] for an early appraisal[2]). In particular, the commitment problem is quite subtle. Consider the case of capital collateral. If the collateral constraint is binding, one gets by mere time differentiation of the constraint that the only way to borrow more is to invest more, or in other words, additional borrowing should be backed by planned investment, which in turn involves a commitment assumption. While such an assumption seems reasonable as a benchmark in a closed economy, it seems most doubtful when the debt contract is decided upon by foreign lender. Following Boucekkine and Pintus [7], a more realistic picture would be to assume that while borrowers cannot borrow against the promise to invest, they can borrow, however, if they document that they have invested in the past. This observation leads them to consider lagged capital as the collateral, the informational delay induced being inversely related to the borrowers reputation. International creditors then have to rely on limited information to choose how much to lend, and past investment is arguably a very relevant piece of information. When inserted into an otherwise standard AK model of a small open economy, Boucekkine and Pintus show that this departure from commitment has some dramatic consequences on macrodynamics[3]: Instable growth regimes may set in mainly into the form of growth reversals and growth breaks, leapfrogging may arise as well. Instability occurs because of the interaction between the so-called *history effect* generated by the informational lag in the collateral constraint and the growth effect inherent in any AK structure. Such an instable growth may occur even for small delays.

Fabbri [20] extends the deterministic framework described just above adding uncertainty on net capital (domestic capital net of foreign debt). The main question is to which extent the history effect highlighted by Boucekkine and Pintus [7] is affected by the exogenous volatility of net capital.[4] In other

[2]An earlier seminal paper is due to Eaton and Gersovitz [19].

[3]Under commitment, one gets the typical picture for AK models: no transitional dynamics!

[4]Boucekkine, Fabbri and Pintus [8] is an earlier stochastic extension of Boucekkine and Pintus [7] but it assumes commitment, thus zero delay.

words, how do exogenous shocks interact with the endogenous fluctuation engine inherent in the history effect? This is a quite challenging question especially from the technical point of view. The analytical cost paid to address this question is the solution of an optimal control problem of a neutral stochastic differential equation, which is in itself an authentic *tour de force*. Fabbri [20] is then able to show two important results. First of all, the total strength of the history effect (that's the impact of the whole historical data, as determined by the informational lag given, on the optimal path for net capital at any date) is not reduced by the volatile environment. Second, an "oblivious" process is however under way: the relative weights of the older parts of the historical path decrease in a more risky situation whereas the importance of the recent past increase.

International transmission of sunspot fluctuations and bubble crashes

While the interlinkage of business cycles has extensively been studied in the literature on economics under intrinsic uncertainty,[5] the analysis of extrinsic uncertainty is more recent and based on the literature on indeterminacy and sunspot equilibria. Building on the seminal contribution of Benhabib and Nishimura [1], a number of contributions study the impact of trade globalization on the international transmission of sunspot fluctuations and expectation-driven business cycles. In Nishimura and Shimomura [35], sector-specific externalities are introduced in a continuous-time version of the Hecksher-Ohlin two-country, two-sector infinite-horizon model with symmetric technologies. They show that if in both countries indeterminacy of the equilibrium path holds under autarky then local indeterminacy also holds in the world market once trade opens. The limitation of this result comes from the fact that there is no real international transmission of sunspot fluctuations as in both countries these pre-exist the opening to free-trade. Moreover, the same basic framework is also used by Sim and Ho [38] except that they break the symmetry in which externalities enter the production function in the two countries. Assuming that under autarky indeterminacy holds in one country but determinacy in the other, they show here that trade can on the contrary overturn indeterminacy.

Ghiglino [24] considers a similar discrete-time version of the Nishimura-

[5] See for instance Cole and Obstfeld [15], and Obstfeld [37].

Shimomura's model but with labor-augmenting global externalities. He assumes that both countries have the same sectoral production functions, the consumption good being produced with a Cobb-Douglas technology while the investment good is produced with a Leontief technology. He shows that provided the inverse of relative risk aversion is not a linear nor concave function, the equilibrium under free-trade may be locally indeterminate even if the equilibrium under full autarky is determinate. Ghiglino then exhibits a global destabilization effect of international trade. However, a limitation of this paper, beside the restriction to a zero elasticity of capital-labor substitution in the investment good sector, is that as soon as standard CES preferences are considered (a case in which the inverse of relative risk aversion is linear), market integration plays no role on the occurrence of indeterminacy.

In a non HOS framework with asymmetric technologies, Nishimura, Venditti and Yano [36] consider a discrete-time two-country, two-sector infinite-horizon model in which producers of one country differ from those of the other country in respect to the share of capital and labor in each sector. They show that the capital exporting country's expectation-driven fluctuations can spread throughout the world once trade opens even if the capital importing country has determinacy under autarky. In this case, globalization and market integration have a destabilizing effect on the capital importing country and is a channel for some international transmission of business cycle fluctuations. More recently, Iwasa and Nishimura [27] extend the HOS model with production externality presented in Nishimura and Shimomura [35] by assuming that the capital good is consumable. As in Ghiglino [24], but in a framework with standard preferences, they exhibit a global destabilization effect of international trade by proving that the opening of trade can create expectation-driven fluctuations at the world level while the closed-economy equilibrium in each country is locally determinate.

Although this literature clearly explains the possible role of globalization and trade in the process of international transmission of waves of pessimistic expectations, as in the last Great recession, it does not shed light on the possible consequences of the bursting of an asset bubble in one country on the financial markets in other countries. The analysis of asset bubbles have been strongly developed since the last financial crisis. Following Tirole [39, 40], a bubble is understood as the difference between the market price

of an asset and its fundamental value, that is, the discounted value of future dividends, and is traditionally studied within overlapping generations models. Most of the recent literature assumes financial frictions and examines the real effects of bubbles in closed economies, highlighting some interesting conclusions related to the Great Recession. For instance, Clain-Chamosset-Yvrard and Seegmuller [13] consider an overlapping generations exchange economy where households realize a portfolio choice between money and a bubble under a partial cash-in-advance constraint affected by the size of the bubble. A higher value of the bubble reduces the need of cash, and thus increases the fraction of consumption purchased on credit. Multiple steady-states (global indeterminacy) and expectation-driven fluctuations (local indeterminacy) are shown to occur for arbitrarily small market distortions. In order to stabilize the economy, the authors show that a monetary policy rule responding only to expected inflation has a destabilizing effect, while a monetary rule responding also to asset prices can be stabilizing and rules out the multiplicity of steady states.[6]

However, this type of contributions does not provide any information of international transmissions of bubbles. A few recent papers focus on such a question but assuming initially that the different bubbles comove (see e.g. Ventura [41], and Martin and Ventura [34]). In the paper contained in this special section, Clain-Chamosset-Yvrard and Kamihigashi [12] study the international transmission of bubble crashes by analyzing stationary sunspot equilibria in a two-country version of the overlapping generations exchange economy with stochastic bubbles initially developed by Weil [42]. Both countries, called "home" and "foreign", have symmetric fundamentals with a unique consumption good consumed worldwide and an intrinsically useless asset, i.e. a bubble. The good and asset markets are fully integrated at the international level and agents of both countries have access to them.

The authors consider two types of stationary sunspot equilibria. The first one assumes that only the foreign country receives a sunspot shock, while the second one assumes that both countries independently receive sunspot shocks. In the first type of equilibrium, a bubble crash due to a sunspot shock in the foreign country inevitably causes the home bubble to burst. In the second type of equilibrium, a bubble crash in the foreign

[6]See also Bosi and Seegmuller [5, 6] for related results, and Bidian [3] for a general analysis of bubbles under various sources of frictions.

country either bursts simultaneously the home bubble, as in the previous case, or increases its level. Here, the home bubble indeed jumps to a higher level in order to absorb the entire world's wealth. This paper then shows that, as examplified by the last Great Recession, a bubble crash in one country necessarily has some international consequences through financial integration even without introducing any friction or fundamental uncertainty.

Financial frictions, imperfect informations and credit crunches

The financial crisis of 2007-2008, known as subprime mortgage crisis, has been mainly generated by three ingredients: a strong development of subprime loans distributed to households with insufficient collaterals, new banking practices with respect to risk based on insufficient banks' own funds and the development of a shadow (opaque) banking system leading to an increasing difficulty to evaluate assets' risks. Following the housing bubble crash and the bankruptcy of Lehman Brothers, the drop in the value of collaterals in the US, the titrization of bad credits and the spread of toxic assets promoted a liquidity crisis and thus a credit crunch together with financial and real market instability in the U.S. and Europe. Governments have then decided to increase the collateral constraints to both households and banks to avoid bad credits and reduce opacity of the banking system. However, besides the problems related to sovereign debts, the effects of this policy on growth have been contrasted. While the U.S. seem to slightly recover its pre-2007 growth rate, most European countries suffer from stagnation or even recession with large macroeconomic fluctuations.

Since the seminal contribution of Kiyotaki and Moore [28], it is now well-known that credit constraints crucially affect the existence of endogenous fluctuations and macroeconomic instability. More recently, Ferraris and Watanabe [21, 22], by embedding a model of credit *à la* Kiyotaki and Moore [28] into a money search model *à la* Lagos and Wright [31], show that larger fluctuations arise when the credit constraint is binding and agents are at their borrowing limit.[7] Focusing more on collaterals, Bosi, Ismael and Venditti [4] consider a model in which heterogeneous consumers can borrow

[7]See also Fostel and Geanakoplos [23] in which the existence of collateralized assets affects market prices and allocations and can generate fluctuations.

to consume more than the cash they hold but they are constrained by the amount of collateral they own. Similarly to Ferraris and Watanabe [21, 22], when the constraint is binding for all agents, expectation-driven fluctuations based on the existence of sunspot equilibria may occur. However, increasing the possibility of collateralization moderates the effect of the credit market imperfection and makes macroeconomic fluctuations less likely. In a framework with constrained agents' behavior, raising the weight of collaterals for all borrowers could then represent a mean to shelter the economy from the destabilizing effects of credit rationing.

While this type of literature explains the possible consequences of credit constraints, it does not provide explanations for the existence of credit crunch like the one that followed the global financial crisis of 2007-2008. In the paper contained in this special section, Li and Wigniolle [33] propose to incorporate a microeconomic mechanism based on a credit market with asymmetry of information between borrowers and lenders into an overlapping generations model to prove the existence of credit crunches, and endogenous fluctuations derived from regime changes and local indeterminacy. They first extend the static model of Deers, Eckwert and Vardy [18] where investors can choose between more or less opaque projects depending on the level of the interest rate. Here, the authors endogenize the choice for a firm (a borrower), who has an information advantage on its project, to be opaque or transparent, assuming that information revelation induces a cost that is supported by the borrower. A firm then decides to be transparent either if it is necessary to get a loan, or if it can get a lower interest payment and earn a higher profit. Of course, only good projects have an incentive to be transparent. The authors then show that there exists an intermediate interval of interest rates for which two types of equilibria exist, opaque or transparent, and the economy may experience a jump from an opaque to a transparent equilibrium that leads to a credit crunch. As a consequence, loans fall with transparency requirements and so does production.

Incorporating this static model into an overlapping generations framework, it is shown that the economy may experience endogenous fluctuations either from a change of regime between opaque and transparent equilibria, or from indeterminacy coming from the co-existence of both regimes at the same time. In such a case, the coordination of agents on one regime may depend on self-fulfilling prophecies. This model is then able to generate dif-

ferent features illustrated by the crisis in 2007-2008: increase in the interest rate, credit rationing, increase in macroeconomic volatility and tightening of credit standards.

Twin banking and sovereign debt crisis within a monetary union

Another remarkable feature of the 2007-2008 financial crisis is the subsequent acute twin banking and sovereign debt crisis which has even threatened the existence of the Eurozone (EZ hereafter). While this episode and possible related economic mechanisms have been accurately described by De Grauwe [16] and Lane [32], among others, very few theoretical analyses have been provided so far. Cheng, Dai and Dufourt [11] contribute in this special section to the understanding of the failure of the EZ institutional design to prevent the occurrence of the twin crisis.

The early phase of the twin crisis is quite well understood. The elimination of the currency risk allowed by the EZ has indeed led banks in the periphery of the zone (like Spain or Ireland) to massively accumulate international short-term financial resources at low interest rates. As outlined by Lane [32], one of the notable consequences of the 2007-2008 was to reallocate these international flows away from the periphery of the EZ (*sudden stop*), leading to the devastating liquidity crisis and ultimately to the intervention of the governments of the EZ periphery through massive bank bailout programs. In a context of economic contraction, this episode did aggravate the public debt sustainability problem in the periphery, even before the 2009 Greek sovereign debt crisis. From late 2009, the increasingly apparent Greek risk of default quickly triggered a systemic crisis: with the inherent large increase in the risk premia (not only for Greek bonds but also for all the sovereign bonds in the EZ periphery) questioning even more public debt sustainability, and the associated strong deterioration of the balance sheets of most of the major banks of the region, the EZ was thought to be close to a final collapse.

In this special section, Cheng et al [11] address essentially the following question: why did the early institutional architecture of the EZ fail to stop the diabolic circle described above? Specifically, Cheng et al focus on the *safety net* prior to the intervention policy decided by the ECB in 2012 (that's 2 years after the start of the twin crisis).[8] This intended safety net has

[8]Indeed, the ECB started to purchase (in principle unlimited) amounts of government

two components: in first place, banks are forced to hold a fraction of their assets in the form of high-grade government bonds (liquidity regulation). Second, at country level each government provides a deposit guarantee and is committed to raise additional resources for banks bailout in the case of liquidity crises (guarantee deposit).

To investigate the efficiency of the above mentioned safety net, Cheng et al [11] build on the seminal work of Chang and Velasco [10]. But since the latter only considers emerging markets, Cheng et al's work is more than incremental. In particular, the two components of the EZ safety net are introduced in the model. A fundamental mechanism that launches the crisis is the *sudden stop* of short-term financial inflows event described by Lane (2012) and reported above. Chang and Velasco's model does allow for this type of event to happen. In this model, domestic banks are entitled to collect resources from domestic residents and external investors and to invest these funds in short-term and long- term investment. Following Diamond and Dybvig [17], there is a maturity mismatch between assets and liabilities, and 2 equilibria may arise, the bad one being characterized by agents running, and therefore forcing banks to liquidate long-run investment projects before going bankrupt. Within this type of framework, Cheng et al [11] show that in certain circumstances, the EZ safety net may even favor the occurrence of the bad equilibrium and produce the twin crisis experienced by the EZ. The main mechanism works through self-fulfilling changes in investors expectations which depend on their perception of the sustainability of sovereign debt. As long as the investors are confident about the solvency of the country, the safety net is credible. If they think that public debts are no longer sustainable, the safety net cannot be credible, a sudden-stop will occur ultimately leading to the twin crisis.

bonds of the EZ from august 2012.

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