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A Primer on Financial System Meltdown

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Abstract

Ideologues are quick to explain the current financial meltdown: it's the markets, stupid. Economists agree but add: It's politics too, stupid. Ideologues agree but counter: First and foremost it's capitalism, stupid. Economists agree but reply: §$%&?!, stupid. This is where this short paper takes us: it makes an attempt to give a brief overview of the economists' views on the ongoing financial system crisis explaining '§$%&?!, stupid'.

JEL classification: E22, G00, G30, O16, O40.

Keywords: financial system crisis, systemic risk, macroeconomic stability, financial regulation.

1. Introduction

The thrust of the public discussion about the ongoing financial crisis is disgust for both financial markets and financial managers. The general perception is that financial markets are monsters of wickedness (neoliberalism, that is). Most notably, financial derivatives such as options, futures, and swaps are viewed as the work of the devil, securitization has been even discredited as devil incarnate. Financial managers have quickly turned scum of the earth. Forgotten are the times of plenty when financial markets seemed to work wonders.

In the aftermath of crises, political climate is usually against reasonable discussion and reflection. This particularly applies to the current financial crisis. Risk is running high that politics, with the friendly assistance of activist economists, is throwing the baby out with the bath water. True, financial markets are imperfect and have recently done badly. But just as true is that financial markets can do much better than the public currently perceives. Recent history proved just that too.

New theoretical research explains why financial systems can do both work well and work not so well. Through this new school of thought fresh light is shed on the working of modern financial systems and sound evidence is provided for the existence of increased financial fragility due to financial development. The key finding of this theoretical work is that financial innovation has made both the market economies more stable and financial crises less likely, but potentially more severe. Most importantly, this new view holds that financial markets are inherently pro-cyclical due to endogenous financing constraints. The latter is the principal source of financial inefficiency and, thus, the prime cause for a clarion call for political action (i.e., implementing both effective and efficient regulation). This note aims to give an introduction to this new line of reasoning. In doing so, we will revisit an artful theoretical notion, the renowned downward sloping supply curve.

The paper is structured as follows: section 2 gives a line-up of the right questions to be asked when faced with financial system crisis like that we just live through. Section 3 introduces theory apt to give the right answers (not all but the big ones, for sure). Section 4 rounds up the lessons to be drawn.

2. Asking the Right Questions

The right questions to our theme have been put forward most competently by *Rajan* (2005). If one truly wants to understand modern financial system fragility in general, and the present financial turmoil in particular, this is the paper to turn to. The author addresses the key question of these days right away in the main title of his paper: Has financial development made the world riskier? In a world with a perfect financial system this question would be meaningless (since all idiosyncratic risks could be insured against, all remaining shocks would be systematic and, thus, uninsurable risks). Since we undoubtedly live in a world where financial systems operate under frictions this question has risen to paramount importance. *Rajan* (2005) forcefully calls to our mind that (at least) three questions have to be answered profoundly before we can hope to get a handle on system problems caused by advanced but still imperfect finance. These questions are:

Has financial development magnified or lessened financial frictions such as socially excessive risk-taking by financial market participants (efficiency question)?

Has financial development made financial systems more or less prone to stress (stability-robustness question)?

Has financial development made financial systems more or less prone to crises (fragility question)?

In the following section we make an attempt to introduce theoretical evidence, old and new, based on equilibrium analysis and mostly well-suited for providing 'sound answers' to the questions posed by *Rajan* (2005). We do this in a non-technical form with the aim to be accessible to non-specialists.

3. It's the Slope, Stupid.

3.1 First-Generation Models of Financial Crises

An excellent primer on understanding financial markets friction is the analysis of the backward-bending supply curve. The latter is the centerpiece of the first-generation models of equilibrium credit rationing developed in the 1970s. These models are built around asymmetric information tending to impede financial markets to be efficient. As to credit markets, informational problems such as adverse selection and/or moral hazard occurrences are closely related to expected returns on bank loans that are only partially a monotonic function of the loan rate R. This may be such because too high loan rates can lead to increased credit default rates which superimpose rising expected returns that come with high loan rates. Thus, a major implication of the existence of asymmetric information is that the credit supply function may be backward bending for high levels of interest rates (see, for example, *Stiglitz – Weiss*, 1981). If demand for credit is well-behaved (that is, a downward-sloping function with respect to the loan rate) then it might happen that under certain market conditions there is no market-clearing equilibrium, that is, supply and demand curve do not intersect. This has given rise to the introduction of an alternative equilibrium concept, the equilibrium credit rationing where demand for credit exceeds supply (for a competent treatment of this literature, see *Freixas – Rochet*, 1997).

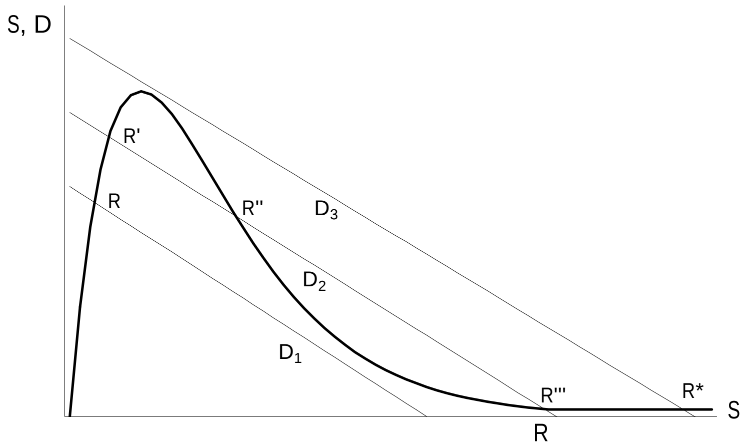
Models of credit rationing proved to be good at explaining how asymmetric information can distort market results and, thus, cause financial markets to be inefficient. However, rationing models are not good at explaining the occurrence of a credit crunch as an equilibrium result of a market clearing process. Yet, looking at these models from the viewpoint of market clearing (that is, demand curve and supply curve are assumed to always intersect at least once) reveals that they hide a rich structure capable of providing a plethora of insights, among others, due to making possible the study of multiple equilibria and, hence, an insightful analysis of credit crunches (that is, low liquidity supplied at very high rates that may emerge as a market clearing equilibrium).

A simple nonlinear credit market model introduced by *Hahn* (1986) shows that within a market clearing framework the backward-bending supply function, in combination with a well-behaved demand function, may generate multiple equilibria with structural stability characteristics that portray the sudden occurrence of a credit crunch as a jump from a 'good' market equilibrium to a 'bad' market equilibrium.

The demand side of this model, denoted D, is formed by competitive risk-neutral firms maximizing long-run expected profits while facing output price uncertainty, denoted α (i.e. the latter may be caused by instable aggregate demand). Firms are assumed to use external funds in the form of bank loans to finance their fixed investments. This motivates the demand function for credit to be downward sloping with respect to the loan rate. Increasing output price uncertainty α, as measured by the mean-preserving spread criterion due to *Rothschild – Stiglitz* (1970), causes an upward-shift of the credit demand function (i.e., increasing output price uncertainty raises expected long-run profits of the firms).

Credit supply S is formed by competitive risk-neutral banks which offer loans with regard to uncertain profits of the loan-demanding firms. The banks are supposed to maximize their expected profits while expected return on a bank loan is a concave function of the loan rate R due to the existence of asymmetric information. As a result, loans supplied by banks may follow a curve with a backward-bending shape beyond a critical loan rate (see Figure 1). To be specific, the supply function is upward sloping and concave up to a certain loan rate, beyond that the supply function is downward sloping and convex[1]). Further, increased output price uncertainty α, again as measured by the mean-preserving spread criterion, causes a downward-shift of the credit supply function, because expected profits of the credit-seeking firms become more uncertain.

Figure 1: Backward-bending Supply Curve of Credit

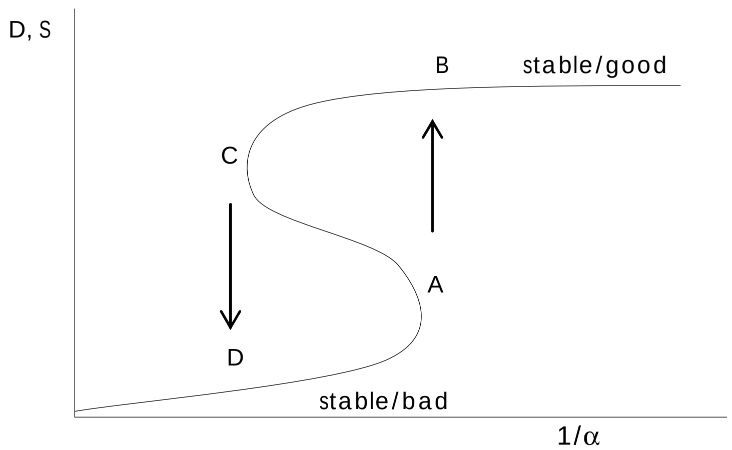


As mentioned above, within a market-clearing framework backward-bending optimal loan offer curve S may give rise to multiple equilibria depending on the level of output price

1) It is worth noting that the single-peaked, concave-convex supply function S as depicted in Figure 1 is a simplification. This supply curve is a possibility rather than a stringent consequence of the assumptions made.

uncertainty. 'Good' equilibria (market clearing at high levels of credit volume and low loan rates due to low price uncertainty) occur because credit supply is well-behaved (increasing on R). 'Bad' equilibria or equilibrium credit crunches, that is, market clearing at low levels of credit volume but high levels of loan rate due to high price uncertainty, occur because credit supply is ill-behaved (decreasing on R). Both good and bad equilibria are depicted in Figure 2 (in line with standard practice, attention is only paid to stable equilibria). If the credit market clears at good equilibria (that is, upper equilibrium strand in Figure 2) and price uncertainty α is increasing credit volume decreases continuously while loan rate R increases continuously. However, if price uncertainty reaches a critical level the credit market jumps form a good equilibrium (C on the upper strand in Figure 2) to a bad equilibrium (D on the lower strand in Figure 2). The change is abrupt and shows all signs of a credit crunch as observed in reality (that is, sudden occurrence associated with abnormally high loan rates and abnormally low credit volumes traded). This simple model also captures the remarkable observation that getting trapped in a credit crunch and escaping from it is a highly asymmetric process. It takes much lower levels of price uncertainty to get out of a credit or liquidity crunch than to fall into it as depicted in Figure 2.

Figure 2: Credit Market Equilibria



Though first-generation models of imperfect credit markets (that is, vintage 1970s and 1980s) are quite attractive while capable of explaining the occurrence of financial market singularities such as equilibrium credit crunches or equilibrium credit rationing they do not provide convincing answers to all the core questions raised by *Rajan* (2005). To begin with, these models are designed as partial equilibrium models and, thus, quite restrictive in nature (though most of these models can be easily integrated in a general equilibrium framework). More importantly, these models do not allow for analyzing financial development and its impact on financial system efficiency and stability, respectively. If financial innovations stabilize aggregate output demand and, thus, lower output price uncertainty, the model presented above predicts that the credit market works well and friction free. The opposite is predicted by the model when financial development increases output price uncertainty. But these features are left out of account because the model is restricted to partial equilibrium analysis.

Most important, the credit crunch and/or credit rationing results gained by the first-generation models solely depend on the existence of a backward-bending loan offer curve. This has been both strength and weakness of these models since 'concavity' of the supply function is a possibility rather than a stringent consequence of the models' assumptions. Thus, 'backward bending' may be a rare event, if such a thing is possible at all. For, subsequent research showed forcefully that if aspects of loan contracting beyond expected profits of credit-seeking firms are accounted for backward bending of the credit supply curves disappears in any circumstance (see, *Freixas – Rochet*, 1997). This particularly applies to loan contracts containing collateral as sorting device. Accounting for collateral in loan contracts (in combination with the borrower's net worth, that is, her cumulated expected profits) causes banks to provide loans in compliance with a well-behaved, upward-sloping supply function on the entire domain of R. The good thing about it is that considering lending on collateral opens up new vistas concerning the analysis of financial system fragility making possible much deeper systemic insights primarily (what a big surprise) due to the introduction of another downward-sloping supply function (let in by the back door, so to speak).

3.2 Second-Generation Models of Financial Crises

The new generation of models aimed at tackling financial system fragility is primarily built on theoretical work closely related to *Bernanke – Gertler* (1990), *Bernanke et al.* (1999) and *Kiyotaki – Moore* (1997). The former two analyze shocks to the net worth of borrowers due to the financial accelerator effect on investment. The latter investigate the occurrence of credit cycles induced by credit-constrained firms that use their productive assets as collateral. In their seminal paper, *Kiyotaki – Moore* (1997) show that the effects of temporary adverse productivity shocks may be amplified by capital market imperfections such as financial contract enforcement problems which tend to affect the net wealth of credit-constrained borrowers negatively. Since the borrowers are credit constrained and the loans taken are collateralized the value of collateral affects the creditworthiness of the borrowers directly. That is, if the price of the collateral decreases because of a productivity shock the firms' investment declines due to tightened credit constraints. This, in turn, affects the firms' net worth negatively which again depresses investment (and the price of the productive assets used as collateral) even further. This downward spiral stops not before the price of the collateralized asset reaches a level so low that it can be sold to firms that are not credit-constrained.

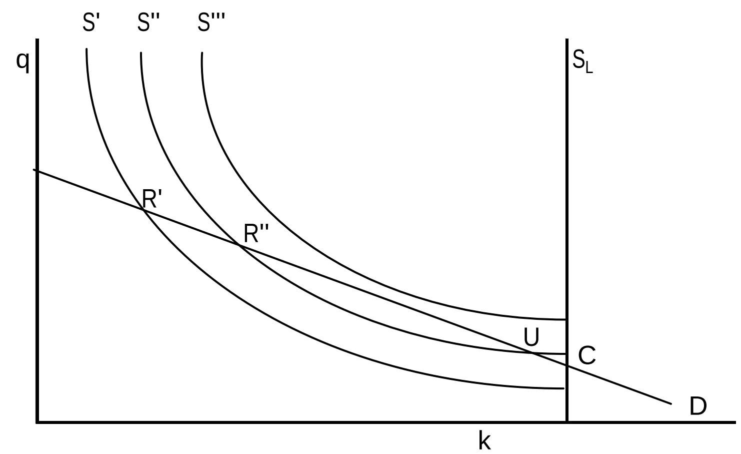
The new generation models of lending go one step further by endogenizing both financial constraints and asset prices. Pioneers of the latest developments in this field are, among others, *Lorenzoni* (2008), *Gai et al.* (2006), (2007), (2008), and *Korinek* (2008). The major building blocks of this new line of theorizing are: the models are dynamic, nested within a general equilibrium framework, and focus on ex ante decentralized financing (and investing) decisions made by rational, atomistic agents. Second, financial contracts are subject to limited commitment and as such a potential source of financial constraints. Third, financial constraints in combination with a competitive market for real asset give rise to pecuniary externalities that may have real effects[2]). Since atomistic financial intermediaries take asset prices as given, they do not account for the effect of their own sales on asset prices. This particularly applies to times of distress (i.e., occurrence of adverse shocks) when financial intermediaries are forced to fire-sell their assets in order to remain solvent. In so doing, they depress asset prices that potentially induce further asset sales triggering a downward asset price spiral. Consequently, potential liquidity crises caused by own asset sales are not internalized by atomistic financial intermediaries. This induces them to take on more risk than socially optimal causing financial markets to inherently allocate resources inefficiently. As shown in *Korinek* (2008), financial intermediaries tend to inherently undervalue the social benefits of liquidity in crisis states. Forth and finally, due to the existence of this pecuniary externality large adverse shocks may trigger a downward asset price spiral with the potential to devolve into financial disaster, that is, financial system meltdown. Yet, most interestingly it may be solely beliefs held by financial intermediaries that finally decide upon whether a

[2]) Note in a perfect world pecuniary externalities do exist but have no real effects.

shock grows into a full-blown financial crisis or levels off at a mild 'recession'. This can be nicely tracked by going through Figure 3. This graph has been developed by *Gai et al.* (2007) for the purpose of providing intuition and motivation for the key results of the new generation models. At this point of analysis of systemic financial crisis it won't surely come as a big surprise that the downward-sloping convex supply curve enters the stage to again play the lead, as it does in the first-generation models.

Figure 3 is aimed at depicting demand and supply for capital k after an adverse shock. Demand for capital D is standard while falling with increasing asset price q. Supply of capital S is non-standard while, ditto, downward sloping subject to increasing q. This is due to the downward asset price spiral driven by the solvency-feedback effect described above. The supply curve for capital is convex because the more the asset price falls the more capital must be sold by financial intermediaries to remain solvent in times of stress.

Figure 3: Demand and Supply for Assets in Times of Stress



Source: *Gai et al.* (2007).

The vertical line S_L in Figure 3 indicates the state that forces financial intermediaries to sell all their assets and go into liquidation. Within the model framework, this corresponds to the occurrence of a financial system meltdown. Supply functions $S^{'}$, $S^{''}$, and $S^{'''}$ represent three different realizations of adverse shocks.

As discussed in the previous section, the potential existence of downward-sloping convex supply curves indicates that multiple equilibria may occur as a consequence of a negative shock. This potential is represented by supply curve $S^{''}$. In this instance, there are two equilibria of interest, $R^{''}$ and C (U represents an instable equilibrium and, thus, remains unconsidered). Most importantly, this equilibrium constellation reflects the situation where beliefs of financial intermediaries solely determine which of the two equilibria actually prevails. If the financial intermediaries believe ex ante (before the realization of the shock) that in case of an occurrence of an adverse shock the states are such that fire sales will be limited in order to remain solvent then the market outcome will be $R^{''}$, representing a 'recession' or 'mildly bad' equilibrium. If financial intermediaries don't believe so, the system will go berserk and the market outcome will be C, representing a financial system meltdown. As stressed in *Gai et al.* (2007): the financial intermediaries' "ex ante investment and borrowing decisions depend on their beliefs. Therefore, multiple equilibria arise ex ante: after beliefs have been specified, investment and borrowing decisions will be made contingent on those beliefs and the equilibrium will be fully determinate, even in states for which there could have been another equilibrium." Consequently, there may be situations where financial disaster is the outcome of a self-fulfilling process.

Note within the presented model context multiple equilibria and system crises are a potential, not a must result related to states involving asset sales. If supply of capital behaves as represented by function $S^{'}$, then the market outcome is a unique equilibrium, at $R^{'}$, implying that systemic financial crises never occur no matter how pessimistic the beliefs of the financial intermediaries. Supply function $S^{'''}$ depicts the opposite case where a financial crisis appears to be unavoidable again regardless of the beliefs. The latter supply function may be more likely when the shock is extremely negative, the former function ($S^{'}$) is more likely when the shock is only mildly negative.

Now, we have reached the point where we can proceed with confronting the key implications of the new generation models of systemic financial crises with the core questions in finance as outlined in section 2. In so doing, we put these models' explanatory powers to the (Rajan-)test.

First and foremost, the new models provide convincing evidence that financial markets tend to work inherently inefficiently when agents face binding financial constraints which are endogenously determined. To understand why modern financial systems may fail, zooming in binding financial constraints is paramount because they may induce a built-up of a socially excessive level of systemic risk in the financial sector. Having said that this new school of financial fragility analysis does indeed support the hypothesis that financial innovations may do both foster economic growth and mitigate economic fluctuations primarily due to widening access to liquidity and deepening resale markets for capital. However, these new models do not support the view that financial innovations make intermediaries more inclined to internalize systemic risk induced by their own behavior. Importantly, if they did so they would be immediately punished by the markets, because not to do so is privately optimal for financial intermediaries (see, for example, *Korinek*, 2008). Thus, these models provide strong evidence in favor of the implementation of regulatory measures aimed at making it very costly for financial intermediaries to take on excessive systemic risk, in the first place. This finding is clearly supportive of a macro-prudential view of financial regulation. This point is forcefully brought forward by *Korinek* (2008) who argues in favor of adjustable capital adequacy requirements in order to discourage financial intermediaries from imposing superfluous costs on the society due to their excessive systemic risk-taking. Since excessive systemic risk-taking appears to be pro-cyclical, regulatory capital adequacy rules for financial intermediaries are to be adjustable in order to be effective.

Second, the new generation models of systemic financial crises provide evidence that financial innovations may strengthen financial stability and lessen macroeconomic volatility. Referring to Figure 3, financial development tends to both flatten demand for capital and shift S_L rightward. Both make recession states and crises less likely. The latter is because greater stability makes severe shocks less frequent.

Third, the new generation models of systemic financial crises provide evidence that financial development makes financial crises less frequent, but much larger and more severe. Referring to Figure 3, financial development tends to cause S_L to shift rightward indicating that financial intermediaries increase their borrowing and asset holdings. If a negative shock occurs and a crisis ensues, the negative impact will be larger because more capital is available to be fire-sold driving asset prices down further.

To sum up, Rajan's key question concerning whether financial development has made the world riskier is being answered by the new school of systemic crises analysis clearly and to the point: Financial development has made the world not riskier but distinctly more explosive.

4. Concluding Remarks

The views on financial crises reviewed in this note suggest that modern financial markets may have a lot in common with nuclear power stations. Both are capable of working for the good of humanity. Both work particularly well in times of no or little stress. Both can be made more resilient through innovation and technical progress. Both need effective regulation and oversight to make sure that systemic risk remains low. However, both will remain vulnerable to large adverse shocks at all times, even up to the extent to which shocks may activate a core melt accident throwing the world as we know it into ultimate chaos.

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