# On the Eve of Global Financial Collapse.

## Explanations, necessity, and policy conclusions

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Abstract

Most people involved in the actual dynamics of the current disastrous developments in international finance are surprised by the ignorance that this deepest crisis of capitalism since the interwar period experiences in the world of academic economic theory. As was the case with the economics that Keynes' criticized in the thirties, there now again the ruling alphabet of mainstream economic theory simply seems to have no words to express what actually is going on – and academic merits can only be gained by not remaining silent, thus many rather talk about something else.

This paper sets out to identify and to model four aspects of this global financial crisis which are essential for understanding it:

(1) The threat of instability due to ***securitization*** at the meso-economic level. By most observers of the crisis the specification of the transformation of a credit contract into an asset is seen as one of the major sources of financial instability. As a consequence we provide a detailed account of this process showing that it is the network character and the involvement of meso-economic characteristics of these networks (the structure of network links as well as the emerging incentive structure of agents) which has to be held responsible for securitization threats.

(2) The ***'Minsky Moment' argument***, which holds that switch-points in financial behavior periodically and necessarily build-up. Minsky's description of such processes is transformed into a set of strategic games played by financial transactors with internal model-building and communication. The slow change of elements of the payoff matrices induced by current communication and processes of forgetting past

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experiences eventually leads to sudden shifts of some individuals strategic choices and sometimes even to economy-wide avalanches and turbulences.

(3) The ***critical mass argument***, i.e. the role played by the sheer quantity of deteriorating meso-events. Since the appearance of bad loans is a phenomenon that hardly can be avoided the first interesting point is to see how the repair mechanism of financial systems usually is able to stabilize the situation. In a second step this should enable the study of the threshold of mass default, the identification of the critical mass of failures that kills the repair mechanism.

(4) The impasses and incentive deficiencies of ***national monetary policy***. Since finance today always is international finance but monetary policy still is national monetary policy the emerging gap between the incentive structure of policy makers and financial entities is an additional important source of possible failure. The paper will try to incorporate this aspect in the description of the first three points.

Each of these aspects has already been discussed at some length in specialized parts of the literature, though with different degree of depth and formalization. The innovation here is to combine these aspects to produce a common coherent framework. First the paper is devoted to a sequential treatment of the four aspects and to shows how they fit together.

In the conclusion we use the framework to discuss the question of necessity and results of global financial collapses. In particular possible scenarios on how the economic world after the collapse will look like are proposed.

**Introduction**

The global financial crisis has just arrived and soon will disperse into every corner of economic activity. Most people involved in the actual dynamics of the current disastrous developments in international finance are surprised by the ignorance with which this deepest crisis of capitalism since the interwar period is encountered in the world of academic economic theory. As was the case with the economics that Keynes' criticized in the thirties, there now again the ruling alphabet of mainstream economic theory simply seems to have no words to express what actually is going on. This paper is a modest attempt to conceptualize, and to sort out the essential ingredients of the current crisis[2]. Starting more or less from scratch, several empirically oriented diagnosis found in recent research papers are selected and tied together in a logically consistent argument.

Indeed in this paper we insist that the essential features of the global financial crisis theoretically boil down to four elementary explanations, which we dub:

- The 'Securitization' argument,
- The 'Minsky Moment' argument,
- The 'Critical Mass' argument,
- The 'Monetary Policy Failure' argument.

By discussing this sequence of arguments not only most of the more rudimentary issues can be touched upon, it also turns out that there is an ascending overarching link between them. In other words, this crisis is not the outcome of an unfortunate coincidence of basically unrelated processes. It rather bears some necessity as soon as a sufficient number of thresholds in certain areas are surpassed. Thus even with the mildest form of soft landing and following regulatory reform that can be imagined, there is a good chance for this type of crisis to reappear.

***1 – Securitization***

As Hyman Minsky observed as early as 1986 [Minsky, 1986] the phenomenon of securitization has been a crucial shift of practice in finance in the USA. It occurred at least partly as a response to the monetarist way to fight inflation: If policy is constraining monetary growth it forces finance to look for nonbanking financing techniques. Thrifts engaged in the U.S. mortgage market were the first to be impaired by monetarist measures and thus also the first financial institutions to resort to securitization techniques.

The essence of these techniques, of securitization, is to free the creation of credit from the straitjacket of an institutional unit, a bank. If a bank provides credit to an agent this involves

[2] One of the best accounts of the actual development of the crisis is provided by Calomiris [Calomiris, 2008].

a contract, an enforceable agreement which contains a well defined schedule of money flows (compare figure 1).
A certain amount of money, C, is transferred to the agent (i), a certain sequence of interest and of redemption payments, R, is specified (ii), and a transfer of some security from the debtor to the bank, S, for the case of inability of repayments is fixed (iii).

These three elements (C, R, and S) are specified in a contract that is signed by both parties. Since future developments play a substantial role, the present value of such a contract at the moment when it is signed is not computable. Only ex post – after the end of the contract duration - it is possible to assign a unique value to such a contract, call it V. What can be stated however at the beginning (time $t0$) is that if it is signed by both parties, then this fact implies that each party assigns an expected utility to the value of the contract ($V_{t0}^{i}$) which must exceed what it assigns to the expected utility of value of not signing it ($\tilde{V}_{t0}^{i}$):

[1] $$V_{t0}^{i} > \tilde{V}_{t0}^{i}$$ for i = 1 (agent), 2 (bank)

Note first that in the framework used here utility is depending expected mean and variance, vulgo risk, of achieving this mean. Note second that both expected utilities of present values are the result of simulation runs of an internal model of the respective party measured in monetary units. All four relevant expected utilities of present values at time $t0$ are at this stage of analysis unrelated to actual ex post computed monetary value V – which moreover only exists if conditions [1] were met.

Due to the very nature of their relationship agent (debtor) and bank are not symmetric entities. In particular, the bank has a second type of relationships which it uses to generate the funds it redistributes via credit. Again this relationship can be characterized by a contract specifying the terms of interest payments on savings and deposits that the bank receives. The difference between interest rates for credit and interest rates for savings constitutes the core source of profit for traditional banking.

So while the debtors might be households which try to adjust their financial profile to their time preference rates[3], the banks are always capitalist firms. They maximize profit (defined as difference between revenue and cost) by cost-reducing innovations vis-à-vis their employees and with respect to interest paid on savings and deposits, and by increasing revenues with innovations aimed to increase credit volume and interest on this volume.
Contemporary financial innovation of banks is typically closely linked to the new possibilities opened up by the spreading of new information technologies, to understand the historical emergence of the current crisis these changes in technological environments is of utmost importance. From a technical point of view advances of information technology usually are

[3] Note that ideological elements like 'Every true US citizen must have his own house:' will influence the expected value of a contract for households. Such a statement, if believed, will induce them to assign a higher expected value to the contract.

described as increases in storage space and computing speed, and in the last two decades both dimensions were exploding. This clearly not only exerted pressure on the employment in the banking industry, it also produced more variety and more layers of seemingly different banking activity.

Still, from the point of view of political economy banks never were just ordinary firms[4]. In most advanced economies their activities are regulated by special laws and are bound to conform closer to political circumstances than other firms (with the exception of the weapons industry). This was already the very reason for the emergence of national banks, linking a more political side of banking activity to the more business oriented side of the service providing commercial banks. One of these regulatory principles goes back to the lessons learned from the Great Depression in the Thirties and states that there should be some state intervention possibility to limit the overall credit volume in a country[5]. The main purpose of such a measure was to have an instrument to fight inflation – a macroeconomic phenomenon out of reach of the usual stability enhancing mechanisms of markets.

It is exactly this restriction to the growth of the revenue side of banks, of their credit volume, executed by the new US monetary policy, which led to the surge of what later was called ***securitization***. Getting credit contracts off the balance sheet of banks freed the banking industry from regulatory control. Of course, calling the same contract an asset and selling it on a market does not by itself change the content of the contract. It still consists of a specification of C, R, and S as explained above. But the essential point is that now two financial institutions interact on that market, ***two partners whose incentive structure points in the same direction***, namely manifesting in the sale of the contract as asset a substantially reduced risk. This can be done because the expected utility (as its name tells) is based on expectations and cannot be easily verified.

The ***incentive for the paper creator***, the bank loan officer, to assume lower risk is straight forward since this raises the price of the asset. For the ***buying institution***, which typically is called a 'special purpose vehicle' (SPV), a higher price serves as a vehicle to signal a higher value. As long as the buyer can be sure to be able to rapidly re-sell the asset this signaled higher price enhances his business. As the famous financial guru André Bertholomew Kostolany once pointedly remarked, the art of finance resembles a bath in a cold swimming-pool: get in fast and get out fast. Evidently a chain of buying and selling might follow. The further away from the original credit it moves, the more blurred will the distinction between the original C, R and S be. While in old traditional banking the collateral S was of minor immediate importance, since repayments were the central source of profits; now for instantaneous market evaluation expectations on all three elements are interwoven: What will be the prices of houses ($S$), will the owners earn enough to repay ($R$) their respective

[4] In the few texts where Engels dared to describe a future society (Marx hardly ever did) even he seems to imagine something like a generalized bank accounting system ruling economic processes.

[5] Keynes favored the direct setting of limits for total credit volume, while in the after-war period the use of minimum reserves to be held at the central bank has been considered as Keynesian policy (aiming in the same direction).

debt ($C$)? An overall probability describing answers to these questions is implicit in the assets price. But self-fulfilling prophecies, since they are independent from economic reality checks, easily can turn into a game of musical chairs[6]. This then leads to the burst of the bubble, which is the more disastrous the longer it was growing. Note that on its way towards its burst the bubble made people rich who will not suffer when it finally explodes – bubbles typically redistribute wealth and force institutional shake-up and restructuring.

Relation [2] sums up a securitization process with a bubble bursting at time $t4$.

[2] $$V_{t0}^{2}(M_{t0},\sigma_{t0}) \rightarrow V_{t1}^{3}(M_{t1},\sigma_{t1}) \rightarrow V_{t2}^{4}(M_{t2},\sigma_{t2}) \rightarrow V_{t3}^{5}(M_{t3},\sigma_{t3}) \rightarrow V_{t4}^{6}(M_{t4},\sigma_{t4})$$

With $\rho_{t0} > \rho_{t1} > \rho_{t2} > \rho_{t3}$ and $\rho_{t3} < \rho_{t4}$.

Remember that the respective utilities are results of internal models of the financial agents owning the asset at time t and the variances $\rho_t$ of the mean price $M_t$ are some heuristically computed elements entering the computation. Entity 6 will find it hard to sell the asset if variance developments are to some extent public knowledge, i.e. the bubble will burst.

***2 – The Minsky Moment***

It might be asked why the decoupling of signal exchange from the real economic processes starting those signals does not occur more often. The simple answer is that it actually does occur very often but is not remarked by the general public and does not do too much harm in economic terms. Most parts of the entertainment industry are busy in branding products that work in the consumer communities as self-fulfilling choices of common taste. Even the less entertaining religious communities mostly base their product on the impossibility to check its economic value, and indeed are the real masters in preventing the burst of the bubble.

A more subtle answer is to hint at a stabilizing mechanism in human society which is embedded in the very special capacity of human entities to act strategically. This argument can elegantly be displayed by the use of game theory.
Imagine an agent facing the decision change her portfolio of papers in 6 different ways. As explained above, the expected utility of any of the six possibilities is derived by the use of an internal simulation model of the agent, with which essential characteristics of relevant future interactions are anticipated. Assume further that the agent knows that the expected utility of the action depends on the expectation processes and actions of all his competitors. If everybody did buy a certain asset in the immediate past, prices went up in the immediate past, and the agent expects everybody else to wait till prices move further up – like he does, then there will be little supply of this asset and self-fulfilling prophecy will work. Prices go

[6] In algorithmic terms securitization is a kind of recursive program, the stop condition being the point where the inequality between two expectaions suddenly changes sign: The music stops!

up. Can they increase forever? As problems and fashions in the real economy ceaselessly initiate new needs and in the sequel assets of production units engaged in satisfying these needs, there always will be new stars appearing on the firmament. Some competitors will switch towards the new trend and this will start to slow price increase in the traditional papers – they need money to buy the new ones and therefore sell the old ones. Nevertheless many agents will still stick to the old portfolio, since it remains the optimal choice in their strategic world.

Consider this game in strategic form (figure 3). The agent is the row player and in the moment posseses portfolio 2. The column player is the community of competitors represented by the mixed strategy $(p_1, p_2, p_3, p_4, p_5, p_6)$.

| | Portfolio 1 | Portfolio 2 | Portfolio 3 | Portfolio 4 | Portfolio 5 | Portfolio 6 |
|---|---|---|---|---|---|---|
| Portfolio 1 | | | | | | |
| Portfolio 2 | | | | | | |
| Portfolio 3 | | | | | | |
| Portfolio 4 | | | $\propto_{4,3}, \beta_{4,3}$ | | | |
| Portfolio 5 | | | | | | |
| Portfolio 6 | | | | | | |

**Figure 3**

The probabilities of the mixed shares are interpreted as the shares of competitors using a certain portfolio in the total number of competitors. The existence of discrete portfolio choices might be interpreted as the consequence of a cost of change making continuous transitions less attractive. On the other hand the sheer existence of competitors holding different portfolios implies that the starting point of the argument is a diversity of anticipations of the future. This is the opposite of the neoclassical assumption of the existence of a representative agent. As argued elsewhere[7] the evolution of a diversity of behavioral traits is a direct consequence of evolution in an environment changing in unforeseeable manner.
The agent knows her payoff in the last rounds, which reflects that if the environment can be assumed to have hardly changed in the immediate past, then observing more or less constant payoffs are hinting[8] at a set of competitors which is close to a (local) evolutionary stable state (in static terms a Nash equilibrium).

Following Steven Brams' idea of a long-run equilibrium with a historically given starting point [Brams, 1994] a player will only move away from this strategy if the whole sequence of other matrix entries visited after the deviation leads to an improvement[9]. Considering the

[7] If the environment changes faster, then diversity (via mutation) is more pronounced; see [Hanappi H. and Hanappi-Egger E., 2004].
[8] Compensating changes of portfolios are rather unlikely.
[9] In the case that the sequence cycles back tot he origin Brams suggests that a deviation is avoided.

assumption that mean and variance of payoffs enter the utility function, it is obvious that this contributes to the stability of points where a strategy-set settles down for some time. Additionally it is plausible that the payoffs of matrix entries rarely visited are more and more forgotten and therefore constitute additional risk and thus less utility.
From this perspective the change of strategy will need a rather strong, enduring and visible change of the expected payoff structure to induce a serious change of portfolio. But ***if slow and continuous changes in payoffs*** – eventually caused by technological advances and shifts in consumer needs – ***have visibly reached such a critical area***, then an ***avalanche of strategic shifts is triggered***. This is what can be called the ***Minsky Moment***.

But as the turbulence once set off is hard to calm, it is extremely difficult to predict the direction it will take. Remember that the major advantage of holding a portfolio is that it can reduce variance without loss of mean value in cases of very different states of the world. In a turbulent environment, which just passed the Minsky moment portfolio holdings should flourish – but their choice cannot follow textbook prescriptions since these new states are just explored or re-discovered. It necessarily will be somewhat erratic.

It is tempting – and probably correct – to interpret the current indecisiveness in financial markets as a sign that a Minsky Moment has been reached.

***3 – Critical Mass***

It can nevertheless be correctly argued that bubbles and swarming of strategic changes have always been present in capitalist economies, that they even are necessary ingredients enabling to conquer new territories and to weed out the less robust economic agents. There is some truth in such statements, in particular if one subscribes to an evolutionary interpretation of economics – though in looking at the current crisis one might doubt if really the fittest and not just the largest merge and survive.

But even such a friendly attitude towards crisis needs to insist that in the end the downturn must turn into a repair mechanism. In the vulgar economic language heard these days: Once the crisis has shown the lack of regulatory control of financial markets, this deficit has to be repaired by a set of new institutions and new rules. Amplification at some point will have to make room for dampening and repair.

It is interesting to look at the self-similarity between such processes at different scales. Return to the single debtor introduced in chapter 1. If she fails make a single credit repayment rate the bank will offer conditions designed to repair the relationship. It probably will insist on the size of repayment but will offer conditions that enable the debtor to get back on track. If that works, then nothing serious has happened. Even if the debtor repeatedly fails to repay, if she hits a borderline of acceptable failures, the bank will touch upon the collateral and eventually will manage to get rid of this partner. Again this can be

seen as a successful repair process. The bank needs these repair process to learn how to select its customers, they are part and parcel of the game the bank plays. More sophisticated organizations do entertain a structured hierarchy of repair processes – but this does not relate to the concept of a crisis.
What is ***crucial*** – and what raises a repair procedure to the level of a crisis – evidently is ***sheer mass of occurrences of failure***. A large bank can easily handle an astonishing amount of bad loans; but there is a limit that – once it is reached - forces the bank to turn to its inter-bank side to maintain liquidity. This is even more important if one looks at the new financial institutions discussed above under the header of securitization. Just stay too long in a cold swimming-pool too often and you freeze to death! If some of the already freezing stick together closer, or merge, then some strains of shortages of liquidity can be bridged; but for how long, if several of such 'very lonesome and very quarrelsome heroes stand all along the open road'. It therefore is significant that the current crisis first manifests itself as a problem of inter-bank lending.

At the meso-level, i.e. the level where medium-sized financial institutions are chasing for liquidity, the crisis usually first is amplified, if no intervention of a superior institution occurs. Part of the highest layer of finance still interprets the difficulties as a healthy repair process; the size of amplification is played down. The current crisis has passed this stage in summer 2008. If continuing amplification is ignored and liquidity at the meso-level is not restored in time, then large players start to tumble and to fall. This happened in September 2008. As final safeguard now the international finance community of central banks is called for help. The current crisis now has arrived at this stage and has become the most severe challenge for the global political economy since World War 2.

Until now the number of entities involved as well as well as the mass of money concerned has been continuously underestimated. While this is understandable as a didactic measure to avoid a panic in the general public, it is disastrous if the central decision makers start to believe in their own rhetoric. Why is the liquidity shortage currently amplifying itself with unprecedented speed?

The solution to this puzzle to a large extent can be found in the tight network structure that links the different nodes of financial institutions – and the hardly less numerous ties that this net has to all sorts of non-financial economic activity which acts as a body of resonance. Add the speed of the connection lines and you have a good answer.
With respect to the methodological question if this critical mass process can be usefully described by a sand-pile model in the style of Per Bak, it should be clear that such a model would have to incorporate new elements: The forces, which are driving the system to the avalanche into the next layer are speeding up (i), and there is a potential countervailing force, which – if it acts correctly and in time – might be able to stop the rush into the next layer. It can be doubted that a model with these two amendments resembles the original in many important aspects; its development goes beyond the scope of this paper.

But the discussion of the two amendments leads nicely to the last dimension of the current financial crisis – the policy failure argument. Could timely set intervention of financial authorities prevent the spreading of a liquidity shortage in inter-bank lending? Or is a wrong choice of monetary policy instruments even responsible for the emergence of the crisis?

***4 – Monetary Policy***

For obvious reasons the policy dimension of the global financial crisis is mostly discussed under the perspective of national monetary policy, or more precisely, of the national monetary policy of the US Federal Reserve Bank. As already mentioned above, the monetary authorities of the Fed did play a decisive role for the emergence of securitization. More generally, it is important to see that monetary economic policy indeed does play an important role for financial markets and the whole economy. The reason for this strong impact – which usually is stronger than the much more cautious changes in fiscal policy – is simple: an abstract sign system residing on electronic networks can react very fast with volumes not limited by any physical constraints. If this is understood, then it should be clear that monetary policy should be carried out with extraordinary cautiousness.

Unfortunately politicians with little education in economic theory often fall prey to extremely simplified worldviews or even outright wrong macroeconomic models stipulated by influential lobbies. This is not a new phenomenon, but - as Keynes' judgment in the concluding chapter of his opus magnum proves – it evidently takes more than one big depression to be learned:
*"..., the ideas of economists and political philosophers, both when they are right and when they are wrong, are more powerful than is commonly understood. Indeed the world is ruled by little else. Practical men, who believe themselves to be quite exempt from any intellectual influences, are usually the slaves of some defunct economist. Madmen in authority, who hear voices in the air, are distilling their frenzy from some academic scribbler of a few years back.*"
[Keynes, 1936, p.383]

Fighting inflationary expectations on the basis of the classical quantity theory of money, which is assuming a direct link between money supply and price level, is an example of the type of ignorance that Keynes addressed. But beyond Keynes' critique: With the Fed's regular announcement of changes in the money supply the U.S. price setters adjusted to the suggested rule and therefore ***created it*** as a self-fulfilling prophecy. Interaction in money and bond markets thus is even more sophisticated than sketched Keynes' remark. ***Economic laws are not just out there*** in 'economic reality' waiting to be discovered by a clever economist, they are ***produced*** by the ensemble of interdependent economic entities that constitutes our global society. It is this property which in the end makes international finance not only superbly flexible and shapeable but also fragile and vulnerable.

As long as the diagnosis of policy error remains within the confines of the US economy the arguments usually just hint at the lack of control and regulation which makes the central bank guilty. As a matter of fact more and better control mechanisms were already introduced in the aftermath of the Great Depression, but later on (in the last 30 years) were not adequately adapted and exercised. The loosening of controls by the Fed is quite understandable if one considers the renaissance of laisser-faire attitudes in economics that accompanied the conservative roll-back starting with Ronald Reagan's seize of power in 1980. To 'leave things to the market' was the general message of Reaganomics which dominated the public mood. In a sense the re-occurrence of ever deeper financial crisis is the price to be paid by the US economy to have followed this impasse of economic policy.

Additionally there is a second type of US internal critique identifying a group of financial managers as major source for financial disaster. According to John Bogle this social strata has conquered many important decision making positions, and has misused them:
"*The change in the nature of corporate ownership constitutes one of today's greatest challenges. It's all well and good to fly the banner for owners' capitalism, but today only one-third of corporate America is held directly by principals (the direct owners), with the remaining two-thirds held by agents (the financial managers), creating a vicious circle in which corporations own and control, or heavily influence, how their own shares are voted. The challenge is to force our financial intermediaries to honor the traditional standards of fiduciary duty, with their actions dictated solely by the interests of those whom they serve as servants – fund managers serving fund owners, pension trustees and managers serving plan beneficiaries, trust officers serving the families whose estates they manage, and so on.*" [Bogle, 2005, p.222]

Though Bogle goes on to advocate the somewhat outdated American vision of peoples capitalism, what he provides in the details of his very informed analysis is worth considering seriously. The 'soul of capitalism', which he proposes to preserve in its administrative detail could as well be understood as a program for some kind of market socialism.

It is nevertheless finally worth to look at the role of global monetary policy developments and their relation to the financial crisis. Sure, it originated in the US housing market, but still international influences could have played a certain role in curbing incomes of US house owners. The implied decrease in the degree of creditworthiness might have been the pivotal last push that initiated the chain reaction. Though there are interesting hypothesis around – and several econometrically oriented research is on its way – no clear judgment on the matter seems to be possible right now.

But as the crisis spreads its wings to cover the globe, it is obvious that any regulatory response must take place on a worldwide scale, a set of global institutions. This indeed was the idea of the IMF, the Worldbank and the UNO, which were designed as answers to global manmade disasters. It does not take wonder that a growing group of scholars now looks at

the experiences with these institutions to learn how adequate contemporary institutions of that kind could look like[10].

***Outline of a Common Theoretical Framework***

While the mentioned four sources of the current crisis certainly are plausible aspects, they are not linked by a stringent theoretical framework yet. This chapter will sketch such a framework, a framework which cannot avoid touching upon some of the most fundamental ideas of economic theory. The severe character of the current turmoil might explain, and excuse, this necessary detour. Starting point is the description of a closed economy as an input-output matrix of monetary flows, i.e. the framework of I-O-analysis (compare figure 4).

| | Sector 1 | Sector 2 | Sector i | Sector m | Sector n | Consumption | Investment | State |
|---|---|---|---|---|---|---|---|---|
| Sector 1 | $\mu_{1,1}^t$ | $\mu_{1,2}^t$ | $\mu_{1,i}^t$ | $\mu_{1,m}^t$ | $\mu_{1,n}^t$ | $C_1^t$ | $I_1^t$ | $G_1^t$ |
| Sector 2 | $\mu_{2,1}^t$ | $\mu_{2,2}^t$ | $\mu_{2,i}^t$ | $\mu_{2,m}^t$ | $\mu_{2,n}^t$ | $C_2^t$ | $I_2^t$ | $G_2^t$ |
| Sector i | $\mu_{i,1}^t$ | $\mu_{i,2}^t$ | $\mu_{i,i}^t$ | $\mu_{i,m}^t$ | $\mu_{i,n}^t$ | $C_i^t$ | $I_i^t$ | $G_i^t$ |
| Sector m | $\mu_{m,1}^t$ | $\mu_{m,2}^t$ | $\mu_{m,i}^t$ | $\mu_{m,m}^t$ | $\mu_{m,n}^t$ | $C_m^t$ | $I_m^t$ | $G_m^t$ |
| Sector n | $\mu_{n,1}^t$ | $\mu_{n,2}^t$ | $\mu_{n,i}^t$ | $\mu_{n,m}^t$ | $\mu_{n,n}^t$ | $C_n^t$ | $I_n^t$ | $G_n^t$ |
| Wages | $W_1^t$ | $W_2^t$ | $W_i^t$ | $W_m^t$ | $W_n^t$ | | | |
| Profits | $P_1^t$ | $P_2^t$ | $P_i^t$ | $P_m^t$ | $P_n^t$ | | | |
| Taxes | $T_1^t$ | $T_2^t$ | $T_i^t$ | $T_m^t$ | $T_n^t$ | | | |

**Figure 4**

The elements $\mu_{r,s}^t$ of the intermediate flow matrix are the money flows from sector r to sector s during year t. Sector m is the sector of financial intermediaries. The final demand part to the right consists of the usual components of consumption, investment and government expenditure, and the value added part below distinguishes between wages, profits and taxes.

If stocks of households, firms and the state are assumed not to be touched upon[11], then the well-known conditions for GDP, $Y^t$, hold:

$$Y^t = \sum_{s=1}^{s=n} W_s^t + \sum_{s=1}^{s=n} P_s^t + \sum_{s=1}^{s=n} T_s^t = \sum_{r=1}^{r=n} C_r^t + \sum_{r=1}^{r=n} I_r^t + \sum_{r=1}^{r=n} G_r^t$$

Note that with this assumption the possibility to describe the accumulation of wealth as a growth of a stock is not possible, and it thus contradicts the basic tenet of classical political

[10] A good example is [Blackburn, 2008].

[11] This includes the assumption that the value of the physical capital stock remains constant, i.e. depreciation is zero.

economy from Adam Smith's 'The Wealth of Nations' (a stock variable) to Marx exclamation 'Accumulate, accumulate! That is Moses and the prophets!' .

Three important remarks are immediately necessary:

1) Positive aggregate profits cannot be caused by particularly skilled bargaining between firms. If the sector split-up is carried down to the firm level, then a look at the intermediate flow matrix shows that

$$\sum_{r=1}^{r=n} \mu_{r,s}^{t} = \sum_{s=1}^{s=n} \mu_{r,s}^{t}$$

During the year all bargaining skills of single firms cancel each other out, they cannot be the source of aggregate firm profits.

2) Using arbitrary, but well-defined physical units for commodities and services[12] it is straight forward to compute an implicit average ***price***, $p_i^t$ ,for one such unit in every sector $i$,

$$p_i^t := \frac{C_i^t + I_i^t + G_i^t + \sum_{s=1}^{s=n} \mu_{i,s}^t}{Q_i^t}$$

with $Q_i^t$ simply being the total amount of physical units sold for intermediate use and final demand in year t.

Note further that since 2500 years commodity producing societies facilitate exchange by the use of ***money***. Money appears as a system of signs on a carrier medium, which is understood, accepted and used by all participants involved in exchange acts. In the simplest case assume that the carriers are silver coins and that the number of coins representing a flow is equal to the number of coins used to represent it in monetary terms. Given these assumptions it is evident that the implicit average price of a commodity is at the same time its price in money terms, it measures how many coins have (on average) been necessary to buy one unit of a certain commodity. With respect to aggregates these assumptions imply the possibility to define (unobserved) 'real' values for the flows considered so far, which thus from now on are given the adjective 'nominal'.

Since the actually observed flow by definition is the product of the amount of an assumed physical unit and its derived unit price, and since its exchange is mediated by a number of coins identical to this price the so-called ***quantity equation of money*** follows:

$$\sum_{i=1}^{i=n} p_i^t \cdot Q_i^t = M^t \cdot V^t$$

[12] These units may be tons of corn, the number of pieces of a certain industrial product, or the hours used for a certain service.

The right hand side simply states that the number of coins needed to mediate all exchanges between firms plus all sales to final demand is called $M^t$ and is equal to the total sum of the respective flows, if every coin is used only once in year t, i.e. $V^t = 1$. If on average a coin is used more than once, this fact increases the so-called velocity of money ($V^t$) and for a given sum of flows reduces the amount of coins necessary ($M^t$) to accompany their exchange. The tautological quantity equation becomes the ***quantity theory of money*** when additionally it is assumed that a change in the number of coins made available by the state, an increase of money supply, necessarily will increase average prices by leaving money velocity and quantities of flows relatively unchanged. This theory and its underlying trivial story thus is the overly simplistic background of monetarist advices to fight inflation by reducing the money supply. Its shortcuts are nevertheless important because they show the necessity to develop are more sophisticated notion of money. This will be attempted below.

3) The money system - consisting of signs on a carrier system given authority by the political unit of the state - just introduced is insufficient to understand the mechanisms at work in modern society. As an essential ingredient of the current mode of production the transformation of money into capital is as old as capitalism itself. While ***money is a structure*** that is necessary to provide a certain ***stability*** of production and consumption[13], ***capital is process***, a blueprint for procedures, which change the fundamental properties of production and consumption.

   So while a change in money supply certainly might have an impact on prices (If a king conquers a foreign territory and uses the defeated monarch's gold to increase his expenditure, then the additional demand for his luxury goods will drive up the price level; inflation follows the boom.), the corresponding ***stimulus for the capital process***, usually called ***credit***, not only will have an influence on money and prices, but will change the structure and content of the quantity system underlying figure 4. As classical political economy already saw, the historical mission of capitalism is to promote a process, which links private profit maximization of innovating capitalists to an increase of overall labor productivity[14]. Since such innovations introduce novelty, they first exist only as a plan, which has to be evaluated by financial intermediaries to convince them to provide credit to let it become reality. The financial system and the capitalist innovation procedure are inextricably interwoven.

   This argument takes the consideration to the sector level: The plan to maximize profits means to choose a plan (out of j possible plans) maximizing the expected[15] difference between total revenues and total cost of sector i

[13] In particular , the money structure helps to bridge the falling apart of exchanges in time and space, and in that sense works as a store of value and unit of account.

[14] From that perspective Schumpeter's work is an enhancement of economic classics.

[15] To keep it simple the formula below only considers one future period instead of an anticipation of all future flows.

$$\max_j P_{i,j}^{t+1} = \left(C_{i,J}^{t+1} + I_{i,j}^{t+1} + G_{i,j}^{t+1} + \sum_{r=1}^{r=n} \mu_{r,s}^{j,t+1}\right) - (W_{i,j}^{t+1} + T_{i,j}^{t+1} + \sum_{s=1}^{s=n} \mu_{r,s}^{j,t+1})$$

If in sector i plan v is chosen and the sector of financial intermediaries decides to provide credit for it, then $\mu_{i,m}^{t}$ shows the amount of money, the credit in money terms, which enters the revenue row of sector i in year t. Since this credit is only paid back in the future (in the one period simplification, this is the next year), there is a risk associated with it. As explained in part 1 the existence of this risk leads to a contract, which not only specifies $\mu_{i,m}^{t}$ but also the increased amount $\mu_{m,i}^{t+1}$ to be paid back next year and the value of a collateral $S_i^t$ for the case of failure. The collateral is a stock, which can be turned into a flow in case of default. All parts of the contract are specified in money terms, but they nevertheless concern an algorithmic plan of innovation, they are a kind of summarizing footprint of this algorithm.

Internal model building of firms and financial intermediaries as well as communication between them is an essential element of this model of capitalism. Firms typically only observe their own profits without being able to distinguish between effects coming from redistribution in the intermediate exchange matrix and those coming from aggregates. In that respect their models are more bounded than those of financial intermediaries. On the other hand firms encapsulate engineering knowledge and anticipations of consumer utility, which they transform into innovation proposals – an expertise less developed in financial intermediaries. But the latter additionally perform the social function to attract idle funds of money from all parts of society by the promise to pay interest on savings[16]. This interest rate on savings necessarily is smaller than the interest rate on credit provided – and there is no bi-laterally agreed upon collateral in case of bankruptcy of the financial intermediary.

Return now to the concept of accumulation. Though growth in mainstream economic growth theory usually is the growth of the flow variable GDP, it nevertheless is linked to the stock variables, which are entering the production function:

***Capital stock is increased by investment***: Money expended on investment, $\sum_{i=1}^{i=n} I_i^t$ , in classical political economy is assumed to be equal to the sum of profits, $\sum_{j=1}^{j=n} P_j^t$ . But though the flows thus leave the sum of wealth measured in coins unchanged, quantities of investment goods bought are added to existing quantities constituting the capital stock. The quantitative property of means of production therefore is accumulating. A further element complicating the measurement of the growth of these heterogeneous quantities is the aforementioned process of innovation.

[16] As a consequence a well functioning financial system will be able to finance innovation at a lower interest rate for credits, and thus will enable more innovation leading to higher labour productivity growth. But, of course, low interest rates on savings will only be translated into low interest rates if there is sufficient competition in the banking sector. Note that a small rate of inflation (in the range of the interest rate on savings) will induce economic entities to carry idle money to a bank.

***Quantity and quality of the workforce:*** While in early 19th century the advance of the degradation of workers seemed to be a clear long-run trend, since then at least that part of employees, which lived in industrialized countries, was able to improve its average knowledge and productive capacity. Thus the stock variable labor force - by its very processing as well as by its successes as political labor movement – was able to transform the continuously emerging growth of economic flows into a stock of a now incredibly increased global number of workers for global capitalism, whose average capability with respect to technology as well as with respect to institutional, democratic re-organization of the global political economy has increased tremendously[17].

Accumulation therefore does appear rather as accumulation of property rights and competence, despite the veil of large amounts of money flows which accompany it – and hide the manifest force of command over production as well as the latent force of knowledge, competence and democratic social innovation.

Money flows – in the course of this development – have changed their forms. The carrier system of silver coins, so comfortable to develop a sovereignage for a feudal monarch, developed into the multi-faceted system of financial instruments of modern states; instruments necessary to provide the infrastructure that encompasses capitalist production. On the hand, bourgeois credit became more and more independent from the actual money supply of the state, from the total amount of silver coins with an emperor's face and a number on it. Adaption of money velocity in the age of electronic carrier systems is just the most obvious case for this argument.

And ***securitization***, the first of the reasons of the current crisis, is just the tip of the iceberg of this long-run trend in the evolution of ever more abstract forms of credit. In terms of the formal framework described above it simply consists of the following procedure of financial intermediaries: Make a contract 1, $Co_t^1(Cr_t^1, R_t^1, S_t^1)$ , with credit amount, repayment and collateral (e.g. a house) specified in brackets; then use this contract as collateral, as stock, for a new contract 2, $Co_{t+1}^2(Cr_{t+1}^2, R_{t+1}^2, Co_t^1)$ **.** The extent to which this process can be said to produce additional money not controlled by the state is of minor importance, the really important fact is that it produces capital. And as any anticipated gain from a capital process, this credit can lead to a profit rate share for the owner of the contract only with a probability less than one. It is the very nature of this game that as soon as profit shares start to appear doomed the contracts will be traded hysterically, in particular if additionally the value of the original collateral suddenly appears to have been manipulated. From this perspective, bubbles per se cannot be avoided if risk taking has a progressive role to fulfill. What has to be ruled out is that those who take the risk – and who suffer if innovation fails – are not the ones who get the risk premium in case of success. The first step to a reform of rules, of course, must be that all involved parties are well informed about what is going on.

[17] It is evident that the gowth of the average capability does not allow a judgement on the distribution of the actual capabilities.

The second line of argument, the ***Minsky Moment argument***, now clearly can be sharpened in the sense that it provides the reason why unavoidable bubbles (see above) burst at well-defined moments in time. The vague notion of a change of expectations now can be given more semantics: holders of contracts form expectations about future probabilities (means, variances and perhaps higher moments) of the payoff matrix relevant for them. The more the empirically working economist knows about the details of these expectation formation processes (the boundedness of rationality), the better she will be able to determine possible turning points. To do so, the game theoretic concept of an equilibrium set of choices of portfolios (in the sense of Brams) will certainly have to be abandoned. It will have to be substituted by a model of small perturbances and oscillations around that point of relative stability; a simple example of such a system is given in appendix 1. The necessary ignorance of decision-makers with respect to constellations rarely experienced and therefore more and more forgotten – and additionally given a certain amount of risk aversion – builds a wall of fear to deviate too much. The essence of the following argument three is to catch the dynamics, which nevertheless from time to time lead to a breakdown of relative stability.

The third argument, the ***Critical Mass argument***, goes beyond normal working of bubbles towards their burst at well determined points in time. To do so, it has to enlarge and to augment the internal models of holders of contracts to picture the full-fledged network of communication networks they entertain. This not only will include observations at the stock exchange, but clearly has to take care of some 'financial mass media' modules (Federal Reserve Bank statements, important financial newspaper news, etc.). Enhancing internal model-building in that way certainly implies a step from analytical mathematical treatment to agent based modeling approaches. As has already been argued above, the action guiding internal models are based on perceptions learned from market price developments, which are interpreted by the use of these internal models. Internal models in turn are subject to – and object of – communication; including self-communication, i.e. remembering analogous experiences. To mimic these processes by computer simulation is possible, but the degree of volatility with respect to typical classes of outcomes is rather frightening and explains why many mathematical economists rather choose the easy way out: They start with 'heroic' assumptions[18] to arrive at strong and general results. Permanent, modest economic fluctuations are thus the way that the necessity of continuous slow technical progress via risky, but small innovative explorations are reflected in aggregate growth. The very success of these small innovations gradually shifts their center of gravity, which is expected average payoff. Since this shift induced by perceptions of real processes occurs on the background of constant values experienced in a distant past, there will be a moment when a strong deviation appears to be profitable – that was the Minsky moment emphasized in argument two. The critical mass argument now adds to this model two new components: (1) Taking a closer look at the average opponent and decomposing it into a network structure enables a view on the importance of relative quantities of opponent types, on critical masses. (2) The

[18] It is revealing that they call such assumptions ‚heroic' – it takes a hero to sacrifice the appropriateness of a model for a formally elegant and general result.

network structure itself, and in particular the communication strength between its nodes can now be made explicit – changes of these elements help to explain the timing of the Minsky moment, the sudden appearance of a 'black swan' (compare [Taleb, 2008]). Again, the archetypical example given in appendix 2 highlights the interplay between the two arguments.

The fourth line of argument, ***monetary policy of the state***, requires a special treatment – following nevertheless from argument three. Financial communication is shaped by public monetary authorities, to understand its dynamics, a closer look at the interdependent financial system of all major states is necessary. To do so, one can again use an I-O framework[19] (compare figure 5):

| | Country 1 | Country 2 | Country i | Sector m | Country n | Means of Production | Workers | State Infrastructure |
|---|---|---|---|---|---|---|---|---|
| Country 1 | $\mu_{1,1}^t$ | $\mu_{1,2}^t$ | $\mu_{1,i}^t$ | $\mu_{1,m}^t$ | $\mu_{1,n}^t$ | $K_1^t$ | $L_1^t$ | $N_1^t$ |
| Country 2 | $\mu_{2,1}^t$ | $\mu_{2,2}^t$ | $\mu_{2,i}^t$ | $\mu_{2,m}^t$ | $\mu_{2,n}^t$ | $K_2^t$ | $L_2^t$ | $N_2^t$ |
| Country i | $\mu_{i,1}^t$ | $\mu_{i,2}^t$ | $\mu_{i,i}^t$ | $\mu_{i,m}^t$ | $\mu_{i,n}^t$ | $K_i^t$ | $L_i^t$ | $N_i^t$ |
| Sector m | $\mu_{m,1}^t$ | $\mu_{m,2}^t$ | $\mu_{m,i}^t$ | $\mu_{m,m}^t$ | $\mu_{m,n}^t$ | $K_m^t$ | $L_m^t$ | $N_m^t$ |
| Sector n | $\mu_{n,1}^t$ | $\mu_{n,2}^t$ | $\mu_{n,i}^t$ | $\mu_{n,m}^t$ | $\mu_{n,n}^t$ | $K_n^t$ | $L_n^t$ | $N_n^t$ |
| Workers | $W_1^t$ | $W_2^t$ | $W_i^t$ | $W_m^t$ | $W_n^t$ | | | |
| Investment | $P_1^t$ | $P_2^t$ | $P_i^t$ | $P_m^t$ | $P_n^t$ | | | |
| Taxes | $T_1^t$ | $T_2^t$ | $T_i^t$ | $T_m^t$ | $T_n^t$ | | | |

**Figure 5**

Here the elements of the intermediate flow matrix are capital flows from the country in the row to the country in the column; diagonal elements are domestically used capital flows. There also still exists a global sector m, which cannot be ascribed to a single country and which works like a buffer used to redistribute international capital flows. Using sector m capital flows could be redirected to serve the needs of final demand in each country: (1) Renewal and improvement of the means of production, (2) feeding (i.e. basic needs) and (as far as it is possible) satisfying more sophisticated cultural needs of the population, (3) maintain and enhance public infrastructure. All these uses are specified in their respective quantities and enter local production functions. The value added part below the intermediate flows shows the same categories as final demand, but now specified as monetary aggregates in a globally agreed upon world currency.

There is no doubt that fig. 5 describes the vision of a future system to be aimed for. But it is also revealing for the current circumstances to see in detail how monetary policies nowadays fail to support the redistributive activities in sector m. First of all, sector m does

[19] Note that this scheme is not to be interpreted in the usual way of I-O-analysis; e.g. quantities and values are mixed.

not have a clear design with a welfare preserving and enhancing goal function[20] – it is not politically (democratically) legitimized. So while it may be of high scientific value to study the failures of current monetary authorities, a large part of scientific work should now concern the overcoming of these mistakes, the design of new global institutions. Experimental simulation studies with ABS systems should help to clarify the issues.
Note that for example urgent global environmental issues should be addressed by specifying them quantitatively in the upper right hand part of figure 5. Then capital necessary to meet them can be derived (in the lower left hand part) and the channels via which it can be transferred can be planned (in the intermediary part). In a similar fashion quantitative needs of a starving population can be treated. But there is also room for less passive, pro-active improvements, for example of a more just enhancement of infrastructure[21].

This sketch of a framework, or better of a research program for a framework, might seem to be a bit far-stretched for the immediate purpose of a reregulation of the international financial system. There are already voices calling for a return to good old practices, which just have to be applied a bit more rigorously. From the point of view of this paper, not only has the downturn of the real economy – and its consequences – not been reached yet[22], the theoretical disaster of skin-deep prevailing theories of international finance[23] has already been testified by the muteness of the former stars of finance departments as soon as the crisis set in[24]. In that sense, another goal of this paper is to take first steps towards conceptual clarity – to blow away the fogs of the superficial jargon of finance industry protagonists. Too often inadequate language has been used for business and ideological purposes; and in the case of financial mathematics even could hide behind a complicated (even consistent) syntax the fact that the semantics were completely misplaced. Now many of these most sophisticated, but economically void theories have been muted by the actual financial collapse. Unfortunately there is no time for malicious joy, since the global economy needs theoretically sound actions urgently. Perhaps this paper is a modest contribution.

***Conclusion***

The described four sources of the current financial crisis are highly interdependent and evolve along a common dynamics. The world of finance has entered a stage of high volatility – strong upturns and downturns will characterize the immediate future, with no dominating overall trend. And this high amplitude of oscillations will kill substantial parts of economic

[20] Global problems in environmental issues, global income distribution, military issues (e.g. in Africa), education, etc. are calling for such a clear global goal setting.
[21] Health, education and cultural needs typically are parts of infrastructure.
[22] This downturn should reach its first nadir towards the end of 2009.
[23] Of course, such analysis can be technically rather sophisticated, e.g. [Buiter, 2008].
[24] Back in 2006 Barry Eichengreen, always a lucid commentator on the failures of standard theory, gave an interesting account of the inherent contradictions of the four prevailing theories explaining global imbalances [Eichengreen, 2006].

enterprises, those who survive will either merge or find a way to isolate and immunize themselves. In other words, financial turmoil will find its way to all parts of the economy.

As any other economic evolution the diverging nature of these dynamics hopefully will lead to learning processes, which themselves will result soon enough in globally oriented institution building. Parts of the necessary theories already exist; part of the necessary knowledge will have to be developed in the course of the practical problems to be mastered. Some of the functions of capital will survive, but they will take on different institutional forms. And many of the tenets of households – visions of the classical labor movement nowadays in disguise – will be incorporated in this evolutionary and democratic framework. “Every opinion that is not optimistic is wrong.” a famous revolutionary once said. Not so much to state something about opinions but rather to define right and wrong.

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