The origin of financial crisis: A wrong definition of value

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Abstract: As the most reliable guide for "value" market value is normally considered. Its change produces profit or loss, respectively. Tumbling market prices produced huge losses recently leading to a so called financial crisis. In this paper we present a standard procedure how to calculate the speculative content in value. Subtracting it leads to intrinsic value. We show that considering intrinsic value is the only reasonable definition for value. (Analogous to considering conservation laws in science leading to thermodynamics and hydrodynamics). In contrast the market value changes chaotically in the mathematical sense. It cannot be predicted. Dealing with it is therefore completely equivalent to gambling. Considering intrinsic value only, the "financial crisis" ceases to exist.

Keywords: Financial crisis; chaos; systemic approach; intrinsic value; conserved quantity.

1 Introduction

The reasons of the recent financial crisis may be manifold. Many people discussed it and tried to find out how to avoid it in the future. Some regulations have been suggested, mainly in the sense of a Tobin (1978) tax. While the cause of the crisis is still debated its effect has never been questioned. It may be seen as the very definition of financial crisis that "values" collapse rapidly. Prices of stocks and derivatives of mortgages decreased. And with it the value of companies and real estate diminished. While the authors do not doubt that prices went down, they severely object to a decrease in value. However, if the values did not deteriorate there was no crisis. But how did this devastating misperception start in the first place? The answer is simple. Because people tend to equate the price (of stocks, etc.) with its underlying value (of the company, etc.). Obviously people defined "value" as *market value.* It is a possible and unfortunately common definition but it is very misleading.

To see the point consider the example of the VW AG's (a German automotive company) stock. On October 28, 2008 its *market* value was Euro 305 billion, the highest ever (below "billion" will be abbreviated "bn" and "million" will be abbreviated "m"). Only days before and after this date the market value was less than half of it. And this is not only a "paper value" of a not functioning stock market. In contrast there was heavy trading leading to, e.g. around Euro 1bn additional cash flow for Porsche (a German sports car maker) and a similar loss for Adolf Merckle (a German entrepreneur). (Most likely the reason behind his suicide on January 5, 2009). Consider in contrast the production and sales numbers of VW within the week of October 28, 2008. There was hardly any change. Compared to its change in market value everything remained boringly similar. Obviously the market value of VW was the worst property to describe the change of the company's (valuation-relevant) business activities. (Not only for the late Adolf Merckle). For more details on it please see chapter 4.

As the *market value* is proven nonsense what else should be used to describe an asset's "value"? Hints to an answer go back more than a century. Marx (1887) defined two sorts of values:

1. Market value ("Tauschwert") and
2. Intrinsic value.

While a definition of market value is obvious, a useful definition of intrinsic value is much newer than Marx's work, however. It is the quintessence of this publication. *Intrinsic value is a value which will change only if some other value changes correspondingly. If that is the case, the amount of intrinsic value is given by its future cash flow it will create.* Please note that market values may create cash flows too. However, their value may change without any outside change. As a consequence the so defined intrinsic value is a *conserved quantity* and the market value is none (Grabinski (2007)). Chapter 3 will explain it in more detail.

The reason why not conserved quantities must not be used has been known in science for quite a while. Please see chapter 2 for more details. Once having a new definition of value one easily sees that it hardly changed during the latest crisis. In other words, there was no crisis. Needless to say, accounting rules and taxation laws should be changed. For more details on this issue please see chapter 5.

2 Background from science

The essence of Gutenberg's systemic approach (1998) is that a business situation can be described by a function of certain variables. Gutenberg borrowed this approach from science. The systemic approach has three ingredients.

1. The existence of such a function is assumed.
2. One has to find proper variables.
3. Only after these two steps one may try to find the function and discuss its behavior. This third step is the main subject of management science; arguably it is its very definition.

While the first step can just be assumed, the second step needs proper investigation. However it is mostly neglected. Up to our knowledge this paper addresses this point for the first time.

To see the point more clearly one should look to science where Gutenberg's approach originated as stated above. Closest to Gutenberg's approach is the second law of thermodynamics (see e.g. Callen (1970)). There the *existence* of a function (called entropy) is predicted. As a second question one has to state proper variables. The first law of thermodynamics says that energy and number of particles are the proper variables. But this is far from being an arbitrary choice. From a pure mathematical point of view there are many more sets of variables describing the system completely and uniquely. However, most of them are irrelevant for most practical purposes. Only *conserved quantities* have any meaning for describing the system. To see why consider e.g. a small room with a flubber ball bouncing back and forth. Its energy is a reasonable variable for describing it. Knowing it will yield the maximum velocity and height of the ball. Furthermore one will know how long it will bounce if the rate of dissipation is known. The energy of the ball changes slowly and very predictable. The reason behind it is that energy is conserved. If the energy of the ball decreases it must be "transferred" to somewhere else. (In this case from the ball to the heat inside the room). It cannot change without changing something else. As one may know from basic science lessons, energy is the sum of kinetic energy (essentially velocity squared) and potential energy (essentially the height above ground here). Purely mathematically, considering two addends separately must be even more precise than considering the sum. However, considering the two addends (here kinetic energy and potential energy) proves to be a complete mess in this case. It becomes especially clear if one considers a system of many (say 100) bouncing balls. The total energy of the balls is easily predicted at each time. However trying to predict the (total) kinetic and potential energy, respectively at any given time will be tedious. For the considered system of balls it can be shown that not only the friction of the balls and the air, but also the gravitational effect of the balls under each other and even the gravitational effect of an observer have a severe influence. Obviously nobody can take into account all this small effects. The behavior appears to be unpredictable though it is completely deterministic from a pure mathematical point of view. This effect is called *"chaos"* (e.g. Schuster (1984)). It is the reason for the impossibility to predict the weather for a long period of time (cf. "butterfly wing effect") or to calculate the numbers of next week's lottery drawing. Only fools will call it a business to guess the number of next week's lottery drawing in order to create a profit. Please note that there are examples where people claim to be able to calculate lottery numbers. They have a mathematical system and some (very few) may even hit the jack pot. However, that proves nothing.

This seemingly clear result from science has clear consequences for business and economics. Within complex systems not conserved quantities may change unpredictably. Therefore building a business on observing and predicting them is as ludicrous as the business of calculating next week's lottery numbers as mentioned above. Applying these chaos effects to management or economics is relatively new, see e.g. Grabinski (2007 and 2008), Ferreira et al. (2010), Filipe et al. (2010). And the archetype for such an economic quantity is the market or exchange value. The example of the VW stock as stated in the introduction is only one prove for it. Betting on increasing or decreasing (market) values of stocks or entire companies may be entertaining and financially rewarding for some. But it is as much of a business as gambling in a casino. Disguising gambling as financial management is maybe nothing but decadence in camouflage. More severe are economic consequences and actions. The burst of the housing market bubble was not equivalent to a burst of an atomic bomb. All houses were almost undistinguishable shortly before and after the bubble collapsed. However, the reactions where more like after the burst of an atomic bomb. And the cost for such reactions influenced the real economy. Please note that the reactions were not superfluous. They became necessary because the growing of the bubble was considered making profit rather than having a lucky phase in a casino. For some additional notes on economic consequences please see chapter 5 of this paper. We will now give a procedure how to distinguish between conserved and non conserved quantities.

3 Methods to define intrinsic value

As noted before, the market value and actual (intrinsic) value of an asset are not necessarily equal. (In the following two chapters we show that the very characteristics of a market suggest that there is not even a market value but just *market prices*). In addition, we argue that the (intrinsic) value of any asset can be forecasted by analyzing the *conserved cash flow*, which is determined by the application of the asset's utility.

Please note that "utility" in our definition is by no means restricted to technical applications. In contrast, we consciously include "soft utilities", which often are examined by sociocultural studies too: For example, if a company is able to ask for premium prices because their products are appreciated for their environmental friendliness, their modern design, their expression for wealth, etc., we would include the price premium into the calculation of intrinsic value of both the products and the company.

Our definition of (intrinsic) value is based on the concept of conserved quantities known from science – therefore the same prerequisites as discussed in chapter 2 apply:

1. As long as the requirement for the asset's utility remains unchanged, the cash will continue flowing unaltered. In order to in- or decrease this part of the total cash flow, macroenvironmental conditions determining the utility will have to change before. (Such macroenvironmental catalyst is comparable with a person letting loose our flubber ball so that it can start bouncing in the small room).

2. Even more important, there must be an outside change of another conserved quantity. In the context of management science, the most obvious example may be revenue – if it increases, the cost of somebody else must increase, too (Grabinski (2007)). (The transfer of the related cash from one market participant to another one bears comparison with the transfer of some part of the total energy of the bouncing flubber ball to the heat inside the room).

Given the fulfillment of these two prerequisites – there is a cause for any change of the conserved quantity under consideration plus there is also a reaction in another conserved quantity – the third characteristic of a conserved quantity is fulfilled too: One gets a certain form for describing something that for sure will affect the future state of a system. (This is the reason why one definitively can compute how long the flubber ball will continue bouncing back and forth). In a managerial context, this parallels with the ability to forecast the development of the cash flow allocation between the individual parties within a (global) economy.

Valuation is rather unimportant as long as an asset is applied by a private person only. However, as soon as a company has to set-up a balance sheet or a price for a transaction has to be determined, the parties have to agree on some valuation approach. For that, the prevailing school of thought is to rely more and more on transaction or market prices. This trend is not only but also advocated by organizations that establish financial accounting and reporting standards, in particular the FASB (Financial Accounting Standards Board (2006)). As stated previously, the market value is (in general) not a conserved quantity. And predicting it is as reasonable as trying to calculate next week's lottery numbers. In typical business situations this is manifested by the following issues:

1. *Distortions* – like price agreements or speculations – can undermine any validity of market prices.

2. *Illiquid assets* – like licenses or shares of non-listed companies – may be traded in opaque markets. In such cases market prices are not only particularly endangered by distortions. In addition one would have to refer to trades of comparables in order to find historic market prices. However, in a not transparent market, who is able to tell whether or not there are (good) comparables?

3. *Assets bought at forced sales* – like auctions in course of insolvency – may be acquired below their intrinsic value.

4. *Collector's items* – like pieces of art, postage stamps, etc. – regularly inveigle people to pay more than the intrinsic value.

As already indicated, not all cash generated by an asset adds to intrinsic value. The most general reasons can be found in cases 1) and 4): Distortions may be falsified, so that market prices rise or plummet like card houses. Collectors may get bored on the short-run and switch to another trendy item or non at all. That does not necessarily mean that no cash flow can be generated. It just means that (some of) the gap towards the intrinsic value is equalized, i.e. that people's buying decisions adjust to a more rational, utility-based scheme. And, since there was no real need to over- or underpay before, such adjustment can occur progressively fast. (Or in the language of science: No conservation law forces a slow "transfer" of value).

The first reported and maybe best known real example leads back to the "great tulip mania", which took place in Holland in the 1630's (figure 1): At the peak of tulip mania in February 1637, some single tulip bulbs sold for more than 10 times the annual income of a skilled craftsman or more than the value of a furnished luxury house in 17^{th} century Amsterdam (Thomson (2006)). However, within a few days, the demand – and with it the market prices – collapsed (Kindleberger and Robert (2005), Shiller (2005)).

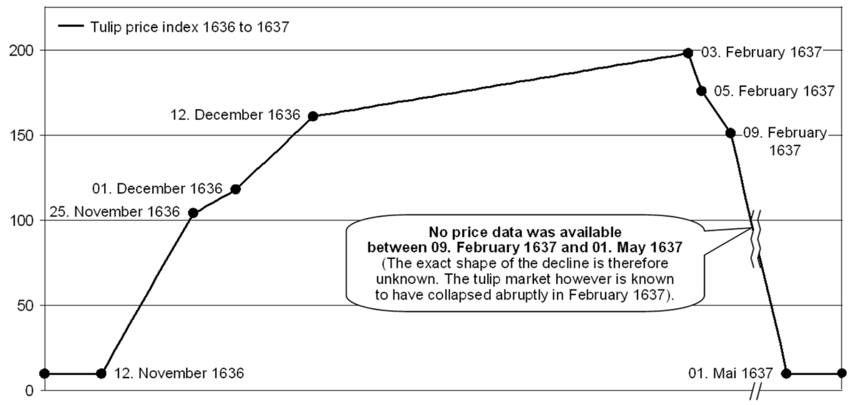

Figure 1: Tulip market price index from 1636 to 1637 (Thomson (2006))

In this context please note that according to Hazlehurst (2006), "[by trading collector's items] value is created when intrinsically valueless objects are transferred by irrational desire." However, even if real cash is gained by trading a collector's item, the corresponding change in "value" is not conserved. It does not lead to an increase in intrinsic value in our definition. (It is impossible, because this would be like generating energy from nothing).

Up to now, it should have become obvious already that our definition of intrinsic value must not be confused with a philosophic sense, where the intrinsic value of something is said to be the value that it has "in itself", or "for its own sake", or "as such", or "in its own right", and extrinsic value is value being not intrinsic (Zimmermann (2007)). Rather it should be understood in an economic sense as *value-in-use*, which is the conserved net cash flow generable in course of the acquisition and application of an asset, adjusted for the expected risk, uncertainty, inflation, currency exchange rates (if applicable) and the asset's obsolescence during its period of use. (Please note that "acquisition" is used in the broadest sense here, i.e. it also contains contractual arrangements like the access to certain assets or licenses via royalty payments, etc.). An asset's intrinsic value therefore may be individual for diverse proprietors, dependent on the context in which it is used, the synergies arising from a management team's capabilities, or even the regional spread of a company. (To handle such diversity, a scenario approach is required, whose description would be beyond the scope of this introductory article; however we will suggest it for a future publication).

Admittedly, we did not coin the term "intrinsic value" in management science. It was Benjamin Graham and David Dodd (1934) in their investing compendium "Security Analysis": "In general terms," they wrote, "it is understood to be that value which is determined by the facts, e.g., the assets, earnings, dividends, definite prospects, as distinctly, let us say, from market quotations." In short, intrinsic value is the value of a company's business, not its stocks (Carbonara (1999)). There are diverse interpretations whose most common thread is that there must be some kind of fundamental, i.e. economic metrics-generated, income stream, which often has to be discounted in order to reflect the time value of money and the risk associated with an investment (therefore the terms "fundamental value" and "investment value" are also customary). Up-to-date, all versions face the common criticism that forecasts may be unreliable (Kamstra (2003)). In principle, we agree – and therefore suggest forecasting conserved quantities only. In turn this implicates that we challenge variable(s) other authors consider as "intrinsic" or "fundamental". (Please note that e.g. real cash flows, like the Euro 1bn by VW stock trading as mentioned in the introduction, would have been considered value adding in previous discussions. In our sense they however do not contribute to intrinsic value because they are based upon non conserved quantities).

In order to clarify the parallels and deviations with our conserved quantity approach, selected common valuation techniques, which at first glance may be mixed up, will be briefly discussed in the following:

1. *"Relative value pricing"* by setting a company's financials in relation to market prices of presumed peers is the most severe deviation from our approach. An often mentioned practitioners' example are the price-to-earning (P/E) or the price-to-sales (P/S) ratios (Kamstra (2003), Matchet (2003)). The reason becomes even clearer when looking at our example in chapter 4: Market prices for sure are not conserved quantities, i.e. they can react chaotically, which increases the quality of any "value" forecast by no means! In addition, accounting figures like earnings – or any other variable taken from the company's financial statements – do not necessarily have to be conserved.

2. *"Discounted dividend models"* were made popular not only but also by Williams (1938) with the publication of his thesis named "The Theory of Investment Value". He considered stocks being typically overvalued by the "winner's curse", i.e. that the stockholders tend to be the most optimistic investors. Williams argued that investment value, defined as the present worth of future dividends or of future coupons and principal, is of practical importance to every investor, because it is the critical value above which no asset can be bought or hold without added risk. Therefore, if someone buys a security below its investment value, there will never be a loss, even if prices fall at once, because the asset can still be held for income to get a return above normal on the acquisition price. However, if someone buys at prices beyond the investment value, the only hope of avoiding a loss is to sell to someone else who must in turn take the loss in the form of insufficient income. Therefore all those who do not feel able to foresee the swings of the market and do not wish to speculate on mere changes in price are well-off if they estimated the investment value as guideline for their buying and selling decisions, according to Williams.

Please note that though Williams' work provides thought-provoking impulses and seminal insights, he *never* addressed conserved quantities, in particular not in his "law of the conservation of investment value": He rather argued that the value of an enterprise consists of the "present worth" of all its future distributions, no matter whether they are interest or dividends, and therefore, it "in no [way] depends on what the company's capitalization is". This means he anticipated the theorem later formalized by Modigliani and Miller (1958), which states that, under certain market conditions, the value of a company is unaffected by how it is financed. Though we do not at all challenge this theorem, we still would like to point out that it has nothing to do with the "conservation laws" in science, which we apply as guideline for identifying and analyzing conserved cash flows.

3. The *"Gordon growth model",* a variant of the discounted dividend model, is intended to be a method for valuing a stock or business. There are two core assumptions: Both the discount rate and the growth rate of the dividends are constants. Then the valuation formula simply is a ratio involving the average dividend growth rate and the average discount rate multiplied by the most recent dividends (Gordon (1959)). Though we also suggest applying some kind of discounted cash flow for calculating intrinsic value, we do not agree with Gordon (and other authors adjusting its model by non-constant growth rates). Here the issue is: What makes the dividend growth rate predictable, if there is no analysis of the company's underlying business? In the case of the Gordon growth model and its successors (cf. Yao (1997)), it is just the simplifying – and as we think unsatisfying – model assumption, that the earnings grow constantly in perpetuity. Also Kamstra (2003) concludes in his review of algorithmic valuation techniques, based on actual company and share date, that "[such techniques] provide, at best, a rough starting point for firm valuation".

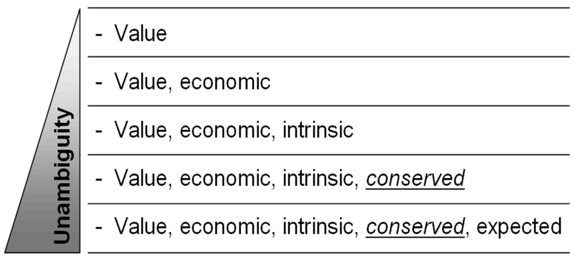

Figure 2: Progressive refinement of intrinsic value

Though there may be parallels between some so-called "intrinsic valuation"-techniques in the current literature and our approach, there is one core difference: It is the selection of the variable under consideration – in our calculations we consider conserved quantities in the form of the conserved cash flow only.

In summary, the key to sensible valuation is to analyze the actual *requirement for the utilities of an asset*, which can considerably *deviate from market demand.*

Then one can compute a forecast for the conserved cash flow. This cash flow related to the requirement for the utility may (slightly) swing as well, there are however no major day-to-day jumps. And it will not change without notice; macroenvironmental catalysts affecting the requirement like political, economic, sociological, technological, legal, or environmental conditions have to change before (cf. Hax and Majluf (1984)). Such factors are inevitable in order to get a "big picture", which is crucial in order to see "where the cash could flow" within the economy. (Williams (1938) implicitly stresses this point when he describes his experiences as a security analyst, "how to estimate the fair value was a puzzle indeed [...]. To be a good investment analyst, one needs to be an expert in economics also"). However, the ultimate test whether or not some part of the total cash flow is conserved, works as follows: If there is a change of the cash flow at point "A", (i) there is however no according change of the cash flow at other points "B", "C", "D", etc., and (ii) the change of the cash flow at "A" occurred ad hoc without any previous change of a macroenvironmental catalyst, then this change is not conserved. If there are changes in macroenvironmental catalysts, which led to a "shift" in the cash flow allocation, the according value is conserved however

4 Analysis of stock market data

The raison d´être of calculating intrinsic economic value is the a priori premise of non-identity between "value" and "price": "In other words, the market is not a weighing machine, on which the value of each issue is recorded by an exact and impersonal mechanism, in accordance with its specific qualities [i.e. it is not efficient]. Rather should we say that the market is a voting machine [i.e. subject to fads and fashions], whereon countless individuals register choices which are the product partly of reason and partly of emotion" (cf. Graham and Dodd (1934) cited by Lehman (1991)).

Bearing in mind the core assumptions of chapters 2 and 3, we analyzed the cash generation of several listed companies, calculated their historic intrinsic firm value and compared it to the share price. In all cases, (intrinsic) firm value followed quite stable trends over time without significant breaks. In parallel, the share prices (= market values) rose and dropped considerably. (Later we will present the example of SAP AG, which shows this typical pattern).

There are forces driving (non conserved) stock market prices above or even far beyond intrinsic firm values. These forces make market participants counter-intuitively willing to buy or sell assets, independently of its over or under valuation as compared to intrinsic value. These forces are generally called *"market expectations"* or *"speculations"* if it had come to transactions.

In our examples, on the long-run, the share prices seldom followed – and never fully matched – intrinsic firm values. Therefore we argue that there are market distortions due to speculations. These distortions exist because speculators focus on the development of market prices.

Recent developments of the stock market structure seem to support this result of our analysis: Increasingly more transactions are performed by so-called "algo-traders". For example, in Europe about 40% and in the USA already about

SAP: Divergence of market capitalization and intrinsic firm value					
Exemplary dates	Market capitalization [€m]	Intrinsic firm value [€m]		Market capitalization / intrinsic firm value [%]	
		Applying average terminal value**	Applying median terminal value**	Applying average terminal value**	Applying median terminal value**
29. December 2000	42,713	5,944	6,759	7.2x	6.3x
02. January 2001*	33,844	5,929	6,747	5.7x	5.0x
Change:					
[%]	-20.76%	-0.25%	-0.18%	N/A	N/A
[€m; x]	-8,869	-15	-12	N/A	N/A
16. October 2002	17,306	8,964	8,950	1.9x	1.9x
17. October 2002	21,709	8,966	8,953	2.4x	2.4x
Change:					
[%]	25.44%	0.02%	0.03%	N/A	N/A
[€m; x]	4,403	2	3	N/A	N/A
Average within review period [€m; x]***	43,697	10,052	10,966	5.0x	4.7x
Median within review period [€m; x]***	42,535	9,098	9,296	3.7x	3.6x

*Due to banking holidays, no trading was performed between 29. December 2000 and 02. January 2001.
**There are two firm value scenarios. Their calculations are identical, except of the calculation of the terminal value.
***At 01. January 1989, the rolling 3,650 days firm value calculation starts based on historic actual values. From 01. January 2010 going forward, cash flows are forecasted by applying growth assumptions with respect to SAP's latest acquisition of Sybase (in Q3/ 2010) and a long-term "steady state" growth rate equal to Germany's ten year average inflation rate.

Table 1: Market capitalization vs. intrinsic firm value applying the example of SAP AG

60% of share trades are performed by largely autonomous acting computers. The issue is that they do not place orders based on well-founded cash flow analysis. This means they do not consider any criterion directly related to the companies' current and future business potential. Instead, the algorithms just react on movements and disparity of market prices. According to "Nanex", a company mandated to analyze the "black Thursday 2.0", such computer-trading led to the bizarre slide of the Dow Jones by nearly 1,000 points as of May 6, 2010. In course of this intermediate disorder, the stock market lost about thousand millions of euros. Even strong quoted consumption shares lost 40%, e.g. the ones of Procter and Gamble Corporation. The plunge had nothing to do with any value based investment or disinvestment logic. The whole issue was speculative, pure market price-driven trading (Seith (2010)).

Presumably nobody would deny that transparency, trust, and in the end stability could lead to more efficient markets. But if the cash flow, which is the "lifeline" of both companies and whole economies, is left aside in the market place, what other criterion or tool could indicate whether or not there is stability? Maybe the answer can be read between the lines of the famous statement of English economist John Maynard Keynes: "The market can stay irrational longer than you can stay solvent". (I.e., while value-based investment may win in the long-term, in the short-run value-stocks can nonetheless fall even further in a bear market and vice versa in a bull market).

If there is trading of high volumes at prices that are considerably at variance with fundamental (intrinsic) values, i.e. trading of products or assets with inflated values, economic or speculative bubbles can occur (King et al. (1993), Lahart (2008)). Also Thomson (2007) follows that for a bubble market prices have to become unhinged from intrinsic values. He adds that even a dramatic rise and fall in prices does not necessarily show the growing and bursting of an economic or speculative bubble (the latter event commonly is called *"financial crisis"*). We agree insofar, that dropping market prices could indeed just reflect prices that in parts are adjusting towards intrinsic values. (Regarding the upswing, it has to be determined whether or not it can be considered conserved. For that please cf. chapters 2 and 3). Obviously, a more unambiguous explanation of the source of financial crisis seems required, such as: "Major parts of market participants consciously hold back their cash and forego consumption and investments, because of macroeconomic developments threatening their long-term purchasing power and business potential". Under such circumstances companies indeed would have reasons to fear the continuity of their businesses, and employees would question their job security. It is a *real* and potentially long-running thread in the real economy, which would affect intrinsic values of assets too. Anything else could be just a simple market swing due to speculations or the manifestation of market prices (partly) adjusting towards intrinsic values as soon as increasingly more speculators leave the market place. (In this context, it seems noteworthy that during the last financial crisis, the term "real economy" was often used by Germanies media to express the diverge of stock market developments, banking activities and the progress of the "real" value creation by production companies and service providers).

As a real example for showing the difference of intrinsic and market value

SAP: Adjustments to balance market capitalization swings by intrinsic firm value influence factors								
Exemplary market capitalization changes	Maximal market capitalization decrease (29. December 2000 to 02. January 2001)*				Maximal day-to-day market capitalization increase (16. October to 17. October 2002)			
Magnitude of market capitalization changes (= target values to be met by intrinsic firm value)	-20.76%		-€8,869m		+25.44%		+€4,403m	
Intrinsic firm value	Applying average terminal value**	Applying median terminal value**	Applying average terminal value**	Applying median terminal value**	Applying average terminal value**	Applying median terminal value**	Applying average terminal value**	Applying median terminal value**
Intrinsic firm value adjustments:								
Cash flow - single pay-out/ -in (within respective first year) [€m]	-961	-1,550	-6,906	-9,793	1,776	1,036	3,429	3,384
Cash flow - equal de-/ increase per year (within review period***) [€m]	-20.76%	-20.76%	-149.20%	-131.22%	25.44%	25.44%	49.12%	49.20%
Growth rate of cash flow - de-/ increase (after review period***) [€m]	-10.44%-pts.	-7.09%-pts.	Drop of market capitalization cannot be met: For example even a reduction of 1,000,000%-pts. is still too low, a reduction of 10,000,000%-pts. only affects the 2nd position after the decimal point.		3.33%-pts.	3.33%-pts.	4.78%-pts.	4.79%-pts.
WACC - equal de-/ increase (within and after review period***)	2.80%-pts.	2.41%-pts.	Drop of market capitalization cannot be met: Even at an increase of about 5,000%-pts., the firm value is still positive. At an increase of about 5,230%-pts., the firm value becomes €0, which - in this case - is the lowest possible value.		-1.81%-pts.	-1.82%-pts.	-2.95%-pts.	-2.95%-pts.

*Due to banking holidays, no trading was performed between 29. December 2000 and 02. January 2001.
**There are two firm value scenarios. Their calculations are identical, except of the calculation of the terminal value.
***At 01. January 1989, the rolling 3,650 days firm value calculation starts based on historic actual values. From 01. January 2010 going forward, cash flows are forecasted by applying growth assumptions with respect to SAP's latest acquisition of Sybase (in Q3/ 2010) and a long-term "steady state" growth rate equal to Germany's ten year average inflation rate.

Table 2: Adjustments to match market capitalization swings applying the example of SAP AG

we have chosen SAP AG. It is the biggest European (worldwide number 4) software company headquartered in Walldorf, Germany. SAP has the advantage of being so big that it is a potential target for speculators. And its value is essentially given by its future cash flow. No big machines, changing value for other reasons, will distort this picture.

In the SAP example, we assumed an investor able to hold the company's shares in the long-run. Because there is no urge to sell – and we additionally suggest that there is no more attractive investment opportunity – the timing for (intrinsic) value-based selling and re-buying of SAP shares would be determined by the spread between the market capitalization (driven by the share price), and the firm's (intrinsic) value.

The firm value is based on a discounted 3,650 days rolling cash flow calculation plus a terminal value. There are two firm value scenarios: The first one calculates the terminal value by applying the rolling average of the ten year cash flow, the second one applies the median. We set up the scenarios in order to being able to have reasonable formulas for calculating the rolling firm value per day. In addition, it allowed us to "balance" SAP's merger and acquisition activities, which two times led to negative (actual and forecasted) cash flows in the closing year and a positive (actual and forecasted) cash flow peak in the following one. It means SAP successfully "bought" cash flow by its acquisitions. This fact justifies both our "average approach" and our "median approach". (Due to statistical reasons, we consider the median being most valid).

The overview in table 1 shows the huge divergence between market capitalization and intrinsic firm value. The related multiple ranges from 1.9x to 7.2x. So it seems appropriate to conclude that SAP's operations cannot match the speculators' expectations. During the period under consideration no average or median and no value at the exemplary dates show such extreme turning points as the market capitalization.

The extreme rise and fall in market capitalization from trading-day-to-trading-day would be even harder to match than any average market capitalization: For example, from December 29, 2000 to January 2, 2001, SAP's market capitalization lost Euro 8,869m (20.76%). From October 16 to 17, 2002, the market capitalization gained Euro 4,403m (25.44%). If there would have been something like an efficient market, what kind of key information could have been hidden? What kind of information justifies a company's value to shoot up or fall down by up to a quarter within one day (cf. Lehmann on the inefficiency of equity markets (2003))?

For example, in order to decrease SAP's firm value by 20.76% (see table 2), the annual cash flow would have to decrease accordingly. Alternatively, there must have been an additional cash outflow of up to Euro 1,550m in the first year of the review period. In order to match the Euro 8,869m fall of the market capitalization, the annual cash flow even would have to decrease by up to 149.2%. This would be equivalent to a one-off cash outflow of up to Euro 9,793m in the first year. In contrast, in order to increase the firm's value by 25.44%, the annual cash flow must increase accordingly. Alternatively, an additionalcash inflow of up to Euro 1,776m in the first year of the review period would have been required. The adjustments to balance the absolute day-to-day market capitalization swing would be even more unrealistic: An additional one-off cash inflow of up to Euro 3,429m, a growth of the annual cash flow by up to 49.2%, an increase of the growing perpetuity of up to 4.79%-pts., or a decrease of the WACC (weighted average costs of capital) by about -2.95% would have been required.

Our research did not provide any information that could justify such extreme breaking in the numbers: Any of the cash flow adjustments seem unrealistic, given that the historic average cash flow to the firm from 1998 to 2009 was Euro 705m and the median was just Euro 581m. Also growth rates to perpetuity that are beyond the ones of the whole economy seem unrealistic, given that SAP already is established and therefore strongly dependant on the growth of their huge customer base containing both big internationals as well as medium-sized businesses. And our initial real WACC, which amounts to 10.4%, bears comparison with actual market expectations. Therefore it seems like (most of) the volatility of SAP's share price was not well-founded, but just due to speculations. In other words its market value is independent of its intrinsic one. (SAP's median intrinsic firm value might even match the "linearized" market capitalization at the end of March 2017, the average firm value might do so in the middle of June 2022. However, since market values cannot be forecasted due to principal reasons, we consider such calculations being nothing more than just "nice" mathematical examples without any actual application).

In this context we want briefly comment on the reasons for speculators' trading behavior. It makes sense to analyze not only the company under consideration (here: SAP) and the market environment. It is more important to consider the disclosures of companies that could be considered as peers: Share prices are not seldom taken into "collective punishment", as soon as one peer does respectively does not perform up to expectations. The question whether or not this practice is sensible opens the door to another research. For now, we just would like to note that already Williams (1938) pointed out that growth per se does not always create value for stock owners: "That a non-growing industry can be profitable is shown [...], and that a fast-growing industry can be unprofitable is shown [...]". And also within industries profitability can differ significantly (Ghemawat and Rivkin (1998)). Therefore looking at peers or whole industries in general does not say anything about the ability of a certain company under consideration to generate above average returns.

Our last figure (figure 3) provides a graphical summary of what we reasoned so far. The upper curve shows SAP's market value, essentially stock price times number of stocks. It fluctuates rapidly and almost everybody will agree that at least some of these fluctuations are due to speculation. Some possible reasons for speculation are included in the figure. In contrast the lower curves (or shaded areas) show SAP's intrinsic value. It is calculated from (future) cash flows as described in detail above. Compared to the upper curve (market value) the lower curves (intrinsic value) show two particularities:

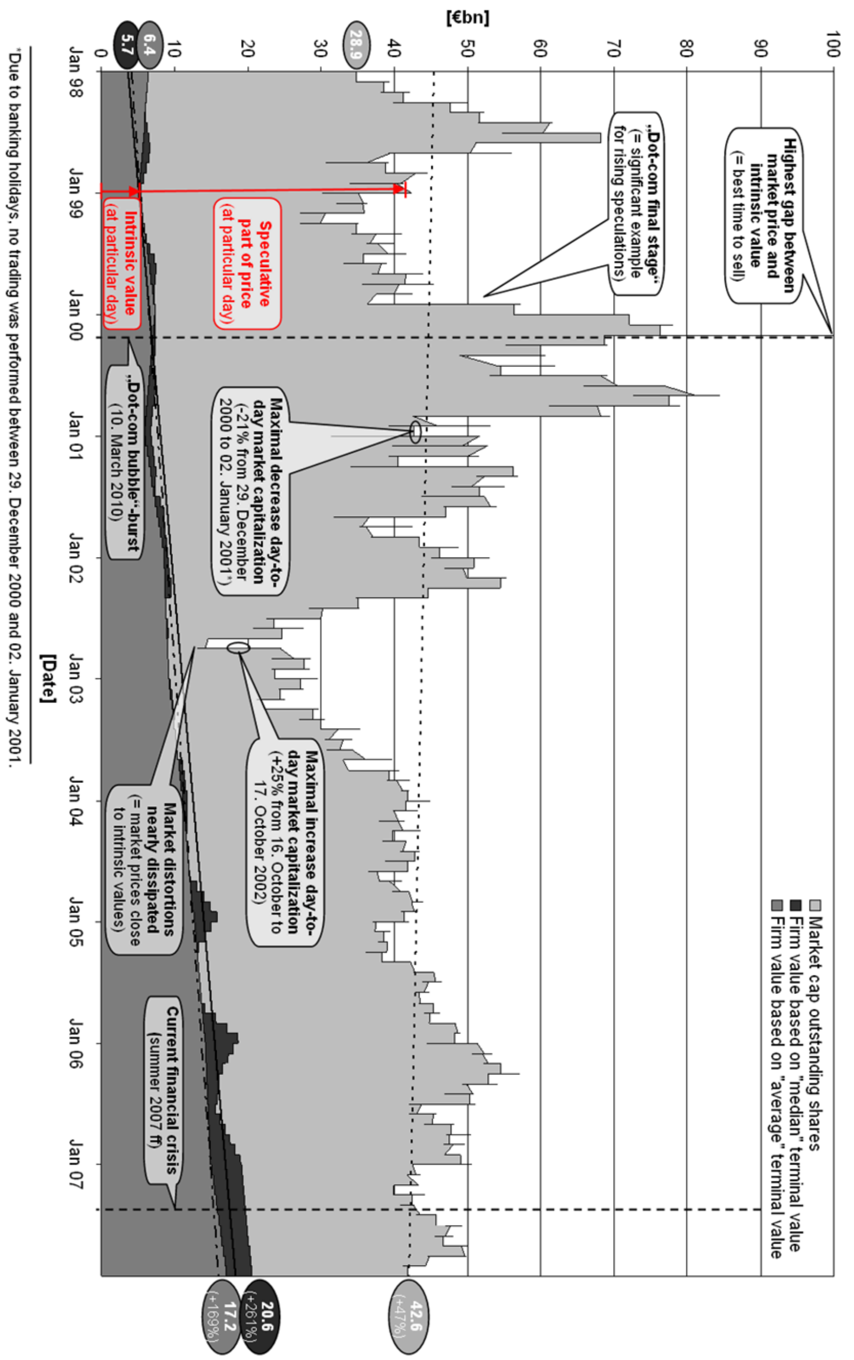

Figure 3: Development of market capitalization (outstanding shares) and intrinsic firm value (10 year rolling forecast) applying the example of SAP AG

1. Intrinsic values are much smaller than market values at almost all times. Though intrinsic value depends on the interest rate assumed, the basic massage stays the same for any reasonable interest rate. The huge gap between the two value curves is the premium being paid due to speculation. The gap fluctuates rapidly which brings us to the second particularity.

2. While the market value fluctuates, intrinsic value is an almost boringly smooth function. This is of course a reasonable result. There have not been any changes within SAP during the last two decades drastic enough for justifying any changes as indicated by the upper market value curve.

While *intrinsic value is a pretty smooth function it is by no means constant*. It is a conserved quantity, and it changes if something else changes (like the energy from chapter 2). This "something else" must be something flowing in or out. And there are two major possibilities:

1. Investments (or disinvestments) and

2. Market changes.

Please note that investment is defined very broadly here. The ordinary investment is the archetype of a conserved value change. Money is removed from somewhere (= decrease in value) and it is pumped into the company (= increase in value). But also things like *innovation* are considered investment here. Instead of money an idea or something like it is invested in the company. The market change is also a conserved effect from the point of view of SAP. The customers (from outside) requiring more or less leading to the corresponding change inside SAP. As an example one may consider the case that SAP's customers are buying more (or less) from a typical competitor (say Oracle). If they are buying more from Oracle, SAP's value rightly decreases while Oracle's value increases correspondingly. Such substitutions can be more complicated in reality, but they are always leading to perfectly conserved values. There may be the case where a company has no ERP (Enterprise Resource Planning) system yet but 100 traditional accountants. Buying an SAP system will increase SAP's value. The customer is now able to lay off its 100 accountants. So the customer's value will also increase (hopefully). But the (economic) value of the poor accountants will decrease. Even in this case we are dealing with conserved quantities only.

While the market change will always lead to something conserved from SAP's point of view, it can be tricky if one considers SAP, its competitors, and its customers as one company. Under such assumption the examples above will show no value change, which is perfectly fine. However, one may consider Porsche as mentioned in the introduction as a customer. It made around Euro 1bn in October 2008 from its speculation with VW stocks. Such increase in value is not based on conserved quantities. Assuming that Porsche will celebrate its gain in money by buying things like a brand new SAP system, SAP's corresponding increase in value is not originated by a conserved quantity. (However, adding the late Adolf Merckle to SAP and its customer (here Porsche) everything is fine again).

Please note that in reality almost nobody will buy an SAP system just because he or she made some money from speculation or gambling. That is the reason why SAP's intrinsic value as calculated here does not chance very much, though the rest of the world lived through many speculative changes. For companies producing more or less luxury goods the situation is expected to be different. But this is left to further research.

5 Conclusions for accounting and taxation

We have clearly shown that considering the market value of an asset is no useful guide to intrinsic value. The former one is not a conserved quantity and may vary chaotically. No reasonable prediction can be met. Though a change in market value may create (real) profit or loss it is nothing but the proceeds from gambling. This has an immediate effect on accounting. Slightly simplified, profit is nothing but a positive change in value. Especially modern schemes such as economic value added take this approach. Without going into detail one has to define value before being able to calculating any profit. As shown above the market value will not lead to a reasonable definition of profit. A profit defined in such way may change from profit to loss without any change in the real world. One needs something like CVBAP (Conserved Value Based Accounting Principles) instead of GAAP (Generally Accepted Accounting Principles) and the likes. But this is of course the content of a further publication.

Needless to say a completely different accounting will have a severe influence on taxation. It does not need much imagination to see that CVBAP will lead to lower profits (and losses) on the balance sheet. Lower profits will imply less tax revenue. However the tax man will nevertheless be better off. The severe jumps in market value as compared to intrinsic value are of course averaging out. Therefore the additional profits and losses will also averaging out. Because profits lead to tax income and losses to tax deductions there is no net gain in taxes over some period of time. But it is even worse than that. Normally there is a steady and slow growth of a bubble. It will lead to a welcome income for the tax man. However the bubble will burst at an unpredictable moment. And at this point the tax man has essentially to pay back all his additional tax from previous years within a very short period. It will create a national crisis. Therefore not taxing in the first place is much smarter than going for every tax euro.

Not taxing gains from speculation bears the same logic as not taxing gains from gambling as accepted by many countries. Taxing proceeds of gambling would also imply to deduct losses from gambling. Speculation or gambling should be considered private pleasure (or maybe addiction). Neither should be considered a business.

We have essentially equated speculation to gambling. Though we consider it rigorous, there is a typical difference in its operation. In speculation many people earn some small amount of money for a while. Then suddenly the bubble bursts and at least some people will suffer from big losses. In gambling it is normally the other way round. One will lose some money for a long period of time (e.g. the weekly fee for the lottery). After a long time a very few people will get a lot of money (by e.g. hitting the jackpot). Please note that there is a form of gambling which operates like a typical speculation. One way of gambling at the roulette table is to bet say Euro 1 on red. If the outcome is red one gains Euro 1. Then the game starts again. If the outcome is not red (black or zero) one looses Euro 1. Then one bets Euro 2 on red in the next game. Let suppose there is "not red" again. One will have lost Euro 3 already. Then one has to bet Euro 4 on red. Let suppose red comes one will win Euro 4. Having lost Euro 3 before, there will be a net gain of Euro 1. In doing so one will always win Euro 1 each time the roulette shows red which may occur over a hundred times within one night. Though it seems to be a foolproof money machine it is not in reality. There are reasons to stop the game before winning. The most severe limit is time. Nobody will live forever. Taking into account the *possibility* of an end before winning and taking into accounting the probabilities for each event one will always end up with a loss. Being forced to stop after n rounds will lead to an average loss of $1 - 38^n/37^n$. Even taking n to infinity (= gambling forever) will lead to a loss. Such kind of gambling is very analogous to speculating in a booming market. Most people have some continuous income over a long period. And then suddenly a catastrophe happens and a huge amount of money disappears. That properly leads to the (false) perception that speculations lead to income. There are also gamblers at the roulette table performing the game stated above. Quite a few never lost over many years leading to a "proof" that money can be made at the roulette table.

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Bibliography

[1] Buchen, P.W. and Kelly, M. (1996). The maximum entropy distribution of an asset inferred from option prices. *Journal of Financial and Quantitative Analysis*, 31 (1), 143-159.

[2] Callen, H. B. (1970). *Thermodynamics.* John Wiley & Sons, Hoboken.

[3] Carbonara, P. (1999). *What is intrinsic value?* Money Magazine, Year 28, Issue 6, Time, Atlanta.

[4] Ferreira, M. A. M., Filipe, J. A., Coelho, M., Pedro, M. I. (2010). *Fishing policies and the contribution of chaos theory for fisheries management.* International Conference on Technology and Business Management.

[5] Filipe, J. A., Ferreira, M. A. M., Coelho, M., Pedro, M. I. (2010). *Chaos, antichaos and resources: Dealing with complexity.* 9-th international conference on applied mathematics (APLIMAT) 2010.

[6] Financial Accounting Standards Board (2006). *Statement of Financial Accounting Standards No. 157 – Fair Value Measurements.* Available at http://www.fasb.org, access on 11/02/2010.

[7] Ghemawat, P. and Rivkin, J. (1998). *Creating competitive advantage.* Harvard Business School, Boston.

[8] Gordon, M. J. (1959). *Dividends, earnings and stock prices.* Review of Economics and Statistics. The MIT Press, Cambridge.

[9] Grabinski, M. (2007). *Management methods and tools: Practical know-how for students, managers, and consultants.* Gabler Verlag, Wiesbaden.

[10] Grabinski, M. (2008). *Chaos – limitation or even end of supply chain management.* High Speed Flow of Material, Information and Capital, Istanbul.

[11] Graham, B. and Dodd, D. L. (1934). *Security analysis.* McGraw-Hill, New York.

[12] Gutenberg, E. (1998). *Die Unternehmung als Gegenstand betriebswirtschaftlicher Theorie (reprint).* Gabler Verlag, Wiesbaden.

[13] Hax, A. and Mayluf, N. (1984). *Strategic management (1^{st} ed.).* Prentice Hall, Englewood Cliffs.

[14] Hazlehurst, J. (2006). *Is intrinsic value in the eye of the bidder?* Colorado Springs Business Journal (CO), June 23, 2006, Colorado Springs.

[15] Kamstra, M. (2003). *Pricing firms on the basis of fundamentals.* Federal Reserve Bank of Atlanta – Economic Review First Quarter 2003.

[16] Kindleberger, C. P. and Robert, A. (2005). *Manias, panics, and crashes: A history of financial crises (5^{th} ed.).* John Wiley & Sons, Hoboken.

[17] Lehmann, B. N. (1991). *Asset pricing and intrinsic value.* Journal of Monetary Economics, Elsevier Science Publishers, Oxford.

[18] Marx, K. (1887). *Capital I.* London.

[19] Matchett, A. (2003). *Valuation.* Adkins & Matchett (UK), London.

[20] Modigliani, F. and Miller, M. (1958). *The cost of capital, corporation finance and the theory of investment.* American Economic Review 48 (**??**): 261–297, American Economic Association, Pittsburgh.

[21] Schuster, H. G. (1984). *Deterministic chaos.* Physik Verlag, Weinheim.

[22] Seith, A. (2010). *Automatischer Boersenhandel – Turbocomputer mischen Aktienmaerkte auf.* Spiegel Online Wirtschaft, available at http://www.spiegel.de/wirtschaft, access on November 02, 2010.

[23] Shiller, R. J. (2005), *Irrational exuberance (2^{nd} ed.).* Crown Business, New York.

[24] Stumm, K. (2009). *Deutsche Bank warnt vor neuer Boersenblase.* Spiegel Online Wirtschaft, available at http://www.spiegel.de/wirtschaft, access on November 25, 2010.

[25] Thomson, E. A. (2006). *The tulip mania: Fact or artifact?* Public Choice 130 (1-2): 99-114.

[26] Tobin, J. (1978). *A Proposal for International Monetary Reform (retrieved 01/31/2010).* Eastern Economic Journal July / October 1978: 153–159, Eastern Economic Association, New Jersey.

[27] Williams, J. B. (1938). *The theory of investment value (reprint August 1997).* Fraser Publishing Company, Flint Hill.

[28] Yao, Y. (1997). *A trinomial dividend valuation model.* Journal of Portfolio Management. Institutional Investor Journals Group, New Yor

[29] Zimmermann, M. J. (2007). *Intrinsic vs. extrinsic value.* The Stanford Encyclopedia of Philosophy. Available at http://plato.stanford.edu/entries/value-intrinsic-extrinsic/#WhaIntVal, access on November 23, 2010.