The Quest for Stability: the view of financial institutions

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A joint publication with de Nederlandsche Bank and Rabobank

SUERF – The European Money and Finance Forum
Vienna 2010

SUERF Study 2010/3

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Keywords: Financial crisis, financial innovation, risk management by financial institutions, credit policy, bank business models, risk monitoring, early-warning systems, exchange rate volatility, general transaction tax.

JEL Codes: E4, E41, E42, E44, E52, F31, F37, G12, G14, G15, G31, G32, H25

Vienna: SUERF (SUERF Studies: 2010/3) – June 2010

ISBN: 978-3-902109-53-8

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1. Introduction

Morten Balling, Jan Marc Berk & Marc-Olivier Strauss-Kahn

On September 3-4, 2009 SUERF and Utrecht University School of Economics organized the Colloquium *The Quest for Stability* in Utrecht the Netherlands. The papers included in this SUERF Study are based on contributions to the Colloquium.

Chapter 2, "Uncertainty and risk management after the Great Moderation: The role of (mis)management by financial institutions", is written by *Hans J. Blommestein,* OECD and Tilburg University, *Lex H. Hoogduin,* De Nederlandsche Bank and University of Amsterdam and *Jolanda Peeters,* De Nederlandsche Bank. The authors take a closer look at the inadequate risk management systems in financial institutions. The rapid pace of financial innovation driven by ICT, developments in academic finance theory and a favourable regulatory environment have presented major risk management challenges for banks and other financial institutions. The risk management discipline developed into a kind of pseudo quantitative science with pretensions far beyond its real risk management capabilities. The authors mention the lack of understanding of the links between incentives across all management levels and risk-taking as perhaps the clearest example of the incompetency of risk management. There was too much reliance on the quantitative side of risk management.

Chapter 3, "Banking in times of crisis: the case of Rabobank" is based on the contribution by *Wim W. Boonstra,* Chief Economist, Rabobank. The author gives an overview of Rabobank's history, structure, cooperative governance and strategy. Due to a conservative credit policy and a strong solvency ratio, Rabobank has shown a much better performance during the financial crisis than its big Dutch competitors. It remained comfortably profitable, its capital ratios stayed intact by a wide margin and its domestic market shares increased substantially. The bank's business model is basically sound. The model is relatively crisis proof. During the crisis, cooperative banks and savings banks appeared to be more stable than shareholder driven commercial banks. Surprisingly, policy makers completely fail to understand that banks like Rabobank are based on a fundamentally different business model. What really matters is company culture. Cultures are not created, they grow over the decades.

In Chapter 4, "Monitoring banking sector risks: An applied approach", *Veronica Vallés* and *Christian Weistroffer,* Deutsche Bank, present an early-warning model that provides timely and readily digestible information on macroeconomic developments. For industrial countries they combine measures of housing and equity prices, domestic credit to GDP and economic output. For emerging markets they base their model on domestic credit to GDP, the real effective exchange rate and equity prices. The number of input variables is low, but the overall performance of the model is robust and it may serve as a useful screening tool across a large number of countries. The model is designed in such a way that it should meet the professional needs of an internationally operating financial institution.

In Chapter 5, "Asset Price Fluctuations, Financial Crises and the Stabilizing Effects of a General Transaction Tax", *Stephan Schulmeister,* Senior Research Fellow, WIFO compares what he calls mainstream economic theory concerning asset price movements with a "bull-bear-hypothesis" which relies on technical analysis of trends in asset prices. According to the author, fluctuations in asset prices remain unexplained in mainstream economics while technical analysts can derive useful buy and sell signals from the observed market movements. For illustration, he presents socalled exchange rate runs and their duration and discusses observed volatility patterns. A small financial transaction tax would, in the view of the author, dampen the fluctuations of exchange rates, stock prices and commodity prices and help to prevent crises in the future.

2. Uncertainty and risk management after the Great Moderation[1]: The role of risk (mis)management by financial institutions

Hans J. Blommestein, Lex H. Hoogduin & Jolanda J.W. Peeters

Abstract

Since the early eighties volatility of GDP and inflation has been declining steadily in many countries. Financial innovation has been identified as one of the key factors driving this "Great Moderation". Financial innovation was considered to have improved significantly the allocation and sharing of financial risks, both from a macro and micro perspective. In particular, the prevailing opinion was that great progress has been made in developing models and other quantitative methods for measuring and managing risk. However, the global financial crisis that started in the summer of 2007 revealed important failures in risk management by financial institutions.

Over-optimism prevailed and risks were underpriced, caused by problems of both a conceptual and technical nature. This paper analyses these two angles from the viewpoint of financial institutions. Conceptually, we will show that risk management degenerated into a "pseudo" quantitative science. This in turn gave a false sense of security to financial institutions and their supervisors. Prior to the crisis, supervisory and regulatory regimes assumed that for the financial sector as a whole, risk management had been improved and that, as a result, financial stability was enhanced. The fact that many financial activities were carried out in a rapidly changing landscape – *i.e.* key decisions had to be taken in situations with uncertainty – was largely ignored. At a very fundamental level it was mistakenly assumed that all uncertainty can be measured in a reliable fashion using a probability distribution – *i.e.* all uncertainty can be treated as "risk".

This attitude had also adverse consequences for the way risk management and decision making were organised in financial institutions. There was too much focus on quantitative models and measurement and too little on the qualitative dimension of risk management, involving such issues as information flows, people and their motives and incentives. In addition, even from a narrow, technical perspective risk management techniques proved to be insufficiently sophisticated.

The second part of the paper focuses on the lessons to be learned from the past episode of inadequate risk management at the level of financial institutions. Apart from technical improvements there is a need for a greater emphasis on handling fundamental uncertainty. More specifically, it will be shown that qualitative risk

1 The views expressed are personal ones and do not represent the organisations with which the authors are affiliated.

management is particularly important to deal with the latter uncertainty. However, even with better risk management the future remains uncertain and human nature will remain largely unchanged. Finding better ways of dealing with fundamental uncertainty remains therefore a continuous challenge.

2.1. INTRODUCTION

For many years prior to the ongoing financial crisis, many advanced and developing countries had experienced a substantial decline in macroeconomic volatility. In the literature, a whole range of explanations has been put forward to explain this "Great Moderation"[2]. These explanations can be classified under three headings: improved performance of macro-economic policies, good luck and structural changes. This paper emphasizes the role of the third explanation, and in particular the role of financial innovation at the level of financial institutions. At this micro level it was widely believed that significant improvements in risk management in the financial sector had been effectively implemented, in particular by the use of credit risk transfer instruments and the widespread securitization of assets[3]. As a result, it was widely assumed by market participants and regulators alike that, for the system as a whole, the allocation and sharing of financial risks had been improved substantially.

However, with the financial crisis that started in the summer of 2007, the Great Moderation turned into the Great Crash. The rosy view that better risk management, new financial products and more complete markets had been key drivers for increased macroeconomic stability, turned out to be a serious miscalculation. With the unfolding of the financial crisis, it became clear that during the Great Moderation excess optimism prevailed and risks in financial markets were to an important degree seriously underpriced or simply ignored. Although the latest wave of financial innovation expanded greatly the opportunities for risk sharing and resulted in far more sophisticated risk management systems, it also led to an increasingly complex financial landscape. In this new environment, risk managers relied too much on risk management models and quantitative techniques that, although more technically sophisticated than in the past, were not capable to deal with the complexities and hidden vulnerabilities of the new financial landscape.

In this paper, we take a closer look at the role of risk (mis)management by financial institutions in the demise of the Great Moderation and the emergence of the global financial crisis. Note that we explicitly take a partial view by focussing predominantly on the *micro* level of risk management, *i.e.* at the level of financial

[2] The term "Great Moderation" was first introduced by James Stock and Mark Watson, in a paper presented at Jackson Hole in 2003. BERNANKE (2004) gave the phrase a wide audience.
[3] BLOMMESTEIN (2006a).

institutions. In other words, we will not provide a full-fledged or comprehensive analysis of the causes of the financial crisis[4]. However, in doing so, we do not exclude the importance of the role of other factors in the origin of the financial crisis. On the contrary, we believe that mistaken macroeconomic policies as well as deficiencies in the official oversight of the financial system were also major factors in the global financial crisis, especially in light of global imbalances and the emergence of systemic risks and network externalities during the evolution of the crisis.

This paper is structured along the following lines. Section 2.2. analyses the role of the risk management discipline in the Great Moderation. Section 2.3. shows which failures in risk management were brought to light by the financial crisis. It will be argued that the inadequacies in risk management prior to the crisis were both of a conceptual and technical nature. Moreover, it will be shown that the risk management framework was constructed as too narrow, because too little attention was paid to qualitative aspects such as information flows, people and their motives and incentives. Section 2.4. focuses on lessons from the past episode of inadequate risk management at both a technical and conceptual level. Section 2.5. concludes.

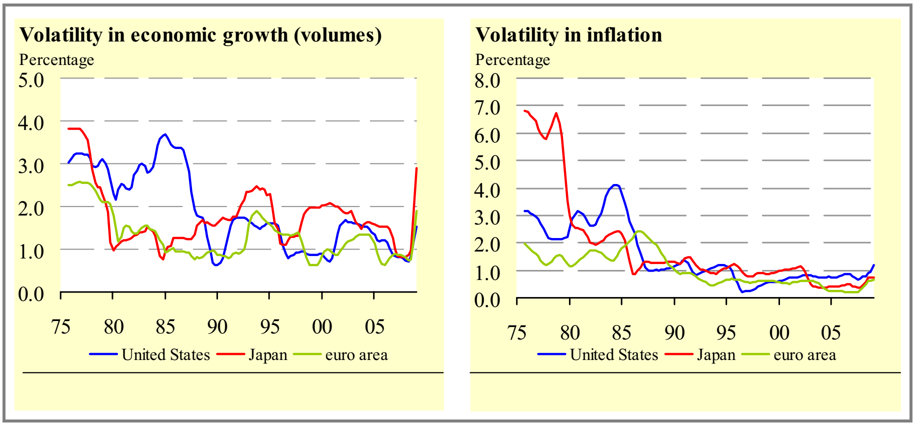
2.2. THE GREAT MODERATION AND THE ROLE OF RISK MANAGEMENT

One of the most striking features of the economic landscape over the approximately 25 years prior to the ongoing financial crisis has been the substantial decline in macroeconomic volatility in many economies (see figure 1). Both industrial and emerging market countries had entered a relatively long phase of low and stable inflation[5]. At the same time, large parts of the world have experienced lower output volatility. This remarkable decline in both inflation and GDP volatility has come to be known as "The Great Moderation" (Bernanke, 2004). The last years prior to the crisis, the Great Moderation was accompanied by strongly performing financial markets with rising asset prices and, in particular in the period 2004-2006, exceptional low volatilities and risk premia.

4 The literature on the causes of the financial crisis is very fast-growing (see *e.g.* FSA (2009); SENIOR SUPERVISORS GROUP (2008); BIS (2009); among many others) and reveals failures on many levels and in varied domains. It is beyond the scope of this paper to address all causes of the financial crisis. However, it is important to note that other authors do emphasise other factors than discussed in this paper.

5 IHRIG *et al.* (2006) and MELICK and GALATI (2005) survey empirical work that documents this trend.

Figure 1: the Great Moderation



In the literature, three types of explanations have been suggested for the Great Moderation. The first class of explanations focuses on the improved performance of macro-economic policies, in particular monetary policy (see *e.g.* Clarida *et al.*, 2000). The increased emphasis of central banks on price stability, accompanied by a greater degree of independence and transparency, contributed to the long-term steady performance of economies. The second class of explanations suggests that the Great Moderation occurred because the shocks hitting the economy became smaller and less frequent (Ahmed *et al.*, 2002; Blanchard and Simon, 2001; Stock and Watson, 2003; Arias *et al.*, 2006). According to this view, the reduction in macroeconomic volatility was largely the result of "good luck". The final class of explanations focuses on the changes in the structure of economies which have improved the ability of economies to absorb shocks. These structural changes can have various sources. Kahn *et al.* (2002), for instance, have argued that improvements in inventory management, based on advances in ICT, have reduced the amplitude of fluctuations in inventory stocks, whereas others attribute the Great Moderation at least partly to the increased openness to trade and international capital flows and the related greater flexibility in labour and product markets.

In this paper, we focus on the role of structural changes in financial markets as a possible explanation of the Great Moderation (as well as of its demise, see Section 3). In short, the underlying idea of this explanation is that innovations in financial markets improved the allocation, sharing, and management of financial risks. This resulted in lower volatility of financial markets, while also contributing to macroeconomic stability by enhancing the capacity of the financial sector to keep credit and liquidity available during periods of financial stress[6].

Over the past decades the financial landscape has changed in myriad ways. One of the most revolutionary and dynamic factors driving financial markets concern the *rapid pace of financial innovations*. In broad terms, financial innovation refers to both technological advances which facilitate access to information, trading and means of payment, and to the emergence of new financial instruments and services, new forms of organisation (risk control methodologies and systems included) and more developed and complete financial markets. Financial innovation has great potential benefits, as the increasing sophistication and depth of financial markets have the potential to improve the efficiency of financial markets by allocating capital where it can be most productive, while the broader dispersion of risk across the financial system might in principle allow firms and households to hedge a (greater) variety of risks more cheaply and/or effectively. Since the 1980s, innovative financial engineering, propelled by financial liberalisation and the widespread availability of information and communication technology, has indeed led to a much richer spectrum of new financial instruments and to a lowering of transaction costs and reduced information and agency costs (Merton, 1998). For instance, technological advances have made it possible to convert relatively illiquid or non-tradable assets into newly created tradable securities. In addition, new techniques have enhanced the ability to develop and estimate sophisticated relative pricing models for a wide array of financial products. Examples include the adjustable-rate mortgage, the bundling of sub prime mortgages into mortgage-backed securities or collateralized debt obligations (CDOs) and credit default swaps (CDSs). In particularly the latest wave of financial innovations has expanded greatly the opportunities for unbundling, sharing and transferring financial risk, resulting in more complete financial markets. Important ingredients contributing to the wider distribution and better allocation of risk have been the increasing use of credit risk transfer instruments and the widespread securitization of assets. While simple forms of securitized credit (*e.g.* corporate bonds) have existed for almost as long as modern banking, the financial system experienced an explosive growth in creating and processing securitized credit since the mid-1990s (FSA, 2009). For example, many commercial banks used collateralized loan obligations (CLOs) to distribute large shares of syndicated loans. In this way, commercial banks were able to sell entire loans rather than retain them on their balance sheet. More generally, in the latest wave of financial innovations, banks began to securitisize a wide range of credit exposures, while selling them (off-balance-sheet) to structured entities. These develop-

[6] Empirical evidence for the proposition that financial innovation has resulted in a reduction in macroeconomic volatility is provided by DYNAN *et al.* (2005). Their results suggest that financial innovation should be added to the list of likely contributors to the mid-1980s stabilisation. However, according to some analysts (*e.g.* BORIO *et al.* (2003)) greater macro-stability comes at the expense of greater occurrence of financial shocks.

ments in financial innovations have resulted into a largely Latin alphabet soup of new financial products and a Greek alphabet of risk measures.

The rapid pace of financial innovations (driven by ICT, developments in academic finance theory and a favourable regulatory environment) presented major risk management challenges for banks and other financial institutions. In an environment with a constant flux of financial innovations, resulting in the availability of a wide range of new financial products, the field of risk management also developed rapidly.

However, financial innovation had two opposing effects on the risk management discipline. On the one hand, the process of financial innovation has made the management of risk easier; risks could be more easily sliced and diced, removed from the balance sheet of financial institutions and hedged using derivatives (Bernanke, 2007). In other words, risk management innovations were to an important degree driven by product innovations. Some simplifications in risk management practices resulted from breakthroughs in academic finance[7], while other innovations originated from within the industry itself; notably VaR had a revolutionary impact on the process of risk management[8]. On the other hand, new instruments and trading strategies made risk measurement and management more complex and challenging (Schmidt Bies, 2004). A prominent example is the valuation and pricing of structured products[9]. These new products are often traded in markets that lack liquidity, resulting in very volatile pricing information. Worse, in many cases historical data is not available and investors have to rely on simulations with relatively arbitrary assumptions about correlations between risks and default probabilities (Colander *et al.*, 2008).

Notwithstanding these difficulties, financial innovation resulted in sophisticated risk management models involving new quantitative techniques for measuring risk. In fact, the risk management discipline developed itself into a kind of pseudo quantitative science, with pretensions beyond its real risk management capabilities. The development of risk management towards an increasingly quantitative science also had consequences for the way in which financial institutions were managed (*i.e.*, the impact on their underlying corporate governance structure). For example, the essence of enterprise-wide risk management is the strategic man-

7 The most prominent example of an academic breakthrough that resulted in a "simplification" of the risk management practice is the development of Black and Scholes option pricing that eventually could even be implemented in a user-friendly way on pocket calculators (COLANDER *et al.* (2008)). The Black Scholes option pricing equation could also be used to construct hedges against various risks. Option pricing theory was probably the most important milestone in academic developments in the area of quantifying and managing financial risk. This innovation was followed by the rapid adoption in the 1990s of the Heath-Jarrow-Morton framework for the analysis of fixed-income securities and their various derivatives. Also this academic innovation could be used fairly easily by traders for pricing purposes and calculating hedges thereby becoming rapidly an industry standard.

8 The best known of these industry "Value at Risk" systems is the Risk Metrics system developed and published by JP Morgan in the mid-1990s.

9 TURNBULL (2009) discusses the difficult challenges of measuring and managing risk of new financial products.

agement of overall institutional risk across all risk categories and business units. In many cases, however, risk management was to an increasingly extent treated as a separate discipline within an institution, in which the main responsibility was actually outsourced to a chief risk manager. Such a chief risk manager was often kept "in splendid isolation" from top management and board of directors. As a result, strategic risk management decisions were in fact not an essential part of the design and implementation of the company's overall business strategy (OECD, 2009).

The latest wave of financial innovations expanded greatly the opportunities for unbundling, sharing and transferring financial risk and resulted in far more sophisticated risk management systems and tools. Nonetheless, the financial instruments-cum-risk management revolution resulted de facto in a situation that can be referred to as a "risk paradox" (Blommestein, 2008b).

On the one hand, the rapid growth in the widespread use of financial innovations resulted in a revolutionary new financial landscape, in which financial engineering, the use of market value structures such as CDOs and CDSs, the integration of products and services from outside suppliers, institutional investors, "carry trade" and "endogenous liquidity" played greater roles than ever before. It was widely believed that this new global financial landscape enabled – in principle – an ever-wider range of financial and non-financial companies to manage risks more effectively. This more efficient allocation of risk, driven by the incentive to equalise risk-adjusted rates of return on investments globally, led in principle to an increase in the creation of value and standards of living.

On the other hand, the continuous process of financial innovation also had an important drawback. It resulted into an increasingly complex and incomprehensible financial landscape in which a complex chain of multiple relationships between multiple institutions and markets emerged (Blommestein, 2008a). Many financial innovations had the effect of creating links between formerly unconnected players and markets, which increased enormously the degree of connectivity and network externalities of the financial system. The growing importance of derivatives for risk management and the leveraging of investment positions was for example a driving force behind the stronger and more complex links between cash and derivatives markets. Note that in this derivatives-connected, complex financial landscape, it were not just commercial banks that played a major role, but also hedge funds and investment banks and other financial institutions such as private equity firms and insurance companies. For example, supervisors discovered after the (near) demise of the hedge fund LTCM (in 1998), the investment bank Bear Stearns (in 2008) and the insurance firm AIG (in 2008) that these players were at the centre of complex webs of trades with other players in the financial landscape that were very difficult to unravel.

The higher degree of connectivity which characterised this new financial landscape had two major implications. First, as is well known from network theory, a more highly connected system could be more vulnerable to shocks and systemic failure (Colander *et al.*, 2008; Haldane, 2009). However, this insight from network theory was largely ignored prior to the financial crisis[10], and the introduction of new derivates was considered as leading pre-dominantly to lead to higher efficiency and better risk sharing. In reality, the risk level in this complex, liberalised financial landscape was inherently and systematically higher than before. The underlying network externalities and unsustainable leverage were largely neglected by market participants (Blommestein, 2000a; Trichet, 2008).

Second, this increasingly interconnected financial system made it harder to price risks correctly, while both market participants and supervisors underestimated the increase in systemic risk. While risk managers had more rigorous risk management tools at their disposal, the changing financial landscape (characterised by more complex products and markets, a higher level of systemic risk and increased financial fragility) weakened the applicability and conditions under which these quantitative tools and techniques can be used effectively. It turned out that even sophisticated market participants had difficulties in understanding the nature and pricing of new products and markets, due to the sheer complexity of many new financial instruments and the underlying links in the new financial landscape. Also securitisation was adversely affected by problems with incentives and information as well as the pricing of tail events (Cechetti, 2009). More generally, a number of widely held assumptions proved to be costly wrong, in particular that the originate-and-distribute model would decrease residual risk on the balance sheet of banks, that the growing use of credit risk transfer instruments would result in better allocated and managed risks and a more stable banking sector and that ample liquidity would always be available.

2.3. THE FINANCIAL CRISIS AND THE EMERGENCE OF FAILURES IN RISK MANAGEMENT

With the outbreak of the financial crisis – which may be dated back to the summer of 2007 when a loss of confidence by investors in the value of securitized mortgages in the United States triggered a liquidity crisis – the Great Moderation era came to an end (illustrative in this regard is the steep increase in GDP volatility in figure 1). The rosy view that the combination of better risk management,

10 In any case by market participants, who were to some extent misled by the fact that a number of shocks hit the financial system without causing major turmoil (like Enron, WorldCom, the crash of the dotcom bubble, the Icelandic crisis in 2006, downgrades of major US companies, etc.). Warnings by the authorities on the possibility of an abrupt correction in financial markets date back to at least 2004 (see, for instance, *Annual reports by the BIS*; TRICHET (2008); WELLINK (2008)). Also academics stressed the danger of systemic breakdowns as a side effect of risk diversification and financial innovation; see, *e.g.*, DE VRIES (2005), HONOHAN (2008a).

new financial products and more complete financial markets would result in a situation with increased macroeconomic stability, turned out to be an illusion. There is growing evidence that the Great Moderation itself was one of the causes of the financial crisis[11], because it strengthened the mistaken belief of lenders and investors that high volatility was a thing of the past. This in turn encouraged them to increase their leverage and risk-taking activities[12]. Moreover, during the past decades financial organisations were allowed to become larger and more complex based on the argument that the combination of more diversification and advanced risk management techniques would allow these bigger firms to be more effective risk managers than smaller, less-sophisticated organisations (Blair, 2009). With the outbreak of the financial crisis, however, the darker side of the risk paradox became visible: it became increasingly clear that there had been a significant and wide-spread underestimation of risks across financial markets, financial institutions and countries (Trichet, 2009). For a variety of reasons, market participants did not accurately measure the risk inherent in financial innovations and/or understand the impact of financial innovations on the overall liquidity and stability of the financial system. Indeed, there is growing evidence that some categories of risks associated with financial innovations were not internalised by markets; for example, tail risks were underpriced and systematic risk (as externality) was not or inadequately priced. This wide-spread underestimation of risks turned out to be at the core of the financial crisis.

The underestimation of risks reflected in our view to an important degree the inadequacy of risk management systems of financial institutions. During the unfolding of the crisis, many financial institutions revealed a huge concentration of risks, suggesting that risk management systems failed to identify key sources of risks, to assess how much risk was accumulated and to price financial risks properly[13]. The underlying problem was that risk management did not keep pace with the risks and uncertainty inherent in financial innovations and the fast-changing financial landscape. Risk managers trusted too much the existing risk models and techniques, while underlying assumptions were not critically evaluated. Unfortunately, the use of these models proved to be inadequate, both from a technical and a conceptual point of view. On top of this, there are indications that risk manage-

[11] Hyman Minsky's instability hypothesis can be used to demonstrate that the Great Moderation period contained indeed the seeds for the financial crisis in the form of spiralling debt that investors have incurred in order to finance speculative investments: "The second theorem of the financial instability hypothesis is that over periods of prolonged prosperity, the economy transits from financial relations that make for a stable system to financial relations that make for an unstable system" (MINSKY (1992), p. 8).

[12] Note however that it is still debated whether the Great Moderation can be considered as one of the causes of the financial crisis. As TRICHET (2008) points out: "The correlation between the reduction of volatilities and the magnitude of risk taking is there, but the direction and even the existence of a possible causality, remains an open question".

[13] In this context, TRICHET (2008) makes the appealing distinction between the "underpricing of a unit of risk" (*i.e.* inadequate assumptions about the distributions of returns to highly complex, new financial securities) and the "under appreciation of the quantity of risk" (*i.e.* failure to identify the quantity of risk that financial institutions were accumulating).

ment fell short from a *qualitative* dimension point-of-view, that is, too little attention was paid to corporate governance processes, the architecture and culture of organisations, business ethics, incentives and people. In sum, risk management fell short from two angles: (1) too much reliance on the quantitative side and (2) too little on the qualitative side of risk management.

2.3.1. The limits of quantitative risk management

On a conceptual (or methodological) level, the financial crisis brought to light that the risk management discipline had developed too much into a pseudo quantitative science with pretensions beyond its real risk management capabilities. To put it plainly, in the years prior to the financial crisis, the risk management discipline relied far too much on sophisticated mathematical risk management models and techniques that proved not capable to deal with the complexities and structural fragilities of the new financial landscape. The over-reliance on sophisticated though inadequate risk management models and techniques contributed to a false sense of security (Honohan, 2008a), reinforced by booming financial markets. As a consequence of these simultaneous developments, the risk management discipline suffered from overconfidence, a phenomenon that happened also to monetary theory and policy in the early 2000s (see Brakman *et al.*, 2001). Increasingly, the idea that outcomes were perfectly under control took firmly hold. It was assumed that quantitative risk management models represented stable and reliable stochastic descriptions of reality. While this might be a reasonable assumption in the world of classic physics, this is certainly not the case in a fast-moving, innovative financial landscape, in which prices of financial instruments are not only driven by objective probabilities (which can be derived from past distribution functions), but also by waves of optimism and pessimism based on self-fulfilling momentum, mood and animal spirits (Keynes, 1937; Turner, 2007). In such an environment the validity of quantitative models becomes highly precarious (Blommestein, 2009). Ironically, by relying to an increasing degree on sophisticated mathematical models and techniques, the risk management discipline lost its ability to deal with the fundamental role of uncertainty in the financial system[14].

[14] While modellers were certainly aware of the limitations and weaknesses of these models and assumptions, the "users" in the financial industry were often ill-informed and ignorant about the snags of using these kinds of models, despite warnings from modellers, see *e.g.* MERTON (1994): "The mathematics of hedging models are precise, but the models are not, being only approximations to the complex, real world. Their accuracy as a useful approximation to that world varies considerably across time and place. The practitioner should therefore apply the models only tentatively, assessing their limitations carefully in each application".

2.3.2. Uncertainty versus risk

There are different views on what uncertainty is from an ontological point-of-view (Hoogduin, 1987; Dequech, 2000; Ben-Haim and Demertzis, 2008), and how it differs from risk. The differentiation between uncertainty and risk can be predominantly traced back to Knight (1921), who defines risk as imperfect knowledge where the probability of the possible outcomes is known, and uncertainty exists when these probabilities are not known[15]. While Keynes shared Knight's resistance to the possibility of the measurement of uncertainty, Keynes stressed – especially in his later economic writings – the concept of ***fundamental*** uncertainty: "*where there is no scientific basis on which to form any calculable probability whatsoever. We simply do not know*" (Keynes, 1937, pp. 213-214). As emphasized by Dequech (2000), this type of fundamental uncertainty refers to situations which are essentially characterised by the possibility of creativity and structural change and therefore by a significant indeterminacy of the future. This indeterminacy stems from the fact that the future is yet to be created and hinges crucially on the (uncertain) actions of economic agents. More importantly, in the face of such ignorance, Keynes (1937) argued that in real-life we rely on conventions such as "the future will be similar to the present". He also noted that, as a result, economic agents attach more importance to the present than is warranted. In addition, agents also attach great weight to the opinion of others in situations with fundamental uncertainty. This implies that herd behaviour is a dominant feature of uncertain situations where objective decision criteria do not exist (Brakman *et al.*, 2001, p. 4)[16]. In fact, this mechanism is an important driver of procyclicality in the financial system, *i.e.* the tendency of the financial system to accumulate too much risk and leverage in good times and to shed risks abruptly during a downturn, thereby increasing up- and down-side swings. This type of herd behaviour – which we have witnessed very clearly during the global financial crisis – is not captured by conventional risk management models. Prior to the financial crisis, the risk management discipline relied increasingly on sophisticated models and techniques, while ignoring the fact that much of the behaviour of economic agents cannot be modelled using a standard stochastic framework, especially in situations with an important degree of fundamental uncertainty and contagious behaviour.

15 BLOMMESTEIN (2008a) argues that with increased knowledge and measurement precision Knightian uncertainty might become randomness with knowable probabilities (thus risk). The ongoing financial crisis is testimony however that the three necessary conditions for the proper pricing of risk derived in that paper are not fulfilled in practice. This implies that risk managers need to learn how to deal with uncertainty.

16 Or, in KEYNES (1937, pp. 214-215) own words: "In particular, being based on so flimsy a foundation, it [*i.e.* a practical theory of the future] is subject to sudden and violent changes. The practice of calmness and immobility, of certainty and security, suddenly breaks down. New fears and hopes will, without warning take charge of human conduct. The forces of disillusion may suddenly impose a new conventional basis of valuation." With hindsight, it turns out that KEYNES' (1937) analysis describes a great deal of recent behaviour in financial markets.

2.3.3. Technical problems

In addition to this fundamental methodological problem, the financial crisis revealed technical failures in risk management in the sense that even sophisticated methods and techniques turned out not to be refined enough. At the core of many risk management systems was (is) the concept of Value-At-Risk (VAR), which became a key tool in the quantification of risk, the evaluation of risk/return trade-offs, and in the disclosure of risk appetite to regulators and shareholders[17]. This concept is effectively based on the idea that the analysis of past price movement patterns could deliver statistically robust inferences relating to the probability of price movements in the future (FSA, 2009). However, the financial crisis revealed the following severe problems with applying the VAR concept to the world of complex longer-term social and economic relationships.

First, measures of VAR were often estimated using relatively short periods of observation, since the instruments whose returns were being modelled were relatively new. This implied not only that "rare" events like a sharp drop in housing prices were outside the sample period and thus not captured by the model, but also that significant procyclicality was introduced, with periods of low observed risk driving down measures of future prospective risks (FSA, 2009).

Second, most models used for risk management assume that the full distribution of possible events is normal in shape, although there is no a priori and empirically robust justification for a normal shape distribution of events in financial markets. On the contrary, by now it is well established that financial returns exhibit fat tails and that risks in the financial sector are non-normally distributed (de Vries, 2005)[18]. Illustrative in this regard is the following example, borrowed from Brouwer (2009); in the past 100 years, it happened 48 times that stock prices fell by 7% in one day, while the probability that this would happen assuming a normal distribution is almost infinitesimally small (*i.e.*, once in 300.000 years!)[19]. Importantly, the fat tails which characterise financial sector risks are not some kind of exogenous "natural phenomenon", but an inherent (endogenous) part of the financial system, given that the system is to an important degree involved in maturity transformation. This means that the system is exposed to liquidity risk. And especially liquidity risks make the system vulnerable to "tail events". Indeed, with all banks trying to sell at the same time (*i.e.* a sharp increase in liquidity preference), liquidity may suddenly evaporate as a result of the simultaneous copy-cat

17 Ironically enough, the October 1987 crash marked the birth of VAR as a key risk management tool. For a very brief history of the birth of VAR, see HALDANE (2009).

18 Of special concern in this regard are so-called "Black Swan" events which are highly improbable events which have a huge impact if they materialise.

19 One could wonder why market participant nevertheless assume a normal distribution. Besides the fact that normal distributions simplify calculations tremendously, this could be explained by disaster myopia, *i.e.* agents' propensity to underestimate the probability of adverse outcomes, in particular small probability events from the distant past (HALDANE (2009)).

behaviour of banks, resulting into a complete drying up of market liquidity and heightened financial market distress. Risk management models (based on normal distribution functions) were often not able to deal adequately with complex interactions, such as those between changes in asset values, leverage and liquidity risk.

Finally, and related to the failure to capture fat tail risks, VAR-based estimates of risks fail to capture adequately systemic risks[20]. As noted, VAR models typically do not take into account that developments in financial markets will induce similar and simultaneous behaviour by other market participants. This is, however, a deeply misleading assumption, because market participants often display similar behaviour, especially in situations of stress. However, the simultaneous pursuit of identical micro strategies may lead to mechanically-induced contagion and may generate an unexpected macro outcome that actually jeopardizes the success of the underlying micro strategies (Blommestein, 2009). Indeed, if market participants display similar behaviour, VAR measures of risk may indicate that risk is low and falling at the precise time when systemic risk is high and rising. De Vries (2005) and others show that the potential for systemic breakdown is strong if the underlying distributions have heavy tails, while it is weak if distributions have a normal shape.

2.3.4. The minor role of qualitative risk management

On top of these fundamental and technical difficulties of risk management and despite the fact that qualitative risk management is particularly important to deal with fundamental uncertainty, risk management in many financial institutions paid insufficient attention to the *qualitative* dimension, involving issues such as organisation, governance[21], incentives, processes and people. For instance, in some cases information about risk exposures of the firm never reached senior levels of management levels as well as the board (Kirkpatrick, 2009). In other cases, risk management turned out to be activity-based rather than enterprise-based. In fact, many financial institutions signalled that they had implemented enterprise-wide risk management, but the financial crisis showed that in many instances this was not, or only superficially, the case. With the unfolding of the crisis, it turned out that financial institutions failed to consolidate information on enterprise-wide exposure and to supplement this with effective risk controls at the enterprise level[22]. This implied that risk was not managed on an enterprise-wide basis, which naturally undermined the ability to take strategic risk decisions (Blommestein, 2008b; OECD, 2009).

20 Note that risks are to an important degree "fungible" and therefore related to each other. For example, liquidity risk and systemic risk are strongly interrelated.

21 For an overview of corporate governance issues, see OECD (2009).

22 For instance because enterprise VAR estimates are often put together in such a way that it hampers enterprise-wide risk stress testing, see ROWE (2006).

But the governance issue which received most attention are structural flaws in compensation schemes resulting in excessive risk-taking. Many compensation schemes in financial institutions were designed so that traders and senior management benefit from the upside of risky behaviour while they are not or much less exposed to the downside[23]. As a consequence of these ill-designed (asymmetric) compensation schemes and other corporate governance problems within large financial institutions (see Calomiris, 2009)[24], important financial institutions had perverse incentives to promote high-risk activities and strategies. These perverse incentives amplified excessive risk-taking that, in turn, severely threatened the global financial systems (FSF, 2009).

Compensation systems had been designed to give incentives to employees to maximise short-term profits and to attract and retain talented employees, while risk management systems had been designed to inform board and/or senior management about the risk exposure of the firm. However, most financial institutions viewed compensation systems as being unrelated to risk management and risk governance (FSF, 2009). Moreover, risk management was to an increasingly large extent treated as a separate discipline, *i.e.* separate from senior management. In addition, in an environment with a constant flux of innovations, senior management and board were often ignorant of the exact risk characteristics of these innovations. Naturally this affected their ability to judge the risk characteristics of (seemingly) highly profitable complex products (Turnball, 2009). As a result of this, as well as the highly complex nature of risk strategies, it was increasingly difficult for senior management and board to assess and exercise judgement over the risks being taken, notwithstanding the fact that risk governance is a key responsibility of the board. Given the insufficient influence of risk management departments in combination with the limitations of senior management and board to properly understand and control risks, the "Wizards of Wall Street" were able to keep financial institutions operating in high-risk areas that generated high bonuses for everybody.

2.4. LESSONS LEARNT AND SUGGESTIONS FOR MOVING FORWARD

The global financial crisis revealed very clearly the need for fundamental changes at both macro and micro levels. Indeed, at the macro level a structural rethinking of the design of an increasingly complex and interconnected international finan-

[23] For example, successful traders can make fortunes, while those that fail simply lose their job (in most cases they move on to a trading job in other financial institutions). Similarly, CEOs of institutions that suffer massive losses walk away with very generous severance and retirement packages, see BLOMMESTEIN (2008a). Note however that there are different forms of bonuses and not all of them translate in excessive risk-taking behaviour.

[24] CALOMIRIS (2009) stresses that corporate governance within large financial institutions was virtually impossible as a result of government regulations limiting who can buy stocks in banks.

cial landscape is urgently required. In particular the question how to deal with the higher level of systemic *risks* in this increasingly complex landscape requires urgent attention, along with the question what reforms in supervision and regulation are needed to minimize the risk of repetition of another financial crisis of this scale. However, it is beyond the scope of this paper to address the required reforms at the macro level (but, for an extensive overview of possible reforms at the macro level, see FSA, 2009, BIS, 2009, and Banque de France, 2009, among many others). Instead, this section focuses on lessons learnt from the past episode of inadequate risk management at an institutional (*micro)* level.

2.4.1. What have we learnt from a conceptual perspective?

From a conceptual point of view, the financial crisis has demonstrated clearly that risk management as a discipline has lost track of its fundamental role of dealing adequately with uncertainty in the financial system. This happened exactly at the time when, as a result of an innovation-driven fast-changing financial landscape, the existence of fundamental uncertainty was increasingly important. To decrease the probability and severity of another global financial crisis, the risk management discipline should not only acknowledge in a frank and open way the potential technical weaknesses (limitations) of risk management models, but also take the existence of fundamental uncertainty more seriously. This would include acknowledging the dangers of model misspecification and/or mis-application and by paying explicit and rigorous attention to the question how to deal with uncertainty rather than trying to measure risks at all costs and in situations where this is clearly not warranted. But what does this paradigm shift imply at a more practical level?

The existence of complications such as fat tails and the fact that it is inherently impossible to discover the "true" model of financial risk events, lead to the central conclusion of this study that effective risk management requires a different and more comprehensive approach to risk management, in which firm-wide exposures and risks are constantly evaluated against the background of a fast-moving environment characterised by fundamental uncertainty. Such an approach to risk (and uncertainty) management requires that market participants should be aware of the possibility that the simultaneous pursuit of identical micro strategies may lead to synchronous behaviour and model-induced contagion[25]. For example, the recent crisis showed that a major dimension of tail risk concerns liquidity risk where market liquidity might completely dry-up. This type of challenges to risk-management requires not only a sufficient degree of flexibility in the management of risk at the corporate specific level, but also the recognition of

[25] In other words, there is always the possibility that liquidity suddenly evaporates, with inevitable consequences for asset valuations and solvencies.

the importance of psychological factors driving the behaviour of market participants. At a very fundamental level this approach requires the introduction of interactions among economic agents together with all sorts of cognitive distortions that can then be used to analyze collective changes in behaviour in (financial) markets (Blommestein, 2009). This would also necessitate the use of adaptive (rather than static) risk management processes[26] and more flexibility to respond to a fast-moving financial landscape (Blommestein, 2006b). Contingency planning, scenario analyses, extensive stress tests, "no regret policies" are examples of approaches to deal with "unquantifiable[27]" uncertainty. They go clearly beyond the scope of a conventional risk management framework.

Furthermore, recent evidence has shown that firms who relied on a wide range of risk measures to gather information and who took different perspectives on the same risk exposures than other financial institutions were in a much better position to cope with adverse developments (Senior Supervisors Group, 2008; Bernanke, 2008; OECD, 2009). This finding supports our contention that a comprehensive or holistic approach to risk management is essential. Such an approach involves both quantitative aspects and *qualitative* features such as the organisation of internal risk controls, transparency in financial reporting and disclosures and legal clarity (Schmidt Bies, 2004). But also more attention to issues such as the firm's culture and the necessity of a timely and effective internal communication structure (in order to share information efficiently across the firm), are required. Effective risk management must be practiced throughout the firm and integrated in the firm's business model, thereby encouraging more responsible behaviour focused on the longer-term health of institutions and avoiding excessive risk-taking.

The financial crisis has clearly shown the impact of structural weaknesses in the corporate governance structure and the need for reform, in particular via urgently needed changes in the relationship between risk managers, board of directors and top management. An improvement in the firm's corporate governance structure and its integration with the risk management function is in our view a necessary response to deal with fundamental uncertainty. In this context, the primary responsibility for the corporate strategy and related risk management strategy lies with the board of directors and top management. Risk management is simply too important to be left to a chief risk manager, since it is (or should be) an integral part of all banking activities. This implies that a sound risk management system must be fully integrated with a firm's business model (Blommestein, 2008b). It is the board of directors who is ultimately responsible for the risk strategy, involving decisions about risk exposure at all levels of the firm. The design of a sound

26 This may also require the use of the adaptive market concept instead of models based on the efficient market hypothesis.
27 And, thus, unmanageable for standard risk models.

corporate governance structure also includes the architecture of remuneration schemes. Understanding the links between incentives and risk-taking is a critical component of effective risk management (Bernanke, 2009). Causation does not only run from compensation structure to risk profile but also in the opposite direction, because inadequate risk controls can undermine the effectiveness of sound compensation schemes. For example, in a situation where weak risk-control systems would allow traders to build up huge losses that would eliminate profits made by other parts of the bank. As noted, there was the tendency in many financial institutions to decouple compensation systems from risk management (Noyer, 2009). Instead, risk management systems should assess the (potential) influence of the structure of compensation systems on the risk-profile[28]. Bonuses and other compensation sources should provide incentives to behave in ways that promote the long-run health of financial institutions[29].

2.4.2. Limits of risk modelling: what have we learnt from a technical perspective?

From a technical perspective, the financial crisis revealed that there are severe problems with applying VAR techniques and other standard quantitative techniques for risk management. For example, VAR is not sub-additive (Artzner *et al.*, 1999), while generating very inaccurate risk forecasts (Danielsson, 2002). More in general, it is very hard to develop risk models that can be used in a practical and reliable way in the world of complex and dynamic social and economic relationships. Replacing standard models such as VAR by alternative risk measures tend to be overly complex and/or impossible to implement in everyday situations (Danielsson, 2009). In this context, it has been noted (*e.g.* Bernanke, 2008; 2009), that robustness is a desirable feature of risk management methods. The theory of robust control provides a toolbox of techniques that may be helpful in this regard (Colander *et al.*, 2008). However, also stress tests and scenario analyses are promising avenues to augment standard risk models as these tools can provide valuable information for detecting risks in complex environments. Indeed, these kind of exercises forces risk managers to think through the implications of scenarios that may seem relatively unlikely but that could pose serious risks to the firm when they would materialize, requiring managers to think "outside the box".

28 In other words, supervisors should scrutinise more thoroughly whether the combined structure of corporate governance, compensation schemes and risk controls encourages excessive risk-taking.

29 In conformity with the FSF Principles for Sound Compensation Practices (see: FSF (2009)) and Principles for a controlled remuneration policy (see: AUTORITEIT FINANCIËLE MARKTEN and DE NEDERLANDSCHE BANK (2009)).

To that end, stress tests and scenarios should allow the modelling of the consequences of extreme events so that they constitute a tail event. For instance, scenarios and tests that allow for abnormally large market moves, the evaporation of market liquidity and/or periods of prolonged market distress. In addition, it is imperative that the spill-over and contagion consequences of the firms' own actions and that of others actions are taken into account, including in particular the second round effects of stresses in the system (*i.e.*, network externalities). This will put firms in a better position to internalise network externalities that have played such an important problem during the ongoing global crisis (Haldane, 2009).

2.5. CONCLUSION

Although the global financial crisis revealed very clearly the need for fundamental changes at the macro level (which are currently being discussed extensively in various international forums), this paper focussed on the need for urgent changes that address weaknesses of risk management systems at the level of financial institutions. Our key conclusion is that (i) the underestimation and underpricing of risk as well as (ii) confusion over the difference between uncertainty and risks were at the core of the ongoing financial crisis. The resulting mismanagement of risk was in part due to the complexity and opaqueness of a fast-moving, innovative financial landscape, which strained the ability of market participants to price risks correctly and resulted in an increase in systemic risk. But also the inadequacy of risk management systems in a narrower, technical sense contributed to the underpricing of risks.

The problems are in our view first and foremost of a conceptual nature. The financial crisis brought to light that risk management had become too much a *pseudo quantitative science* with pretentions outstripping quantitative risk management capabilities of most financial institutions. There was a profound lack of understanding of the role of fundamental uncertainty and confusion over the difference between risk and uncertainty. Indeed, the fact that many financial decisions have to be taken in a rapidly changing environment characterised by a high degree of (fundamental) uncertainty (rather than risk) was largely ignored. This in turn had adverse consequences for the way risk management and decision making were organised in financial institutions. There was an exaggerated sense of confidence in quantitative risk models and measurement and too little appreciation for the key role of the qualitative side of risk management (*e.g.* information flows, people and their incentives/motives). Moreover, even from a purely technical perspective, risk management models and techniques turned out not to be sophisticated enough. In particular, the financial crisis revealed that there are severe problems with applying VAR techniques and enterprise-wide risk management to a world with rapidly changing social and economic relationships.

In sum, important lessons can be learnt from the past episode of inadequate risk management. We showed that there was too much reliance on the quantitative side and too little on the qualitative side of risk management. But we also argued that there is a need for a greater emphasis on dealing with fundamental uncertainty. More sophistication and a further refinement of existing risk management models and techniques is not the most important or effective response. Too much emphasis on a new generation of complex risk models might even lead to similar risk management problems as during the last decade. Instead, a more holistic and broader approach to risk management is needed as part of a paradigm shift where more attention is given to the *qualitative* dimension of risk (and uncertainty) management. This includes the best practice that top managers are actively and directly engaged in the management of the risks confronting their organisation at the strategic level, including the link between risk-taking and incentive structures.

But even when the changes in risk management systems proposed in this paper have been implemented, financial institutions will continue to grapple with a future that is highly uncertain and in which human nature can be expected to remain largely unchanged. For example, experience and laboratory tests show that most humans have an ingrained tendency to underestimate outliers and to take sometimes huge risks in their efforts to earn money. Furthermore, asset markets have a tendency to generate a pattern of bubbles followed by crashes (Blommestein, 2008a), that may or may not be transmitted to foreign markets.

This means in our view that regardless of future technical improvements in risk management practices and techniques, and notwithstanding further progress in macroeconomic policies and more effective macro-prudential supervision that would remove (for long periods of time) potential sources of volatility, we will still have to brace ourselves periodically for financial crisis that are essentially self-generated. After all, fundamental uncertainty is a fact of life. This means that finding improved ways of dealing with fundamental uncertainty will remain a continuous challenge for financial institutions and supervisors alike.

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3. Banking in times of crisis: the case of Rabobank

Wim W. Boonstra[1]

Introduction

The financial crisis, that started in 2007 and had its climax with the fall of Lehman Brothers in the autumn of 2008, created many victims in the financial world. Many banks ran into severe problems and needed additional liquidity from central banks or government support. Quite a large number of them have either been nationalized or have received massive capital injections from governments.

The Dutch cooperative Rabobank is one of the most remarkable exceptions. In this crisis, it has turned out to be one of the most stable banks of the world. It survived the crisis years 2007 and 2008 relatively unscathed and it is the only large bank in the Netherlands that did not need government support. This raises the question: is Rabobank a more stable bank or has it just been lucky? And the second question, of course, is: if Rabobank is a more stable bank, what can be learned from its experience?

In this article, I will start with introducing Rabobank. Special attention will be given to its business model, the way its governance is organized and its strategy. Next, its experience during the crisis will be discussed in more detail. Following this, the topic will be broadened to the question of whether cooperative banks have an impact on the financial system in which they operate. Finally, after some brief thoughts on the future of the banking system, some conclusions will be presented.

3.1. Rabobank

For a number of years, Rabobank has been the only private bank in the world with a AAA rating from both Moody's and Standard and Poor's. It ranks in the top 20 of banks in the world, measured by equity. This is a long way from its origins as a humble microfinance institution in the Dutch countryside.

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3.1.1. Historical development

The history of Rabobank started in the middle of the 1890s with the establishment of small microfinance institutions in the Dutch countryside. This was part of a broader cooperative movement in continental Europe. Starting in Germany in 1864, when the first German credit cooperative was established by Friedrich Wilhelm Raiffeisen, cooperative banks were set up over large parts of the European continent. They were established in reaction to a major market failure of the time: access to finance against acceptable conditions was miserable in the countryside. Traditional banks were hardly active outside the cities and farmers could only borrow money from usurers against prohibitive conditions. The cooperative movement spread very rapidly over the continent and in the Netherlands in 1900 already 67 credit cooperatives were active. In June 1898 the first umbrella organization was established (the Coöperatieve Centrale Raiffeisen-Bank in Utrecht), quickly followed by the Coöperatieve Centrale Boerenleenbank in Eindhoven (December 1898). These institutions organized the activities with a regional or national dimension, organized money market facilities and liquidity support for member banks and, already in the 1920s, organized micro-prudential supervision on local cooperative banks on behalf of the group [Mooij, 2009].

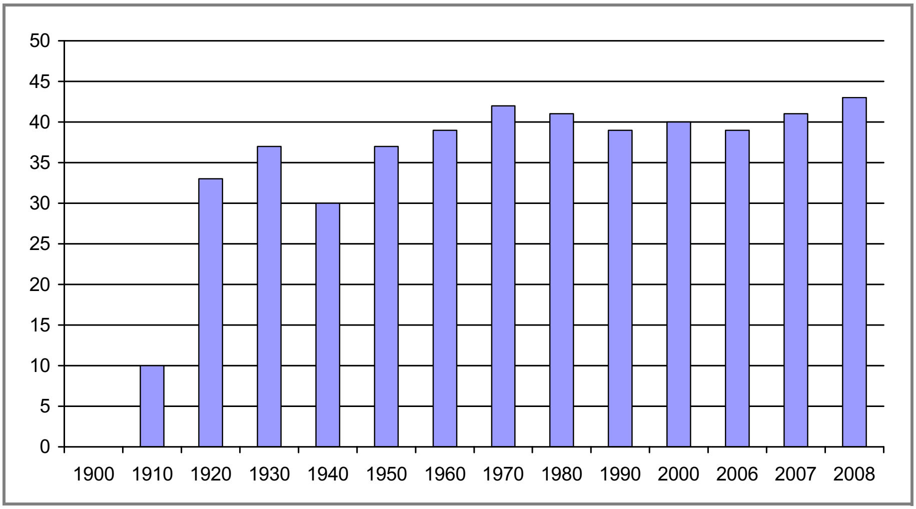
Table 1: Key figures Rabobank

	<= Dutch GAAP			=> IFRS		
	1994	**1999**	**2004**	**2004**	**2007**	**2008**
Total assets (€ bn)	112	282	475	484	571	612
Private sector lending (€ bn)	80	161	253	249	369	409
Due to customers (€ bn)	68	128	192	178	277	304
Tier 1 capital (€ bn)	9	13	23	21	29	30
Net profit (€ million)	583	1020	1536	1793	2696	2754
Tier 1 ratio (%)	9.4	10.0	11.4	10.9	10.7	12.7
BIS ratio (%)	12.0	10.5	11.4	10.8	10.9	13.0

Source: Rabobank, annual reports

Over time, Rabobank gradually lost its microfinance character and developed into an all-finance institution. Initially, the Dutch central bank had its doubts about the strength of the cooperative banks. Its worries concerned above all their weak capitalization at the time. Moreover, their interest margins were lower than those of their commercial counterparts. On their part, the cooperatives argued that they felt that, due to peer pressure, their credit quality was better than that of other banks. As the cooperative banks were not able to convince the central bank of their view, the latter denied them access to its discount facility.

Figure 1: Market shares cooperative banks in savings deposits



Source: Annual reports Rabobank, Meijs (2002)

After the financial crisis of the 1920s, in which the Dutch cooperative banking sector indeed appeared to be more crisis-proof than many commercial banks, the principle of cooperative banking was widely accepted and access to the central banking facilities was fully restored (Mooij, 2009). Gradually the local microfinance institutions developed into fully-fledged banks offering a broad range of products. In the 1960s they expanded into urban areas[2]. In 1972, the Boerenleenbank and Raiffeisenbank organizations merged into the Rabobank, which today is the largest banking group in the Netherlands, with an average market share of some 30% in its home market. In agriculture, where its roots are, the Rabobank market share lies between 80 and 90% of the Dutch market.

Table 2: Market position of Rabobank

	Market shares (%)					
	1981	**1991**	**2001**	**2006**	**2007**	**2009**
SME lending		38	37	38	38	39
Mortgage lending	29	30	25	26	28	30
Food- and agri		88	87	84	84	84
Savings deposits	41	39	40	39	41	43

Source: Rabobank, annual reports

2 One of the mysteries of history is the fact that the initial success of cooperative banking in the Netherlands was limited to the countryside. In this respect, the Dutch developments differed form those in Germany, were Genossenschaftsbanken and Volksbanken developed more or less parallel. It was certainly tried to introduce cooperative banking in the Dutch cities, but al these efforts, such as Hanzebanken, Boazbanken and Middenstandsbanken, ran into serious problems in the 1920s and failed. The government had to step in to fill the gap, establishing the predecessor of the Nederlandse Middenstandbank, that later became part of ING (BOONSTRA (2009)).

In 1980 Rabobank took its first steps abroad by opening a representative office in New York. Since then, its international expansion has been relatively rapid. Today, it has more than 500 branches in 28 countries. Until the mid 1990s the local lending activities of the Rabobank could be more than completely funded by savings deposits. Gradually, however, the lending activities grew faster than savings, forcing the bank to turn to wholesale funding for its domestic activities. At the end of the 1990s Rabobank formulated the ambition to develop into a major international investment bank. This initiative, however, proved to be short-lived (see below).

3.1.2. Rabobank's cooperative identity

As Rabobank evolved from a chain of locally active credit cooperatives into a full fledged financial service provider, it gradually seemed to lose its cooperative character. Many observers in the outside world hardly recognized it as a different bank when compared with its non-cooperative peers. The cooperative structure of Rabobank was scarcely used in its communication, the membership base (which was not very actively used) was declining and many clients barely realized the difference in business model between Rabobank and its peers in the financial sector. Although it was widely known that Rabobank was not quoted on the stock exchange, it was hardly recognized that the underlying business model is different from other banks. Among the people who knew, many had the opinion that the cooperative organization model was a 19th century relict that badly fitted a modern bank. Even within the bank itself this sentiment was wide-spread, which resulted in pressure to convert Rabobank into a commercial bank and list it at the stock exchange. In reaction to this, the executive board opened the so-called cooperation debate, in which all stakeholders were involved. This debate, which ran from 1995 to 1998, resulted in a number of conclusions, which can be summarized as[3]:

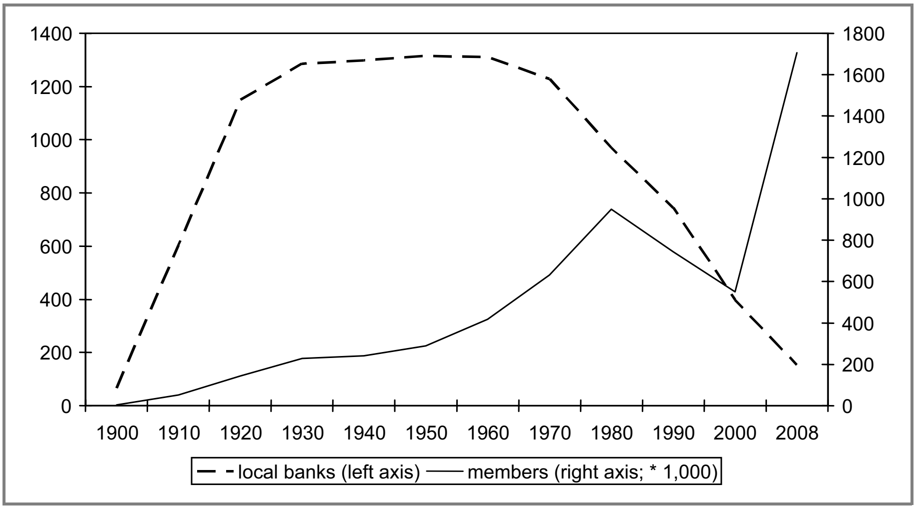
1. Rabobank would retain its cooperative structure and would not convert into a listed commercial bank. The motivation was that the bank felt that its so-called stakeholder model is better fitted for the financial services industry than the shareholder model;
2. the cooperative structure of the Rabobank should be emphasized;
3. the membership based should be expanded and actively developed.

Since then, due to an intensive effort to increase the membership base, the number of members has grown from 0.6 million in 1998 to 1.7 million in 2009. This is not the right place to dwell on the series of local initiatives that were developed at local levels to activate the Rabobank membership base. For the context of this

3 The full list of conclusions can be found in Meijs (2002).

paper it is important to realize that it was not a coincidence, but an explicit and well-motivated decision not to list Rabobank on the stock exchange. The recent increase in popularity of the cooperative model in banking in reaction to the crisis underlines the foresight of this decision.

Figure 2: Number of local cooperative banks and membership base (1900-2008)

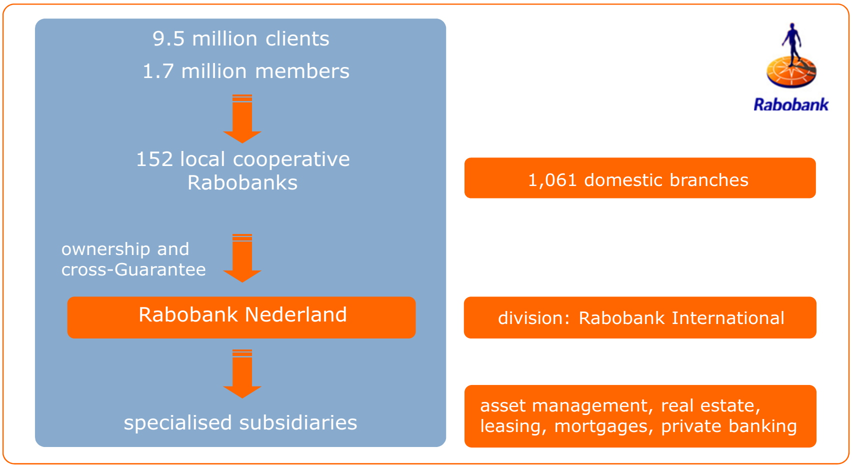


3.1.3. Structure of the Rabobank Group

The foundation of the Rabobank Group is formed by the local member banks. Today, there are some 150 local Rabobanks in the Dutch market. This followed a rapid decline after a peak of 1228 in 1970 just before the merger of the two central organizations into Rabobank. During the last decade, the decline in the number of local banks has accelerated, shown by the fact that the number of member banks in the group decreased form 397 as recently as 2000 to today's number of 152. This decline, which is part of a major efficiency drive, was entirely the result of mergers between small banks in order to improve scale economies. Local Rabobanks have a high degree of autonomy in the region where they are active. They all are individual legal entities, with their own profit and loss account and balance sheet responsibility. Together the local banks own Rabobank Nederland, the central organization. Rabobank Nederland organizes a series of central functions, such as ICT, payments systems, communication, research and risk management on a group level. Moreover, all funding operations are centralized within Rabobank Nederland. Therefore, individual Rabobanks have no direct access to financial markets. All funding surpluses and deficits of local banks are channeled via the central organization.

Rabobank Nederland also runs, via its division Rabobank International, the foreign network of the Group. In addition, it also owns a series of domestic specialized subsidiaries, such as Robeco (asset management), De Lage Landen (leasing) and Schretlen (private banking), and it has a 37% share in the Insurance group Eureko.

Figure 3: Structure Rabobank Group



Compared to most other cooperative banking groups Rabobank has a very coherent structure. The strongest binding factor is its cross-guarantee, under which any individual Rabobank guarantees the obligations of all other member banks. As a result of this guarantee system, Rabobank is treated as a consolidated entity for the regulatory supervision, of solvency, liquidity and other controls. The Dutch central bank (DNB), which is responsible for the supervision of Dutch banks, has delegated supervision of the individual local Rabobanks to Rabobank Nederland.

3.1.4. Governance and ownership issues

Although the local Rabobanks are the owners of Rabobank Nederland and therefore are ultimately "the boss" of the Rabobank Group, the actual power balance within the group is considerably more delicate. On the one hand, all strategic decisions are made or approved by the central delegate committee (Centrale Kringvergadering, CKV), which consists of representatives of local banks. This makes the CKV the most important institution within the Rabobank Group. On the other hand, Rabobank Nederland has power over the local banks originating from two sources. First, it holds delegated authority over local banks as a result of its role as guardian of the collective agreements. Once the CKV has made policy decisions for the group as a whole, Rabobank Nederland assures that every individual member bank sticks to the "club rules". Second, especially its role as guardian of the cross-guarantee system (see above) and its role as banking supervisor, it has a strong influence over the local banks. As a result, the power balance within the Rabobank Group is a delicate equilibrium between the local banks on the one hand and the central organization on the other. Decision making can be time consuming, because many stakeholders are involved. This disadvantage is usually compensated by the fact that, once decisions have been made, implementation can proceed relatively quickly as most relevant stakeholders have already been involved in the decision making process.

The ownership structure of the Rabobank Group is even more complex. Nobody owns Rabobank, the bank "owns itself". By far the largest part of its capital base comes from retained profits which have been built up over a century of profitable banking. All profits are retained,and there is no dividend for member banks. In addition, tier-1 capital was attracted by issuing hybrid instruments such as trust securities and membership certificates. Members have no claim on the capital: it is so-called "locked in" value. And although in principle member banks can decide to leave the group, the costs of doing this are so high that it is only a theoretical option. Finally members, although they have a limited say in the bank's policy, cannot decide to convert it into a listed company and take out the capital, as happened in the UK with the mutual sector (Llewellyn, 2009).

Table 2 gives the key figures of Rabobank. It shows the strong growth over the decades and the most important ratios. It also shows the way diversification pays off, which was well illuminated by the developments in 2008. In spite of substantial losses due to the financial crisis in the US, Rabobank's net profit reached an all-time high that year. This was the result of a extremely strong performance by the local banks in the Dutch retail market (see below).

3.1.5. The cooperative business model

Cooperative banks are different from commercial banks in many respects (Diepenbeek, 2009). It starts with their origins. Cooperative banks were established in reaction to market failures. At the time of their establishment, access to finance for farmers and craftsmen in the countryside was seriously problematic. Traditional banks were hardly or not at all active outside the cities, leaving the farmers at the mercy of money brokers that granted credit against extreme conditions. Usury was a wide-spread phenomenon in those days. The establishment of cooperative banks changed this. Not only did their arrival improve access to credit for farmers and craftsmen, it also brought opportunities for people to employ their savings in a more productive way. Moreover, they undermined the market power of the other suppliers of financial services in the countryside, the aforementioned usurers. Until today, cooperative banks claim that their presence in the market has a disciplinary impact on the market behavior of other entities.

As discussed earlier when introducing Rabobank, there are substantial differences in ownership and governance structure between cooperative banks on the one hand and listed banks on the other. Another important difference is the fact that cooperative banks, in contrast with commercial banks, do not aim at maximum profits. They have a so-called multiple bottom line, in which the interests of all important stakeholders are taken into account. Sound profitability is, of course, of major importance for cooperative banks, because profits are by far the most important source of capital. A slowdown in profitability translates immediately into a lower growth potential.

3.1.6. Rabobank's strategy

Like most banks Rabobank made changes to its strategy over time. Early strategic moves consisted of the move into urban areas (1960s), the international expansion (starting in 1980) and the creation of an all-finance institution in the Dutch market (starting in the 1980s). This strategy was underpinned by a series of acquisitions. Since the 1990s the strategy in its home market has been by and large very consistent: Rabobank has the explicit aim to be the market leader, to be measured in market shares, in all market segments in the Dutch market. In retail banking it is indeed the largest player, although over the years ING was an important competitor. In wholesale banking Rabobank remains a runner up in third position, after ABN Amro and ING. However, during the crisis the Dutch banking market was in some turmoil. ABN Amro lost its international network due to the takeover by Santander, RBS and Fortis. Moreover, after its failed takeover by Fortis it had to be nationalized and is still in repair, so to say. ING, which also needed substantial capital injections by the Dutch government is substantially downscaling its operations, especially abroad. Deutsche Bank has entered the Dutch market by buying a large part of the corporate banking division of ABN Amro.

The short run effect of these developments was a strong increase in Rabobank's market shares for retail savings (due to a flight to quality) and mortgages (due to capital constraints at the other banks). In the longer run, however, this may translate into a much fiercer competition in the home market.

The operations in their home market of Rabobank and other cooperative banks are largely based on traditional banking. Their business model is not based on selling by securitization of commoditized credits (OTD, "originate to distribute") but, with the aim of responding to the needs of their members/customers, it is based on a more traditional "intermediation role" along the OTH ("originate to hold") model. As a consequence, co-operative banks remain committed to the real economy, and they can play an important role in the recovery process after the crisis. However, in the international operations, the operations of Rabobank and its cooperative peers more reflect the business model of commercial banks. It is here that their losses have been concentrated (see below).

The international strategy of Rabobank has seen several changes over the years. Initially, the international network was seen as an essential element in the support of internationally operating Dutch companies. But the international activities were completely subordinate to the domestic activities. The only field where Rabobank saw a major international niche for itself was in the field of International Food- and Agri banking. This is seen as a logical development from its domestic roots in agriculture, where Rabobank even today holds market shares of around 85% in the Dutch market. Gradually, the bank's international ambitions grew wider, culminating in a major move into investment banking at the end of the 1990s. In this aspect, Rabobank followed many other banks with similar ambitions. However, as it soon appeared that the promises of investment banking would not be fulfilled, Rabobank quickly scaled down these operations in 1999. There were two motives for this rather drastic step. First, although the income form investment banking grew quickly, costs rose at the same pace. As a result, the contribution to net profits was very disappointing. Second, and maybe even more important, the culture of investment banking fitted badly with Rabobank's company culture which is deeply rooted in domestic retail banking (Vogelaar, 2009).

Another failed strategic move was the drive to create a pan-European cooperative bank. The first step in this ambitious project was an attempted merger of Rabobank Nederland with Deutsche Genossenschaftsbank (DG-Bank) in 1999, the umbrella organization of the German cooperative system. This move was ill-prepared and neglected the structural differences between, which is in many aspects the very loosely organized German cooperative system and the rather tightly organized Rabobank organization. After a short time this merger effort was aborted at the end of 2000.

Today, Rabobank's strategy can be summarized as follows:

1) stay a predominantly Dutch bank;
2) keep a strong cooperative identity;
3) retain creditworthiness at the highest (AAA) level;
4) further strengthening of all-finance market leadership in the Dutch market;
5) aim to be the world's number 1 Food- and Agri bank;
6) maintain a high level of corporate social responsibility.

The financial target, aimed at maintaining the AAA rating, is of the utmost importance. First a rating of the highest quality translates into low funding costs and access to finance. Even in the current crisis, in which most banks were not able to attract funding without government guarantees, financial markets have had a positive attitude towards issues by Rabobank. Second, to retain the AAA rating it is absolutely necessary to pursue a rather conservative financial policy. High solvency and a stable and healthy profit development are the absolute preconditions for retaining this rating. One might say that the AAA rating and the resulting necessary financial discipline to a certain extent are substitutes for the market discipline that otherwise, if Rabobank was a quoted company, would have been exerted by the financial markets.

However, maintaining a AAA rating is not without disadvantages, especially in times when financial markets do not adequately translate differences in risk profiles into different funding costs. It is often said that for listed banks an AA rating is better than the AAA of the Rabobank. To a certain extent this is true. If a bank's goal is to earn as much as it can for its shareholders, it will have to sail close to the wind in terms of its risk profile. This entails much more volatile income growth patterns. Major profit jumps can sometimes be followed by (sometimes equally sharp) falls in income. Moreover, capital is used more intensively for risk-bearing activities. In financial terms a bank like that makes more extensive use of the leverage of core capital that is fairly limited compared to its activities. On the one hand, this leverage of capital facilitates a clearly higher return on equity than for banks that opt for an extra capital buffer. On the other hand, this type of buffer makes more conservative banks like Rabobank much less vulnerable to unexpected adversity and provides scope for growth if specific opportunities arise.

As a result, the advantages and drawbacks of the AAA rating were discussed within Rabobank in the period before the credit crisis. Since, within Rabobank, not all were convinced of the usefulness of a top rating, there was some pressure to abandon the rating ambitions. However, the credit crisis proved beyond any doubt how important that top rating is for a bank. It was mainly its rating that gave Rabobank continued access to the financial markets even during the financial crisis. It also became clear how wise it had been for the bank not to pursue an extension of its capital leverage, as the continued stretching of leverage by financial institutions and within financial products proved to be one of the chief causes of the woes that were given the name credit crisis.

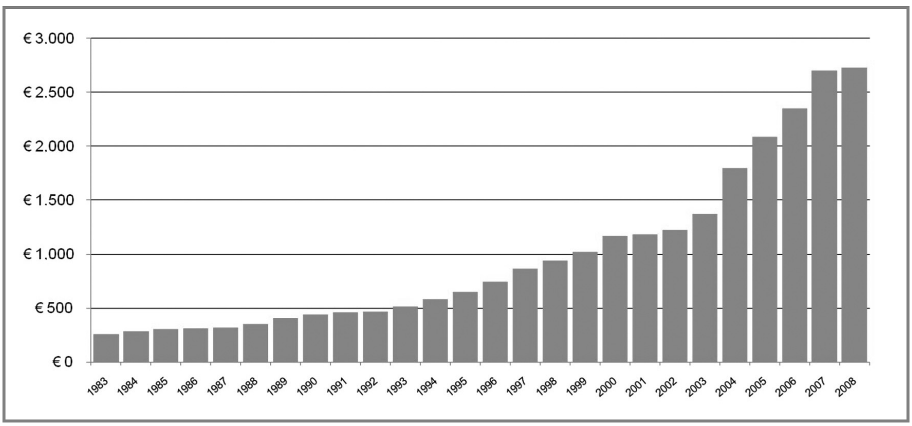
3.2. RABOBANK AND THE FINANCIAL CRISIS[4]

How did Rabobank fare in the turbulent circumstances of the current crisis? As already stated at the start of this contribution, Rabobank is primarily a traditional bank, with lending and savings and other funds entrusted as main items on

4 This paragraph draws heavily on VOGELAAR (2009).

the balance sheet. Around one quarter of the bank's income comes from Rabobank International, the wholesale business (which includes its international retail operation). Within this entity, investments in the form of structured credit products were developed and/or traded on a relatively modest scale. It has already been mentioned how the original plans to create an investment bank division within the Rabobank had been abandoned at the end of the nineties. In the following period, around the turn of the century, solvency proved to be becoming an increasingly scarce asset. Rabobank also experienced limits in its opportunities for growth. In itself that is not bad, but a natural inclination arose to stretch the limits where possible. Securitization was a suitable means to achieve this. This was done in a traditional way, with own lending and (facilitating) loans from customers. But in addition, Rabobank also acquired assets in the form of structured credits with short-term financing via separate investment vehicles. This produced attractive yields, without reducing the bank's solvency. Because the bank supported these investment vehicles it was also exposed to risks as a co-investor. When in 2007 and 2008 investors stayed away because they no longer trusted the assets in these types of funds, Rabobank had to step in itself. Consequently, the bank's investment portfolio (which the bank maintains in order to be able to generate liquidity rapidly if necessary) partly consisted of structured investments. Although the great majority of these carried a AAA rating, once the crisis broke out this rating had less meaning than had originally been thought. In addition, the credit risk had been hedged for a part of the portfolio, chiefly with a view to the advantages this provided in terms of solvency. But such hedges at monoline insurance companies also proved to provide less security than originally intended.

Figure 4: Growth in net profit of Rabobank in 25-year period (in € million)



All in all, the consequence for Rabobank (specifically, Rabobank International) was certainly not that it had direct loans in (US) subprime mortgages, but that it did have an indirect position via its investment portfolio in the form of structured products, particularly RMBS and CDOs[4].

Rabobank eliminated the risk-bearing elements in its investment portfolio as quickly and extensively as possible. At year-end 2008 the "exposure" to indirect positions on subprime mortgages was reduced to only € 158 million. Meanwhile in 2007 and 2008 € 1.7 billion after tax had been written off through the profit and loss account on positions in the banking operations that had been impacted by the financial crisis. The results at the other Rabobank units, the local member banks in particular, proved sufficient to set off the above-mentioned losses, and therefore in 2007 and the first six months of 2008 the bank achieved its net profit target of at least 12 percent growth. For 2008 as a whole the bank reported profit growth of 2 percent, whereas many other banks throughout the world had to report substantial losses or at least sharp falls in profit. Rabobank's relatively stable profits are to a significant extent due to the diversity of its activities, and also to its conservative accounting practices. Unlike shareholder-driven banks, a cooperative bank is not aiming to achieve the maximum attainable result every quarter. In tandem with a basically limited risk profile this leads, in practice, to flatter changes in results, compared to significant volatility at listed banks.

The Tier 1 ratio (the ratio of equity to risk-weighted lending) was still comfortably above 10 percent and, applying the new calculation method ("Basel II") at 12.7 percent, in line with the upwardly revised target of at least 12.5 percent. The cooperative Rabobank thus never opted to strive to extend its capital leverage to the maximum. Quite the contrary, the substantial buffer is intended for tougher times and the fact that it remained unutilized even in the tough times of the credit crisis is a sign of the bank's strength.

However, for a bank that in its Mission Statement gives the creation of customer value the highest priority, there is a question about which values the bank created when it ventured into the complex and risky world of structured credit products in the years before the crisis erupted. In the end this question has to be answered with the conclusion that customer interests were not the primary objective in doing so, but that "profit as an end in itself" was being pursued. In this case, the bank was acting not in its traditional role of intermediary but urgently seeking a yield pick-up at a supposedly acceptable risk level. This did not end well and was also, ultimately, alien to the co-operative culture. Once this was concluded, it was decided that the wholesale business should from now on again target customer-focused activities. The bank is also again acting primarily as an intermediary in the financial markets, as trader, between the money and capital market flows.

To summarize, Rabobank's experiences during the current crisis can be subdivided into several stages. In the years before the crisis broke out, (the first stage) Rabobank experienced strong growth of its international activities. Part of this growth was not client driven, but can be characterized as purely profit driven. This growth also resulted in a strong increase in its dependence on wholesale funding via the financial markets. During this period financial markets seriously under-priced risk. For Rabobank this meant an extra challenge, as its funding advantage was undermined by this development. Especially in its international business, the bank gradually lost its client focus and started to behave more and more like a commercial bank. However, the core of its strategy, its domestic business, remained on course. The second stage, as described above, showed substantial losses on exposures to the US market, in spite of the highest rating of the products in its portfolio. The bank aggressively took its loss and strongly reoriented its international business. Thanks to its good diversification of activities and its very strong performance in its home market, the bank nevertheless reported a record net profit over 2008.

The third stage, however, appears to be the most difficult. The Dutch economy turned into a deep recession in 2009, with a decline in real GDP of approximately 4%. Rabobank, deeply involved in the Dutch economy, suffered strongly from the deterioration in the economic environment. It has had to take large bad loan provisions on its corporate loan portfolio. This is in contrast to its mortgage portfolio, which is still performing extremely well with loan losses of less than 2 pro mille (0.02%) of total mortgage lending. The good performance of Rabobank's mortgage portfolio illustrates that in the Netherlands, unlike in a number of other countries, the market for mortgage loans (and the underlying residential housing market) is fundamentally sound. In addition, the bank has suffered serious losses in Ireland. A second problem for Rabobank is that deposit savings rates in the Netherlands are relatively high. This has to do with the fact that some State supported banks are trying to buy back market share in the savings market. This follows their heavy losses in market share suffered in the run-up to the failure of Fortis/ABN Amro in October 2008. In contrast to several other countries, where the authorities actively intervened to prevent distortions in competition due to State support to banks, the Dutch authorities have so far stayed on the sidelines. Moreover, the Dutch Deposit Guarantee Scheme (DGS) is rather attractive for high risk banks, in many cases from foreign origin, to attract savings under cover of its guarantee. The case of Icesave, a branch of Icelandic bank Landsbanki, that failed in October 2008 is a good example of the way the Dutch DGS is open to abuse (Groeneveld, 2009). The result of all this is a high deposit savings rate which has reduced the profit margins of banks. This is hurting the banks that have survived the crisis without government support, as they struggle to stay profitable in a rather hostile environment. For Rabobank this means that its net profits over 2009 will be significantly lower than its 2008 record profits. This is the first year in its existence in which Rabobank will record a decline in profits[5].

However, the crisis has also brought advantages to Rabobank. Its market share in savings deposits increased substantially in 2007 and especially in 2008, when consumers more and more appreciated Rabobank's low risk profile. In the financial markets, Rabobank's strong performance was recognized by investors worldwide. This was illustrated by the fact that Rabobank was the first bank to launch a major bond issue, without government guarantee, in January 2009. It succeeded to raise € 5 billion in only a couple of hours. Without exaggeration, it can be said that this issue heralded the revival of the world's financial markets' appetite for good quality bonds. Moreover, although Rabobank today has to pay a higher price for its long-term funding than it had in the past, its advantage over its lower-rated competitors has substantially increased.

3.2.1. Rabobank in the crisis: a summary

All in all, Rabobank dealt relatively well with this crisis. It is still comfortably profitable, its capital ratios stayed intact by a wide margin and its domestic market shares have increased substantially. At the height of the liquidity crisis, Rabobank almost drowned in a fresh inflow of liquidity, which in these times is a remarkable position. This reflects the confidence that others clients, banks and authorities have in the bank. The fact that it is not listed on the stock exchange also helped, as it kept the bank out of the turbulence at the stock exchanges in 2008. The explicit decision, made in 1998, not to go for a listing appeared to be a very wise one. Today, its standing in international financial markets is better than ever, its AAA rating was reconfirmed by both Moody's and Standard and Poor's in the summer of 2009 and it ranks in the global top 20 of large banks (ranked by equity)[6]. The first conclusion could be that it is a solid and successful bank with a basically sound business model.

However, Rabobank's management draw some other conclusions as well. First, it was clear that the bank's losses were due to a loss of focus in its international business and that this should be repaired. A strong refocusing of Rabobank International towards more client based business was the result. Moreover, as the growth rate of lending and other assets structurally exceeded the growth in savings deposits, Rabobank increasingly turned to the financial markets for long

5 Rabobank's profits are also hurt by the fact that the Dutch DGS is an ex-post system, in which the surviving banks pay the costs of failures of other banks. After the Icesave debacle, which cost Rabobank over € 30 million, it will also have to pay for the failure of DSB Bank in 2009. The costs of this failure are unknown so far, but ultimately the could increase to several hundreds of million euros.

6 Note, however, that both Moody's and Standard & Poor's have added a negative rating outlook to the rating. However, Rabobank has experienced a negative outlook to its rating before, but succeeded to get this removed by improving its performance. It is strongly committed to retaining the highest credit rating.

term funding. Although it was (and still is) very successful in this respect helped by its AAA rating, it was concluded that the growth of its activities was too high. Extrapolating its growth rate of the last decade it was feared that Rabobank would become too dependent on long term wholesale funding. This fear was further fuelled when, in the last months of 2008 when financial markets closed down almost completely for all non-government issuers, Rabobank also encountered for a short period problems in finding long term professional funding. In January 2009, when this ban was broken, there was huge delight within Rabobank. It was foreseen that 2009 would be a difficult year for attracting long tem funding, but as it turned out Rabobank met its funding target for 2009 as early as the middle of the year. Nevertheless, it was concluded that the balance sheet growth should be substantially reduced. These conclusions had already been drawn in the summer of 2008 and were immediately implemented, which will result in a more or less stable balance sheet total over 2009. In particular, the activities of the Global Financial Markets directorate of Rabobank International were scaled down substantially.

As can be learned from its experience, Rabobank is in many aspects a "normal" bank. Mistakes made by other banks were made by Rabobank as well. It could not withstand the temptations of investment banking. It was tempted into a European adventure that turned out to be a dead end. And it has been involved in securitization activities that were not client focused but were completely aimed at a yield pick-up. Especially in its international operations, Rabobank from time to time wandered from its core business of retail banking.

There are also some strong differences compared with other banks. First, its core strategy, aimed at retail banking in the Netherlands, remained stable over the decades. Second, it has a strong company culture, deeply rooted in its cooperative retail banking background. Once the international operations wandered too far off from its core business, whether that be in effectiveness or in culture, resistance from the local banks quickly mounted. Third, the governance of Rabobank is organized in a democratic way that makes it possible for the local banks to pull the strings on the central organization, including Rabobank International[7]. Fourth, the strategy to keep the AAA rating at all costs has a strong disciplinary effect on the bank's behavior. The result of all this is that, once parts of the Rabobank Group make seriously wrong decisions, the countervailing powers guaranteed quick and effective reversals. Finally, its strong balance sheet, also a direct result of it AAA rating, made it possible to survive last year's event without serious damage.

7 It is the strong governance in which Rabobank differs significantly from other banks, such as ABN Amro. For years, ABN Amro was rather volatile in its overall strategy and kept on investing in its investment banking arm, long after it was clear that it was not a successful strategy. Weak governance finished ABN Amro as a major player (SMIT (2008)).

Rabobank's key success factor is not better banking than its peers, but can be summarized as a better governance structure in combination with a strong company culture and a deeply ingrained conservative attitude towards banking.

3.3. COOPERATIVE BANKS AND THEIR SYSTEMIC IMPACT

In this paragraph we will broaden the topic and discuss the question whether the experience of Rabobank has been a unique event or whether cooperative banks in general fared better during this crisis. Before answering this question, we will start by discussing the systemic impact of cooperative banks.

Cooperative banks themselves feel that they have a positive impact on the financial system. They often state that the presence of a strong cooperative banking group has a disciplinary effect on the behavior of other suppliers of financial services. This feeling goes back directly to their roots as local credit cooperatives, established in reaction of the market failures that were present at the end of the 19th century. Cooperative banks prefer to see themselves as "customer champions" (Oliver Wyman, 2008). Their presence adds to competition in the financial sector, preventing commercial banks to maximize their profits to the disadvantage of their clients. The so-called "presence value" of cooperative banks translate into better deals for their clients, as they do not aim at profit maximization. Other banks have to follow, because otherwise they will lose substantial market shares to the cooperative banks. The problem with this claim is that it is difficult to demonstrate this with precise empirical research as the impact of a strong cooperative group on the behavior on other financial services suppliers is very difficult to quantify: the standard "counter-factual" problem. The best observations can either be obtained when cooperative groups are established or, alternatively, when they have disappeared from the market. Although most economic history books indeed are rather positive on the economic contributions by cooperative organizations – not necessarily banks alone –, hard data are difficult to be found. Moreover, cooperative banks primarily filled the gaps that were left by the other banks, that in many European countries were only present in the countryside at the time. And although most observers agree that the arrival of credit cooperatives substantially improved access to finance against good conditions for farmers and craftsmen, one can of course object that commercial banks in a competitive environment could have done the same job. There also are few examples available of disappearing cooperative banking groups and the consequences of their absence on the financial system in which they operated. The only clear case at hand is the substantial decline in the power of mutual building societies in the UK during the 1990s when many of the largest societies converted to shareholder value status and became commercial banks. This has led to a decrease in competition and to a less stable financial system (Llewellyn, 2008, 2009).

The cooperative claim is not undisputed, however. In 2003, PA Consultants published a paper with the challenging title Mutually Assured Destruction (MAD), in which they stated that the presence of cooperative banks put a strong downward pressure on profit margins in the financial industry. The result, according to the authors, is underperformance of banks and in the end financial instability. At least on one point PA consultants appear to agree with the cooperative banks themselves : both claim that the presence of cooperative banks exerts a downward pressure on profit margins in the financial services industry. However, whereas the cooperative banks claim that this is a beneficial development for the clients, PA Consultants emphasize the negative effect for the efficiency of the financial sector and the stability of the financial system as a whole.

History shows that cooperative banks can be very crisis-proof. The case in favor of the positive contribution of cooperative banks is much broader that Rabobank alone. As illustrated by Groeneveld & De Vries (2009), the European cooperative banking sector on average did much better during this crisis , than the average commercial bank. The same conclusion, however, was also drawn by Ayadi *et al.* (2009) for the European savings banking sector, which adds weight to the argument that for the stability of the financial sector as a whole it is a good thing to have banks with different orientations and ownership structures.

Historical research by Mooij (2009) on the Dutch financial crisis of the 1930s arrived at the same conclusion. In the first half of that decade, which was a time of severe economic problems, a total of more than 100 commercial banks disappeared. Of this total, 17 went bankrupt, 58 had to liquidate their business and the rest were taken over by, or merged with, other banks. In contrast, only 2 cooperative banks ran into problems and were forced to merge with stronger banks from the same group[8]. No client ever noticed there were any problems.

What are the reasons of the good cooperative performance in times of crisis? During the crisis of the 1930s, cooperative banks were still relatively undercapitalized when compared to commercial banks. Their capital ratios were relatively low and their commercial margins were small. Compared with their commercial counterparts they looked relatively vulnerable. Therefore, their performance during that crisis came as something of a surprise. Looking back, one can conclude that the cooperatives' claim that the quality of their loans was better than that of other banks was correct. In the core, the business of local credit cooperatives comes down to enabling entrepreneurs to borrow the savings of their neighbor(s).

[8] Before 1972, two cooperative banking groups were active, viz. the Raiffeisen Bank and the Boerenleenbank (Farmers Lending bank). In addition, there was a small number of credit cooperatives active that were not part of one of these groups. There are no data available about their fate.

This translated in a conservative lending policy, some reluctance by borrowers to go deeply into debt, and very high standards in debt servicing. Peer pressure was high and effective, as people hate to fail their neighbors. On the other hand, savers had confidence that their money was safe, knowing to whom it was lent. It is the discipline of a well-organized microfinance institution that helped the Dutch cooperative banking sector through the first serious financial crisis it had to face.

In today's crisis the situation is rather different. On the one hand group peer pressures, although still present, have lost in strength, as most cooperative banks have evolved in their operations akin to commercial banks. On the other hand, cooperative banks still have their conservative attitude towards banking. This translates into a strong emphasis in their activities towards traditional retail banking. Moreover, their balance sheets are relatively strong when compared to commercial banks. This is illustrated in the next table in which the average performance of the most important European cooperative banks is compared with a series of large peers. It shows that cooperative banks on average have relatively high capital ratios. As a consequence of the lower leverage, their financial performance is slightly worse than that of commercial banks, although on the average cooperative profits appear more stable.

Table 3: Financial performance of cooperative and commercial banks compared, 2002-2007

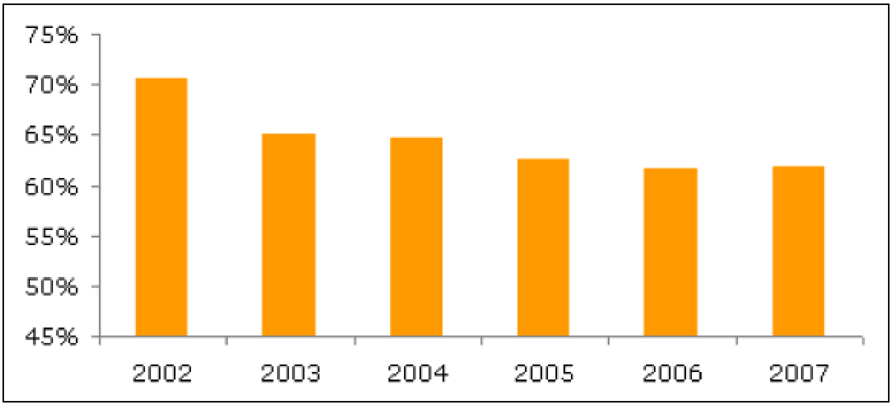
	Cooperative Banks	Commercial Banks
	(N=9/O=53)	*(N=36/O=159)*
ROE	9.3 (4.5)	13.4 (8.5)
ROA	0.4 (0.2)	0.5 (0.3)
Core Capital	4.7 (1.4)	3.6 (1.4)
Tier-1 Capital	9.2 (1.4)	8.4 (1.4)
Cost/income ratio	62 (6.7)	61 (13.3)

Source: Groeneveld and De Vries (2009)

Note: N= the number of banks, O= the total number of observations. The sample consists of large banks (balance sheet total exceeding € 50 billion)in seven countries, viz. Austria, Belgium, France, Germany, The Netherland, The United Kingdom and Switzerland. Note that two of those countries, viz Belgium and the UK, are the home of large commercial banks, but do not have a substantial cooperative banking sector . The columns in the table show averages, standard deviations are between brackets.

Another striking feature from this table is that it shows that in efficiency, as measured by the cost to income ratio, the differences between commercial and cooperative banks are very small. This is in contrast to the view that the absence of shareholder pressures tends to make non-listed banks less efficient than quoted companies. Moreover, efficiency ratios of cooperative banks are more stable than those of their competitors and have been structurally improving. As a result, at the end of the period in many European countries they actually operated more efficient than their commercial peers.

Figure 5: Cost/income ratio of co-operative banks (2002-2007)



Source: Rabobank (2009)

Note: The calculations cover Germany, France, Austria, the Netherlands and Switzerland.

A more comprehensive measure of financial stability is the so-called Z-score. This score is calculated as Z = (ROA + E/A)/ (σ(ROA)), in which ROA is return on assets, E = core capital, A = total assets and (σ (ROA) = standard deviation of ROA. This indicator can be interpreted as the "distance to bankruptcy": the higher the score, the more stable the bank.

Table 4 shows the results of a comparison between commercial and cooperative banks over the period 2002-2007 (both the Z-score and its components). It illustrates that, as a group, cooperative banks are more stable than their commercial counterparts, in any individual year of the period. Moreover, whereas the average Z-score of commercial banks show a gradual but steady decline over the period, cooperative banks' scores are more or less stable.

Table 4: Z-scores and their components

	2002	2003	2004	2005	2006	2007
Commercial Banks						
Core Capital	3.82	3.76	3.49	3.38	3.37	3.05
ROA	0.32	0.45	0.58	0.57	0.57	0.46
sd ROA	0.18	0.17	0.17	0.17	0.17	0.16
Z-score	46	46	45	45	45	41
Cooperative Banks						
Core Capital	4.31	4.38	4.57	4.33	3.95	4.01
ROA	0.29	0.31	0.41	0.46	0.47	0.40
sd ROA	0.10	0.10	0.10	0.10	0.10	0.10
Z-score	55	56	49	57	54	54

Source: Groeneveld and De Vries (2009)

Groeneveld and De Vries also investigated whether the results of table 4 also holds when broken down to national levels. This is shown in table 5. Note that this comparison is limited to only five countries, as the United Kingdom and Belgium do not have a significant cooperative banking sector left.

Table 5: international comparison of Z-scores

Country	Commercial Banks	Cooperative Banks	National average
Austria	15	82	48
Germany	25	80	33
France	115	41	62
The Netherlands	40	108	57
Switzerland	13	97	34

Source: Groeneveld and De Vries (2009)

In four of the five countries it appears that the cooperative banks score significantly higher with their Z-scores than commercial banks. France is the exception to this rule. The relatively low score of the French cooperatives can possibly be explained by the takeover of commercial bank Credit Lyonnais by cooperative giant Credit Agricole. Moreover, it is possible that Credit Agricole, one of the few cooperative banks to be listed on the stock exchange, has more characteristics of a commercial bank than its cooperative peers. However, Groeneveld and De Vries offer no explanation for the extremely high Z-score of the French commercial banks, both in comparison to the French cooperatives and compared to their foreign competitors.

3.4. COOPERATIVE BANKS' PERFORMANCE IN THE CURRENT CRISIS[9]

During the recent crisis, we have observed the failure of a large number of financial institutions. In general the financial institutions that have failed were commercial banks and public savings banking groups' central banks (Landesbanken in Germany) or former cooperative groups that choose to demutualise, such as Northern Rock and Bradford & Bingley in the UK. On the contrary, apart from UK's minor Dunfermline Building Society, no European co-operative bank has failed during this crisis.

Co-operative banks were certainly not immune for the current crisis. Like many commercial banks, many of the large co-operative banks have suffered substantial losses on risky investments. However, they do seem to have been hit relatively

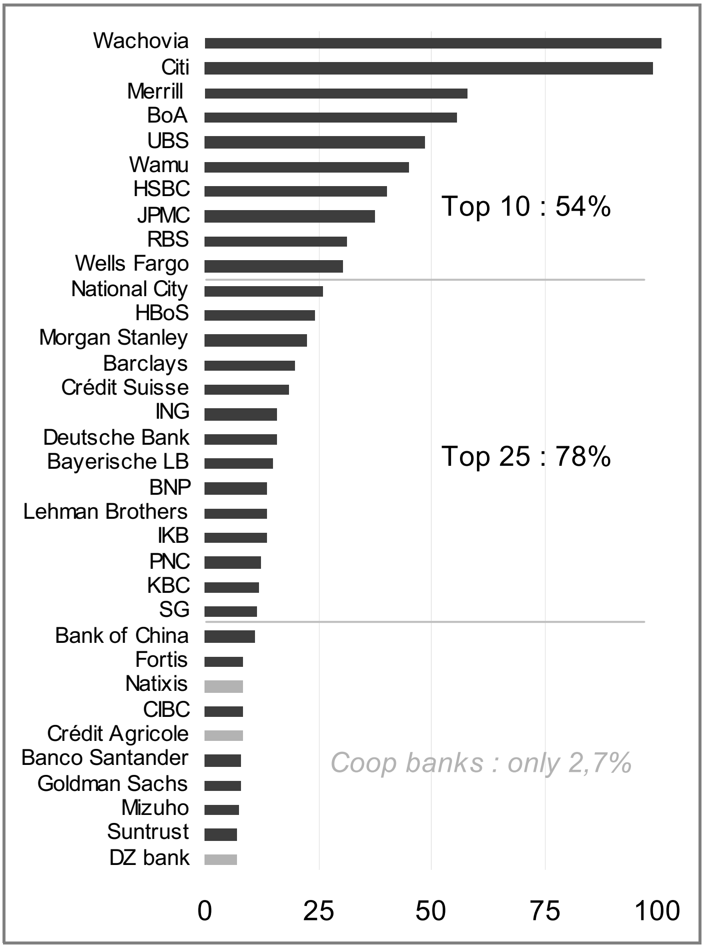
[9] This paragraph is based on EACB (2010).

less severely by the direct effects of the crisis than private and investment banks. Their losses and write-downs appear to be relatively moderate and mainly concentrated in their international activities. This illustrates that in their international business cooperative banks operate more or less identically to commercial banks. Besides, no co-operative bank has fallen under nationalisation programmes nor has been declared bankrupt. As discussed earlier, co-operative banks are predominantly domestically and retail orientated. As such, they have on average better knowledge about the risks in their business than do other players. This does not mean, however, that they are immune: as part of the system they are also affected by the economic downturn because many of their retail and wholesale clients are hit by the recession. As illustrated above by the case of Rabobank, for cooperative banks the impact of the recession may be larger than the losses of the financial crisis as such. This is not surprising as with very strong ties in local economies, co-operative banks are affected by any turbulence at local level.

However at least four characteristics set co-operative banks apart from other banks:
– they are generally well capitalised (see above).
– they apply a distinctive business model in banking that puts the members and customers at its heart, with a long-term perspective through good and bad times;
– they have built-in anti-cyclical behaviour and internal deposit guarantee schemes (such as Rabobank's far more extensive cross guarantee scheme).
– they have tight bottom up control mechanisms.

When looking more closely at the direct costs of the crisis, similar conclusions can be drawn:
– more than 95% of write downs registered worldwide were due to commercial banks and some public banks; the cost in terms of loan loss provisions seems more equally distributed;
– recapitalization (in particular state aids) was also massively directed towards commercial banks and some public banks;
– co-operative banks share of the direct costs of the crisis is much smaller than their weight in the economy, with about 20% in terms of deposits market share.

Figure 6: Global cost of the crisis to date ($ Bn)



Source: Bloomberg

Note: losses taken via the profit and loss account

There are a number of explanations for the lower fragility of cooperative banks. The corporate governance structure plays an important role. Member ownership entails a conservative banking approach with a longer term perspective and a focus on retail banking. This banking area is characterised by relatively lower risks, lower volatility and more stable returns. Although cooperative banks have naturally expanded the scope of their activities in recent years by moving into cross-border markets and rolling out new services, their activities are relatively strongly concentrated in their domestic markets. As far as cooperative banks suffered losses during the financial crisis these were overwhelmingly concentrated in their international business, either in investment banking operations or in foreign banking networks. The further they move away from their domestic market, the more vulnerable cooperatives become.

3.5. CONCLUSION

This contribution is written at the end of 2009. As we write, it becomes more and more clear that the world economy is slowly recovering. Stock exchanges have recovered large parts of their post-Lehman losses and gradually the financial world is turning to business as usual.

Or is it really? Although the investment bankers of Goldman Sachs, already more profitable as ever before, appear to forget that they also needed government support in 2008, many people in the rest of the world have better memories. The world's financial system has escaped the most important and dangerous financial crisis for centuries, and the economic damage is being felt day by day by people who have lost their jobs or see their future tax bill increase. As a result, there are many voices that the financial system should be drastically reformed to prevent crises such as these to reoccur. However, some instability and crisis-proneness is inherent in the capitalist system, which is a logical result of its underlying dynamism. Moreover, given the long term performance of the capitalist system when it comes to creating wealth, it is clear that although the financial system needs some reform, it does not make sense to go back to the world of huge state interventionism. The most stable economy in the world, after all, is North Korea, and no sensible human being would like to live there.

This having said, it is clear that some aspects of finance will change. The underlying trends and market forces will remain the same as before, however (Llewellyn, 1999). Changes in banking may be expected in the field of supervision. Supervision will be broadened, for example by including the shadow banking system (special investment vehicles), and also improved. In Europe, there will be more supervision on an Europe-wide basis, and cooperation between global supervisors will be intensified. So called "too big to fail" institutions will be scaled down or reorganized in such a way that they can easily be broken up without substantial collateral damage, as they turned out to be "too big to save" as well. Some large banks almost brought down the governments that came to their rescue. One could even say that some of them were more or less saved by the euro. Otherwise, countries like Ireland and The Netherlands, that had to conduct huge rescue operations, would have run into much more serious trouble on maybe even an Icelandic scale. Payment structures in the financial industry will be reformed to remove perverse incentives. Deposit guarantee schemes will be harmonized and reformed (Groeneveld, 2009). And the role of short-term shareholder activism will certainly be discussed, as shareholders played an important role in the developments that drove the financial system to the brink of collapse.

Against this background, one would expect a strong increase in interest in financial institutions that are organized in a different way. In this crisis, both cooperative and savings banks appeared to be more stable than shareholder value driven commercial banks. It is surprising that, for example, in the position paper of the Dutch government on the future of banking no reference was made to the potentially positive role of savings and cooperative banks for the stability of the financial system. This reflects that policy makers completely fail to understand that banks like Rabobank are based on a fundamentally different business model. This can be blamed on the fact that the cooperative business model, that until the 1970s was widely discussed in the economic text books, has disappeared from the academic literature (Kalmi, 2007). Generations of students have been educated with profit maximization and shareholder value, although at least in Europe the largest (and as it appeared the most stable) part of retail banking is organized on a different paradigm. Only recently the value of cooperative banking and its underlying multiple bottom line approach has made a modest come back' in the literature (Fonteyne (2007), Mooij and Boonstra (2009), Llewellyn (2009)).

This is not to say that the cooperative banking model is superior to its commercial rival. The aggressive drive from commercial banks in their aim at maximum profits and their financial innovations have driven competition and created substantial wealth. It is the added value of having, to quote Llewellyn (2009), "biodiversity in banking", that makes the system both innovative and stable. However, once they have disappeared form the system, it is very difficult if not impossible to reintroduce cooperative banks. It may be possible to establish new savings banks, but for cooperative banks this may be a bridge too far. The governance model may be copied, just as their decentralized structure and conservative behavior. But who is going to capitalize them? Is, for example, the British government prepared to abstain from its claim on all the tax money it has put into Northern Rock in order to recapitalize this banks? Would the taxpayer understand and accept that the government gives away billions of Sterling to a failed formerly mutual bank, so that it again can "own itself"? Just because of the importance of the biodiversity of the financial system? I really doubt it.

But, as the case of Rabobank illustrates, above all it is company culture that matters. And cultures can be mimicked, but not be copied, They are not created, they grow over the decades.

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4. Monitoring banking sector risks: an applied approach[1]

Veronica Vallés & Christian Weistroffer

Abstract

Despite abundant empirical evidence on the merits and limits of early-warning systems for banking crises the day-to-day use of such systems seems to be limited. Reluctance to use such systems may partly be explained by the difficulties to operationalise the proposed models, which are often demanding in terms of data requirements and/ or methodologies.

We try to overcome these difficulties and show how an early-warning system can be implemented in practice. Drawing on existing empirical work, we develop a model that provides timely and readily digestible information on macroeconomic developments, *e.g.* booming credit volumes, excessively rising asset prices or exchange rates, which in the past typically preceded banking crises. Our model is tailored to meet the professional needs of an internationally operating private sector financial institution and can be applied across a wide range of industrial countries and emerging markets.

Keywords: banking crisis, early-warning system, credit risk management

JEL Classification: E44, F37, G21

4.1. Introduction

Large scale banking sector problems are a persistent threat to both advanced and developing financial systems. Previous efforts to prevent systemic banking sector problems at national and international levels have had limited success. Evidence from Bordo *et al.* (2001) suggests that with the liberalisation and deregulation of markets the crisis problem has not grown less severe – neither in terms of economic cost or frequency of crises. The latest credit crises in the US and Europe are another case in point.

Consequently, national supervisors, central banks and international institutions such as the BIS, IMF or World Bank all strive to prevent crises or at least to

[1] This paper draws on a project conducted by DB Research, the think tank of Deutsche Bank AG. However, the paper presents the authors' personal opinions and does not necessarily reflect the views of Deutsche Bank AG or its staff. We are especially indebted to Bernhard Speyer, Maria Laura Lanzeni and Franz Stevens for inspiring discussions and enduring support. Also, we would like to thank Jennifer Asuncion who contributed extensively to the development of the model in this paper. We thank Dieter Held and Thomas Damer who provided excellent technical support as well as Christian Link and Lilli Bialluch for outstanding research assistance. We are particularly grateful to Michael Frenkel and Stefan Bergheim for valuable comments. Any errors or omissions are, of course, our own.

identify banking sector risks before they materialise. Internationally operating private sector financial institutions likewise have an innate interest to monitor banking sector risks, as they are exposed to credit and market risk across a broad range of countries. For such institutions, it is worthwhile to consider the similarities and reoccurring patterns across crises in different countries and times and using them for internal risk assessment. In fact, evidence from the past two decades and before suggests that banking crises were often linked to financial cycles and thus to some extent foreseeable. Typically, a simultaneous boom in lending and asset prices, followed by a sharp decline, could frequently be observed prior to a crisis. An appreciating exchange rate, accompanied by deteriorating trade competitiveness and subsequent capital flight, has played a major role in many emerging markets too. Most prominent examples include the 1997/98 Asian crisis, the Japanese experience since the early 1990s, and the experiences of the Nordic countries during the late 1980s and early 1990s. More recently, Russia (1998), Ecuador (1999) and Argentina (2001) but also the US (2007) experienced crises that followed similar patterns.

Combining the methodologies used by Kaminsky and Reinhart (1999), Kaminsky (1999) and Borio and Lowe (2002a, 2002b, 2004) we develop a new early-warning system that aims at detecting the above-described economic patterns in time. In doing so, we differentiate between emerging markets and industrial countries. For the emerging markets we develop a model based on three indicators, *i.e.* domestic credit to GDP, the real effective exchange rate and equity prices. For the industrial countries we combine measures of housing and equity prices, domestic credit to GDP and economic output. Indicators are calculated as percentage deviations from their longer-term trends. Our aim is to capture adverse macroeconomic and financial developments that have led to banking sector problems in the past. Ideally, our model can be deployed to serve as a timely snapshot on macroeconomic banking sector risks across a wide range of industrial countries and emerging markets. However, the analysis needs to be complemented by a microprudential perspective on banking sector risks, which should include a thorough assessment of the resilience of banks to common or idiosyncratic shocks as well as to contagion risk.

Complementing previous studies in this field, we focus on the requirements and obstacles that researchers face when designing, implementing and up-dating an early warning system in day-to-day business. We describe the methodology in some detail and present evidence for a broad sample of industrial countries and emerging market countries, respectively.

The remainder of the paper is organised as follows. Section 4.2. asks why a private sector financial institution should care about monitoring banking sector risks. Section 4.3. elaborates on the specific (technical) requirements when designing a model for day-to-day use. Section 4.4. provides information on the methodological background and describes our approach. Section 4.5. presents further details on the implementation of the model, each with the emerging markets and the industrial countries. Section 4.6. concludes.

4.2. THE PRIVATE SECTOR'S CASE FOR AN EARLY-WARNING SYSTEM

Systemic banking crises are associated with sizable costs for the tax payer and the overall economy. Fiscal and quasi-fiscal costs to rehabilitate banking systems after crisis periods are calculated at 12.1% of GDP on average in developed countries and 17.6% of GDP in emerging market countries (Hoggarth *et al.* 2002). Systemic banking crises have caused significant output losses, with estimates ranging from 10.2% (IMF, 1998) to 20.7% (Hoggarth *et al.*, 2002) in developed countries and from 12.1% (IMF, 1998) to 13.9% (Hoggarth *et al.*, 2002) in medium-and low-income countries[2].

The avoidance of major economic costs, stemming from problems in the banking sector, rank high on the agenda of regulators and policy makers and receive enhanced attention from the academic community[3]. But why does the private sector have an interest in monitoring systemic banking sector risk? Simply, because at the level of individual institutions systemic banking sector risk translates into business risk. In order to make sound strategic decisions regarding credit risk and portfolio management the outlook on future banking sector risk is of utmost relevance, both within the home market and in foreign markets.

To the extent that large international banks since the early 1990s have raised their foreign exposures[4] they face new challenges in monitoring country-specific credit risk. Within the context of the implementation of Basel II, large international banks have developed sophisticated internal sovereign risk rating systems. Given the close link between systemic banking crises and sovereign risk these rating systems encompass the assessment of national banking sectors as an integral part. However, when it comes to the assessment of rare but extreme events, such as banking crises, the private sector is often suspected of being short-sighted in its judgement. There is a large body of literature that tries to rationalise fluctuations in credit policies by pointing towards disaster myopia, herd behaviour, agency

2 The IMF (1998) measures output losses as the difference between the trend and the actual growth rate during crisis periods, where the trend growth is calculated over a short three-year period before the crisis. HOGGARTH *et al.* (2002) calculate output losses as the cumulative difference between the actual output level and its trend over a ten-year period before the crisis.

3 For a survey of early-warning systems for banking crises see BELL and PAIN (2000) as well as DEMIRGÜC-KUNT and DETRAGIACHE (2005). Other reviews can be found in ILLING and LIU (2003), EDISON (2004), KING, NUXOLL and YEAGER (2004).

4 *E.g.* SCHILDBACH (2008) highlights the increasing participation of European banks abroad.

problems and limited institutional memory[5]. From a macro perspective these problems account for the so-called procyclicality of the financial system – that is the provisioning of excess credit during economic boom phases followed by a sharp contraction of credit during bust periods[6].

The formulation and implementation of strategies to address these problems poses a great challenge. First steps in that direction are the introduction of through-the-cycle rating systems and the proposal of counter-cyclical capital requirements rules. The use of early-warning systems for extreme but rare events, which incorporate a longer-term perspective, can be another building block. Such systems can help institutionalise the memory of an organisation with respect to past crisis experience. They also offer a systematic approach for identifying possible turning points of the financial cycle at an early stage. While private sector institutions certainly cannot prevent the regular emergence of financial cycles, at least not by their isolated efforts, they can try to monitor cyclical macroeconomic movements and be prepared for the emergence of possible banking sector problems.

To this end, the model presented in this paper tries to anticipate adverse macroeconomic developments that eventually evolve into banking sector distress or outright crisis. As part of a more comprehensive risk assessment programme it needs to be a complemented by the analysis of other factors of systemic relevance as well as the assessment of individual institutions (*e.g.* the institutional environment, interbank exposures and international links).

4.3. USER REQUIREMENTS

When implementing an early warning system for day-to-day use, the requirements of at least two target groups need to be taken into account. First, results must be easily accessible and presented in a format that is straight-forward to interpret by the end-user. Second, there should be easy-to-handle implementation and updating procedures, which suit the requirements of the model developer.

For *the end-user*, the model should serve as a timely snapshot on potential banking sector risks. The user should be able to analyse the most recent information on the macroeconomic variables and to compare them with evidence from past crises. This should include the possibility of monitoring indicators individually but also as a combined measure. Simple charts to contrast indicators with their respective thresholds would be helpful to identify the main drivers of banking sector vulnerabilities. In addition, the user should be allowed to monitor the original time series that are used to calculate the signals, as this would provide a

5 See GUTTENTAG and HERRING (1984), HERRING (1999), JIMÉNEZ and SAURINA (2005).
6 See BORIO, FURFINE and LOWE (2001).

useful cross-check of and more intuitive access to the underlying methodology. Ideally, dynamic website implementation should allow straight-forward interpretation of the model's results (see appendix figures A-1 and A-2).

As to the specific needs of the *developer*, the model should be supportive to the data management process, *i.e.* the frequent updating of input variables and the recalibration of thresholds on a regular basis. The model should be implemented in a dynamic framework that allows the developer to test alternative specifications. The developer should be able to compare results for different indicators, forecast windows and alternative methodologies to build up individual and composite indicators. Once the model is implemented, input time series to calculate the indicators and signals should be automatically updated.

Without loss of generality, only a small number of input variables should be considered to keep the model as lean as possible. Also, the scope of the system in terms of country coverage, data frequency and sample period should account for possible data limitations. Consistent treatment of data errors and outliers should be warranted. Finally, reproducible and robust calculation procedures need to be at the core of the system in order to meet internal and external documentation requirements. Documentation of the model should specify the main objectives, definitions, assumptions and calculations. A clear description of the implementation processes and the rationale behind it would help ensure the system's continuity.

4.4. METHODOLOGICAL BACKGROUND AND MODEL DESIGN

In this and the following section, we develop an early-warning system that is designed to meet the requirements postulated above and show how it can be implemented in practice. We analyse two distinct datasets: One for the *industrial countries* and one for the *emerging markets*. Separate analysis of industrial countries and emerging markets allows us to consider different regimes as regards the selection of indicators, data frequency, forecast horizon and sample periods. Despite both groups sharing common macroeconomic threats to banking sector stability, *i.e.* excessive lending, booming equity or property prices, there is good reason to analyse the two groups separately. First, data availability is a major issue, as reliable time series of property prices for the emerging markets are hardly available. Likewise, for some emerging markets equity price data has become available only after the 1990s since national stock markets were not developed before that time. Second, to the extent that the origins of banking crises vary between the two sub-samples the separate consideration of emerging markets and industrial countries allows us to tailor the set of indicators to the specific requirements of each group.

While the different model specifications and results for the two sub-samples will be presented in section 5, this section focuses on the common methodological framework used in both sub-samples.

4.4.1. The signalling approach

Our model is based on the so-called signalling approach, which builds on a simple idea: A single binary indicator is related to a binary crisis variable. In order to trigger a signal the underlying indicator, *e.g.* domestic credit to GPD, must exceed a predefined threshold. If a signal is preceding a crisis episode it is considered a good signal, otherwise it is considered a false alarm. An indicator is said to have good predictive power if it calls most of the crises while not producing too many false alarms. Within this framework, individual indicators can be monitored on a stand-alone basis but can also be combined to form a composite index.

While the signalling approach was originally developed to predict turning points of business cycles[7], Kaminsky and Reinhart (1999) and Kaminsky (1999) were the first to adopt it to analyse early-warning signs of currency and banking crises. More recently, Borio and Lowe (2002a, 2002b, 2004) applied a similar approach to analyse the build-up of "financial imbalances" prior to banking crises. In contrast to these studies, Demirgüc-Kunt and Detragiache (1998, 1999) prefer using a multivariate logit model in order to analyse early-warning signs of banking crises. Although this approach is commonly used in the literature, no consensus has been reached on whether one approach dominates the other[8]. Both the signalling approach and the qualitative response models such as logit or probit offer unique advantages. On the one hand, multivariate qualitative response models should generally outperform the more parsimonious signalling approach, as they account for more than one indicator at a time and do not restrict the indicators' variability to the discrete states of zero and one. On the other hand, the non-parametric signalling approach holds the advantage of not relying on strict assumptions on the variables' distributional characteristics. Thereby, it avoids one possible source of estimation error compared to the more sophisticated regression models. In addition, the relatively simple calculation routine of the signalling approach can be implemented without comprehensive training in complex regression techniques. As mentioned above, each indicator can be easily followed and interpreted on a stand-alone basis as well as within an index combining individual indicators. Finally, the concept of indicator thresholds allows the model developer to explicitly weigh type-I errors (missed crises) against type-II

7 See STOCK and WATSON (1989), DIEBOLD and RUDEBUSCH (1989).

8 For a general discussion of different early-warning systems of banking crises see DEMIRGÜC-KUNT and DETRAGIACHE (2005). For a direct comparison of the multivariate logit and the signalling approach see DAVIS and KARIM (2008).

errors (false alarms). Thus, for our purpose of developing a straight-forward, easy-to-interpret early-warning system we consider the benefits of the signalling approach to outweigh those of the qualitative response models.

4.4.2. Defining past crisis dates

The careful identification and timing of in-sample crisis dates is one of the key challenges in designing an early-warning system. To this end, two approaches can be distinguished. One is based on the quantitative analyses of more or less high frequency data (*e.g.* Von Hagen and Ho, 2007) the other is based on characteristic crisis events[9]. Following the event-based approach, Demirgüc-Kunt and Detragiache (1998) identify a banking crisis if at least one of the following conditions holds: The ratio of non-performing assets to total assets in the banking system exceeded 10 percent; the cost of the rescue operation was at least two percent of GDP; banking sector problems resulted in a large-scale nationalisation of banks. Extensive bank runs took place or emergency measures such as deposit freezes, prolonged bank holidays, or generalized deposit guarantees were obliged by the government in response to the crisis. According to Caprio and Klingebiel (1996, 2003) a banking crisis is defined as a situation where much or all of the banking systems' capital is exhausted. Lindgren, Garcia and Saal (1996) distinguish between (i) "significant extensive unsoundness short of crisis", which are localised crises or non-systemic episodes, and (ii) systemic banking crises, characterized by bank runs, collapsing financial firms or massive government intervention.

Admittedly, such dating schemes are more arbitrary in assigning crisis dates than measures that relying solely on higher frequency data. However, to the extent that high frequency indicators used to define crisis dates are tested for their ability to predict the crisis, it will be difficult to identify the direction of causal effects. Moreover, since high frequency quantitative indicators will merely cover the symptoms of a crisis, a crisis will not be identified if it does not display the specific symptoms. Conversely, a crisis will be assigned to those periods that displayed the relevant symptoms regardless of whether there were systemic problems or not. Because of such difficulties associated with purely quantitative measures, the literature predominantly uses the event-based identification schemes described above. We do the same, combining and consolidating the different event-based approaches. Thus, we consider events that qualify either as banking sector distress or as systemic crisis according to the following criteria:

(i) ***Banking sector distress** is indicated by the failure of a number of institutions within a short interval, or the failure of a single institution of systemic relevance. Even in the absence of failures, an episode qualifies as banking sector*

[9] See JACOBS *et al.* (2005) for a review of different approaches to identify banking crises.

distress if policy and regulatory actions to overcome strains in the banking sector are taken. Such actions may be revealed by (de facto) forced takeovers or mergers, or by the extension of public assistance (financial or otherwise) to the banking sector;

(ii) an episode evolves into a ***systemic crisis*** *if most or all of the system's bank capital is depleted. Widespread bank runs, large-scale failure of banks, or massive public intervention to avoid systemic breakdown will be considered as indications of a systemic crisis.*

Note that our identification scheme also encompasses borderline events and smaller episodes of systemic relevance. This deviates from the more commonly followed approach in the literature to consider full-blown systemic crises only. However, such a broad crisis definition allows us to analyse the industrial countries separately, as those countries experienced only four instances of large-scale systemic crises during the past 25 years, *i.e.* the Nordic countries' crises and the Japanese crisis during the 1990s. Moreover, to the extent that banking sector problems in modern financial systems do not emerge as full-blown systemic crises – but rather display the symptoms that qualify for banking sector distress as described above – they too will be captured by our crisis definition.

For the dating of systemic crises, we rely mainly on the studies by Caprio and Klingebiel (2003) as well as Lindgren, Garcia and Saal (1996) who provide comprehensive and original research on historical crises dates. Further papers by Laeven and Valencia (2008), the Bank for International Settlement (2004) as well as our own estimates complement these sources.

4.4.3. Selecting indicators

In selecting early-warning indicators we closely follow Borio and Lowe (2002a, 2002b, 2004). The authors calculate indicator deviations (gaps) from their country-specific longer-term trend, *i.e.* credit gap, equity price gap, output gap and exchange rate gap. They use a relatively long forecast horizon of one up to five years prior to the crisis, trying to capture the "build-up of financial imbalances" in the run-up to a crisis. Their results reflect recent international experience, which highlights the role of financial cycles as a frequent cause for banking sector problems. Typically, a simultaneous boom in asset prices and lending followed by a sharp decline could be observed prior to a crisis. Historical evidence seems to confirm the close link between property price cycles and banking sector problems, while the link with equity prices seems to be not as close[10]. In many cases, financial liberalisation or (de facto) deregulation through financial innovation

10 See BIS (2001), BORIO and MCGUIRE (2004).

have promoted the development of excessive lending which in turn fuelled rising asset prices[11].

Theory suggests that rising prices for equity or property during boom markets may have a twofold effect on lending: On the one hand, rising asset prices tend to stimulate economic activity, increasing the need for private sector financing. On the other hand, higher prices raise the value of collateral, thereby reducing the cost of borrowing. As a result, lending will be stimulated, which in turn fuels a further rise in asset prices. Moreover, banks tend to underestimate credit risks when prices are rising and economic conditions are rosy. In light of fierce competition, credit risk premia are squeezed and more risky projects receive financing. When economic conditions are deteriorating, self-enforcing interaction between lending and asset prices may be even more pronounced. As defaulting borrowers are forced to sell their assets, prices decline. Collateral value diminishes, credit costs increase, and credit supply is constrained. If credit is no longer available to finance the purchase of assets, prices will decline further. Eventually, falling asset prices, reduced collateral value, and defaulting borrowers will reinforce each other, forcing banks to realise losses[12].

An appreciating real effective exchange rate accompanied by deteriorating trade competitiveness and capital flight may further contribute to crisis developments, especially in the emerging markets. During the Asian financial crisis of 1997/98, for instance, banking sector vulnerabilities arose from short-term foreign borrowing and portfolio investment, which were used to finance long-term projects (maturity mismatch). Formal or informal regimes of pegged exchange rates further increased vulnerabilities by creating incentives to borrow in foreign currency, while lending or investing in local currency (currency mismatch). During the boom phase prior to crisis, lenders tended to underestimate credit risks, while borrowers took the risk associated with foreign currency exposures too lightly. In the run-up to the crisis, speculative inflows contributed to the overvaluation of national currencies in real terms. As a consequence, trade competitiveness declined, weighing on exports and eventually leading to an economic slowdown. As soon as capital flows started to reverse and asset prices fell, maturity and currency mismatches on bank and corporate balance sheets led to a vicious circle: Collateral value declined and borrowers were no longer able to repay their debt. At the same time, banks experienced liquidity problems because they found it difficult to refinance themselves short-term or in foreign currency. Financial sector problems in turn undermined confidence in the stability of the currency, fuelling further capital flight and eventually leading to the abandoning of the currency peg (twin crises)[13].

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11 REINHART and ROGOFF (2008).

12 See KINDLEBERGER (1996), KIYOTAKI and MOORE (1997), BIS (2001), BORIO and LOWE (2002a).

13 See KAMINSKY and REINHART (1999), GLICK and HUTCHISON (2001), EICHENGREEN and HAUSMANN (1999), RADELET and SACHS (1998), HARDY and PAZARBASIOGLU (1998).

Exploiting the economic patterns described above, Borio and Lowe (2004) find for the industrial countries that a composite indicator combining the credit and the equity price gap performs best in predicting in-sample banking crises. Thus, for the industrial countries, we use the domestic credit gap, equity price gap and output gap[14]. Furthermore, we are able to extend the analysis by including also the property price gap, using a measure of nominal residential property price data[15]. Since the property price indicator is available on a quarterly basis only, we base our model for the industrial countries on quarterly observations. The real effective exchange rate gap does not contain significant information on the likelihood of banking crises in the industrial countries, therefore it is not included.

For the emerging markets, we find that the best composite indicator combines the credit gap with the equity price and exchange rate gap. Thus, we use those indicators in our model. Due to data constraints for property prices in the emerging markets, using equity prices as a proxy for overall asset prices is the best we can do.

4.4.4. Computing indicator gaps

Following Borio and Lowe (2002a, 2002b, 2004) we identify financial imbalances by looking at indicator percentage deviations from a longer-term recursive Hodrick-Prescott (HP) trend (gaps)[16]. We use a recursively calculated HP filter, with the recursive calculation ensuring that only information that was available at the time of judgement is taken into account. More than just a technical refinement, a recursively calculated HP filter yields different results from the standard HP filter which uses information from the entire time series: Turning points are much earlier for the standard HP filter, since for each considered point in time (except the last observation) future information is taken into account. Using a standard HP filter would thus lead to a misjudgement of the actual early warning capabilities of the indicator in question.

The calibration of our model is based on revised data instead of real-time data. However, in the day-to-day use, only real-time data will be available for the most recent observations. This could lead to a noisier signal when trying to forecast banking sector risks out of sample. The updating procedure of our model, however, assures that estimations are automatically updated as soon as the provider publishes the revised data[17]. In addition, to overcome possible problems related

14 For an overview of the indicator sources, see appendix tables A-3 and A-4.
15 The dataset is constructed according to ARTHUR (2006).
16 Variations in the growth rate of the trend component are penalised by a factor of 400,000. Although we use monthly observations for the emerging markets and quarterly observations for the industrial countries, we use the same factor for the two distinct samples, with one exception: for the emerging markets we apply a factor of 1,500,000 to the real effective exchange rate (REER).
17 An alternative way to address this problem would be to use real-time data for in-sample calculations.

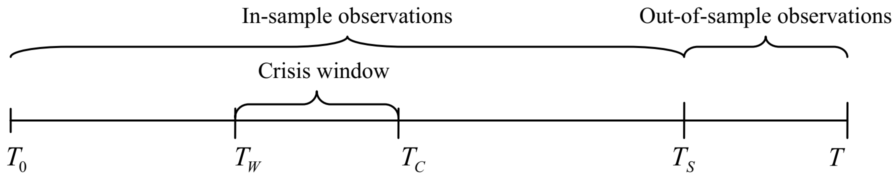
with the use of real-time data the composite indicator is calculated as a moving average of signals from the last three quarters for industrial countries, and nine months for emerging markets. Also, we use a long forecast horizon (from three to five years), which further dissipates the possible noise stemming from the revision of individual real-time observations.

4.4.5. Deriving signals

The following section and the Appendix describe the methodological heart of our approach. We believe this section encompasses significant value-added by describing the methodology in technical terms. To our knowledge this has not been accomplished by the existing literature – at least not in detail. The description will be helpful to the reader interested in developing a similar model and all others who wish to follow the technical details. Although more technical than the rest of the paper, we tried to reduce the complexity of formulas and highlighted the intuition behind them.

The database used in the model has three dimensions: (i) indicator, (ii) country, and (iii) time. For each crisis episode we define a corresponding "crisis window", which precedes the actual crisis starting date. A signal falling into the "crisis window" will be counted as a "good" signal and as "noise" otherwise. Outside the "crisis window" a signal will be counted as "noise". In section 5 we will show that a suitable window for industrial countries is four years and three years for emerging markets.

Before going into the formulas we provide some notation: There are I total number of indicators $(i = 1, \ldots I)$, J total number of countries $(j = 1, \ldots J)$) and T number of observations $(t = T_0 \ldots T)$. In addition, there are C number of crisis or distress episodes $(c = 1, \ldots C)$. The following time line defines the different time periods used for calculation in our model, ranging from the beginning of the sample to the most recent available data.



Only time periods between T_0 and T_S will be considered for in-sample calculations. Observations from T_S up to T are used for the out-of-sample judgment[18].

[18] In-sample observations are used to calculate indicator's thresholds. These thresholds will also be employed to compute signals for the outs-of-sample period. However, observations from the out-of-sample period will have no influence in the threshold optimisation process.

T_W is the starting period of the time window set before a crisis date and T_C is the crisis window's end-period. There will be as many crisis windows (T_W to T_C) as systemic crises and distress episodes included in the sample.

A warning signal will be issued if an indicator (*e.g.* domestic credit to GDP) lies above a critical threshold. More formally, the (continuous) indicator value X_{ijt} is transformed into a (binary) signal at the (time discrete) period t when it crosses the threshold x_{ij}, which is a country specific threshold to the indicator i:

$$S_{ijt} = \begin{cases} 1 & \text{if } X_{ijt} \geq x_{ij} \\ 0 & \text{if } X_{ijt} < x_{ij} \end{cases} \tag{1}$$

The Appendix includes a detailed description of the methodology employed to calculate country-specific and aggregate percentile tresholds. The following paragraphs lay out how various indicator statistics, *e.g.* type-I error, type-II error and noise-to-signal-ratio, are derived. These statistics are used to select optimal thresholds. In contrast to Borio and Lowe, (2002a, 2002b, 2004) who employ thresholds that are invariant across countries, our approach takes country-specific differences into account. In this regard, we follow Kaminsky and Reinhart (1999) and use percentile rankings of time series values to derive critical thresholds (see Appendix: Percentile threshold). This ensures that the critical percentile cut-off is common across all countries, while accounting for country-specific absolute threshold levels.

4.4.6. Measuring indicator performance

Once raw time series have been transformed into signals finding the "optimal" threshold becomes an iterative process. For each threshold level p_i four possible combinations need to be considered: A signal preceding a crisis episode is counted as a good signal (*A*), while a signal that is not followed by crisis is counted as noise (*B*). If no signal is issued, a crisis may nonetheless evolve (*C*), or it may not (*D*). The higher the amount of good signals and the lower the number of noisy signals, the better the indicator's performance. In order to find the optimal threshold level, type-I and type-II errors[19] as well as the ratio of noise to good signals is evaluated at different percentile levels. If the null hypothesis is defined as H_0: "Given a signal a crisis is evolving", we can derive the following relations[20]:

19 Type-I error is the error committed when a "correct" null hypothesis is rejected. Type-II error is committed if a "false" null hypothesis is not rejected.

20 Note that the conventional approach has been to define tranquil times as the null hypothesis. Yet, in order to make "bad" signals (B) compatible with the concept of noise the null hypothesis is defined as crisis times.

	Crisis	*No crisis*
Signal	***A***	*B*
No signal	C	***D***

$$A_i = \sum_{c=1}^{C}\sum_{j=1}^{J}\sum_{t=T_W}^{T_C} S_{jt},\ B_i = \sum_{j=1}^{J}\sum_{t=T_0}^{T_S} S_{jt} - A_i,$$
$$C_i = \sum_{c=1}^{C}\sum_{j=1}^{J}\sum_{t=T_W}^{T_C} (1-S_{jt}),\ D_i = \sum_{j=1}^{J}\sum_{t=T_0}^{T_S} (1-S_{jt}) - C_i \qquad (2)$$

$$\text{type-I error}_i = \frac{C_i}{A_i + C_i} \qquad (3)$$

Which is the probability of not signalling a realised crisis.

$$1 - (\text{type-I error})_i = \frac{A_i}{A_i + C_i} \qquad (4)$$

Which is the probability of correctly signalling a crisis.

$$\text{type-II error}_i = \frac{B_i}{B_i + D_i} \qquad (5)$$

Which is the probability of incorrectly signalling a crisis.

$$Nsr_i = \frac{\text{type-II error}_i}{1 - (\text{type-I error})_i} = \frac{B_i/(B_i + D_i)}{A_i/(A_i + C_i)} \qquad (6)$$

Which is the noise-to-signal ratio according to Kaminsky and Reinhart (1999).

Since the crisis window encompasses several periods, and thus potentially captures several signals, it is not clear from the 1 – (type-I error) statistics (4) how many crises are actually predicted. In other words, a 1 – (type-I error) statistic of 0.5 could mean that 50% of all crises are signalled by the model, but only if the indicator signals in every time period of the crisis window for half of the crises. It could also mean that 100% of all crises are signalled if the indicator signals in only half of the periods within the crisis window, but for all crises. To overcome this problem, we developed an additional indicator, which captures the actual number of correctly signalled crises. We call this measure "indicated crises", which is the share of crises correctly signalled in at least one time period within the crisis window over the total number of crises.

$$\text{Indicated crises}_{ij} = \sum_{c=1}^{C} \frac{S_{ijc}}{C}, \text{ where } S_{ijc} = \begin{cases} 1 & \sum_{t=T_W}^{T_C} S_{ijt} > 0 \\ 0 & \sum_{t=T_W}^{T_C} S_{ijt} = 0 \end{cases} \quad (7)$$

Although the statistic overstates the interpretation of a single signal, it is a useful measure to select percentile thresholds in combination with the other measures defined above. In addition to minimising the noise-to-signal ratio, we will therefore ensure that each individual indicator signals a reasonable percentage of past crises[21].

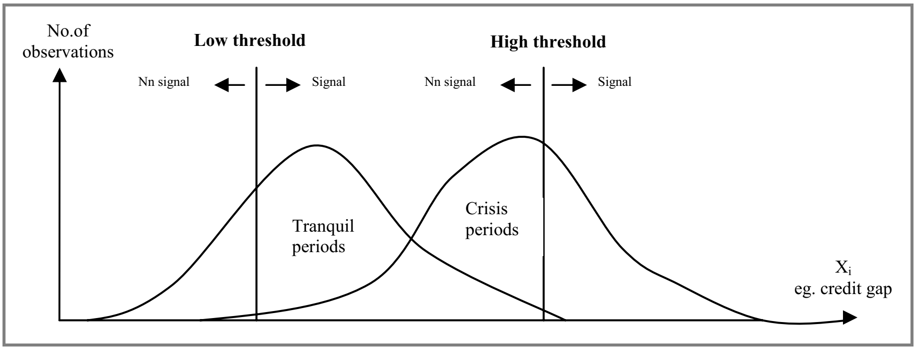
4.4.7. Balancing type-I and type-II errors

Kaminsky and Reinhart (1999) suggest optimising critical threshold levels along the noise-to-signal ratio. However, optimising thresholds solely on the basis of the noise-to-signal ratio would in some cases achieve low numbers of false alarms, but possibly at the expense of too few crises being detected. If the analyst views the risk of missing a crisis more important than falsely calling one, then more weight should be given to minimising type-I errors[22]. Thus, the optimisation rule should involve a careful weighing between the two objectives of predicting most crises and not producing too much noise. The following figure visualises the trade-off between these two objectives. While a low percentile threshold will generally produce more false alarms (high type-II error), a high threshold level is likely to miss all but the severest crises (high type-I error). The better the indicator, the larger is its power to distinguish between crisis and tranquil periods.

21 This is in line with BORIO and LOWE (2004), p. 10. Rather than minimising the noise-to-signal ratio, they ensure that a satisfactory number of crises are predicted.

22 For instance, DEMIRGÜC-KUNT and DETRAGIACHE (1999), pp. 12-13, propose a decision-maker loss function which allows to formally assign weights (costs) to type-I and type-II errors, respectively.

Figure 1: Low versus high thresholds[23]



Since we want to place a relatively large weight on minimising type-I error (avoid missing a crisis) we set a rule to choose thresholds that ensure at least 80% of in-sample crises are correctly signalled. We use our measure "indicated crises" as in equation (7) to capture the actual number of crises predicted correctly. If predicting 80% of all crises leads to a percentile threshold below 50%, the threshold is assigned to that percentile[24].

4.4.8. Constructing a composite index

The construction of a composite index rests on the idea that simultaneous signals coming from multiple indicators imply a higher possibility of impending banking sector distress. We thus combine individual indicators into a composite index.

Assessing different weighting schemes, Kaminsky (1999) finds that weighing individual indicators by their inverse noise-to-signal ratio is the most efficient way to combine individual indicators. This ensures that indicators with a relatively good track record and a low noise-to-signal ratio will be assigned relatively greater weights than indicators that in the past showed a less accurate prediction performance. We thus combine individual indicators in the manner described above. In addition to adding individual indicators, we filter out noisy signals, by averaging signals across three quarters for quarterly time series and nine months for monthly time series. Averaging over time also ensures that individual indicators which may signal in nearby periods, but not exactly at the same time will be captured simultaneously:

23 Observations of crisis periods on the left-hand side of the vertical threshold line represent crisis periods that were missed (type-I error). Observations of tranquil periods on the right-hand side of the threshold represent noisy signals (type-II error).

24 A percentile threshold below 50% will give a random character to signals instead of distinguishing between tranquil and crisis times.

$$\text{Quarterly series:} \quad \text{Composite}_{jt} = \frac{1}{3}\sum_{i=1}^{I}\frac{(S_{ijt-1}+S_{ijt-2}+S_{ijt})}{Nsr_i} * \frac{1}{\sum_{i=1}^{I}\frac{1}{Nsr_i}} * 100$$

$$\text{Monthly time series:} \quad \text{Composite}_{jt} = \frac{1}{9}\sum_{i=1}^{I}\frac{(S_{ijt-9}+S_{ijt-8}+\ldots+S_{ijt})}{Nsr_i} * \frac{1}{\sum_{i=1}^{I}\frac{1}{Nsr_i}} * 100 \quad (8)$$

4.5. IMPLEMENTATION OF THE MODEL

This section implements the model described above for the emerging markets and the industrial countries, respectively. For both the emerging markets and the industrial countries we consider crisis as well as non-crisis countries in order to avoid selection bias[25]. Including non-crises countries, however, comes at a cost: Since the concept of common percentile thresholds ensures that a certain fraction of signals will be generated for each country, each signal in non-crisis countries within the sample period, by definition, will be a false alarm. Thus, overall noise levels will be higher compared to a sample that includes crisis countries only.

4.5.1. Industrial countries

Our analysis of the industrial countries covers 21 OECD countries, namely Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Sweden, Spain, Switzerland, The United Kingdom and The United Sates.

4.5.1.1. The sample

Bordo *et al.* (2001) observe that banking crises were almost absent during the period of the Bretton-Woods arrangement. They count only one larger banking crisis between 1944 and 1973 but a total of 19 crises thereafter until 2001. According to their analysis, the more recent period of frequent crises is only rivalled by the inter-war years from 1919 to 1939[26]. However, data limitations prevent us from considering crisis episodes that evolved before the Bretton Woods era. Due to the unique environment in which banks were operating during the Bretton Woods system and the reduced risk of banking crisis during that time there is little benefit in extending the sample to include the period between 1944 and 1973. Therefore, we limit our sample to quarterly observations from the beginning of 1975 until the end of 2001. Observations of the composite index

25 Compare DEMIRGÜC-KUNT and DETRAGIACHE (1998), p. 90.
26 BORDO *et al.* (2001), p. 56.

from the beginning of 2002 until the end of 2007 (see appendix) will be out-of sample predictions.

During that period we identify a total of 18 episodes of banking sector problems. 16 out of 21 industrial countries experienced either banking sector distress or systemic banking crises. Only Spain (1978), Japan (1991) and the Nordic countries, Norway (1988), Finland (1991) and Sweden (1991) experienced full-blown systemic crises (see appendix). The US distress period of 2007 is not considered for in-sample testing. Likewise, the Spanish crisis of 1978 is excluded from our sample since a 5-year forecast horizon prior to the crisis is not available.

4.5.1.2. The crisis window

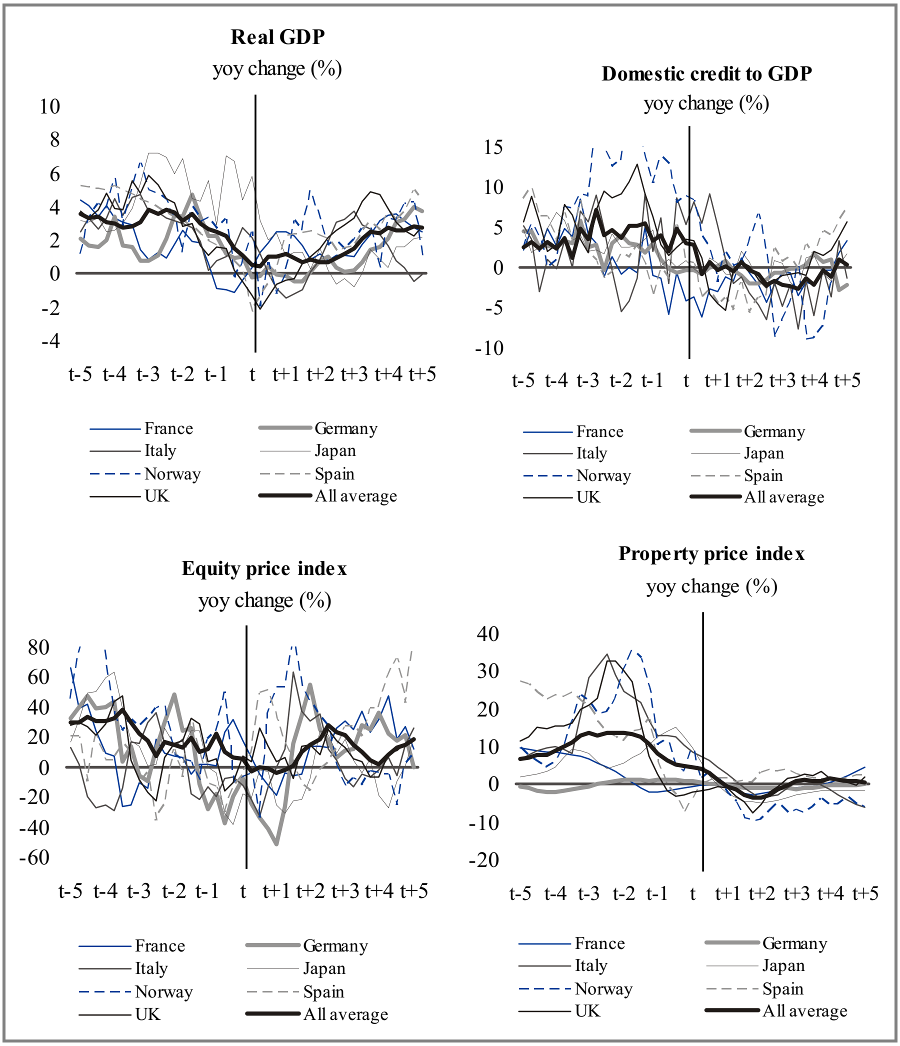
Crisis starting periods are arbitrarily assigned to the last quarter of the crisis year according to the identification scheme described above (see also the appendix for an overview of crises dates). Our crisis window – as introduced in section 4 – captures a leading horizon of 4 to 16 quarters before the actual crisis starting date. Comparing indicator performance for different horizons, we find that this horizon yields superior results in terms of the share of crises predicted and noise-to-signal ratio (see sensitivity analysis below). The individual indicator results as well as the results of the composite index in the appendix are based on this crisis window.

4.5.1.3. The indicators

The following figures display how indicators behave around crisis starting dates. For instance, property prices display a typical boom and bust cycle around crises starting dates: on average, yoy growth in property prices peaks three years prior to crisis. Property prices decline or remain depressed for at least five years following the onset of a crisis. Also for domestic credit and real GDP the boom and bust cycles around crisis starting dates are quite pronounced, whereas for equity prices the development is more ambiguous.

Indicator behaviour around crisis dates also allows us to narrow down possible options for setting the forecast horizon. Later in this section we compare different forecast horizons ranging from 2 years until 5 years before crisis starting dates. Note that for descriptive purposes the figures below show yoy percentage changes. For our analysis, however, indicators are computed as percentage deviation from their respective long-term trend and translated into signals based on common percentile threshold according to equations in the Appendix.

Figure 2: Indicator behaviour around crisis starting dates – industrial countries



4.5.1.4. The indicator thresholds

At this point we want to determine the "optimal" threshold levels for the indicators in question. However, optimality in this case depends on our somewhat subjective decision on how to balance type-I error (missing too many crises) against type-II error (producing too much noise) as discussed above. To be able to make an informed choice, a grid search is performed[27]. The results of this grid search

[27] By using the term "grid search" we refer to the calculation of the statistics used to assess indicator performance, *i.e.* type-I error, type-II error, nts ratio, indicated crises, for each indicator and each percentile threshold.

are summarised by the charts depicted in the appendix, Figure A-1. Each point on the x-axis represents a percentile threshold for which the type-I error, type-II error, share of indicated crises and noise-to-signal-ratio are calculated respectively.

For the output gap, we find a common percentile threshold of 60% to satisfy our selection rule as postulated in section 4.4.7.[28]. For the credit gap, equity price gap and property price gap the threshold is 65%, 50% and 80%, respectively. Comparing the performance of different indicators, the property price gap offers the lowest noise-to-signal ratio of 0.23 as most of the crises were preceded by booming property prices. The credit gap is the second best indicator with a noise-to-signal ratio of 0.33 and the output gap is the third best with a noise-to-signal ratio of 0.38. The equity price gap is the worst performing indicator, with a noise-to-signal ratio of 0.75. Compared to property prices, fewer crises were preceded by booming equity prices and more equity price boom and bust cycles did not lead to subsequent banking crises. The composite index displays a lower noise-to-signal ratio (0.11) than any of the individual indicators. Apparently, combining information from individual indicators reduces overall noise levels. The weights within the composite indicator reflect individual indicator performance, with the property prices gap constituting the most important individual indicator.

Table 1: Individual thresholds and weights within the composite indicator – industrial countries

Indicator	Percentile threshold	Type-I error	Type-II error	Nts ratio	Indicated crises	Weight within composite
Output gap	60%	0.25	0.29	0.38	81.3%	23%
Credit gap	65%	0.23	0.25	0.33	81.3%	27%
Equity price gap	50%	0.42	0.43	0.75	81.3%	12%
Property price gap	80%	0.38	0.14	0.23	80.0%	38%
Composite	73%	0.42	0.06	0.11	80.0%	100%

4.5.1.5. Sensitivity analysis: time horizon

Both the time horizon as well the threshold levels are important parameters to calibrate the model, which determine its overall performance. Thus, in order to assess the robustness of the chosen parameters we run different specifications of the model varying either the forecast horizon (crisis window) or the threshold level of individual indicators[29].

[28] This rule ensures that at least 80% of in-sample crises are signalled correctly. If that constraint yields a percentile threshold below 50%, the threshold is assigned to that percentile.

[29] Out-of-sample tests further confirmed the robustness of the model. However, given a limited number of crises and country observations, absolute threshold levels vary depending on the chosen in-sample definition.

We start by looking at different forecast horizons. The forecast horizon is defined as the time before the crisis date, where a signal is considered a "good" signal or a "false alarm" as described in section 4. Recall that a horizon of three years would mean an alert of banking crisis after the signal is triggered for the following three years. In order to find the optimal forecast horizon we test for a wide range of different horizons[30]. We consider 8, 12 and 16 quarters prior to crisis, as well as 16 quarters excluding the first 4 quarters before crisis, and 20 quarters excluding the first 8 quarters. In order to compare model performance across different specifications, we determine individual thresholds but also thresholds for the composite indicator as stated above: Percentile threshold must not exceed 50%, while the percentage of indicated crisis should exceed 80%.

Table 2: Indicator performance with varying time horizons – industrial countries

Time horizon	Percentile threshold	Type-I error	Type-II error	Nts ratio	Indicated crises	Weight within composite
8 quarters						
Output gap	50%	0.28	0.44	0.61	75%	21%
Domestic credit gap	65%	0.22	0.28	0.36	81%	36%
Equity price gap	50%	0.63	0.48	1.27	38%	10%
Property price gap	65%	0.23	0.29	0.38	80%	34%
Composite	50%	0.27	0.32	0.44	73%	100%
12 quarters						
Output gap	60%	0.34	0.31	0.48	81%	21%
Domestic credit gap	70%	0.30	0.22	0.31	81%	32%
Equity price gap	50%	0.50	0.46	0.91	75%	11%
Property price gap	75%	0.32	0.19	0.28	80%	36%
Composite	50%	0.32	0.21	0.30	73%	100%
16 quarters						
Output gap	60%	0.31	0.29	0.42	81%	21%
Domestic credit gap	75%	0.36	0.17	0.26	81%	33%
Equity price gap	50%	0.46	0.43	0.81	81%	11%
Property price gap	80%	0.41	0.14	0.24	80%	36%
Composite	63%	0.36	0.10	0.15	80%	100%
16 quarters (excluding 4 qtrs before crisis)						
Output gap	60%	0.25	0.29	0.38	81%	23%
Domestic credit gap	65%	0.23	0.25	0.33	81%	27%
Equity price gap	50%	0.42	0.43	0.75	81%	12%
Property price gap	80%	0.38	0.14	0.23	80%	38%
Composite	73%	0.42	0.06	0.11	80%	100%

30 BORIO and LOWE (2004) find that for the industrial countries a crisis window encompassing five years prior to crisis (excluding the 2 years before the crisis) yields superior results. By contrast, KAMINSKY and REINHART (1999) and KAMINSKY (1999) use a crisis window encompassing 12 months before and 12 months after the defined starting date of a crisis.

Time horizon	Percentile threshold	Type-I error	Type-II error	Nts ratio	Indicated crises	Weight within composite
20 quarters (excluding 8 qtrs before crisis)						
Output gap	65%	0.23	0.21	0.28	88%	28%
Domestic credit gap	65%	0.23	0.25	0.32	81%	24%
Equity price gap	50%	0.33	0.41	0.61	88%	13%
Property price gap	80%	0.35	0.15	0.23	80%	34%
Composite	55%	0.30	0.16	0.23	80%	100%

A horizon of 16 quarters (excluding the first 4 quarters before a crisis) yields the lowest noise-to-signal ratio, holding the level of indicated crises constant. The results confirm the importance of property prices as an important indicator for assessing the risk of banking sector problems. Except for the 8 quarters horizon, the property price gap has the largest weight in all the specifications, reflecting its superior performance relative to the other indicators. The domestic credit gap together with the property price gap constitutes 58%-60% of the composite index. The results confirm that the equity price gap displays the least favourable performance as measured by noise-to-signal ratios and percentages of indicated crises.

4.5.1.6. Sensitivity analysis: threshold level

Next, we assess two additional specifications: one with a 10% higher threshold of individual indicators; the other with a 10% lower threshold compared to the base case. This allows us to check the robustness of the composite indicator with regard to our threshold selection rule. Ideally, the composite index should display superior performance qualities compared to the two alternative cases. For the individual indicators, we expect the higher threshold (+10%) to produce fewer false alarms, while missing more crises. The lower threshold (-10%) is likely to predict most of the crisis but only at the expense of producing more noise than the base case.

In this exercise, we stick to the crisis window of 16 quarters (excluding 4 qtrs before crisis). Again, we keep to our rule that thresholds for the composite index are set at either 80% of indicated crises or the 50% percentile. Results are summarised in Table 3.

Table 3: Indicator performance with varying threshold levels – industrial countries

	Percentile threshold	Type-I error	Type-II error	Nts ratio	Indicated crises	Weight within composite
Low threshold (-10%)						
Output gap	50%	0.20	0.40	0.50	88%	22%
Domestic credit gap	55%	0.23	0.35	0.45	81%	25%
Equity price gap	40%	0.27	0.52	0.71	94%	16%
Property price gap	70%	0.22	0.23	0.30	80%	37%
Composite	75%	0.27	0.12	0.17	80%	100%
Base threshold (+/-0%)						
Output gap	60%	0.25	0.29	0.38	81%	23%
Domestic credit gap	65%	0.23	0.25	0.33	81%	27%
Equity price gap	50%	0.42	0.43	0.75	81%	12%
Property price gap	80%	0.38	0.14	0.23	80%	38%
Composite	73%	0.42	0.06	0.11	80%	100%
High threshold (+10%)						
Output gap	70%	0.45	0.19	0.35	75%	18%
Domestic credit gap	75%	0.36	0.17	0.27	75%	24%
Equity price gap	60%	0.55	0.34	0.75	56%	9%
Property price gap	90%	0.52	0.06	0.13	67%	49%
Composite	50%	0.45	0.07	0.13	60%	100%

This test confirms the robustness of our threshold selection rule, as the overall performance of the composite indicator (measured by the noise-to-signal ratio) is best for our base case. Comparing individual indicator performance, the low threshold yields a higher type-II error and a lower type-I error. The reverse is true for the high threshold. While these results do not come as a surprise, it is noteworthy that they are not necessarily mirrored by the composite index. Holding the percentage of crises predicted constant, the -10% threshold yields a noise-to-signal ratio of the composite equal to that of the "optimal" specification. This can be explained by the trade-off between type-I and type-II errors within the composite. Apparently, the more noisy signals will be compensated by a higher number of crises predicted, resulting in a relatively low noise-to-signal ratio at the chosen high threshold of the composite. Also, the differences in weighing and the accumulation across signals of different kinds play an important role for the performance of the composite indicator.

4.5.2. Emerging markets

Our analysis of emerging markets covers 36 countries from different regions. In Latin America we include: Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela; in Eastern Europe: Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Kazakhstan, Latvia, Lithuania, Poland, Romania, Russia and Ukraine; in

Asia: China, Hong Kong, India, Indonesia, Malaysia, Pakistan, Philippines, Singapore, South Korea, Taiwan, Thailand, Vietnam and in Africa & Middle East: Egypt, Israel, Nigeria, South Africa and Turkey.

4.5.2.1. The sample

Kaminsky and Reinhart (1999) mentioned that the event of banking crisis was rather seldom with regulated financial markets during the 1970s. The number of crises increased significantly in the post-liberalisation period during the 1980s and 1990s. We observed that several Latin American countries experienced banking crises during the 1980s, mainly driven by the withdrawal of international capital, inadequate regulation, real effective exchange rate appreciation combined with pegged exchange rates and highly dollarised banking systems. In the early 1990s, with the monetary and fiscal convergence in the preparation for possible future EMU accession, many Eastern European countries experienced banking crises. Between 1997 and 1998, Asian banking sectors collapsed when capital inflows turned into outflows with currency pegs, highly leveraged corporate sectors and unhedged short-term debts. Afterwards, similar macroeconomic vulnerabilities triggered banking crises in Mexico (1994), Russia (1998), Turkey (2000) and Argentina (2001). The appendix lists the periods of distress and baking crises experienced by emerging markets since 1990.

Data restrictions prevent us from starting our in sample calculation before January 1990, leaving out Latin American and Eastern European banking crises but including Asian crises and other significant banking crises experienced in the 1990s[31]. Within the sample of 36 countries a total of 28 systemic crises and 8 periods of banking sector distress were identified but only 19 of these periods (15 systemic crises and 4 periods of distress) are captured by the composite indicator on account of data restrictions. The remaining crises and distress periods are still in the model, captured by individual indicators. The in-sample calculation of the model runs from 1990 to 2004. Observations of the composite index from the beginning of 2005 until the end of 2007 (see appendix) will be out-of-sample predictions.

4.5.2.2. The crisis window

Since the precise months of banking crises are difficult to identify, systemic crises and distress periods are arbitrarily assigned to the month of December in the respective year. For emerging markets, the 36-months window before crisis dates was found to be the most efficient in terms of low noise-to-signal ratios and ade-

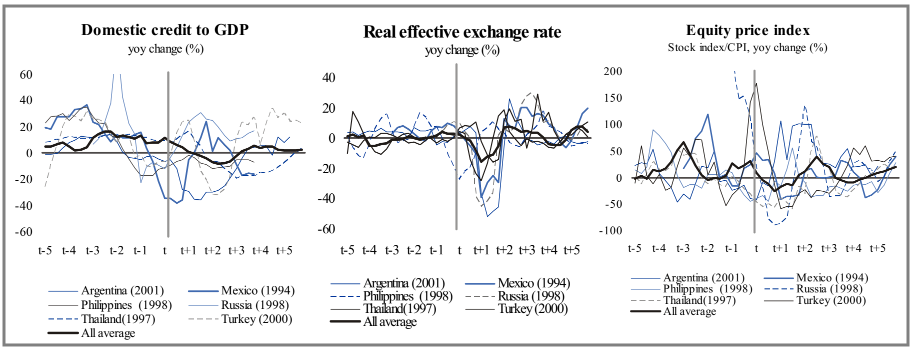
[31] Many Eastern European countries suffered banking crises between 1990 and 1992 which are excluded from our sample since a 3-year forecast horizon prior to crisis is not warranted.

quately predicted banking crises (see sensitivity analysis) which will be our benchmark model to assess individual indicator performance.

4.5.2.3. The indicators

Around crisis dates the boom and bust cycle of the explanatory variables can be also observed in emerging markets. On average, credit started to accelerate three years before crisis dates to slow down some months before crisis dates. The REER experienced a slow and modest increase about four years before crisis dates to plummet sharply after crises. Kaminsky and Reinhart (1999) observed that problems in the banking sector typically precede currency crises but sharp devaluations afterwards aggravate banking sector problems. Peaks of stock prices are distributed in different time periods five years before crisis dates. We test different time horizons to assess the performance of the model, but given the simultaneous approach of signals from individual indicators, we can anticipate an enhanced performance of the model on a 36-months time horizon.

Figure 3: Indicator behaviour around crisis starting dates – emerging markets



4.5.2.4. The indicator thresholds

The selection of percentage thresholds for emerging market indicators follows the same rule of industrial countries, *i.e.* setting individual percentile thresholds to capture at least 80% of indicated crises and assigning a 50% percentile threshold when the first condition does not apply (in some models it is not possible to obtain the pre-fixed percentage of indicated crises). Figure A-2 in the appendix yields a graphical a representation of the result from the grid search, the selected threshold including their respective performance measures are given by the following table.

Table 4: Individual thresholds and weights within the composite indicator – emerging markets

Indicator	Percentile threshold	Type-I error	Type-II error	Nts ratio	Indicated crises	Weight within composite
Credit gap	70%	0.55	0.28	0.63	88.%	39%
REER gap	60%	0.48	0.42	0.80	93%	31%
Equity price gap	60%	0.59	0.33	0.82	86%	30%
Composite	63%	0.77	0.06	0.27	75%	100%

The credit gap is the individual indicator with superior performance. The REER indicator displays a high percentage of predicted past crises but a relative sizable noise-to-signal ratio. The equity index is the indicator with inferior performance. Considering the superior performance the credit gap is the most important individual indicator for emerging markets.

Similarly to the industrial countries, the composite indicator displays a lower noise-to-signal ratio than all individual indicators, highlighting the advantage of combining individual signals. At 75% of indicated crises, the composite indicator has a noise-to-signal ratio of 0.27.

4.5.2.5. Sensitivity analysis: time horizon

We ran the model for the same time horizons tested in industrial countries. To compare different models, we fixed the percentage of indicated crises at the values mentioned in the previous table with the condition that percentile threshold must be at least 50%.

With the percentage of indicated crises for the composite indicator fixed at 75%, the 36-months time horizon model minimises the noise-to-signal ratio. In the context of the selected time horizon, a composite indicator signal can be interpreted as possible banking sector distress within the next 36 months after the signal is triggered. The persistence of the signal should be also considered in assessing the probability of a distress period.

The superior performance of the credit gap indicator is verified given that this indicator gained the highest weight in all models but the 60-months (excluding 24 m before crisis) model. A longer time horizon benefits the equity price gap as peaks of this variable were distributed along a five-year horizon before crisis dates, but the two other indicators display a higher noise-to-signal ratio and smaller percentage of indicated crises in the 60-months time horizon model. The performance of the composite indicator worsens in longer time horizons on account of less simultaneous signals.

While the noise-to-signal ratio of the REER gap tends to increase in longer time horizons (from 24 to 48 months), the best performances of the credit gap indicator and the composite indicator are reached at a 36-months time horizon.

Table 5: Indicator performance with varying time horizons – emerging markets

Time horizon	Percentile threshold	Type-I error	Type-II error	Nts ratio	Indicated crises	Weight within composite
24 months						
Credit gap	59%	0.46	0.40	0.73	88%	33%
REER gap	54%	0.39	0.47	0.77	93%	31%
Equity price gap	60%	0.53	0.32	0.67	86%	36%
Composite	50%	0.51	0.29	0.58	75%	100%
36 months						
Credit gap	70%	0.55	0.28	0.63	88%	39%
REER gap	60%	0.48	0.42	0.80	93%	31%
Equity price gap	60%	0.59	0.33	0.82	86%	30%
Composite	63%	0.77	0.06	0.27	75%	100%
48 months						
Credit gap	75%	0.62	0.25	0.65	88%	37%
REER gap	70%	0.61	0.34	0.88	93%	28%
Equity price gap	63%	0.58	0.29	0.69	86%	35%
Composite	50%	0.78	0.08	0.35	70%	100%
48 months (excluding 12 m before crisis)						
Credit gap	65%	0.48	0.35	0.67	88%	38%
REER gap	51%	0.39	0.54	0.88	93%	29%
Equity price gap	62%	0.60	0.32	0.79	86%	32%
Composite	50%	0.49	0.23	0.45	75%	100%
60 months (excluding 24 m before crisis)						
Credit gap	50%	0.34	0.55	0.84	77%	31%
REER gap	50%	0.36	0.59	0.92	86%	28%
Equity price gap	75%	0.73	0.17	0.63	86%	41%
Composite	50%	0.55	0.24	0.54	70%	100%

4.5.2.6. Sensitivity analysis: threshold level

With the selected model of 36-months time horizon we analysed the indicators' performance with different individual thresholds, *i.e.* we analyzed a +/- 10% change in individual thresholds. To compare results we have fixed the percentage of indicated crises at previous levels.

In general, higher individual thresholds mean higher individual noise-to-signal ratios at a fixed percentage of indicated crises. However, base thresholds are the optimal thresholds for the composite indicator, given that the noise-to-signal ratio reached a minimum value at 75% of indicated crises.

Table 6: Indicator performance with varying threshold levels – emerging markets

	Percentile threshold	Type-I error	Type-II error	Nts ratio	Indicated crises	Weight within composite
Low threshold (-10%)						
Credit gap	60%	0.43	0.38	0.67	92%	38%
REER gap	50%	0.37	0.52	0.82	96%	31%
Equity price gap	50%	0.49	0.44	0.86	86%	30%
Composite	67%	0.64	0.13	0.37	75%	100%
Base threshold (+/-0%)						
Credit gap	70%	0.55	0.28	0.63	88%	39%
REER gap	60%	0.48	0.42	0.80	93%	31%
Equity price gap	60%	0.59	0.33	0.82	86%	30%
Composite	63%	0.77	0.06	0.27	75%	100%
High threshold (+10%)						
Credit gap	80%	0.67	0.18	0.54	77%	41%
REER gap	70%	0.61	0.32	0.82	86%	27%
Equity price gap	70%	0.69	0.22	0.71	67%	31%
Composite	50%	0.77	0.07	0.31	65%	100%

4.6. CONCLUSION

This paper develops an early-warning system to capture adverse macroeconomic developments, which in the past have led to large-scale problems in the banking sector. We show how such a model can be implemented in practice, addressing the specific requirements of an internationally operating private sector institution. We argue that the incorporation of an early-warning system into credit risk management can be an effective means to address disaster myopia and the lack of institutional memory, which have been blamed for short-sighted credit policy by the private sector before.

We implement the proposed model for both the industrial countries and emerging markets. Separate consideration of the two samples allows us to consider different indicators, sample periods and crisis forecast windows. Our results affirm those of previous studies, which show that excessively rising credit to GDP in combination with booming asset prices were often at the heart of banking sector problems. We contribute to that literature by also assessing property prices and show – for the industrial countries – that the property price gap is a superior indicator compared to the equity price gap.

Overall performance of the model is in line with the literature. At the reported threshold levels, the industrial countries composite indicator predicts 80% of the in-sample crisis periods, while achieving a relatively low noise-to-signal ratio of 0.11. For emerging markets, the composite indicator predicts 75% of in-sample crisis periods, with a noise-to-signal ratio of 0.27. For both models the equity price indicator seems to perform worse, while the domestic credit gap always ranks among the best indicators. Combining individual indicators into a composite index reduces overall noise levels.

While the model performs relatively well in terms of predicting in-sample crisis episodes, a number of limitations need to be taken into account when interpreting out-of-sample predictions: first, it will be difficult to determine future starting dates of banking sector problems once a signal is issued, because – by construction – the forecast horizon encompasses several years. Thus, a crisis may evolve shortly after the issuance of a signal or up to four years later in the industrial countries and up to three years later in the emerging markets. Second, just like any other forecasting tool, the predictive power of the proposed systems depends on future crises following patterns observed in previous ones. Third, given our preference for capturing a high fraction of crises and including countries that did not experience crises, the model will likely produce a considerable number of false alarms. Finally, the model looks only at common macroeconomic threats to the banking sector. It neglects the resilience of the banking system to deal with such threats, as well as further threats stemming from idiosyncratic shocks and subsequent contagion effects. These caveats stress the necessity to regard the early-warning system as merely a further building block of a more comprehensive risk assessment programme, which also incorporates measuring the resilience of the banking sector on an aggregate as well as a micro-prudential level. In fact, a crisis signal should only be taken as a first call to monitor more closely banking sector vulnerabilities in the country concerned; while the absence of a signal should not lead to the negligence of possible banking sector risks.

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APPENDIX

Percentile thresholds

Suppose now X_{ijt} is a real-valued random variable and its cumulative distribution function (cfd) is given by $F(x_{ij}) = P(X_{ijt} \leq x_{ij})$ for $x_{ij} \in R$. If we assign probability of $1/T_S$ to each of the observations X_{ijt}, we are able to define the empirical distribution function as:

$$F_{ij}(x_{ij}) = \frac{\sum_{t=T_0}^{T_S} I(X_{ijt} \leq x_{ij})}{T_S}, \text{ for } x_{ij} \in R \qquad \text{(A-1)}$$

With $I(.)$ being the indicator function, which – for a given threshold x_{ij} – yields one if the indicator is equal to or below the threshold and zero otherwise. T_S is the number of time periods included in the sample and $F_{ij}(x_{ij})$ is the cumulative frequency of observations less than or equal to x_{ij}, increasing from zero to one. This is how we calculate the percentage share of signals for a given threshold x_{ij}. If we want to calculate the country specific thresholds, given a certain percentile level, we need to use the quantile function[32]:

$$F_{ij}^{-1}(p_{ij}) = \inf\{x_{ij} \in R: F_{ij}(x_{ij}) \geq p_{ij}\}, \text{ for } 0 < p_{ij} < 1 \qquad \text{(A-2)}$$

First, we chose a certain percentile level $p_{ij} = \alpha$, then, we determine the country-specific thresholds so that $F_{ij}^{-1}(\alpha_i) = x_{ij}$. In order to derive indicator signals, we insert the country-specific thresholds x_{ij} that will trigger individual signals into equation (1) (p. 68). We can now calculate the (aggregate) empirical distribution of signals – spanning the time as well as the country dimension. This corresponds to one minus the (aggregate) frequency of signals. Using the signals S_{ijt} as defined in equation (1) (p. 68) we receive:

$$F_i(\alpha_i) = 1 - \frac{\sum_{j=1}^{J} \sum_{t=T_0}^{T_S} S_{ijt}}{m} \qquad \text{(A-3)}$$

Where $m = J * T_S$, which is the total number of observations for all countries and all time periods within the sample (number of panel observations), and α_i is the common percentile threshold for indicator i. Note that each percentile threshold at the aggregate level corresponds to the same percentile threshold at the country level, while the absolute thresholds $x_{ij} = F_{ij}^{-1}(\alpha_i)$ are country-spe-

32 Where inf is the abbreviation of "infimum", meaning the largest lower boundary.

cific. To exemplify, the common percentile threshold level for the credit gap is 70%. Looking at the historic time series of Singapore reveals that 30% (100%-70%) of all credit gap observations are above 4%. By contrast, Estonia has seen more episodes of comparably high output gaps – here the 70% percentile threshold level corresponds to a threshold value of 5.8%. Consequently, a warning-signal for Singapore will be issued as soon as the credit gap exceeds 4%, while Estonia will not trigger a signal unless the credit gap exceeds 5.8%.

Table A-1: Crisis dates industrial countries

Country	Date	Comment
Australia	1989-1992	Distress: Two large banks received government aid, fiscal costs amounted to 2% of GDP, NPL were 6% of total assets (1991-92)
Canada	1990-1992	Distress: Large loan losses at Canadian banks and trusts due to real estate price collapse
	1983-1985	Distress: Fifteen members of the Canadian Deposit Insurance Corporation failed, including two banks
Denmark	1987-1992	Distress: 40 out of 60 problem banks were merged, accumulative loan losses amounted to 9% of total loans (1990-92)
Finland	1991-1994	Crisis: Savings banks were badly affected by macro shocks, government took control of three banks representing 31% of total deposits
France	1994-1995	Distress: Credit Lyonnais experienced serious problems, estimated losses totalled USD 10 bn.
Germany	2002-2003	Distress: The banking sector experienced structural problems after equity market bust; failure of some smaller institutions (e.g. Schmidt Bank, Gontard & MetallBank, BkmU Bank, and others)
Greece	1991-1995	Distress: Significant injections of public funds into troubled specialised lending institutions
Italy	1992-1995	Distress: Between 1990-94, 58 problem banks were merged, accounting for 11% of total lending
Japan	1991-2003	Crisis: Up to March 2002, 180 deposit taking institutions were dissolved, fiscal costs for dealing with NPL amounted to 20% of GDP
New Zealand	1987-1990	Distress: Solvency problems of one large state-owned bank due to high levels of NPL, capital injection of 1% of GDP
Norway	1988-1993	Crisis: Smaller regional banks, and later large banks, experienced difficulties caused by deep recession, recapitalisation costs amounted to 8% of GDP
Spain	1978-1983	Crisis: 52 of 110 banks experienced solvency problems, broad government intervention, estimated losses amounted to 17% of GNP
	1993	Distress: First half of 1990s: failures of small banks; 1993: failure of Banesto
Sweden	1991-1992	Crisis: 2 large banks were insolvent, 5 out of the 6 largest banks experienced difficulties, recapitalisation costs amounted to 4% of GDP
Switzerland	1991-1996	Distress: Banks incurred estimated losses of more than 10% of GDP; regional problem-banks were merged to mitigate problems
UK	1991-1992	Distress: 'Small Banks Crisis': a number of small banks failed due to credit losses during recession

Country	Date	Comment
USA	1983-1991	Distress: 1320 savings and loans institutions failed, estimated resolution costs amounted to 3% of GDP, 1650 federally insured banks had to be resolved
	2007-ongoing	Crisis. Major commercial banks and most large investment banks (incl. Bear Stearns, Lehman Brothers, Freddie Mac and Fannie Mae) either defaulted, were closed by the authorities or forced to merge. Large scale public assistance was granted to the banking sector in order to avoid systemic breakdown.

Sources: Caprio and Klingebiel (2003); Lindgren, Garcia and Saal (1996), BIS (2004); except for Germany (own estimate) and Canada (Illing and Liu 2003).

Although some sources identify an episode of distress also for Portugal (1986-1989), this episode is not included as major indicators for Portugal are only available from 1988 onwards.

Table A-2: Crisis dates emerging markets

Country	Date	Comment
Argentina	1995	Systemic crisis: By the end-1997, 63 of 205 banking institutions were closed or merged.
	2001-no end date	Systemic crisis: A bank run started in 2001, withdrawal restrictions on deposits were imposed and fixed-term deposits reprogrammed. In 2002, bank assets were asymmetrically pesified affecting banks solvency. One bank closed and three were nationalised by 2003.
Brazil	1994-1999	Systemic crisis: The central bank intervened or took the temporary administration of 43 institutions. NPLs reached 15% by end-1997.
Bulgaria	1995-1997	Systemic crisis: The banking system experienced a bank run in 1996 and 19 banks closed (one third of total banking assets).
China	1990s	Systemic crisis: Larger state-owned banks (68% of total banking assets) were deemed insolvent at the end of 1998. NPLs were estimated at 50%.
Croatia	1996	Systemic crisis: Five banks (about 50% of total banking system loans) were deemed insolvent and taken over by the bank rehabilitation agency.
Czech Republic	1991-no end date	Systemic crisis: Several banks closed and NLPs reached 38% in 1994-95.
Egypt	1991-95	Distress: Four banks received capital assistance.
Estonia	1992-1995	Systemic crisis: Several banks were deemed insolvent (41% of assets), five licences were revoked and four major banks were merged, nationalised or helped by the recovery agency.
	1994	Systemic crisis: One bank who controlled 10% of total assets failed.
	1998	Distress: Five small banks failed.
Hong Kong	1998	Distress: One large investment bank failed.
Hungary	1991-1995	Systemic crisis: 8 banks were deemed insolvent (25% of financial system assets).
India	1993-no end date	Distress: Non-performing assets reached 11% in 1993-94 and 16% in 1998.
Indonesia	1994	Distress: Non-performing assets reached 14% and more than 70% were held by state banks.
	1997-no end date	Systemic crisis: By 2007, 70 banks were closed and 13 nationalised of a total of 237 banks. NPLs were estimated at 65-75% at the peak of the crisis.

Country	Date	Comment
Korea, Rep. of	1997-no end date	Systemic crisis: By 2002, 5 banks were forced to exit the market, 303 institutions closed (215 credit unions) and 4 banks were nationalised. NPLs peaked to 30-40%.
Latvia	1995-no end date	Systemic crisis: Between 1994 and 1999, 35 banks saw their licences revoked, were closed or ceased operations.
Lithuania	1995-1996	Systemic crisis: 12 small banks (out of 25 banks) were liquidated, 3 banks failed (29% of banking system deposits) and 3 state-owned banks were deemed insolvent.
Malaysia	1997-no end date	Systemic crisis: Total number of finance companies was reduced to 10 from 39 and two insolvent banks merged. NPLs peaked at 25-35%.
Mexico	1994-1997	Systemic crisis: Government intervened at 9 banks and 11 of 34 commercial banks participated in a capitalisation programme.
Nigeria	1990s	Systemic crisis: Insolvent banks accounted for 20% of banking system assets were insolvent in 1993 and in 1993 almost 50% of banks reported financial distress.
	1997	Distress: Distressed banks accounted for 4% of total assets.
Philippines	1998-no end date	Systemic crisis: One commercial bank, 7 of 88 thrifts and 40 of 750 rural banks were placed under receivership. NPLs reached 12% in 1998.
Poland	1990s	Systemic crisis: 7 of 9 treasury-owned commercial banks (90% of the credit) and two other banks experienced solvency problems.
Romania	1990-no end date	Systemic crisis: NPLs reached 25-30% in six major state-owned banks in 1998.
Russia	1995	Systemic crisis: The interbank loan market stopped working in 1995 due to concerns about connected lending by new banks.
	1998-1999	Systemic crisis: About 720 banks (4% of total assets add 32% of retail deposits) were deemed insolvent and 18 banks (10% of total assets and 41% of deposits) experienced serious difficulties.
Taiwan	1995	Distress: Failure of an important credit cooperative sparked round on other credit unions.
	1997-1998	Systemic crisis: NPLs reached 15%.
Thailand	1997-no end date	Systemic crisis: 59 of 91 financial companies and one bank (of 15 banks) have to close. In addition, 4 banks were nationalised (of 15 banks). NPLs reached 33%.
Turkey	1994	Distress: three banks failed.
	2000-no end date	Systemic crisis: two banks closed and 19 banks were taken over by the Savings Deposits Insurance Fund.
Ukraine	1997-1998	Systemic crisis: 32 of 195 banks were liquidated and 25 underwent financial rehabilitation. Bad loans reached 50-60% of assets in some banks. In 1998, government's decision to restructure debt hit banks.
Venezuela	1994-1995	Systemic crisis: Insolvent banks accounted for 35% of financial system deposits, government intervened at 22 of 47 banks and 4 were nationalized.
Vietnam	1997-no end date	Systemic crisis: two of four state-owned banks were deemed insolvent and the other two experienced solvency problems (51% of total banking loans). NPLs reached 18%.

Sources: Caprio and Klingebiel (2003)

Table A-3: Indicators industrial countries

Indicator[a]	Underlying series	Rationale	Data source
Credit gap	Domestic credit to the private sector / GDP	Banks will be adversely affected by an abrupt down-turn of the credit cycle. If credit and asset prices collapse simultaneously, adverse effects on bank stability will be even more pronounced.	Credit: IFS Line 22d; GDP: national sources
Equity price gap	Major national equity price index	An equity price collapse may adversely affect the banking system, either directly via bank balance sheets or indirectly via decreasing collateral value and fee & commission income.	OECD Main Economic Indicators and IFS Line 62
Property price gap	National residential housing price index (in nominal terms)	A property price collapse may adversely affect the banking system, either directly via bank balance sheets or indirectly via decreasing collateral value and fee & commission income.	BIS (Stephan Arthur)
Output gap	Real GDP (seasonally adjusted)	A fall in real economic activity will adversely influence the quality of banks' credit portfolios and reduce banks' income possibilities.	National sources

a. All indicators are constructed as gaps between the actual series and an underlying ex ante recursively calculated HP trend (expressed as percentage of the trend level). The larger the (positive) deviation from the long-term trend, the higher the risk of banking sector problems.

Table A-4: Indicators emerging markets

Indicator[a]	Underlying series	Rationale	Data source
Credit gap	Domestic credit to the private sector / GDP	Banks will be adversely affected by an abrupt down-turn in the credit cycle. If credit and asset prices collapse simultaneously, adverse effects on bank stability will be even more pronounced.	Credit: IFS Line 22d/ 32d; GDP: national sources
Equity price gap	Major national equity price index	An equity price collapse may adversely affect the banking system, either directly via bank balance sheets or indirectly via decreasing collateral value and fee & commission income.	IFS Line 62, Bloomberg, Global Insight
Real effective exchange rate	Real effective exchange rate	For emerging markets, and specially for small and open economies, the REER appreciation captures capital inflows pressures as well as potential build-up of foreign currency mismatches	Global Insight, IFS, EUROSTAT, National Sources, DB Research calculations

a. All indicators are constructed as gaps between the actual series and an underlying ex ante recursively calculated HP trend (expressed as percentage of the trend level). The larger the (positive) deviation from the long-term trend, the higher the risk of banking sector problems.

Figure A-1: Indicator performance – industrial countries

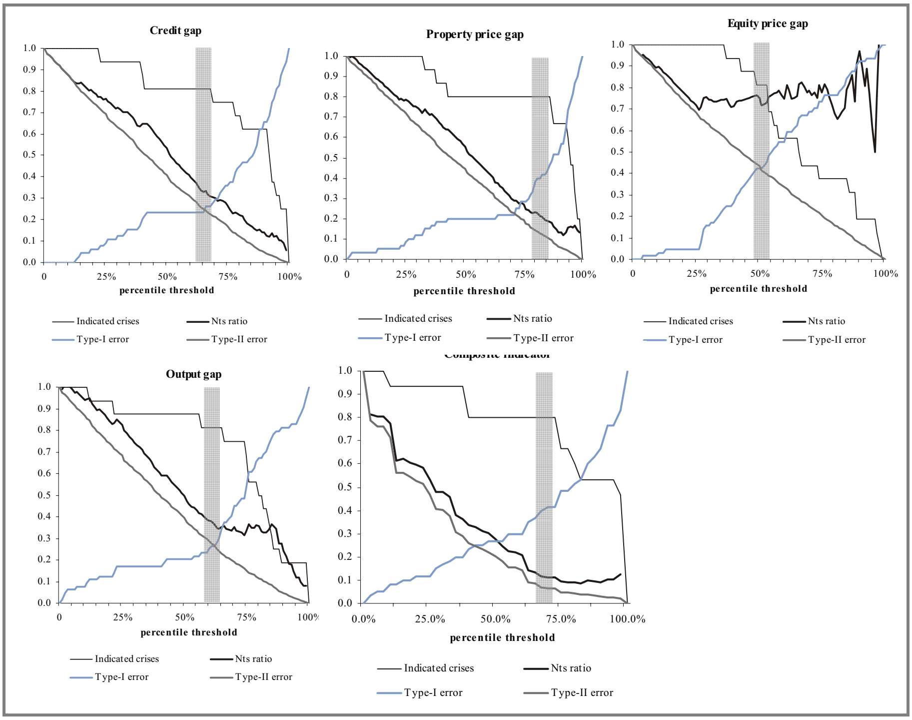


Figure A-2: Indicator performance – emerging markets

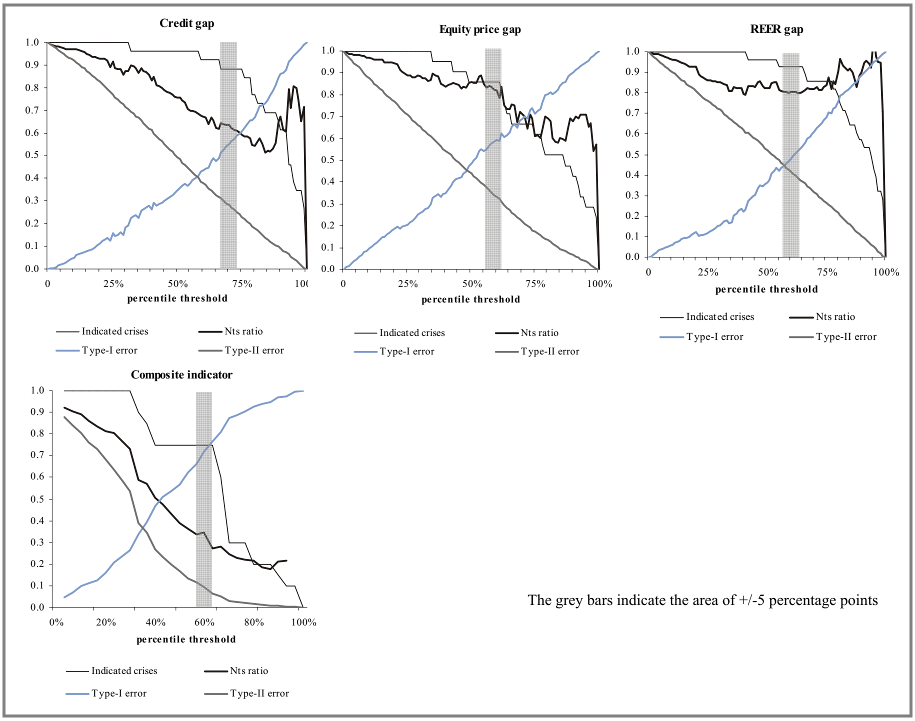
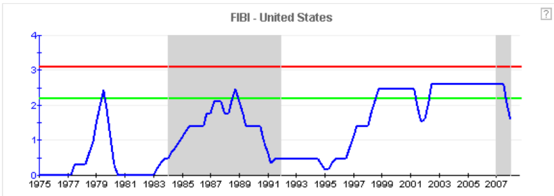


Figure A-3: Example of web-based output – industrial countries



Calibration

Forecast horizon (quarters)	16
Threshold green	2.200
Threshold red	3.100
Absolute maximum	4.000
Historical maximum	2.601

Historical Episodes of Crisis / Distress

01/07	Banking crisis. Major commercial banks and most large investment banks (incl. Bear Stearns, Lehman Brothers, Freddie Mac and Fannie Mae) either defaulted, were closed by the authorities or forced to merge. Large scale public assistance was granted in order to avoid systemic breakdown.
01/84	Distress: 1320 savings and loans institutions failed, estimated resolution costs amounted to 3% of GDP, 1650 federally insured banks had to be resolved

Component Indicators	Weights (%)	Thresholds (%)
output gap	23.1	60.0
domestic credit gap	26.9	65.0
equity price gap	11.8	50.0
property price gap	38.1	80.0

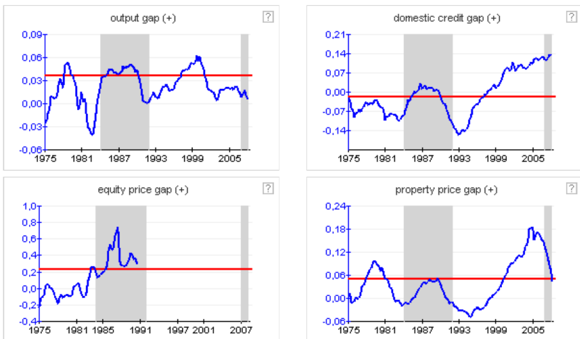
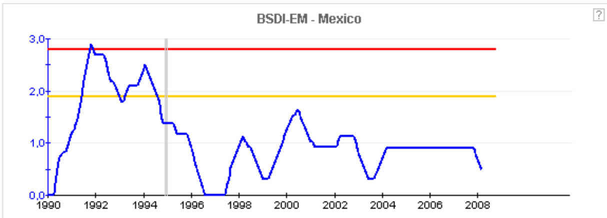


Figure A-4: Example of web-based output – emerging markets



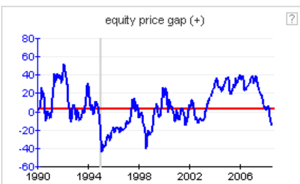
Calibration	
Forecast horizon (in months)	36
Threshold amber	1.900
Threshold red	2.800

Historical Episodes of Distress	
12/94	Systemic banking crisis

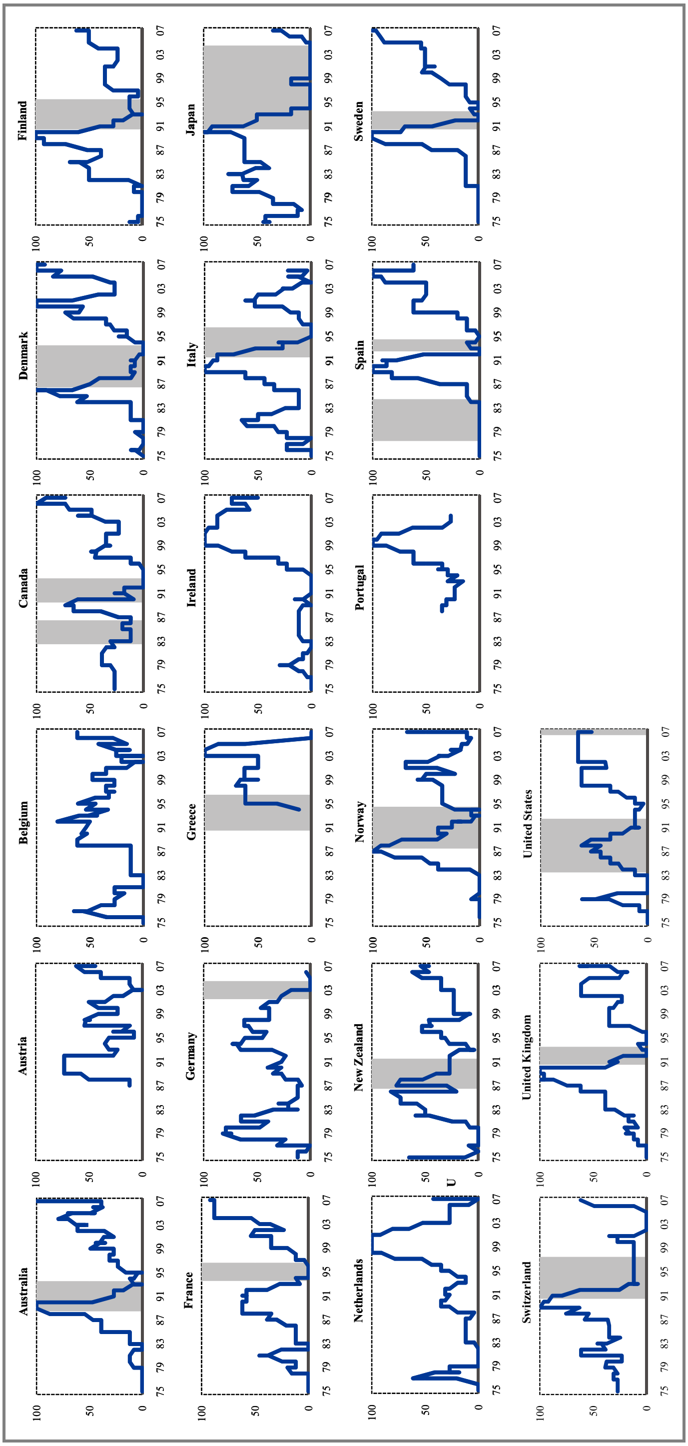
Component Indicator	Weights (%)	Thresholds (%)
domestic credit gap	39.0	70.0
REER gap	30.8	60.0
equity price gap	30.2	60.0

See the original time series

See the original time series

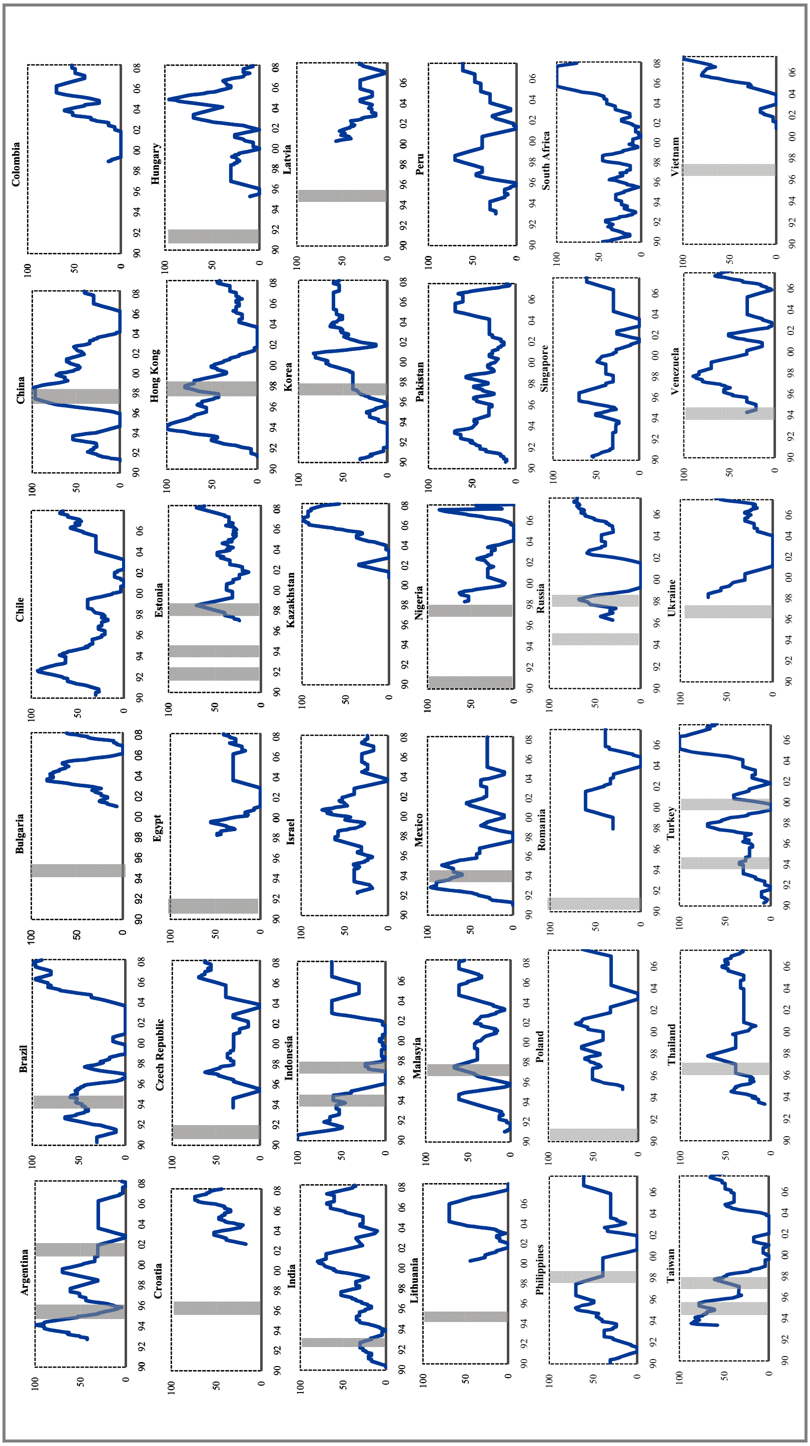


Graph A-5: Composite indicator - industrial countries*



*Shaded areas represent crisis times. Observations from 2002 onwards are out-of sample predictions.

Graph A-6: Composite indicator-emerging markets*



* Shades areas represent starting crisis dates. Observations from 2004 onwards are out-of sample predictions.

5. Asset Price Fluctuations, Financial Crises and the Stabilizing Effects of a General Transaction Tax

Stephan Schulmeister

Abstract

The deepening of the recent crisis was driven by the simultaneous devaluation of stock wealth, housing wealth and commodity wealth. The potential for this devaluation process had been "built up" during the boom of stock prices, house prices and commodity prices between 2003 and 2007. Hence, this paper sketches the main causes and effects of long swings in asset prices in the context of the current crisis. It is shown that "bull markets" are brought about by upward price runs (*i.e.*, monotonic movements) lasting longer than counter-movements for an extended period of time (and vice versa for "bear markets"). This pattern of asset price dynamics is the result of "trading as usual" on (highly regulated) derivatives exchanges. The most popular trading practices like "technical analysis" contribute significantly to asset price overshooting. These practices strengthened both, the boom of asset prices until mid 2007 as well as their collapse in recent months. A general financial transaction tax would limit the wide fluctuations of stock prices, exchange rates and commodity prices.

JEL: E30, F31, G12, G13, G14, H25

Keywords: Boom and bust of asset prices, speculation, technical trading, transaction tax.

5.1. Introduction

Within 18 months a mortgage crisis in the US has turned into a deep crisis of the world economy. This process was (and in part still is) driven by the simultaneous devaluation of stock wealth, housing wealth and commodity wealth. The devaluation reduces consumption and investment directly as well as indirectly (*e.g.*, via the devaluation of pension and college funds, of credit collaterals and through the deterioration of the current account of commodity exporters). The potential for the decline of stock prices, house prices and commodity prices had been "built up" during the boom of these asset prices between 2003 and 2007.

This paper sketches the main causes and effects of long swings in asset prices in the context of the current crisis. These fluctuations are the outcome of "trading as usual" on (highly regulated) derivatives exchanges. The most popular trading practices like "technical analysis" contribute significantly to asset price overshooting. Hence, these practices and the related "speed" of transactions strengthened both, the boom of asset prices until mid 2007 as well as their collapse in recent months. A general financial transaction tax would limit the fluctuations of stock prices, exchange rates and commodity prices.

5.2. THE "FUNDAMENTALIST HYPOTHESIS" AND THE "BULL-BEAR-HYPOTHESIS" OF ASSET PRICE DYNAMICS

According to mainstream economic theory, asset prices are determined by the respective equilibrium conditions, *i.e.*, by the so-called market fundamentals. Hence, destabilizing speculation will influence prices at best over the very short run (if at all). In this chapter, I shall at first summarize the main assumptions of this theoretically (deductively) derived concept of asset price formation which I term "fundamentalist hypothesis". I will then discuss the key elements of the alternative "bull-bear-hypothesis" which is rather empirically oriented.

The main assumptions of the "fundamentalist hypothesis" can be summarized as follows (see also figure 1 and table 1):

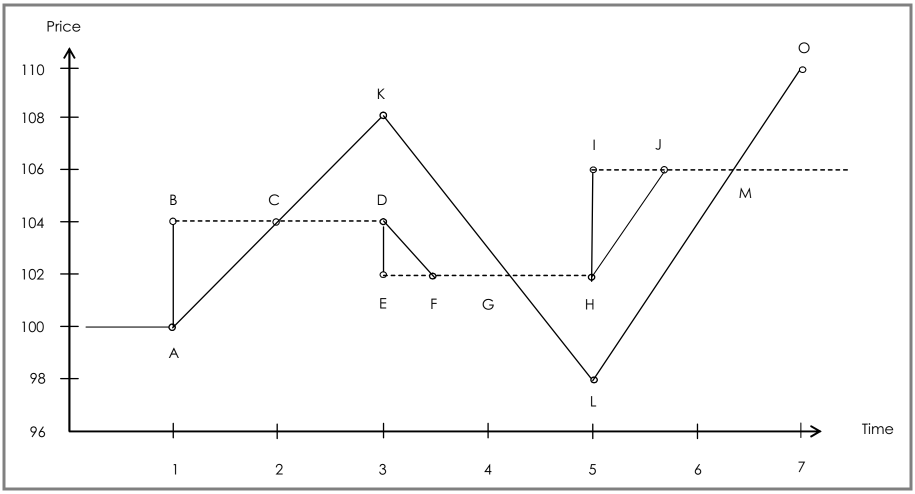
- the theoretical benchmark model of the "fundamentalist hypothesis" is an ideal, frictionless market where all participants are equipped with perfect knowledge and where no transaction costs exist ("world 0");
- the model underlying the "fundamentalist hypothesis" relaxes the assumptions of perfect knowledge and of no transaction costs. Also in this "world I" actors are fully rational, but they do not know the expectations of other actors. Hence, prices cannot reach a new equilibrium instantaneously but only through a gradual price discovery process;
- the high transaction volumes in modern financial markets stem mainly from the activities of market makers. The latter provide just the liquidity necessary for facilitating and smoothing the movements of asset prices towards their fundamental equilibrium;
- speculation is an indispensable component of both, the price discovery process as well as the distribution of risks. As part of the former, speculation is essentially stabilizing, *i.e.*, it moves prices smoothly and quickly to their fundamental equilibrium (Friedman, 1953);
- an endogenous overshooting caused by excessive speculation does not exist. Any deviation of asset prices from their fundamental equilibrium is due to exogenous shocks and, hence, is only a temporary phenomenon;
- the emergence of news and shocks follows a random walk and so do asset prices. Therefore, speculation techniques based on past prices cannot be systematically profitable (otherwise the market would not even be "weakly efficient" – Fama, 1970).

The "bull-bear-hypothesis" perceives trading behaviour and price dynamics in asset markets as follows ("world II"):

- imperfect knowledge is a general condition of social interaction. As a consequence, actors use different models and process different information sets when forming expectations and making decisions[1];
- as human beings, actors' expectations and transactions are governed not only by rational calculations, but also by emotional und social factors;
- not only are expectations heterogeneous but they are often formed only qualitatively, *i.e.*, as regards the direction of a price movement. *E.g.*, in modern financial markets traders try to gauge within seconds if news will drive the price rather up or rather down;
- upward (downward) price movements – usually triggered by news – are lengthened by "cascades" of buy (sell) signals stemming from trend-following technical trading systems;
- the "trending" behaviour of asset prices (based on daily or intraday data) is fostered by the dominance of either a "bullish" or a "bearish" bias in expectations. News which are in line with the prevailing "market mood" gets higher recognition and reaction than news which contradict the "market mood";
- in the aggregate, this behaviour of market participants cause price runs in line with the "market mood" to last longer than counter-movements. In such a way short-term runs accumulate to long-term trends, *i.e.*, "bull markets" and "bear markets";
- the sequence of these trends then constitutes the pattern in long-term asset price dynamics: Prices develop in irregular cycles around the fundamental equilibrium without any tendency to converge towards this level.

1 In a recent, pathbreaking book, FRYDMAN and GOLDBERG (2007) demonstrate that recognizing the importance of imperfect knowledge is key to understanding outcomes in financial markets.

Figure 1: Three stylized paths of asset prices



In order to clarify the theoretical differences between the "fundamentalist hypothesis" and the "bull-bear-hypothesis", it is useful to distinguish between three (theoretical) paths of asset prices, depending on the assumptions made about market conditions (figure 1):

– in "world 0", new information at t = 1 causes the asset price to jump instantaneously from the old equilibrium at P = 100 (at point A) to the new equilibrium at P = 104 (B). The price stays there until news in t = 3 cause the price to jump to P = 102 (E). Finally, in t = 5 new information once again causes an instantaneous price adjustment to P = 106 (I);
– in "world I", it takes a series of transactions to move the price from P = 100 to P = 104, *i.e.*, from A to C. Since there are only rational traders in this world, the price movement will stop at the new fundamental equilibrium level and stay there until t = 3 (then the price starts to move from D to F, and later from H to J);
– in "world II", there exist traders who form their expectations according to the most recent price movements, *i.e.*, when prices move persistently up (down) they expect the respective short-term trend to continue. Hence, they buy (sell) when prices are rising (falling), causing the price to overshoot (from C to K, from G to L, and from M to O).

Table 1: Features of three hypothetical 'worlds' of financial markets

	World 0	World I	World II
General characteristic	Perfect knowledge and foresight. Rational expectations. No transaction costs (frictionless markets).	As in world 0 with two exceptions: – Transaction costs matter – Expectations of other actors due to news have to be discovered in a gradual adjustment process.	Imperfect knowledge as general condition of social interaction: Actors process different information sets using different models. Actors are human beings: Expectations and transactions are governed by rational, emotional und social factors.
Expectations	Homogeneous.	In general homogeneous, but heterogeneous during the price discovery/adjustment process.	Heterogeneous.
Expectations formation	Quantitative.	Quantitative.	Often only directional (qualitative).
Price adjustment to news	Instantaneous jumps to the new fundamental equilibrium.	Gradual price movement towards the new fundamental equilibrium.	Price movement overshoots the ('region' of) the new fundamental equilibrium. Short-term trending of asset prices accumulates to medium-term trends due to optimistic or pessimistic biases in expectations ('bullishness/bearishness').
Transaction volume	Low (counterpart of the 'underlying' transaction in goods markets).	'Basic' liquidity necessary for the price discovery process => Trading volume higher than the 'underlying' goods markets transactions, moving in tandem with the latter over time.	'Excessive' trading causes transaction volumes to grow significantly faster than the 'underlying' transactions in goods markets.
Trading is based on	Fundamentals.	Fundamentals.	Fundamentals, technical models as well as on psychological factors on the individual level (e.g. emotions) as well as on the social level (e.g. market moods, herding).

As a consequence of asset price "trending", rational investors (in the sense of profit-seeking) will try to systematically exploit this non-randomness in price dynamics. The conditions of "world II" will therefore almost inevitably emanate from those of "world I": if prices move smoothly from one fundamental equilibrium to the next, and if this price discovery process takes some time, then profit-seeking actors will develop trend-following trading strategies (for models dealing with the interaction of heterogeneous actors see DeLong *et al.*, 1990a and 1990b;

Frankel and Froot, 1990; De Grauwe and Grimaldi, 2006; Hommes, 2006; Frydman and Goldberg, 2007).

Over more than 100 years people have developed and used a great variety of "technical" trading systems. All models of "technical analysis" have in common that they attempt to exploit price trends and by doing so they reinforce the pattern of asset price dynamics as a sequence of upward and downward trends (for a comprehensive treatment of technical analysis see Kaufman, 1987; the interaction between technical trading and price dynamics is explored in Schulmeister, 2006, 2009b).

In our stylized example those transactions (in "world II") which cause the price to overshoot (driving it from C to K, from G to L and from M to O) have to be considered "excessive" (as in "world I" price movements are triggered by news also in "world II"). These overshooting price changes amount to 12 between t = 1 and t = 7. The overall price changes over this period amount to 30 (8 + 10 + 12), whereas only cumulative price changes of 10 (4 + 2 + 4) would be fundamentally justified.

This stylized example shows that once prices start to overshoot, their overall price path becomes much longer and the related transaction volumes get much bigger than under purely rational expectations (as in "world I"). At the same time the trending of asset prices provides opportunities for technical (*i.e.*, non-fundamental) speculation, and the use of these speculation systems in turn strengthens asset price trends.

5.3. PATTERN OF ASSET PRICE DYNAMICS

I shall now investigate how short-term runs of asset prices bring about long-term overshooting. Hence, I address the relationship between the following two phenomena:

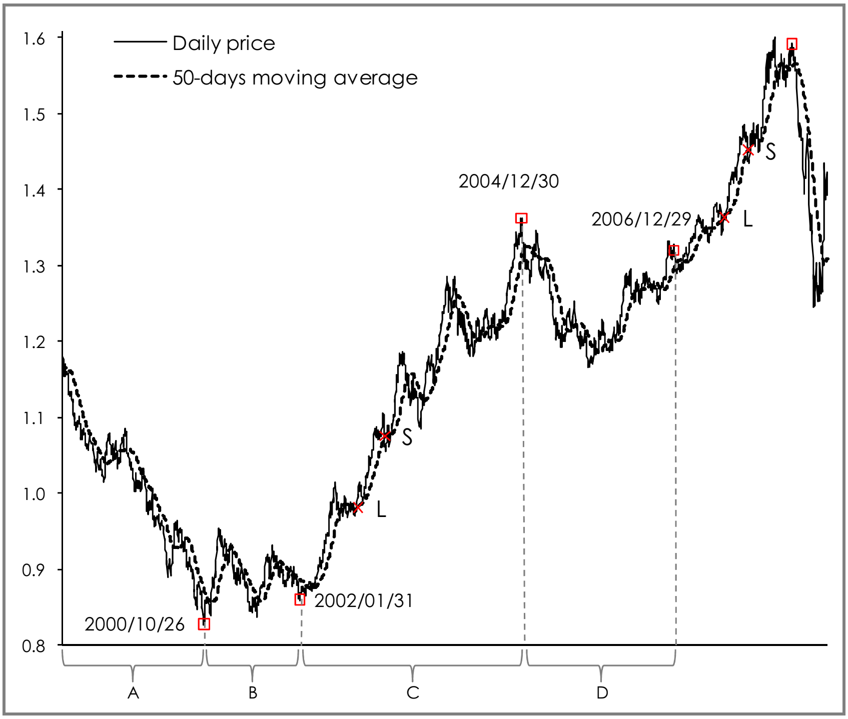
- exchange rates but also stock prices and commodity prices move in a sequence of upward trends ("bull markets") and downward trends ("bear markets") which last for several years;
- trading volume in financial markets has expanded enormously, at present it is almost 100 times higher than nominal GDP of OECD countries. This expansion is mainly driven by the acceleration of trading: The time horizon of most transactions is shorter than a few hours.

The coincidence of both developments constitutes a puzzle. How can very short-term transactions generate asset price movements which accumulate to long-term "bull markets" and "bear markets"? To put it differently: which properties of asset price dynamics cause asset prices to move in long-term irregular cycles, *i.e.*, in a sequence of upward and downward trends?

To find preliminary answers to these questions, I investigate the movements of the dollar/euro exchange rate with respect to the following hypothesis (a special case of the more general "bull-bear-hypothesis"):

- over the short run, asset prices fluctuate almost always around "underlying" trends. If one smoothes the respective price series with simple moving averages, one can easily identify the "underlying" trends;
- the phenomenon of "trending" repeats itself across different time scales. *E.g.*, there occur trends based on 1-minute-data as well as trends based on daily data. However, the volatility of fluctuations around the trend is higher the higher is the data frequency;
- long-term upward or downward trends ("bulls and bears") are the result of the accumulation of price runs based on daily data which last for several years longer in one direction than the counter-movements.

Figure 2: The movements of the dollar/euro exchange rate and technical trading signals 1999-2008

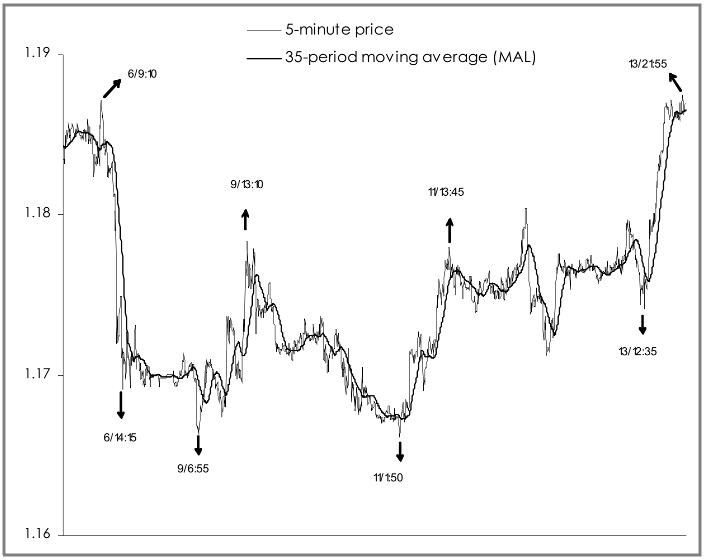


Source: Federal Reserve System, WIFO.

At first, I look at the "Gestalt" of exchange rate movements taking the dollar/euro rate as example. The (irregular) cycle of the dollar/euro exchange rate between 1999 and 2005 was shaped by two pronounced long-term trends, a downward trend lasting from January 1999 to October 2000, and an upward trend lasting from January 2002 to December 2004 (marked by A and C in figure)[2].

Both long-term trends were realised in a sequence of shorter (medium-term) trends. For example, the euro depreciation over period A was brought about in three downward trends which were interrupted by only small counter-movements (figure 2). In a similar manner the euro appreciation during period C was realised in a sequence of several trends, each lasting some months. Figure 2 shows how an extremely simple technical model would have exploited exchange rate trends: Whenever the price crosses the 50-days moving average from below (above), a buy (sell) signal is given (marked in some cases by L(ong) and S(hort) in figure 2).

Figure 3: Technical trading signals based on intraday dollar/euro exchange rates, June, 6-13, 2003 – 5-minute data



Source: Olsen Ltd., WIFO.

The pattern of exchange rate dynamics as a sequence of trends, interrupted by counter-movements and – comparatively seldom – by non-directional movements ("whipsaws"), seems to repeat itself across different time scales. Figure 3 displays exchange rate movements based on five-minute data over six business days in June 2003 (also the trading signals of a simple MA model are given).

As next step, I demonstrate how the accumulation of monotonic movements ("runs") of the daily exchange rate brings about exchange rate trends lasting

2 In the following, I present some results on a recent study (SCHULMEISTER 2009d) which covers the period 1999 to 2006. Hence, the second dollar/euro "bull market" between end 2005 and mid 2008 is not included in the analysis.

several years (as during period A and C). As table 2 shows, the euro depreciation in period A was primarily due to downward runs lasting by one third longer than upward runs (2.4 days versus 1.8 days), the average slope of upward and downward runs was approximately the same.

This pattern is particularly pronounced on the basis of 5-days moving averages of the original price series (table 2): The long-term appreciation (depreciation) trend of the $/€ exchange rate in period A (C) is primarily brought about by upward (downward) runs lasting longer than "counter-runs" – the differences in the slopes of upward and downward runs play only a minor role[3].

I will now document the distribution of the single upward and downward runs according to their length for two periods, first, for the period of a long-term depreciation trend of the euro (period A), and, second, for the period of an appreciating euro (period B).

Over the depreciation phase A, short upward runs occurred more frequently than short downward runs (93 runs compared to 69 runs; short runs are defined as lasting up to 2 days). By contrast, within the set of medium runs (between 3 and 6 days) and long runs (longer than 6 days), downward runs occurred more frequently than upward runs (table 3).

By the same token, short downward runs occurred more frequently than short upward runs over the appreciation phase C, however, medium and long runs were more often upward directed than downward directed (table 3).

Table 2: Runs of the $/€ exchange rate 1999/2006 – Daily data

	Upward runs			Downward runs		
Period	Number	Average duration in days	Average slope 1)	Number	Average duration in days	Average slope 1)
			Based on original data			
A	113	1.79	0.47	113	2.38	-0.48
B	79	1.97	0.51	79	2.13	-0.46
C	210	1.95	0.56	209	1.66	-0.51
D	139	1.80	0.51	39	1.93	-0.48
			Bsed on 5 days moving average			
A	44	3.80	0.23	45	6.64	-0.24
B	37	3.97	0.25	36	4.75	-0.20
C	70	6.77	0.24	68	4.06	-0.24
D	56	4.36	0.23	56	4.82	-0.22

Source: WIFO. – 1) Average change in exchange rate level per day in cents.

Note: Period A: 1/1/1999 bis 25/10/2005, period B: 26/10/2000 bis 31/1/ 2002,
Period C: 3/1/2002 bis 30/12/2004, period D: 31/12/2004 bis 14/11/2006.

[3] This result was already obtained in a study which elaborated the pattern of exchange rate dynamics by measuring the path of the daily deutschemark/dollar exchange rate between 1980 and 1986 (SCHULMEISTER 1987). Also the "bull markets" ("bear markets") of commodity futures are realized by upward (downward) runs lasting longer than counter-movements (SCHULMEISTER 2009a).

In order to test for the robustness of these results, I generate 1000 random series ("random walks without drift"). I then compare the observed distribution of monotonic price movements to the expected distribution under the random walk hypothesis (RWH). This comparison shall reveal in which class of runs (by length) and based on which smoothing parameter (length of moving average = MA) does the observed number of runs deviate (most) significantly from the expected number according to the RWH.

Table 3: Non-random components in the duration of exchange rate runs – Daily data

		Upward runs		Downward runs		Upward runs		Downward runs	
		observed	RWH	observed	RWH	observed	RWH	observed	RWH
		Period A: 1/1/99 to 25/10/2000				*Period C: 1/2/2002 to 30/12/2004*			
Original Data	1-2	93	88.7	69 ***	88.8	163 ***	141.9	117 ***	141.8
	3-6	20 ***	27.7	42 ***	27.5	43	44.3	32 ***	44.3
	≥ 7	0 ***	1.8	2	1.8	4	2.9	0 **	2.9
	All	113	118.2	113	118.2	210 ***	189.0	209 ***	189.1
5 days moving average 1)	1-6	37	35.9	27 *	36.0	44 **	57.2	53	57.1
	7-14	5 ***	10.4	11	10.4	18	16.6	15	16.8
	≥ 15	2	2.0	7 ***	2.0	8 ***	3.3	0 **	3.2
	All	44	48.4	45	48.4	70	77.1	68 *	77.1
20 days moving average 1)	1-14	16	18.0	11 *	18.0	29	28.7	31	28.7
	15-34	3	4.1	5	4.1	4	6.5	6	6.6
	≥ 35	0 *	1.4	4 ***	1.4	5 **	2.4	0 **	2.3
	All	19	23.5	20	23.5	38	37.5	37	37.5

1) Before being classified, the observed exchange rate series as well as the 1000 random walk series are smoothed by the respective moving average.

Notes: The table compares the observed numbers of exchange rate runs by duration to their expected means under the random-walk-hypothesis (RWH). These means are derived from a Monte-Carlo-simulation based on 1000 random walk series (without drift). The random walks were constructed with an expected zero mean of the first differences and with an expected standard deviation of the first differences as observed in the original exchange rate series over the respective period. * (**, ***) indicate the significance of the difference between the observed means and the expected means under the random-walk-hypothesis at the 10% (5%, 1%) level.

Based on the original data (MA = 1), there occurred significantly more short runs than under the RWH over the appreciation period C (this holds to a larger extent true for short downward runs as compared to short upward runs). At the same time there occurred significantly less medium and long downward runs (table 3). Over the depreciation period A, by contrast, there occurred significantly less short downward runs, but significantly more medium downward runs, and less medium and long upward runs than under the RWH (table 3).

Table 4: Non-random components in the duration of exchange rate runs – 30-Minutes data

		Upward runs		Downward runs		Upward runs		Downward runs	
		observed	RWH	observed	RWH	observed	RWH	observed	RWH
		Period A: 1/1/99 to 25/10/2000				*Period C: 1/2/2002 to 30/12/2004*			
Original Data	1-2	4571***	4037	4611***	4037	7105***	6594	7203***	6594
	3-9	1234***	1325	1196***	1324	2118*	2164	2019***	2162
	≥ 10	3***	10	2***	11	6***	16	6***	18
	All	5808***	5372	5809***	5372	9229***	8773	9228***	8773
5 periods moving average 1)	1-6	1907***	1631	1863***	1631	3040***	2664	3054***	2664
	7-14	468	477	495	479	789	779	788	782
	≥ 15	52***	93	69***	92	101***	152	88***	150
	All	2427***	2202	2427***	2202	3930***	3596	3930***	3596
50 periods moving average 1)	1-14	492	516	488	515	772**	843	785*	841
	15-34	85**	69	63	70	87***	112	114	115
	≥ 35	91**	103	117***	102	205***	169	164	167
	All	668	688	668	688	1064*	1124	1063*	1124
100 periods moving average 1)	1-14	350	363	330	364	559	595	575	596
	15-34	41	46	36*	47	63*	75	77	77
	≥ 35	70*	78	95***	76	145***	128	114*	125
	All	461	488	461	488	767	798	766	798

1) Before being classified, the observed exchange rate series as well as the 1000 random walk series are smoothed by the respective moving average.

Notes: The table compares the observed numbers of exchange rate runs by duration to their expected means under the random-walk-hypothesis (RWH). These means are derived from a Monte-Carlo-simulation based on 1000 random walk series (without drift). The random walks were constructed with an expected zero mean of the first differences and with an expected standard deviation of the first differences as observed in the original exchange rate series over the respective period. * (**, ***) indicate the significance of the difference between the observed means and the expected means under the random-walk-hypothesis at the 10% (5%, 1%).

Based on smoothed series (both, the observed exchange rate series as well as the random series are smoothed by a 5 days and 20 days moving average), the most significant deviations of the observed number of runs from their expected values under the RWH concern the most persistent runs (lasting longer than 14 days in the case of a 5 days MA, and longer than 34 days in the case of a 20 days MA – table 3). Over the depreciation period A, e. g, there occurred many "abnormally" long lasting monotonic downward movements (many more than upward movements). In an analogous way, over the appreciation period C there occurred many "abnormally" long lasting upward movements (many more than downward movements).

Finally, I show the results of the same exercise based on 30 minutes data. The frequency of these data is by a factor of 48 higher than the frequency of daily data. Hence, the length of the moving averages is much longer than in the case of daily data. The most important results for the original (unsmoothed) 30-minutes exchange rates are as follows (table 4):

– short lasting exchange rate runs occurred significantly more frequently than expected under the RWH, whereas persistent runs occurred less often than under the RWH;
– the overall number of observed exchange rate runs is significantly higher than is to be expected if 30 minutes exchange rates followed a random walk.

When the 30-minutes data are smoothed by a 50 period MA and by a 100 period MA, respectively, a very different picture emerges (table 4):

- over the depreciation period A, there occurred less short exchange rate runs than under the RWH. At the same time, there occurred significantly more long downward runs, but significantly less upward runs than under the RWH;
- also over the appreciation period C, the number of short lasting runs is smaller than expected under the RWH. Analogously to the depreciation period A, there occurred significantly more long lasting upward runs than under the RWH. At the same time there occurred less persistent downward runs;
- the overall number of upward and downward runs is in all but one case (period A/50 period MA) lower than expected under the RWH.

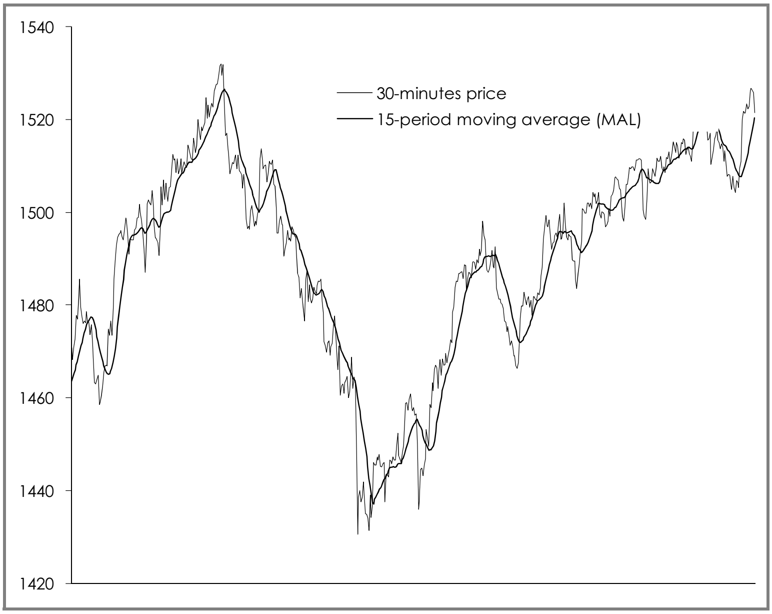
To conclude: The volatility of exchange rates based on intraday data, *i.e.*, the frequency of short lasting ups and downs, is even higher when measured on the basis of intraday data than on daily data. In both cases the observed short-term volatility is higher than in the case of a random walk. However, in both cases the exchange rate fluctuates around an "underlying" trend. As a consequence, there occur less short lasting runs and more long lasting (persistent) runs when the exchange rate series is smoothed by moving averages. Persistent upward (downward) runs last longer during an appreciation (depreciation) phase than the counter-movements. Hence, the sequence of these runs results in a stepwise appreciation (depreciation) process, *i.e.*, in long-term exchange rate trends.

This pattern in the dynamics of speculative prices conflicts with the most fundamental assumption of the "efficient market hypothesis". According to this concept any asset price reflects the fundamental equilibrium value of the respective asset. If new information arrives, actors will drive the price instantaneously to its new equilibrium. This (rational) behaviour assures that asset prices follow a random which in turn implies "weak market efficiency". This concept means that one cannot systematically make trading profits from exploiting just the information contained in past prices (as do the popular trading rules of technical analysis)[4].

Since the most popular trading technique in financial markets, the so called "technical analysis", is based on the (assumed) exploitability of asset price trends, I shall finally sketch the interaction between this trading practice and asset price dynamics.

4 Recent contributions to the debate about the efficiency of asset markets are LE ROY (1989), SHILLER (2003), LO (2004).

Figure 4: Technical trading signals for the S&P500 futures contract, July and August, 2000



Source: Futures Industry Instittute (Washington D.C.), WIFO.

5.4. TECHNICAL TRADING AND THE TRENDING OF ASSET PRICES

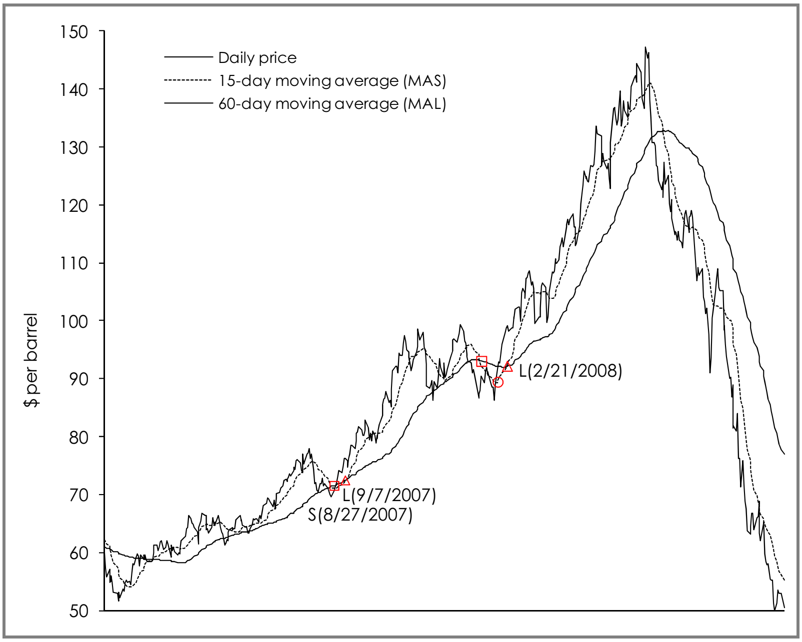
Technical analysis tries to exploit price trends which "technicians" consider the most typical feature of asset price dynamics ("the trend is your friend"). Hence, these trading techniques derive buy and sell signals from the most recent price movements which (purportedly) indicate the continuation of a trend or its reversal (trend-following or contrarian models)[5]. Since technical analysts believe that the pattern of asset price dynamics as a sequence of trends interrupted by "whipsaws" repeats itself across different time scales, they apply technical models to price data of almost any frequency, ranging from daily data to tick data.

According to the timing of trading signals, one can distinguish between trend-following strategies and contrarian models. Trend-following systems produce buy (sell) signals in the early stage of an upward (downward) trend, whereas contrarian strategies produce sell (buy) signals at the end of an upward (downward) trend, *e.g.*, contrarian models try to identify "overbought" ("oversold") situations.

[5] KAUFMAN (1987) provides an excellent treatment of the different methods of technical analysis. For a short description of the most important trading rules see SCHULMEISTER (2007a).

Technical analysis is omnipresent in financial markets. In the foreign exchange market, *e.g.*, technical analysis is the most widely used trading technique (for recent survey studies see CHEUNG *et al.*, 2004; GEHRIG and MENKHOFF, 2006; MENKHOFF and TAYLOR, 2007). It seems highly plausible that technical analysis plays a similar role in stock (index futures) markets as well as in commodity futures markets (IRWIN and HOLT, 2004, provide evidence about the popularity of technical analysis in futures markets).

Figure 5: Technical trading signals for WTI crude oil futures contract 2007-2008

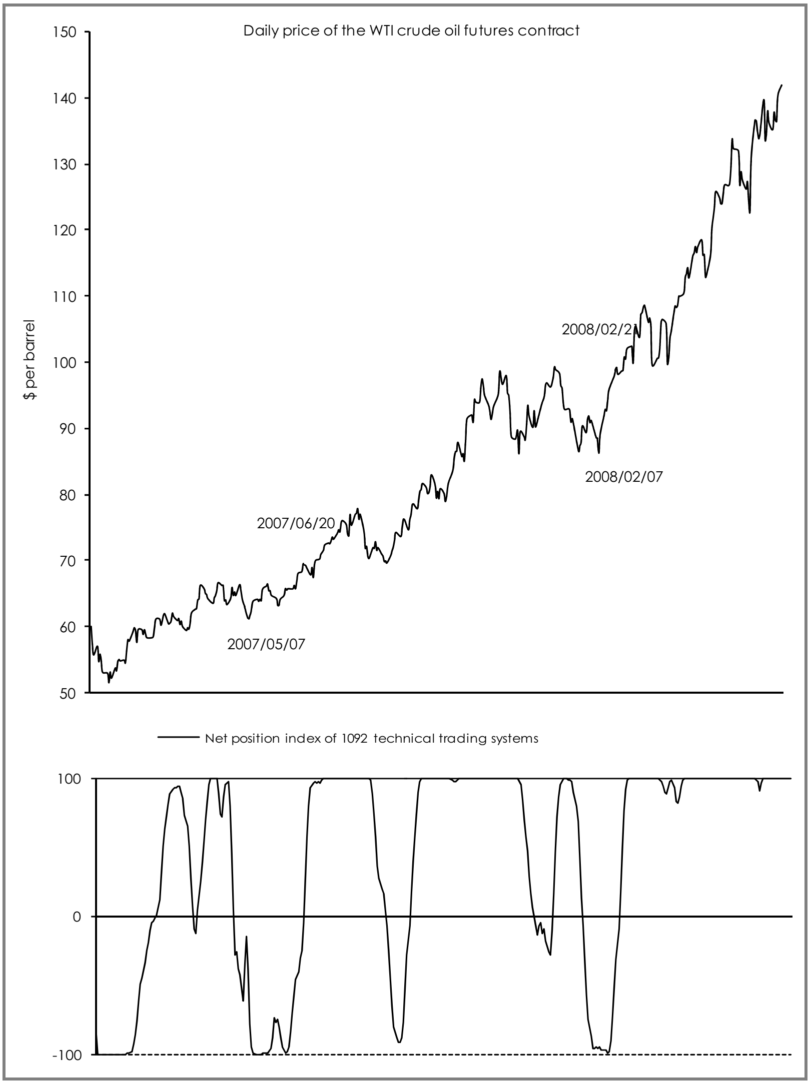


Source: NYMEX, WIFO.

Many factors have contributed to the popularity of technical trading systems among practitioners. First, these systems can be "universally" used, *i.e.*, they can be applied to any kind of price data frequency. Second, these price data have become easily available (at ever falling costs). Third, computer software has been continuously improved (and got cheaper at the same time). Fourth, the internet has enabled traders (professionals as well as amateurs) to trade in real time on all important market places in the world.

Figures 2, 3, 4, 5 show how simple MA models based on different data frequencies operate in the dollar/euro market, the stock index futures market and the oil futures market (if a model uses two moving averages, then their crossing indicates a trading signal). There is one universal property of the performance of technical trading systems in asset markets of all kinds: these models produce (much) more often single losses than single profits, however, profitable positions last on average three to four times longer than unprofitable positions which causes the models to (often) produce an overall profit. This profitability pattern reflects the fact that technical trading systems focus on the exploitation of price trends (for a detailed analysis of profitability of technical models in different asset markets see Schulmeister, 2008a, 2008b, 2009a, 2009c, 2009d).

Figure 6: Aggregate trading signals of 1092 technical models and the dynamics of oil futures prices, January 2007 to June 2008



Source: NYMEX, WIFO.

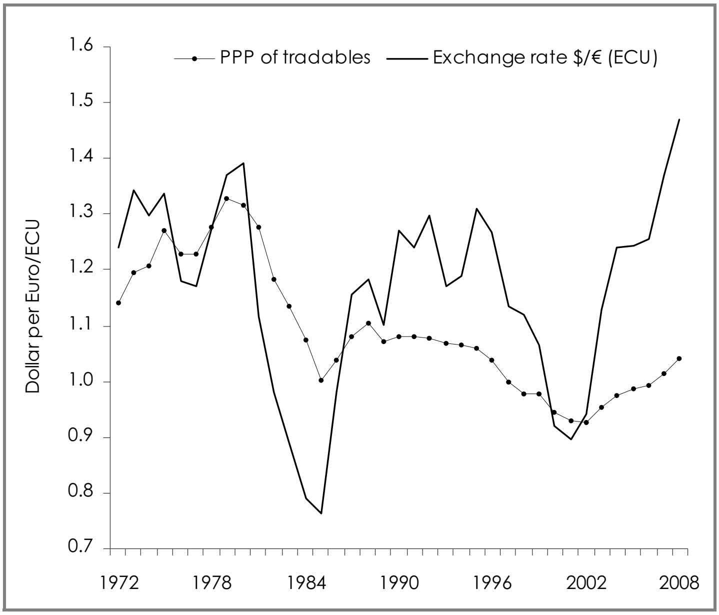
There operates an interaction between the "trending" of asset prices and the use of technical models in practice. On the one hand, many different models are used by individual traders aiming at a profitable exploitation of asset price trends, on the other hand the aggregate behaviour of all models strengthen and lengthen price trends. Figure 6 documents this interaction, it compares the change in the aggregate position of 1092 technical models in the oil futures market to the movements of the oil futures price (a value of +100 (-100) of the net position index means that 100% of the models hold a long (short) position).

Figure 6 shows the gradual adjustment of the 1092 technical models to oil futures price movements between January 2007 and June 2008. On February 7, 2008, *e.g.*, all models hold a short position due to a preceding decline in oil futures prices. The subsequent price rise causes the models to gradually switch their position from short to long, the "fast" models at first, the "slow" models at last. On February 21, all models hold a long position. During this transition period from short to long, technical models exert an excess demand on oil futures since any switch implies two buy transactions, one to close the (former) short position, and one to open the (new) long position.

Studies on the aggregate trading behaviour of the many different models, based on daily as well as on intraday data and operating in different markets reveals the following (Schulmeister, 2006, 2009a, 2009c, 2009d). First, most of the time the great majority of the models is on the same side of the market. Second, the process of changing open positions usually takes off 1 to 3 days (or 30-minute intervals) after the local futures price minimum (maximum) has been reached. Third, it takes between 10 and 20 trading days (or 30-minute intervals) to gradually reverse the positions of (almost) all models if a persistent price trend develops. Fourth, after all technical models have adjusted their open positions to the current trend, the trend often continues for some time.

One can therefore conclude that the widespread use of technical trading systems strengthens and lengthens short-term asset price trends (runs). At the same time, the sequence of price runs accumulates to long-term trends when an expectational bias ("bullishness" or "bearishness") prevails in the market. Hence, the technical trading together with the frequent predominance of a "market mood" can be considered the most important causes of the overshooting of asset prices. I shall present some empirical evidence on this phenomenon.

Figure 7: Dollar/euro exchange rate and purchasing power parity

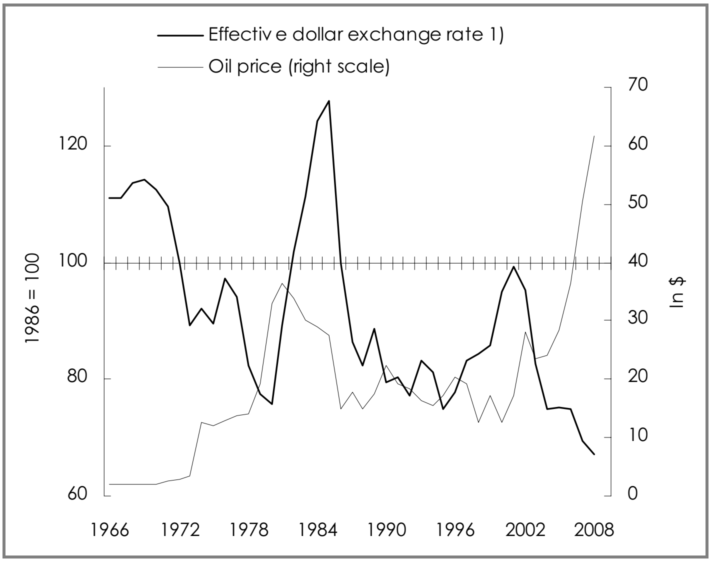


Source: OECD, WIFO, Schulmeister (2005).

5.5. OVERSHOOTING OF ASSET PRICES

Figure 7 shows the wide fluctuations of the US-dollar/Euro(ECU) exchange rate around its theoretical equilibrium level, *i.e.*, the purchasing power parity (PPP) of internationally traded goods and services (for the calculation of PPP based on tradables see Schulmeister, 2005).

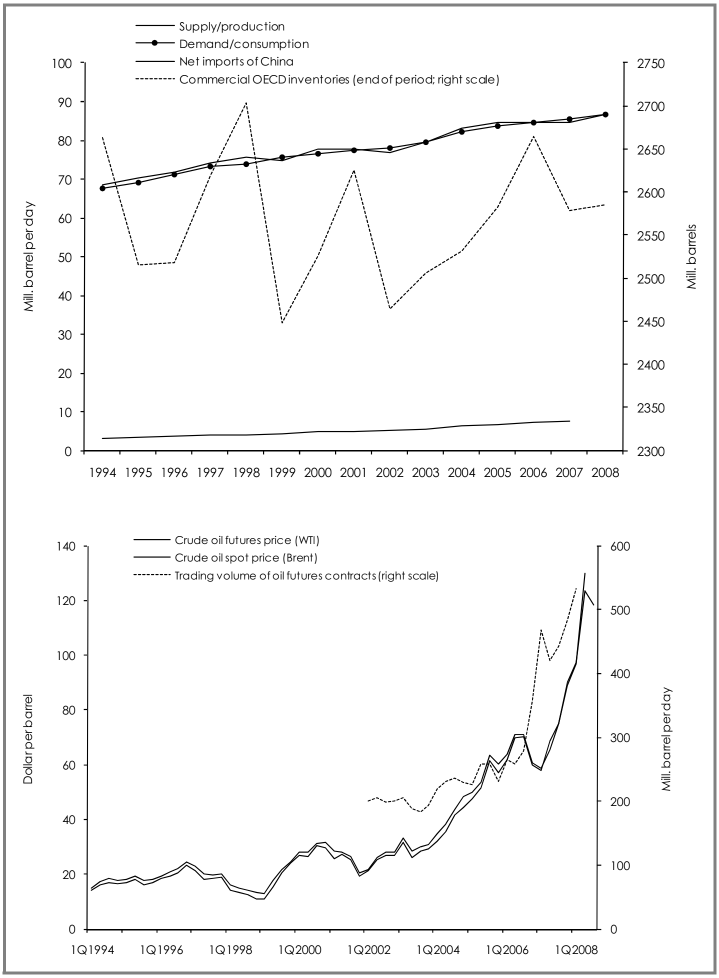
Figure 8: Dollar exchange rate and oil price fluctuations



Source: OECD, IMF. - 1) Vis-à-vis DM, Franc, Pound, Yen.

Figure 8 displays the sequence of booms and busts of the US dollar exchange rate and of the crude oil price since the late 1960s. Even though one can hardly quantify the fundamental equilibrium price of crude oil, it seems implausible that the latter fluctuates as widely as the market price (figure 8). It is much more plausible that oil price overshooting is the result of the interaction between news-based trading and technical trading in oil futures markets.

Figure 9: World market for crude oil, oil futures trading and oil price movements

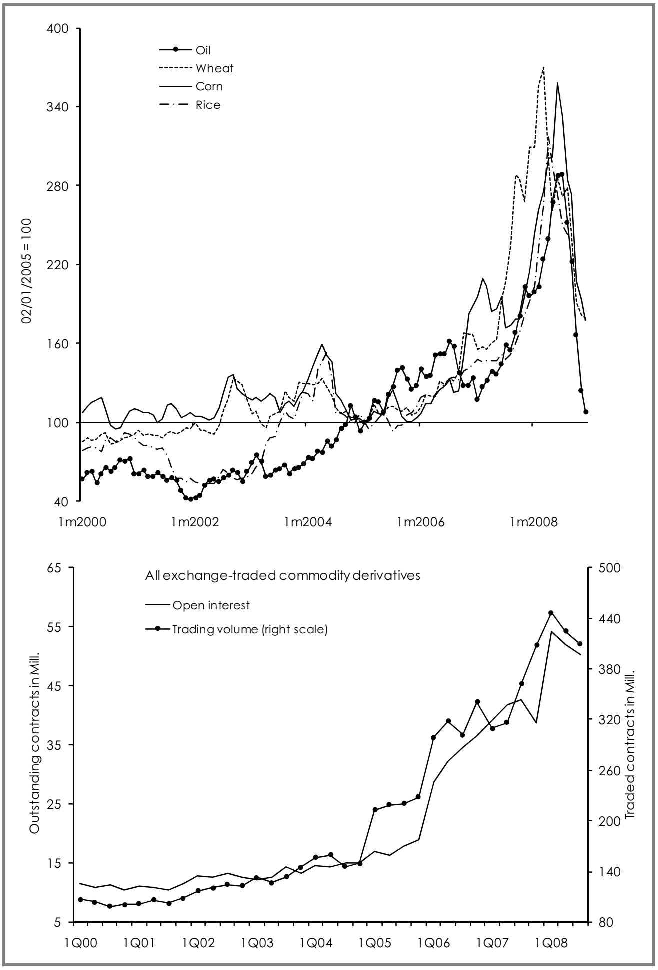


Source: Energy Information Agency (EIA), OECD, New York Mercantile Exchange (NYMEX), Intercontinental Exchange (ICE), WIFO.

This presumption is confirmed by the development of supply and demand in the market for physical oil as well as by the expansion of trading activities in the oil derivatives markets (figure 9). During the oil price boom between 2002 and 2008, oil production rose slightly stronger than demand, causing inventories to rise. The demand for oil of China – often quoted as the most important single cause for the oil price boom – can hardly explain the extent of the oil price increase. Net oil imports of China account for only 9% of global demand (China still produces roughly half of its oil consumption). Moreover, China's net oil imports have expanded very continuously over the past 15 years (figure 9).

The tremendous increase in trading activities in oil futures markets since 2003 suggests that (technical) speculation might have contributed significantly to the oil price boom (figure 9). This presumption gets support from the fact that also the boom of other commodity prices coincided with a spectacular rise in trading of commodity derivatives in general, in particular since 2006 (figure 10).

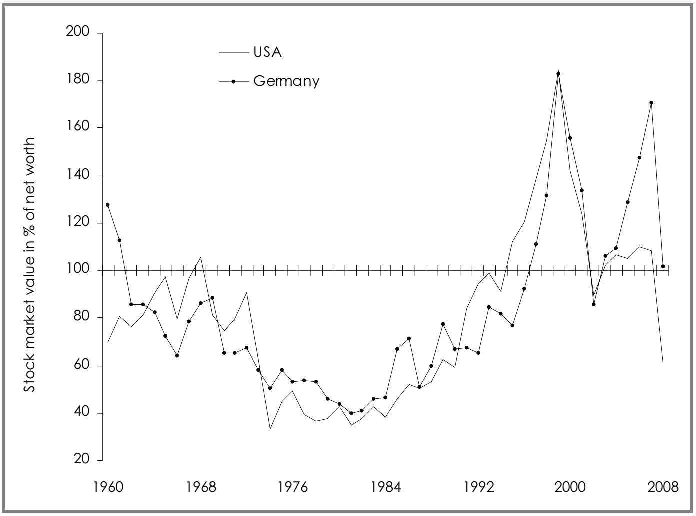
Figure 10: Dynamics of commodity futures prices and derivatives trading activities, 2007-2008



Source: New York Mercantile Exchange (NYMEX), Chicago Board of Trade (CBOT), BIS, WIFO.

Figure 9 also suggests that the overshooting of the dollar exchange rate and the overshooting of the oil price are inversely related to each other, at least during periods of marked "bull markets" and "bear markets". Since the dollar serves as global key currency, crude oil is priced in dollars (like all other commodities). As a consequence, any dollar depreciation devalues real oil export earnings. This valuation effect in turn strengthens the incentive for oil-producing countries to increase the price of their most important export good. If their market power is strong, oil exporters are able to put through oil price increases which by far over-compensates them for the losses due to the preceding dollar depreciation. The oil price "shocks" 1973/74, 1978/80 and 2002/2007 are the most impressing examples for the inverse relationship between dollar depreciations and subsequent oil price movements (see also Schulmeister, 2000).

Figure 11: Stock market value and net worth of non-financial corporations



Source: Fed, Deutsche Bundesbank, Schulmeister (2003).

Figure 11 shows that stock prices in the US and Germany became progressively undervalued over the 1960s and 1970s: The stock market value of non-financial corporations strongly declined relative to their net worth (real assets at goods market prices minus net financial liabilities[6]. This development can be explained by the fact that during this the striving for profits focused on the real side of the economy. As a consequence, real capital accumulation was booming und stock prices rose comparatively little (partly because corporate business financed investments through increasing the supply of stocks).

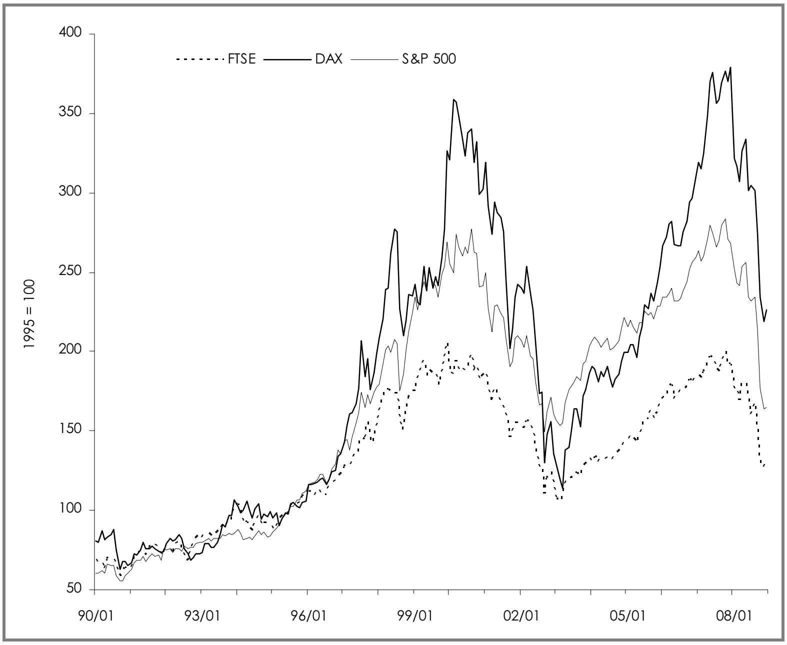
The stock market boom of the 1980s and 1990s and the slow-down in real investment dynamics caused stock prices to become progressively overvalued. By the end of the 1990s the stock market value of corporate business in the US as well as in

6 The relation depicted in figure 11 is an estimate of Tobin's q. For the data series and the method to calculate this relation see SCHULMEISTER (2003).

Germany was roughly 80% higher than its net worth. This discrepancy was the most important cause of the “tilt” from a “bull market” into a “bear market” in 2000.

Between spring 2003 and summer 2007 stock prices were again booming, in Germany even stronger than in the US. At the same time real investment expanded in the US much stronger than in Germany. Hence, the discrepancy between the stock market value of non-financial corporate business and its net worth rose much stronger in Germany than in the US (figure 11). Unsurprisingly, since summer 2007 stock prices have fallen much stronger in Germany as compared to the US.

Figure 12: Stock price fluctuations in Germany, the United Kingdom and the US



Source: Yahoo Finance (http://de.finance.yahoo.com/m8).

Figure 12 shows the two “bull markets” and two “bear markets” which developed since the mid 1990s. The amplitude of the irregular cycles is much higher in the case of Germany as compared to the traditional market places in the US and the UK. Also this observation confirms the presumption of a systematic overshooting of asset prices: The real economy in Germany fluctuated less than in the US or the UK (the German economy was stagnating most of the time since the mid 1990s), and also the recovery between 2003 and 2007 was much weaker in Germany than in the US or the UK.

Equilibrium economics under rational expectations cannot account for wide fluctuations of asset prices around their fundamental equilibrium. This is so because conventional theory can only explain two types of equilibrium paths, either convergence towards the fundamental equilibrium or a bubble. Hence, exactly that phenomenon, which can most easily be observed in real life and which practitioners call sequences of "bulls" and "bears", remains unexplained in mainstream economics.

Empirical exchange rate studies, *e.g.*, conceive the "purchasing power parity puzzle" primarily as the (unexplained) low speed at which an over- or undervalued exchange rate returns to its fundamental equilibrium. The preceding process of "overshooting" is simply attributed to "shocks" and, remains unexplained (Rogoff, 1995; Sarno and Taylor, 2002; Taylor and Taylor, 2004). This kind of perception prevents conventional economists from looking at the interdependency between upward trends and downward trends in asset price dynamics.

Empirical stock market studies focus in most cases on specific "anomalies" like the "momentum effect" (caused by the "trending" of stock prices) or the "reversal effect" (caused by trend reversals). However, these phenomena are not analyzed in the context of the irregular cyclicality of asset prices (for surveys of empirical stock market studies see Campbell, 2000; Cochrane 1999; Lo and MacKinlay, 1999; Shiller, 1999). An important reason for this "myopic" perception lies in the fact that the relatively new and popular school of "behavioural finance" uses equilibrium concepts as the reference or benchmark models, too. As a consequence, observations which contradict equilibrium models can only be perceived as "anomalies"[7].

5.6. DEVELOPMENT OF THE CURRENT CRISIS

The sequence of "bull markets" and "bear markets", and, hence, the overshooting of exchange rates, commodity prices and stock prices, affects the real sphere of the economy through many channels, *e.g.*, by increasing uncertainty, by producing waves of positive and negative wealth effects (strengthened by the rising importance of pension and college funds), by inflating and deflating the balance sheets of financial institutions and by redistributing trade earnings between consumers and producers of commodities:

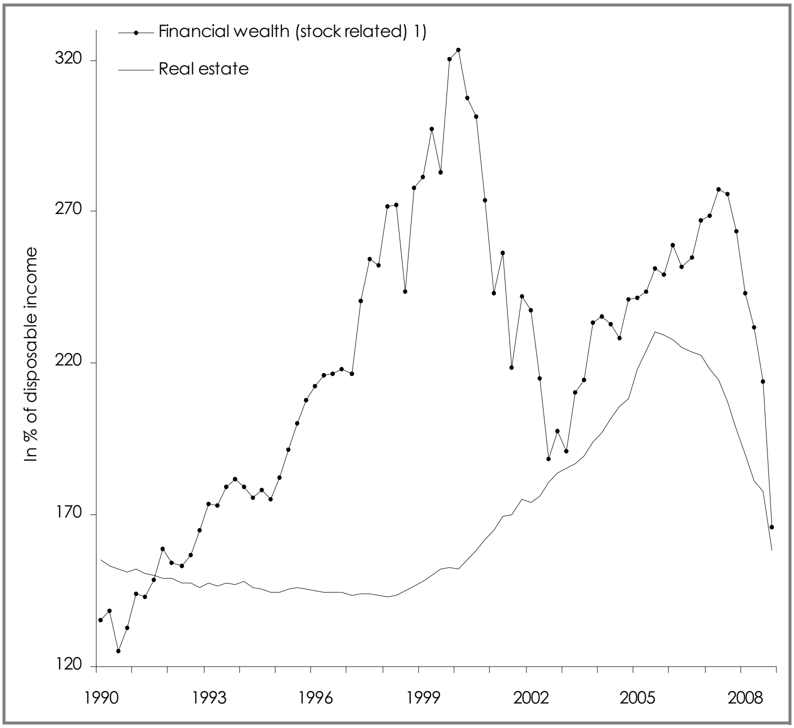
– the boom of stock prices in the 1990s and again between 2003 and 2007 as well as the boom of house prices between 1998 and 2005 stimulated the US economy through positive wealth effects (figure 13). At the same time, however, the "twin booms" led the ground for the subsequent "twin busts". The

[7] SCHULMEISTER (1987) and FRYDMAN and GOLDBERG (2007) offer models which explain asset price dynamics as a sequence of systematically overshooting upward and downward trends ("bulls" and "bears"). For the "long swings" of the dollar exchange rate see ENGEL and HAMILTON (1990).

related devaluation of financial as well as housing wealth will depress consumption and investment for years (figure 13);

- after the outbreak of the sub-prime mortgage crisis the third "bull market", *i.e.*, the commodity price boom, accelerated, mainly driven by speculation of financial investors in commodity derivatives markets (figures 5, 6 and 10). This development further deteriorated global economic prospects;
- since mid 2008 the devaluation process of stock wealth, housing wealth and commodity wealth is globally "synchronized" (as was the preceding "triple booms"). This – in part still ongoing – process sets free several contraction forces, not only through wealth effects and balance sheet compression but also via import reductions on behalf of commodity producers (commodity prices fell by roughly 60% within 4 months – figure 10);
- the fall of stock prices and commodity prices has been strengthened by trend-following technical trading via taking huge short positions in the respective derivatives markets. Due to the extraordinary strength of these "bear markets", hedge funds using these models (in many cases "automated trading systems") reported higher returns than ever before (figure 16).

Figure 13: Wealth of private household in the US

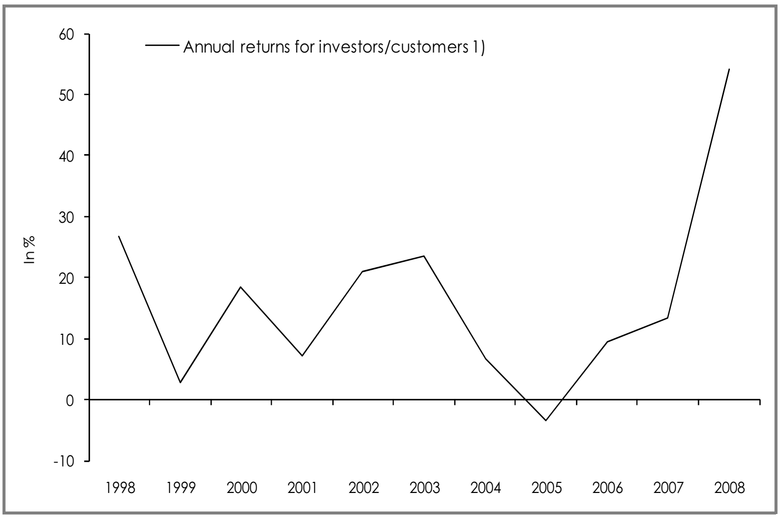


Source: Federal Reserve Board, OEF. - 1) Stocks, Investment funds, Pension funds.

The "epicentre" of the "financial tsunami" is the threefold wealth devaluation process (the last time when stock wealth, housing wealth and commodity wealth collapsed simultaneously was between 1929 and 1933). The extent of this devaluation process was made possible through the preceding overvaluation through the simultaneous boom of stock prices, house prices and commodity prices. The three "bull markets" and the three "bear markets", are the result of "business as usual" in modern financial markets (I do not need exceptionally greedy bankers etc. to explain how the potential for the crisis was built up).

Many feed-back processes strengthened the process of wealth devaluation (*e.g.*, the fall in house prices caused more and more homeowners to default on their mortgage, the subsequent foreclosures depressed house prices further). One feed-back process is most typical for modern "finance capitalism" (figure 14): Trend-following hedge funds opened huge short positions in the markets for stock and commodity derivatives in reaction to the price decline in these markets (in particular after the default of Lehman Brothers). This "bear speculation" became extremely profitable for these hedge funds due to the steepness of the asset price fall. At the same time, this strategy strengthened the asset price decline and, hence, the devaluation of the savings of 100 million people all over the world.

Figure 14: Profitability of trend-following hedge funds



Source: www.turtletrader.com 1) Unweighted average of the returns net of fees and transaction costs of 17 hedge funds using trend-following technical trading systems.

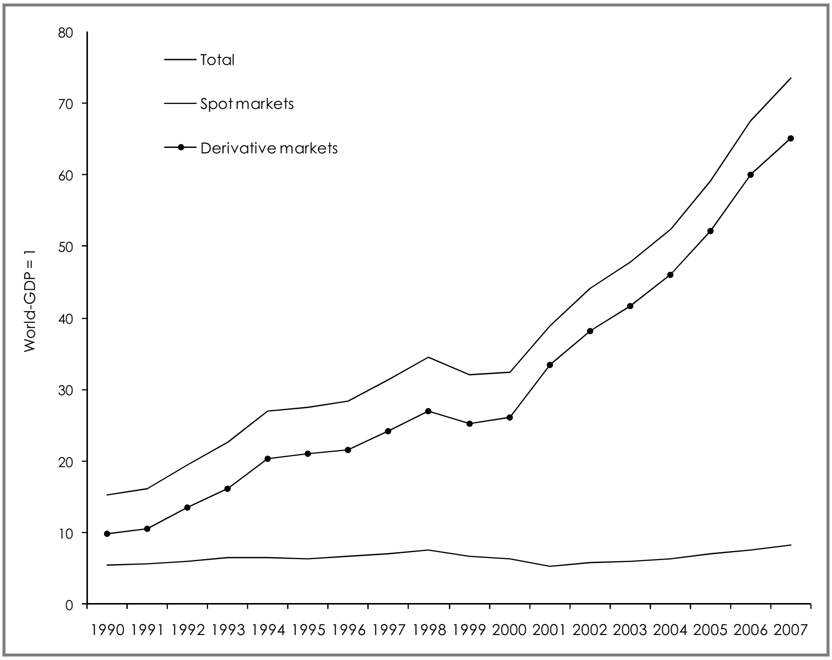
The transformation of financial markets and institutions from a sector servicing the "real economy" to an (dominant) sector to which the "real economy" has to adjust, can only be understood in the context of the latest "long cycle" (Schulmeister, 1998).

The trough of this cycle was the Great Depression of the 1930s. The learning process enforced by this crisis resulted in a new macro-economic theory (Keynesianism), an active economic policy focusing on stable growth and full employment, a stable international monetary system ("Bretton Woods"), de-regulation of goods markets (*e.g.* though the GATT rounds), but strict regulation of financial markets. The essential characteristic of the system was the following: The driving force of capitalist development, the striving for profits, was systematically directed towards activities in the "real economy" (hence, I termed this regime "real capitalism" – Schulmeister, 2004). Under these conditions the "Golden Age" of capitalism was realized over the 1950s and 1960s.

The "monetarist counterrevolution" of the late 1960s got support from "big business" because permanent full employment had strengthened trade unions as well as the welfare state. The stepwise realization of the monetarist/neo-liberal demand for de-regulation of financial markets changed the "rule of the capitalistic game" fundamentally. Under the condition of widely fluctuating exchange rates and commodity prices, and of a high interest-growth-differential (until the late 1970s interest rates had been kept lower than the rate of economic growth), financial and non-financial business shifted activities from the "real economy" to financial investment and short-term speculation ("finance capitalism"). This shift was supported by the tremendous amount of financial innovations (*i.e.*, derivatives of all kinds) which have been realized since the 1980s as well as by the rising instability of asset prices. Both factors provided more and more chances for making huge speculative profits from short-term trading.

The expansion of financial transactions is therefore one of the most typical characteristics of the late phase in a "finance-capitalistic" development (together with the rising instability of those asset prices which are most important for the "real economy" like exchange rates, commodity prices and stock prices).

Figure 15: Overall financial transactions in the world economy



Source: Bank for International Settlements (BIS), World Federation of Exchanges (WFE), WIFO.

5.7. DYNAMICS OF FINANCIAL TRANSACTIONS

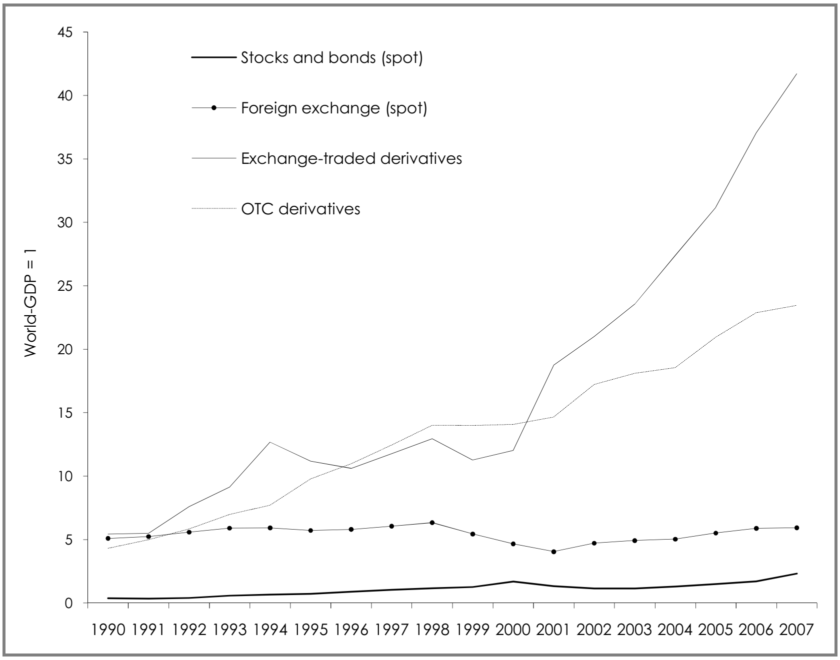
Trading activities in financial markets have exploded over the past 20 years[8]:

- there is a remarkable discrepancy between the levels of financial transactions and the levels of transactions in the "real world". In 2007, the former was roughly 74 times higher than nominal world GDP. This discrepancy has risen tremendously since the late 1990s (figure 15);
- trading in derivatives markets has expanded significantly stronger than trading in spot markets, this holds true for any kind of asset/instrument. In the world economy, derivatives trading volume is roughly 66 times higher than world GDP, whereas spot trading amounts to "only" 8 times world GDP (figure 15);
- trading of futures and options on organized exchanges (which is open to the general public) has risen stronger than "over-the-counter"-transactions (which are restricted to professionals), in particular since 2000 (figure 16);

8 A comprehensive estimate of financial transaction in the global economy, differentiated by types of instruments and regions, is provided by SCHULMEISTER, SCHRATZENSTALLER and PICEK (2008).

– these developments are particularly pronounced in Europe where the volume of financial transactions was more than 100 times higher than nominal GDP;
– given the spectacular level of derivatives trading only a comparatively small share of transactions stem from hedging activities. The greatest part of transactions is related to speculative trades between actors with heterogeneous price expectations.

Figure 16: Financial transactions in the world economy by instruments



Source: Bank for International Investments (BIS), World Federation of Exchanges (WFE), WIFO.

5.8. STABILIZING EFFECTS AND REVENUE POTENTIAL OF A GENERAL FINANCIAL TRANSACTION TAX

A small financial transaction tax (hereafter FTT) would dampen the fluctuations of exchange rates, stock prices and commodity prices over the short run as well as over the long run. At the same time, such a tax would yield substantial revenues.

A general FTT would specifically dampen very short-term oriented and destabilizing trading in derivatives markets. There are two reasons for that. First, a FTT makes trading the more costly the shorter its time horizon is (*e.g.*, technical trading based on intraday data). Second, a FTT will dampen specifically derivatives trading since the tax rate refers to contract value (*e.g.*, the effective tax on the margin "invested" is by the leverage factor higher than the tax relative to the value of the transaction).

Derivatives transactions for hedging purposes as well as "real-world-transactions" (spot) would hardly be affected by a low FTT between 0.1% and 0.01%.

Assuming that trading declines due to the introduction of a FTT of 0.01% (1 basis point) by roughly 30%, overall tax revenues would amount to 0.529% of world GDP or 287.3 bill. $ (based on 2007 data – table 5). More than half of the revenues (164.4 bill. $) would stem from derivatives transactions on exchanges (these transactions could be taxed most easily due to the use of electronic settlement systems). Taxes on spot transactions would amount to only 11.6 bill. $.

In Europe (EU27 plus Norway and Switzerland) a FTT at the (low) rate of 0.01% would yield roughly 130 bill. $ or 0.734% of nominal GDP (table 1).

Table 5: Hypothetical transaction tax receipts in the global economy 2007

	World		Europe		North America		Asia and Pacific	
	In % of GDP	In Bill. $	In % of GDP	In Bill. $	In % of GDP	In Bill. $	In % of GDP	In Bill. $
Spot transactions on exchanges	0.0233	12.8	0.0251	4.4	0.0384	6.0	0.0335	2.2
Derivatives transactions on exchanges	0.2975	163.2	0.3170	56.2	0.5883	91.2	0.2167	14.0
OTC Transactions	0.2059	112.9	0.3818	67.7	0.1529	23.7	0.3144	20.3
All transactions	0.5268	288.9	0.7239	128.4	0.7796	120.9	0.5646	36.5

The introduction of a general FTT could help to overcome the current economic crisis and to prevent similar crises in the future. This is so for several reasons. First, such a tax addresses one of the most important factors of building up the potential for the ongoing devaluation of financial and commodity wealth, *i.e.*, the "manic-depressive" fluctuations of stock prices, exchange rates and commodity prices. Second, a low FTT of 0.01% would specifically dampen short-term and destabilizing transactions in derivatives markets. Third, the revenues of a FTT are substantial (even at a rate of only 0.01%), and this would help governments to consolidate their fiscal stance.

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