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WHAT DO WE KNOW ABOUT MARKET DISCIPLINE IN INSURANCE?

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What Do We Know about Market Discipline in Insurance?

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Abstract

The aim of this paper is to summarize the knowledge on market discipline in insurance and other financial service sectors. Market discipline can be defined as the ability of customers, investors, intermediaries (agents, brokers), and evaluators (analysts, auditors, rating agencies) to monitor and influence a company's management. Looking at banking is especially interesting, since market discipline in this field has been studied extensively. Based on existing knowledge, we develop a framework for researching market discipline in insurance that includes its most important drivers and impediments. The results highlight a significant need for continuing research. The findings are of relevance not only for European insurers and regulators, but for institutions outside Europe.

1 Introduction

An important new dimension of the regulatory environment in banking and insurance is explicit reliance on market discipline. Market discipline—the influence of customers, investors, intermediaries (e.g., agents), and evaluators (e.g., rating agencies) on firm behavior—is a central element of both Basel II and Solvency II. Market discipline has been a perennial topic of research in the financial services sector since the 1970s (see Flannery, 2001). Likely due to the fact that Basel II has been in force for several years, most research into market discipline's ability to regulate financial services has focused on banking (see, e.g., Martinez Peria and Schmukler, 2001; King, 2008), but some research has also been conducted for the insurance sector.[1] Solvency II should add even more impetus to the study of market discipline. It is thus

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[1] Related papers, such as Harrington (2004, 2005) and Nocera (2005), will be discussed in detail throughout this paper. Another excellent introduction to market discipline in the German language is Hartung (2005). Furthermore, Solvency II's approaching effective date has resulted in several recent empirical studies on market discipline in insurance (e.g., Eling and Schmit, 2011). Also, experimental evidence from behavioral insurance (Wakker, Thaler, and Tversky, 1997; Albrecht and Maurer, 2000; Zimmer, Schade, and Gründl, 2009; Zimmer, Gründl, and Schade, 2009) is relevant for market discipline. Furthermore, the European Commission conducted research when designing Solvency II (see CEIOPS, 2009 and other information on

important to consider what is already known about market discipline in the insurance and related sectors.

To that end, this paper summarizes extant knowledge on market discipline in insurance and other financial services sectors. Looking at banking is especially interesting, since market discipline has been studied extensively in this field and much can be learned from that work. Based on existing knowledge, we develop a framework for researching market discipline in insurance that includes its most significant drivers and impediments. Our results also highlight a significant need for future research.

The results provide a clearer understanding of how market discipline works as a direct and indirect mechanism for *monitoring* and *influencing* by *customers*, *investors*, *intermediaries*, and *evaluators*. There are significant differences between banking and insurance with regard to market discipline. We also identify important differences between lines of business and legal forms in the insurance industry, which reveal that market discipline might be weak in some areas (e.g., in personal lines with complex products or with mutuals) and strong in others (e.g., in commercial lines or with stocks). We thus find a number of reasons why a "one-model-fits-all" approach might be inappropriate for market discipline in the insurance industry. The results of this analysis will be useful for insurers, regulators, and policymakers involved in revising regulatory standards both in Europe and in other markets. The article is not meant as an argument in favor of any particular type of regulation, but as an outline of potential impediments regulators may face in their efforts to enhance market discipline.

This paper is organized as follows. In Section 2 we review definitions and characteristics of market discipline that highlight differences between insurance and other financial services sectors. In Section 3 we take a look at the extant literature, especially that involving the banking field, and derive drivers of and impediments to market discipline in insurance. Section 4 concludes with potential policy implications and a summary of future research needs.[2]

2 Definition and measurement of market discipline

2.1. Definition of market discipline

There are several definitions of market discipline currently in use. For example, in the banking literature, there is widespread agreement that market discipline involves two distinct components (see Flannery, 2001; Bliss and Flannery, 2002, Forssbæck, 2009): (1) the ability of

the Commission's Internet pages). Finally, there is a long research tradition in the field of theory of competition, which is related to this topic (see, e.g., Stigler, 1971; Joskow, 1973; Posner, 1974; Munch and Smallwood, 1981; Stiglitz, 1984).

[2] Throughout this work, we analyze the role of both investors and customers in market discipline, instead of focusing on just one of these stakeholders; we also do not focus on any specific country. It is, however, important to keep in mind that differences across countries, such as governance mechanisms, insolvency experiences, and cultural norms, will affect the level of market discipline.

market participants to accurately assess the condition of a firm (*monitoring*) and (2) their ability to impact management action in a way that reflects that assessment (*influencing*). Market discipline thus has both an indirect and direct dimension (see Forssbæck, 2009). Monitoring captures the information aspect of market discipline, i.e., current and prospective bank claimants inform themselves about the bank's condition and set prices for their claims accordingly. Influence refers to the mechanism by which banks, in order to avoid the adverse consequences of stronger discipline (such as higher financing costs and, ultimately, liquidity problems) decrease their risk exposure or avoid increasing it in the first place.[3]

In the insurance field and with regard to the first component (monitoring), intermediaries (agents, brokers), evaluators (auditors, analysts, rating agencies), and regulators assess the financial strength and service quality of insurers. Due to the post-insolvency assessment funding mechanism of many guaranty funds and potential contagion effects of financial problems among insurers, insurers in selected lines also have an incentive to monitor each other (see Downs and Sommer, 1999). Overall, it thus seems that there are enough market participants willing to monitor risk taking in insurance. Guarantee schemes and the opaqueness of some insurers, however, could limit the willingness and ability to observe insurer behavior (see Lee, Mayers, and Smith, 1997; Babbel and Merril, 2005; Pottier and Sommer, 2006; Zhang, Cox, and Van Ness, 2009).

The second component, influencing, is difficult to evaluate. The finance literature contains numerous reasons why we should be skeptical about the ability of market participants to influence managers (see Bliss and Flannery, 2002), including asymmetric information, costly monitoring, principal-agent problems, and conflicts of interest among stakeholders. Another impediment to market discipline is a legal environment that makes shareholder activism, e.g., a hostile takeover, difficult. From the shareholders' perspective, monitoring and incentive contracts can be combined to mitigate the agency problem, and there are also other mechanisms that may induce managers to act in the shareholders' best interests, such as reputational concerns, competitive labor markets, and the threat of takeover, dismissal, or bankruptcy (see Aggarwal and Samwick, 1999). The insurance sector has a number of characteristics that might limit the influencing component. For example, there is a relatively small risk of a bank run, at least in selected lines.[4] Furthermore, especially in personal lines, individual policy-

[3] Compared to the neoclassical definition of market discipline in a complete and frictional market with symmetric information (leading to different willingness to pay depending on the default put option value; see Doherty and Garven, 1986), these definitions typically emphasize the aspect of asymmetric information, which is reduced by increasing market transparency.

[4] In non-life insurance, payments are linked to claim events and insurers are funded in advance. In life insurance, surrendering a contract has disadvantages, such as lapse costs, and thus the policyholder has an incentive not to terminate the contract. See Eling and Schmeiser (2010). In countries with low lapse costs and higher mobility of capital, there could be a risk of an "insurance run," at least in selected insurance sectors.

holders are relatively small in terms of contract volume, which limits their ability to affect decisions. It thus seems that the influencing component of insurance sector market discipline is not without difficulties and needs more study.

While most definitions of market discipline in the banking context include the monitoring and influencing components, Harrington (2004) and Nocera (2005) add another interesting dimension that is especially relevant in the insurance context. They differentiate between *investor-driven market discipline*, i.e. financial market discipline, and *customer-driven market discipline*, i.e. the extent to which demand by policyholders is sensitive to insolvency risk and thereby motivates insurers to manage their risk. In creating an insurance-specific definition of market discipline, it is also important to recognize the other monitoring and influencing elements (in addition to customers and investors), i.e., intermediaries (agents, brokers) and evaluators (analyst, auditors, rating agencies) that are involved in the buying decision. We thus define market discipline in the insurance sector as the ability of *customers*, *investors*, *intermediaries*, and *evaluators* to *monitor* and *influence* the management of insurance companies.

2.2. Measurement of market discipline

Table 1 contains a review of the different facets of market discipline and derives measures for quantifying it. Based on the definition developed in the last section, we distinguish between "direct" and "indirect" monitoring and influencing. While in theory, customers and investors directly influence management decisions, intermediaries and evaluators have both a direct and an indirect influence. For example, customers or investors react to market signals set by evaluators (e.g., changes in ratings)—a direct influence by customers; an indirect influence by evaluators. However, given that evaluators' indirect influence can lead to direct influence by customers and investors, they might also have an opportunity to exert a direct influence themselves if, for instance, managers are keen to do anything possible to avoid a rating downgrade.

Who?	Customers and investors (direct monitoring and influencing)			Intermediaries and evaluators (direct and indirect monitoring and influencing)		
	Customers	Investors-stockholders	Investors-bondholders	Rating agencies	Auditors/ analysts	Agents/ brokers
How?	Risk-sensitive customer demand	Risk-sensitive stock prices	Risk-sensitive bond yields	Product and company ratings	Recommendations to investors	Recommendations to customers
Measurement	Growth in premiums and policies/lapse	Equity prices	Debt yields	Rating changes	New recommendation	New recommendation
Relevance in insurance	High	Limited	Limited	High	Limited	High

Table 1: Facets of market discipline

In the banking literature, investor-driven market discipline is usually studied either by analyzing stock prices or yields on debt instruments (see, e.g., Martinez Peria and Schmukler, 2001;

See DeAngelo, DeAngelo, and Gilson (1994) with regard to the collapse of First Executive in the United States in the early 1990s.

King, 2008). However, the insurance sector is different from the banking sector, especially as to business models and financing. Regarding legal form, in banking and insurance both, many companies are mutuals and many stock companies are not traded on the capital market. Furthermore, for many of the insurance companies that are traded on the stock exchange, there are no liquid markets, since only a small fraction of the stocks are in free float. Stock prices are thus of only limited use when evaluating risk sensitivity in insurance.[5] Furthermore, the financing of insurers is different from that of other providers in the financial sector in that debt instruments typically are not traded (the reserves of the policyholders are the major debt instruments). The debenture spreads typically considered as market elements disciplining management behavior for the banking industry thus, for the most part, do not exist in the insurance industry.[6/7]

An alternative way to measure market discipline is by looking at it as customer-driven. To this end, the studies on market discipline in insurance consider premium growth and lapse. Epermanis and Harrington (2006) and Eling and Schmit (2011) analyze premium growth around rating changes as a proxy for market discipline. Zanjani (2002) considers changes in lapse rates following rating changes. But there are also limitations in measuring customer-driven market discipline. For example, premiums are not the price of insurance, but the price times quantity. Typically, we cannot observe insurance prices, i.e., the premium rates per unit of coverage, and even if such information were available, it would be very difficult to compare insurers since the underlying expectations of claims costs used for calculating rates might be very different and are not observable (see Harrington, 2004). A proxy for insurance prices sometimes used in literature is the relation of insurer premiums to realized claims (see Sommer, 1996; Phillips, Cummins, and Allen, 1998).

From the above discussion, we conclude that in the insurance sector, market discipline focuses on the risk sensitivity of customer demand (for insurance coverage) and investor willingness to pay (for equity and debt). To measure market discipline, we thus need to identify market signals that affect the risk sensitivity of customers or investors. The second step is then to evaluate whether this signal has a significant impact on our measures of market discipline, i.e., demand and willingness to pay. Table 2 reviews a selection of potential signals.

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5 Reinsurers are different from insurers in that many of them have stocks traded on capital markets. Furthermore, many large holdings, such as Allianz SE, are listed on the capital market. Overall, however, the number of liquid stocks is very limited. A broad empirical analysis based on stock prices is thus difficult.

6 There are some debt instruments, for example, credit-default swaps or hybrid instruments (e.g., participating certificates), but the number of observable instruments and the number of companies involved in such transactions is, again, very small. Catastrophe bonds or other forms of alternative risk transfer are not suitable since these are issued in special purpose vehicles and thus are not linked to the default risk of the sponsor.

7 There are other important differences between insurance and banking. For example, the insurer's assets and liabilities are stochastic, particularly in the non-life sector. In banking, questions of duration (which do not play a large role in non-life insurance) and asset risk are the main risk factors. In life insurance, duration is also of high importance; additionally, insurers' liabilities often embed many options and guarantees.

Market signal with regard to risk situation (input variable)	Signal given by	Market reaction (output variable)
Investor-driven market discipline		
Annual and interim reports with outlook	Company	*Investors' willingness to pay reflected in* Stock prices Bond yields
Ad-hoc disclosure	Company	
Director´s dealings	Company	
Analysts' comments	Analysts	
Company financial strength ratings	Rating agencies	
Takeover bids	Competitor	
Customer-driven market discipline		
Product ratings	Rating agencies	*Customer demand reflected in* Premium growth Lapse
Surplus participation	Company	
Complaint statistics	Regulator	
Statistics published by associations	Insurance associations	

Table 2: Measuring market discipline

Table 2 can be used to formulate hypotheses with regard to the disciplining impact. For example, we might expect that a better company rating has a positive influence on equity prices (i.e., an increase in price) and a negative influence on the debt yields (i.e., the spread over the risk-free interest rate decreases).[8] We consider three main sources of market signals: the company, the evaluators (analysts, rating agencies), and the regulator (other sources of information such as consumer protection institutions or recommendations by friends are also important, but are not discussed in this paper). Table 2 also allows us to identify elements unique to the insurance sector that might be used to measure market discipline. Among these are product ratings, surplus participation, complaints, and other published statistics.

2.3. Discussion of market discipline in the context of other regulatory measures

Basel II and Solvency II are two examples of how market discipline research is relevant to regulatory problems. In both systems, market discipline is the third fundamental pillar. The expectation is that a transparent market will require less overt intervention by regulators as market participants themselves force appropriate firm behavior. The third pillar of Solvency II will be composed of public disclosure and reporting requirements that are intended to facilitate more rigorous and uniform analysis of capital adequacy across firms and across national borders. Improved market discipline is the hoped-for result. The extent to which market discipline can be relied on for successful regulation, however, depends on the strength of its influence.

Different mechanisms have been employed during the last decades in an effort to limit default probability in the financial services sector. Historically, solvency regulation focused on different types of safety nets, including deposit insurance schemes in banking (such as the Federal Deposit Insurance Corporation (FDIC) in the United States after the Great Depression) and guarantee funds in insurance. Until the early 1990s, many countries in the European Un-

[8] As we will discuss below, typically the downside risk of a bad market signal is greater than the upside potential of a good market signal. See, e.g., Hong, Lim, and Stein (2000) and Halek and Eckles (2010). The direction of impact also depends on the signal. For example, a takeover bid might be a signal that the stock is underpriced because of poor management.

ion addressed default risk by limiting competition via market entry restrictions and price and product regulation (see Eling, Klein, and Schmit, 2009). Rules for capital adequacy—imposing certain minimum capital requirements—on either an absolute or a risk-adjusted basis (e.g., Solvency I, U.S. RBC Standards) have also been introduced (see Eling, Schmeiser, and Schmit, 2007, for an overview).

None of these market interventions is without disadvantages. Safety nets can create moral hazard since the risk reduction the parties face leads them to take riskier actions or fail to take precautionary measures (see Demirgüç-Kunt and Detragiache 2002; De Ceuster and Masschelein, 2003). Distortions of competition, such as price and product regulation, decrease efficiency and limit innovation. Capital adequacy rules might be subject to adverse incentives, as illustrated in the recent financial crisis, e.g., by AIG and its credit default swap business, which was motivated by regulatory and rating arbitrage (see Eling and Schmeiser, 2010).

Recently, regulators have begun to incorporate a new market-based element into regulatory regimes by increasing transparency and disclosure requirements. Basel II's inclusion of "market discipline" among its three regulatory pillars is the most notable example. Regulators see two main advantages to market discipline, which is, theoretically, brought into play by greater disclosure requirements. First, stakeholder monitoring should improve due to the availability of more information and, second, this improved monitoring is expected to influence insurer behavior, i.e., the stakeholders are expected to use their market power to influence management decisions with regard to risk taking.

Which of the different regulatory mechanisms is best is a question yet to be answered. In the case of Solvency II, regulators advocate a combination of capital adequacy (Pillar 1) and market discipline (Pillar 3). This provides the opportunity to integrate different approaches, but has several disadvantages too, one of which is cost: requiring insurers to employ extensive financial models (Pillar 1), as well as increased reporting requirements (Pillar 3), are both going to impose a substantial financial burden on insurers. The cost of regulation might outweigh its benefits.[9] This argument is especially relevant for small insurers that might be pushed out of the market by requirements too costly to meet.

Market discipline cannot completely replace regulation. In a perfect and arbitrage-free market, where providers and policyholders have perfect information, one might argue that policyholders should be free to purchase insurance with a lower safety level as long as the contract pricing is fair, i.e., the net present value is zero (see Doherty and Garven, 1986; Gatzert and

[9] There is no clear evidence as to whether the costs of Solvency II are higher than its benefits. The EU Commission demands an assessment of the costs of regulation for each new tool, including Solvency II. See, e.g., CEA (2007) for estimations of the administrative costs. Problems that arise are: (1) only direct costs (companies' costs of implementation and future use) are considered and no indirect costs (inefficiency, effects on premiums and their result on other markets that depend on the insurance sector) and (2) potential benefits are described, but not quantified in any way.

Schmeiser, 2008). In this world, the policyholder, being fully informed, could choose to accept the default risk and hence there would be no need for capital regulation. However, in the insurance context, there is a "third-party problem", i.e., the policyholder may cause an injury to a third party. This third party has no ex-ante contractual relationship with either the insurer or the policyholder, and hence cannot agree to some possibly low safety level in regard to the insurer's default, with a consequent lower premium. In this situation, there is still a need for solvency requirements and regulation that cannot be replaced by enhanced market discipline per se.

Furthermore, there are interactions between the different pillars of Solvency II that need to be kept in mind when designing the regulation, especially regarding incentives. One important interaction is between the risk-based capital requirements in Pillar 1 and market discipline in Pillar 3. Under Pillar 3, insurance companies must publish their solvency testing results, thus informing the stakeholders and making the insurer's safety level a competitive factor in the market. However, since internal risk models can be used for this purpose (as long as they are approved by the regulator), insurance companies may have an incentive to use internal models that "make them look safe" instead of models that would more accurately reflect their true risk situation (for a more detailed discussion on the pros and cons of internal models, see Eling, Schmeiser, and Schmit, 2007).

3 Evidence for market discipline (including facilitators and impediments)

We consider 62 peer-reviewed empirical studies on market discipline in financial services. For the field of insurance, we also include recent material presented at peer-reviewed conferences so as to increase the number of studies. Twenty of the 62 studies address the insurance industry; the other 42 studies are from the banking literature, reflecting the fact that, at least in terms of research questions and countries analyzed, more work has been done in banking field. However, as we highlight in the following discussion, some of the insights from the banking studies might be transferable to the insurance industry, e.g., with regard to safety nets.[10]

3.1. Evidence for market discipline in banking

There is a vast literature on market discipline, especially for the banking industry; research on the topic in this field dates back to the 1980s (see Table 3). The motivation for all this work is that innovation, e.g., in financial engineering, enabled financial intermediaries to become in-

[10] The 16 oldest papers in banking are also summarized in Gilbert (1990). We also identified studies in other sectors of financial services, such as mutual funds (see, e.g., Dangl, Wu, and Zechner, 2008), but to reduce the complexity of the review, did not include them. Given the broadness of literature on market discipline in banking, we also cannot claim that our collection of 62 studies is complete, but we believe that the most important studies are included. Also note that experimental evidence, such as Wakker, Thaler, and Tversky (1997), is mentioned in our paper but is not included in the tables.

volved in complex financial operations that were very costly to monitor. Furthermore, excessive risk taking in the 1980s resulted in the failure of some depository institutions, which raised concern over safety and prompted calls for stricter regulation. Thus, by the 1980s, banking regulators had market discipline on the policy agenda (see Park and Peristiani, 1988). Research in this area was given another boost when market discipline was made one of the three pillars of Basel II.

There are two main empirical results in regard to market discipline found in the banking literature. First, there is evidence of market discipline in banking over the last decades across a variety of measures and countries, i.e., with regard to stock prices (e.g., Baer and Brewer, 1986), debt (Avery, Belton, and Goldberg, 1988; Sironi, 2003), and deposit growth (Park and Peristiani, 1998).[11] Second, investors in bank stocks have the strongest incentives to be risk sensitive,[12] while market discipline in debt is often hampered by safety nets. Safety nets of all kinds create moral hazard and reduce market discipline (Billett, Garfinkel, and O'Neal, 1998; Demirgüç-Kunt and Huizinga, 2004; Nier and Baumann, 2006). There is evidence that reducing safety nets increases market discipline (Flannery and Sorescu, 1996). A potential policy implication is that regulators should enforce modifications of existing guarantee schemes to bring market discipline into play. In this context, a number of authors (e.g., Benink and Wihlborg, 2002) advocate for banks to issue a substantial amount of uninsured deposits in order to enhance market discipline.

In addition to these two main results, we identify four other aspects from the banking literature that might be of relevance to the insurance industry. First, the strength of market discipline depends on the line of business. Morgan and Stiroh (2001), e.g., show differences for credit card, commercial, and industrial lending, all of which carry a penalty in terms of higher spreads. Second, Sironi (2003) found differences depending on ownership structure, i.e., less discipline was found for government-owned institutions. This is an important finding in light of the traditional separation of stock, mutual, and public companies in the insurance industry and the resulting differences in agency conflicts (see, e.g., Eling and Luhnen, 2010). Third, Nier and Baumann (2006) emphasize that market discipline depends on the level of competition, i.e., market discipline is more effective in curbing the greater risk taking that arises in the face of competition in those countries or industries where the competition is strong. Finally,

[11] There are also authors who find no evidence of market discipline (Gorton and Santomero, 1990) but, compared to the number of papers that do find such evidence, they are few in number. Of special relevance to Solvency II because of the focus on European data is the work by Sironi (2003), who finds that European banks' debenture spreads reflect risk. More recently and also using European bank data, Distinguin, Rous, and Tarazi (2006) observe that the accuracy of models in predicting bank financial distress through use of stock market information depends on the extent to which bank liabilities are tradable. Models that account for these nuances, therefore, will be more valuable.

[12] In spite of their residual claimholder position and risk of total loss, this result is not trivial, since with limited liability, equity holders might have an incentive to increase risk taking, as shown by Merton (1977). One might thus argue that equity holders are less suitable monitors. Empirically, however, and also in more complex theoretical models, this risk-increasing influence is not clear. See De Ceusters and Masschelein (2003).

Pop (2006) finds international differences in market discipline and argues that much work needs to be done, especially in Japan and certain European countries, to level the playing field so that market discipline can operate. Thus, there might be variation in the effectiveness of market discipline depending on the regulatory and cultural environment. The findings also highlight the potential for regulation to undermine market discipline (see, e.g., Billett, Garfinkel, and O'Neal, 1998).

Finally, it should be noted that almost all studies in the banking sector address the monitoring element of market discipline; that is, they test whether investors accurately understand changes in the firm´s condition and incorporate these into prices. Such testing, however, reveals nothing about the influencing component of market discipline, i.e., the response of firm managers to investor feedback. Bliss and Flannery (2002) is one of the few studies that directly measures this component by developing an influence regression using equity returns and expected managerial behavior. Their results show that market influence is weak. More research into the influencing component would be extremely useful.

3.2. Evidence for market discipline in insurance

Market discipline in insurance has not been as extensively researched as it has in the banking field and what work there is on the subject rarely employs non-U.S. data. Table 4 presents an overview of this research, dividing it into three categories: investor-driven market discipline (equity prices), customer-driven market discipline (price of insurance contracts, sum of premiums, number of contracts, lapse), and selected other aspects (impact of guarantee funds, studies on opaqueness).

#	Authors	Title	Country	Main results		
	Equity prices					
1	Beighley, Boyd and Jacobs (1975), J of Bank Research	Bank Equities and Investor Risk Perceptions: Some Entailments to Capital Adequacy	US	evidence for MD	…in stock prices	Share prices of bank stocks are estimated as a function of capital ratios, earnings and growth of earnings, asset size, and loss rates; banks with higher capital ratios and lower loss rates tend to have higher share prices.
2	Pettway (1980), J of Financial and Quantitative Analysis	Potential Insolvency, Market Efficiency, and the Bank Regulation of Large Commercial Banks	US	evidence for MD	…in stock prices	Considering several large banks that failed, returns to shareholders are simulated for several years prior to their failure. Returns on the stocks of banks that failed decline relative to simulated returns two years before failure.
3	Brewer and Lee (1986), Economic Perspectives	How the Market Judges Bank Risk	US	evidence for MD	…in stock prices	Betas are estimated as functions of accounting ratios; some of the measures chosen to reflect risk have positive, significant regression coefficients.
4	Cornell and Shapiro (1986), J of Banking and Finance	The Reaction of Bank Stock Prices to the International Debt Crisis	US	evidence for MD	…in stock prices	Percentage of Latin American loans to total assets has a significant, negative impact on returns in 1982; energy loans had a negative impact in 1982-83. Loans purchased from Penn Square Bank had a negative impact on returns in the month in which that bank failed.
5	Shome, Smith and Heggestad (1986), J of Financial Research	Capital Adequacy and the Valuation of Large Commercial Banking Organization	US	evidence for MD	…in stock prices	Stock prices are estimated as functions of earnings and capital ratios; the coefficient on the capital ratio is positive and significant for some years, insignificant for other years.
6	Baer and Brewer (1986), Economic Perspectives	Uninsured deposits as a source of MD: Some new evidence	US	evidence for MD	…in stock prices	Variability of stock prices help explain CD rates; Even when banks are solvent, the deposit market does charge riskier banks more; weak evidence for MD in uninsured deposits; coefficients on risk measures used by bank supervisors not significant.
7	Smirlock and Kaufold (1987), J of Business	Bank Foreign Lending, Mandatory Disclosure Rules, and the Reaction of Bank Stock Prices	US	evidence for MD	…in stock prices	Evaluates the effect of the Mexican debt crises on bank value; banks were not required to disclose their Mexican debt at the time of the 1982 moratorium; nevertheless investors were able to discriminate among banks with different levels of exposure.
8	Randall (1989), New England Economic Review	Can the Market Evaluate Asset Quality Exposure in Banks?	US	evidence for MD is weak	…in stock prices	Stock prices of the bank holding companies that reported relatively large losses declined relative to market average stock prices only after the problems became public knowledge, not during the periods which the banks began assuming relatively high risk.
9	Distinguin, Rous, and Tarazi (2006), J of Financial Services	MD and the use of stock market data to predict bank financial distress	Europe	evidence for MD	…in stock prices	Early warning model for European banks, which tests if market based indicators add predictive value to models relying on accounting data; link between market information and financial downgrading in the light of the safety net and asymmetric information hypotheses.
10	Park and Peristiani (2007), J of Banking and Finance	Are bank shareholders enemies of regulators or a potential source of MD?	US	evidence for MD	…in stock prices	Shareholders' risk-taking incentives were confined to a small fraction of highly risky institutions; even though shareholders have incentives to transfer wealth by pursuing riskier strategies, this risk taking is mostly outweigh trough the possibility of losing charter value.
11	Curry, Fissel, and Hanweck (2008), J of B. and Finance	Equity market information, bank holding company risk, and MD	US	evidence for MD	…in stock prices	Investigate whether equity market variables can add value to accounting models that predict changes in bank risk ratings; findings suggest that one-quarter lagged market data adds forecast value to lagged financial statement data and prior supervisory information.
12	Pop and Pop (2009), Quarterly Review of Economics and	Requiem for MD and the specter of TBTF in Japanese banking	Japan	evidence for MD is weak	…in stock prices of too-big-to-fail companies	The functioning of MD in Japanese banking may no longer be valid in the post-Resona period (bailout); the too-big-to-fail doctrine created a hostile environment for effective MD; incentives to monitor and influence risk taking behavior are comprised.
	(Subordinated) debt prices					
13	Pettway (1976), J of Finance	Market Tests of Capital Adequacy of Large Commercial Banks	US	evidence for MD is weak	… in subordinated notes and debentures	The rate premium is estimated as a function of the capital ratio of banks and other variables; the coefficient on the capital ratio is not significant.
14	Beighley (1977), J of Bank Research	Bank Equities and Investor Risk Perceptions: Some Entailments to Capital Adequacy	US	evidence for MD	… in subordinated notes and debentures	The rate premium is estimated as a function of several measures of risk including a loss ratio and a leverage ratio; the coefficients on the loss and leverage ratios are positive and significant.
15	Fraser and McCormack (1978), J of Fin. and Quant. Analysis	Large Bank Failures and Investor Risk Perceptions: Evidence from the Debt Market	US	evidence for MD is weak	… in subordinated notes and debentures	The rate premium is estimated as a function of the capital ratio and the variability of profits divided by total assets; none of the independent variable has a significant coefficient.
16	Avery, Belton, and Goldberg (1988), J of Money, C. and B.	MD in regulating bank risk: New evidence from the capital markets	US	evidence for MD is weak	… in subordinated notes and debentures	SD risk premiums are weakly related to Moody's and Standard and Poor's ratings, but uncorrelated with the FDIC Index and any balance-sheet variables. Moreover, the FDIC Index of bank riskiness is found to be negatively related to the public bond ratings.
17	Gorton and Santomero (1990), J of Money, Credit and Banking	MD and bank subordinated debt: Note	US	evidence for MD is weak	… in subordinated notes and debentures	Virtually no relation between a bank's risk measures and its implied asset volatility; results offer little support for the presence of MD in the subordinated debt market.
18	Flannery and Sorescu (1996), J of Finance	Evidence of bank MD in subordinated debenture yields: 1983-1991	US	reduction of safety nets increases MD	…in subordinated debt yields	SD yields become more closely correlated with indicators of bank risk as regulatory treatment of failed banks' debentures became more harsh; Investors have rationally reflected changes in the government's policy toward absorbing private losses in the event of failure.
19	Morgan and Stiroh (2001), J of Financial Services Research	MD of banks: The asset test	US	evidence for MD	…in bond spreads	Bond spreads reflect the asset mix; credit card and commercial and industrial lending also carry a penalty in terms of higher spreads; Banks contemplating a shift into riskier activities, e.g., in trading, can expect to pay higher spreads.
20	Jagtiani and Lemieux (2001), J of Economics and Business	MD prior to bank failure	US	evidence for MD	…in bonds during period prior to failure	Bond spreads start rising (up to 100 %) as early as 6 quarters prior to failure as financial condition and credit rating deteriorates; increase MD by increasing subordinated debt would be effective at the bank holding company level.
21	Sironi (2002), J of Banking and Finance	Strengthening banks' MD and leveling the playing field: Are the two compatible	cross country	evidence for MD	… in subordinated debt	Spread/rating-relationship is same for US & European banks; US banks tend to pay higher average spread because of poorer rating; controlling on default risk US banks pay lower average spread than corresponding European banks; spreads rise when ratings worsen.
22	Sironi (2003), J of Money, Credit and Banking	Testing for MD in the European banking industry: Evidence from subordinated debt	Europe	evidence for MD	… in European subordinated notes and debentures	Results support the hypothesis that SD investors are sensitive to bank risk, with the exception of SD issued by public sector banks, i.e., government owned or guaranteed institution; sensitivity of SD spreads to measures of stand-alone risk has been increasing from the first
23	Goyal (2005), J of Financial Intermediation	MD of bank risk: Evidence from subordinated debt contracts	US	evidence for MD	…in subordinated debt with restrictive covenants	MD through writing restrictive covenants (on investments, payment of dividends, financing) in bank debt contracts; deregulation leads to higher risk-taking so private incentives to monitor bank's risk taking are stronger.
24	Ashcraft (2008), J of Financial Intermediation	Does the MD banks? New evidence from regulatory capital mix	US	evidence for MD	…in SD	The FDIC Improvement Act has impact on the influence of debt investors over bank outcomes; increase in SD has positive effect in helping a bank recover from distress; fixed income investors able to exert influence on behavior of distressed institution.

Table 3: Results of literature review for banking (CD: certificate of deposit, J: journal, MD: market discipline, SD: subordinated debt)

#	Authors	Title	Country	Main results		
	Deposits (uninsured and insured)					
25	Crane (1976), J of Bank Research	A Study of Interest Rate Spreads in the 1974 CD Market	US	evidence for MD is weak	...in uninsurance deposits	The determinants of CD rates are evaluated using factor analysis; a factor that reflects profit rates and capital ratios is not a significant variable in explaining CD rates.
26	Hannan and Hanweck (1988), J of Money, Credit and Banking	Bank Insolvency Risk and the Market for Large Certificates of Deposit	US	evidence for MD	...in uninsurance deposits	Estimate the relationship between the rates individual banks offer on large uninsured certificates of deposits and perceived bank risk. CD rates tend to be higher at banks with more variable income and lower capital ratios, holding constant the influence of total assets.
27	Cargill (1989), J of Financial Services Research	CAMEL Ratings and the CD Market	US	evidence for MD	...in CD rates	Investigates the relationship between CD rates as a measure of bank risk and the CAMEL scores assigned to a bank as a result of an onsite examination; results suggest that CAMEL ratings are primarily proxies for available market information about the quality of a bank.
28	Ellis and Flannery (1992), J of Monetary Economics	Does the debt market assess large banks' risk? Time series evidence from money center	US	evidence for MD	...in CD rates	CD rates paid by large money center banks include significant default risk premia; consider time series data on specific banks' daily offering rates during the period May 1982 through Julv 1988.
29	Park (1995), Quarterly Review of Economics and Finance	MD by depositors: evidence from reduced-form equations	US	evidence for MD	...large time deposits	Riskier banks offered higher interest on large time deposits but attracted less of these deposits; large time depositors forced risky banks to pay higher premiums; analysis also considers the effects of bank size, but fails to find evidence that depositors prefer large banks.
30	Billett, Garfinkel, and O'Neal (1998), J of Financial Economics	The cost of market versus regulatory discipline in banking	US	safety nets reduce MD	...insured deposit are impediments to MD	Insured deposit financing shields banks from the full costs of MD; Moody´s downgrades are associated with negative abnormal equity returns that are increasing in the bank´s reliance on insured deposits; banks raise their use of insured deposits following increases in risk.
31	Park and Peristiani (1998), J of Money, Credit and Banking	MD by Thrift Depositors	US	evidence for MD	...debt and deposit (in thrift institutions)	Riskier thrifts are found to pay higher interest rates and attract smaller amounts of uninsured deposits; qualitative results are similar for fully insured deposits, but the statistical significance is substantially lower.
32	Mondschean and Opiela (1999), J of Financial Services	Bank time deposit rates and MD in Poland: the impact of state ownership and deposit	Poland	evidence for MD is weak	...in partial deposit insurance	Establishment of explicit deposit insurance lowers incentive for monitoring; insurance coverage per bank forces to spread (concentration) risk; MD is weak with fully guaranteed banks.
33	Martinez Peria and Schmukler (2001), J of Finance	Do depositors punish banks for bad behavior? MD, deposit insurance, and	cross-country	safety nets do not reduce MD	...deposit insurance and the impact of banking crises	Depositors discipline banks by withdrawing deposits and by requiring higher interest rates; deposit insurance does not appear to diminish the extent of MD; investors' responsiveness to bank risk.
34	Demirgüç-Kunt and Huizinga (2004), J of Mon. Economics	MD and deposit insurance	cross-country	safety nets reduce MD	...deposit insurance limits MD	Deposit insurance reduces required deposit interest rates, while at the same time it lowers MD on bank risk taking; deposit insurance schemes internationally vary in their coverage, funding, and management.
35	Imai (2006), J of Banking and Finance	MD and deposit insurance reform in Japan	Japan	evidence for MD	...deposit insurance reform on partly insured time	Reform raised sensitivity of deposit rates and growth to bank default risk; interest rate difference between partially insured time-deposits and fully insured deposits increased for risky banks; reform had positive effects on MD by reducing supply of time deposits of risky banks;
36	Spiegel and Yamori (2007), J of Banking and Finance	Market price accounting and depositor discipline: The case of Japanese regional banks	Japan	evidence for MD	...in deposit levels (evidence for depositors discipline)	Banks that opt for price-to-market accounting have more intense depositors discipline; depositors in price-to-market-sample are more sensitive to bank financial condition.
37	Uchida and Satake (2009), J of International Financial Markets,	MD and bank efficiency	Japan	evidence for MD	...in banks with more outstanding deposits / more	Banks with more depositors have lower cost inefficiency (consistent with the hypothesis that depositors put a substantial pressure on bank management); being listed at the stock market has a positive impact on cost inefficiency (not consistent with the MD hypothesis).
	Other (off-balance sheet activities, safety nets)					
38	Hassan, Karels, and Peterson (1994), J of Banking and Finance	Deposit insurance, MD and off-balance sheet banking risk of large US commercial banking	US	evidence for MD	...in off-balance sheet activities	Examine the riskiness of off-balance sheet activities by employing option-pricing models to calculate bank asset risk; empirical results suggest the existence of MD of off-balance sheet activities; market participants price these as risk-reducing.
39	Koppenhaver and Stover (1994), J of Banking and Finance	Standby letters of credit and bank capital: Evidence of MD	US	evidence for MD	...in off-balance sheet contingent liability	Hypothesis that MD causes a joint relationship between bank capital and standby letter of credit decisions for banks that are active participants in the standby market or that rely heavily on purchased funds is tested and cannot be rejected.
40	Bliss and Flannery (2002), European Finance Review	MD in the governance of US bank holding companies: Monitoring vs. Influencing	US	evidence for MD is weak	...here focus on influence (market influence is weak)	Influence regression using equity returns and expected managerial behavior, among others; although some patterns consistent with market influences are identified, the methodology does not provide strong evidence taht investors influence managerial actions.
41	Nier and Baumann (2006), J of Financial Intermediation	MD, disclosure and moral hazard in banking	cross-country	safety nets reduce MD	...government safety nets reduce MD	Safety nets result in lower capital buffers; stronger MD resulting from uninsured liabilities and disclosure results in larger capital buffers; also finds that the effect of disclosure and uninsured funding is reduced when banks enjoy a high degree of government support.
42	Carow, Heron, Lie, and Neal (2009), J of Corporate Finance	Option grant backdating investigations and capital MD	US	evidence for MD	...in option grant patterns related to agency-costs	Capital markets are proactive in disciplining companies for heightened agency problems even if there are no formal inquiries to that matter; markets began to anticipate which firms would have backdating problems and bid their stock prices down.

Table 3: Results of literature review for banking (CD: certificate of deposit, J: journal, MD: market discipline, SD: subordinated debt) (continued)

Regarding the impact of rating changes on equity prices (investor market discipline), the early study by Singh and Power (1992) and the recent studies by Halek and Eckles (2010, 2011) find conflicting results. Singh and Power (1992) find no price reaction to rating changes, whereas Halek and Eckles (2010, 2011) document asymmetric responses (downgrades cut share prices, upgrades have little effect). Halek and Eckles (2010) attribute these differences to the structure of the ratings data, the event study methods, and the timing of the data. Other work on the impact of market signals on equity prices (Fenn and Cole, 1994; Brewer and Jackson, 2002) is more in line with Halek and Eckles (2010, 2011), so that overall it seems that there is evidence for market discipline in insurer stock prices.

The work on price of insurance offers implications rather than direct tests of market discipline. For example, studies from the 1990s (Sommer, 1996; Phillips, Cummins, and Allen, 1998; Cummins and Danzon, 1997) find a negative relationship between price proxies and firm risk in the property-casualty industry. This finding is consistent with market discipline, but as lower prices could also cause greater risk, it is difficult to identify the cause and effect relationship in this case. Also in a property-casualty context and using simple experiments, Wakker, Thaler, and Tversky (1997) show the risk sensitivity of policyholders in that an increase in default risk severely affects policyholder willingness to pay. Similar experimental evidence is found in Albrecht and Maurer (2000), Zimmer, Schade, and Gründl (2009), and Zimmer, Gründl, and Schade (2009). An important result of these studies is that in a transparent setting, market discipline will work, since knowing about differences in default risk severely affects policyholder behavior.

As to consumer influences, Zanjani (2002) uses A.M. Best ratings as a risk measure to study their relationship with life insurer lapse rates and finds some evidence of market discipline, with a positive relationship between risk (i.e., ratings) and lapse. Epermanis and Harrington (2006) consider insurer ratings in a property/casualty context and observe significant premium declines following rating downgrades, particularly for firms that had low ratings even before the downgrade. They also note the concentration of premium declines in commercial lines, which tend not to be protected by guarantee associations. In line with these findings for property-casualty insurance, Baranoff and Sager (2007) find that life insurance demand declines after a rating downgrade. Eling and Schmit (2011) confirm this finding for the German market. They find premium declines as well as increased lapse rates following rating downgrades. All these studies document asymmetric responses to positive and negative news.

Moreover, three studies from the 1990s (Lee, Mayers, and Smith, 1997; Brewer, Mondschean, and Strahan, 1997; Downs and Sommer, 1999) show that the establishment of guarantee funds increases risk taking. The establishment of guarantee funds might hamper risk sensitivity, especially that of policyholders.

#	Authors	Title	Country	Main results		
	Equity prices					
1	Singh and Power (1992) J of Risk and Insurance	The Effects of Best's Rating Changes on Insurance Company Stock Prices	US	no evidence for MD	...in stock prices	Statistically insignificant stock price reactions to both rating upgrades and downgrades; suggest that A.M. Best & Co. is a monitor of publicly available information; it is not an agency that reveals new information to the financial markets.
2	Fenn and Cole (1994), J of Financial Economics	Announcements of asset-quality problems and contagion effects in the life insurance industry	US	evidence for MD	...in stock prices	Contagion effects in the returns of life insurance stocks at time of announcements of problems in their investment portfolios; effects are larger for insurers with significant junk bonds/commercial mortgage assets and mobile customers represented by GICs.
3	Brewer and Jackson (2002), Fed. Reserve Bank of Chicago	Inter-Industry Contagion and the Competitive Effects of Financial Distress Announcements:	US	evidence for MD	...in stock prices	Insurers with risky assets experience larger stock price declines than those with less risky assets during downturns in the real estate and bond markets.
4	Halek and Eckles (2010), J of Risk and Insurance	Effects of Analysts' Ratings on Insurer Stock Returns: Evidence of Asymmetric Responses	US	evidence for MD	...in stock prices	Examine the information value contained in insurer rating changes; downgrades cut share prices by approximately 7 percent, upgrades have little significant effect; share prices react more strongly to A.M. Best and Standard & Poor's downgrades than to Moody's.
5	Halek and Eckles (2011), Working Paper	Determinants of Abnormal Reactions to Insurer Rating Downgrades	US	evidence for MD	...in stock prices	Observe that abnormal insurer returns resulting from rating downgrades are associated with, among other insurer characteristics, the extent of the downgrades and the level of institutional ownership.
	Price of insurance					
6	Sommer (1996), J of Risk and Insurance	The Impact of Firm Risk on Property-Liability Insurance Prices	US	evidence for MD	...in the price of insurance	Examines the impact of insolvency risk (implied by the option pricing model of insurance) on the prices the insurer obtains for its products (proxied by net premiums/discounted losses) in the property-liability market; finds negative relationship between firm risk and prices.
7	Cummins and Danzon (1997), J of Financial Intermediation	Price, Financial Quality, and Capital Flows in Insurance Markets	US	evidence for MD	...in the price of insurance	Price of insurance (ratio of premiums to discounted losses) is inversely related to insurer default risk; evidence that prices declined in response to loss shocks of the mid-1980s.
8	Phillips, Cummins, and Allen (1998), J of Risk and Insurance	Financial Pricing of Insurance in the Multiple-Line Insurance Company	US	evidence for MD	...in the price of insurance	Prices vary across firms depending upon overall-firm default risk and the concentration of business among subsidiaries; within a given firm, prices do not vary by line after adjusting for line-specific liability growth rates, negative relation between price and risk.
9	Carson, Doran, and Dumm (2011), Risk Man. and Ins. Review	MD in the Individual Annuity Market	US	evidence for MD	...in the price of annuties	Measure annuity contract yields during the accumulation phase and find that firm financial strength is positively related to yield; this anomaly can be viewed as a form of market discipline itself, for at least four related reasons; one is the incentive to provide a track record
	Sum of premiums/number of contracts/lapse					
10	Zanjani (2002), Federal Reserve Bank of New York	MD and Government Guarantees in Life Insurance	US	evidence for MD	...in lapse	Uses A.M. Best ratings as his measure of financial risk to study its relationship with life insurer lapse rates; finds some evidence of MD, with a positive relationship between risk (i.e., ratings) and lapse.
11	Epermanis and Harrington (2006), J of Money, Cr. and B.	MD in Property/Casualty Insurance: Evidence from Premium Growth	US	evidence for MD	...in premium growth	Consider insurer ratings in a property/casualty context and observe significant premium declines following rating downgrades, particularly for firms that had low ratings even before the downgrade.
12	Baranoff and Sager (2007), Working Paper	MD in Life Insurance: Insureds' Reaction to Rating Downgrades in the Context of Enterprise	US	evidence for MD	...in premium growth (number of policies), life insurance	Observe reduced demand for life insurance products (measured by the number of policies written) when ratings decline; Granger causality demonstrates that the direction of the relationship flows from ratings downgrade to decline in demand, rather than the reverse.
13	Eling and Schmit (2011), Geneva Risk and Insurance Review	Is There MD in the European Insurance Industry? An Analysis of the German Insurance	Germany	evidence for MD	...in premium growth, lapse	Analyze MD in the German insurance market using Epermanis and Harrington's (2006) research design and find premium declines as well as increased lapse rates following rating downgrades.
14	Eling and Kiesenbauer (2011), J of Financial Services Research	Does Surplus Participation Reflect Market Discipline?	Germany	evidence for MD	...in premium growth, lapse	Find a significant positive dependence between surplus participation and new business growth as well as a significant negative dependence between surplus participation and growth of lapse volume for the German market. Customers thus react to changes.
	Other (safety nets, opaqueness)					
15	Lee, Mayers, and Smith (1997), J of Financial Economics	Guaranty funds and risk-taking Evidence from the insurance industry	US	safety nets reduce MD	...impact of guarantee funds	Evidence suggests that the risk of insurers assets portfolio increases after the enactment of state guaranty funds; this effect is significant only for stock insurers.
16	Brewer, Mondschean, and Strahan (1997), J of Risk and Insurance	The Role of Monitoring in Reducing the Moral Hazard Problem Associated with Government Guarantees: Evidence from the Life Insurance	US	safety nets reduce MD	...impact of guarantee funds	Risk taking by life insurers is higher in states with guaranty funds that are underwritten by taxpayers. In states where taxpayers pay for the costs of resolving insolvencies, life insurers hold portfolios with higher overall stock market risk and higher levels of risky assets. By contrast, in states where the guaranty funds are underwritten by the industry, overall risk is no higher than in states without these funds.
17	Downs and Sommer (1999), J of Risk and Insurance	Monitoring, Ownership, and Risk-Taking: The Impact of Guaranty Funds	US	safety nets reduce MD	...impact of guarantee funds	Empirical results provide support for the risk-subsidy hypothesis and demonstrate the essential link between insider ownership and risk-taking.
18	Liu, Epermanis, and Cox (2005), Working Paper	Agency Conflicts and MD: Evidence from Guaranteed Investment Contracts	US	evidence for MD	...in guaranteed investment contracts	Study the influence of GICs as a disciplinary mechanism for bondholders and find some MD influences. The agency conflict risk-shifting behavior has, however, a much stronger influence.
19	Pottier and Sommer (2006), Risk Man. and Ins. Review	Opaqueness in the Insurance Industry: Why Are Some Insurers Harder to Evaluate than Others?	US	some insurers are difficult to evaluate	...e.g., smaller insurers, stock insurers	Identifies insurer characteristics that are associated with greater difficulty in financial strength evaluation (smaller insurers, stock insurers, greater stock investments, more diversified), as proxied for by the level of rating disagreement by Moody's and Standard and Poor's.
20	Lin, Oppenheimer, and Chen (2008), Risk M. and Ins. Review	Intangible Assets, Going-for-broke and Asset Risk Taking of Property and Liability Insurance	US	evidence for MD	...regarding asset risk and ratings	Intangible assets play an important role in P&L insurers' asset risk taking incentives; negative relationship between insurers' asset risk and intangible assets.

Table 4: Results of literature review for insurance (J: journal, GIC: guaranteed investment contracts, MD: market discipline)

Recently, some studies have documented the opaqueness of insurers, which might limit the monitoring element of market discipline. For example, smaller insurers, stock insurers, insurers with greater stock investments, and more diversified insurers are, in general, more difficult to evaluate (see Pottier and Sommer, 2006). The willingness to monitor insurers might particularly depend on the line of business considered. Zhang, Cox, and Van Ness (2009) find evidence that differences among insurers in the opacity of lines of business (life vs. non-life, long vs. short tail) affect adverse selection for investors in the market for insurer equities, which should directly affect market discipline.

3.3. Derivation of trends, consensus, and notable conflicts in the subject areas

Looking at the relevant work published over the last few decades reveals that the definition of market discipline has evolved from simply considering the risk sensitivity of debt prices and spreads to accounting for the effects of this risk sensitivity on managerial decisions (see Covitz, Hancock, and Kwast, 2004). Market discipline is thus not an easy-to-measure one-dimensional construct, but is, instead, multifaced. These different facets are reflected in how market discipline is defined in the insurance context (see Section 2.1). Both in banking and insurance almost all studies focus on the monitoring component of market discipline, which is easier to measure than its influencing component (see Bliss and Flannery, 2002).

Overall, it appears that market discipline is reasonably strong in most insurance markets, but that there is some variation when it comes to legal form (Liu, Epermanis, and Cox, 2005), lines of business (Epermanis and Harrington, 2006), and countries (Eling and Schmit, 2011). All these results are confirmed on a broader empirical basis in the banking sector (see, e.g., Morgan and Stiroh, 2001; Sironi, 2003; Pop, 2006).

Moreover, and again for both banking and insurance, there appears to be a consensus that informational limitations and the regulatory environment play a major role in the level of market discipline, especially with regard to incentive conflicts between principals (stockholders, debtholders) and agents (managers). Agency problems are far stronger in those cases where market discipline is undermined by informational limitations. For example, agency effects are more common among mutual insurers, which generally have lower informational requirements than stock insurers. This result might be interpreted to mean that market discipline is an appropriate approach in some contexts, but that regulatory efforts will work better in others. In particular, regulatory efforts are likely more appropriate where informational limitations exist, while market discipline might be more effective when much information is available (see Eling and Schmit, 2011).

Another aspect is the asymmetry in findings regarding positive and negative news. The downside risk of sending a bad market signal is typically greater than the upside potential of a good market signal. Examples in the insurance sector are papers by Epermanis and Harrington

(2006), Baranoff and Sager (2007), and Halek and Eckles (2010). These results are consistent with those found in the finance literature on the effects of negative and positive news (see, e.g., Chan, 2003; Hong, Lim, and Stein, 2000).

There is thus a great deal of similarity between banking and insurance when it comes to findings from market discipline research. However, there are also notable differences between the two fields, especially regarding the relevance of debt instruments, which can be traced back to differences in the business models of these two financial institutions. For example, Zhang, Cox, and Van Ness (2009) discuss differences in opaqueness between banking and insurance that might affect market discipline. They argue that some sources of information opaqueness for banks and insurers are common, but that others are unique to insurers. In banking the liabilities are typically well-defined with respect to duration and amounts. In insurance there is greater asymmetric information because of the less certain duration of claim payments and the difficulty to predict loss amounts. Babbel and Merrill (2005) note in this context that the opaqueness and complexity of insurance contracts allow managers to create illusory values. Colquitt, Hoyt, and McCullough (2006) show that property-liability insurers are able to use greater discretion in setting loss reserves. Polonchek and Miller (1996) find greater information asymmetries with respect to the assets and liabilities of insurers compared to banks. Also Morgan (2002) provides evidence that insurers can be more opaque than banks, in his case considering disagreements among rating agencies.

Harrington (2005) directly compares market discipline in banking and insurance. He argues that market discipline is greater in insurance than in banking and concludes that capital requirements should be less stringent for insurers. Based on an analysis of risk sensitivity, buyer sophistication, search costs, and franchise value, he argues that overall market discipline is highest in reinsurance, moderate in life and non-life, and low in banking (see Table 1 in Harrington, 2005).

3.4. Derivation of facilitators and impediments to market discipline in insurance

The discussion has shown that market discipline is strongly affected by outside factors that can either facilitate or impede it. Recent government rescue efforts and direct intervention in the insurance and, especially, banking markets has created a great deal of distortion that has affected market discipline to a significant degree. These interventions give rise to some complicated, but highly interesting, questions involving moral hazard, the role of guarantee funds, the structure of rescue operations, the obligations of the firm being rescued, and the impact intervention has on competition. The most important impediments to market discipline in insurance are the following.

1. Work on banking finds that guarantee associations are an impediment to market discipline (see, e.g., Demirgüç-Kunt and Huizinga, 2004). Without guarantee schemes, bank manag-

ers have strong incentives to avoid risky loans and risky investments; however, mandated deposit insurance eliminates much of the risk involved in these activities. There are also several insurance studies that observe increased risk taking following the establishment of guarantee associations (see Lee, Mayers, and Smith, 1997; Downs and Sommer, 1999). One study also finds that risk levels increase when the amount of insurance sold increases in jurisdictions where guarantee associations exist (Brewer, Mondschean, and Strahan, 1997). These findings are in line with the expectation that the establishment of guarantee funds reduces monitoring incentives and thus negatively affects market discipline. There could thus be differences in market discipline between different lines of business or different regions, depending on the insurance guarantee fund design in place.

2. In addition to these direct market distortions, there might also be indirect or implicit market distortions. An example is bailout schemes, such as the "too-big-to-fail" concept, where governments feel obliged to rescue a troubled bank or insurer because they fear financial contagion.
3. The financial crisis revealed specific impediments to market discipline, e.g., the complexity of financial products. Financial institutions are often highly complex both in their ownership structure and in the nature of their business. For example, many insurers have dozens of reinsurance arrangements primarily intended to diversify risk, but these also reduce transparency and can sometimes mask financial problems (see Harrington, 2004).
4. Harrington (2004) mentions the judgment-proof problem as an impediment to market discipline. Under a compulsory insurance regime (e.g., auto liability, workers' compensation, or professional liability), individuals with few assets to insure might simply buy the cheapest insurance they can find, with no regard to insolvency risk. The combination of compulsory insurance and judgment-proof buyers reduces the risk sensitivity of demand.

There are thus a number of reasons to expect differences in market discipline depending on the line of business. (1) The judgment-proof problem that arises in the case of compulsory insurance impedes market discipline. (2) Government or privately organized fund guarantees of all insurance claims and benefits destroy all incentives for market discipline. Reducing coverage, however, could be quite conducive to market discipline. (3) Differences in lines of business due to products and business complexity affect the degree of market discipline. Standardized products make it easier to identify differences between insurers, but this is more difficult when it comes to complex products and businesses. (4) An increase in financial leverage increases company risk. Life insurers typically have a much higher leverage than non-life insurers and this might affect the risk sensitivity of investors. (5) Market discipline could be stronger in commercial lines compared to personal lines. Policyholders in personal lines have less resources and competence (e.g., in terms of education to read financial reports) to

engage in efficient monitoring than do policyholders in commercial lines, which are usually larger and have more resources. On the other hand, personal line insurance decisions directly affect an individual's own wealth, whereas commercial insurance decisions do not usually have much of a personal impact on the decision maker. This situation can create moral hazard problems, which lowers the efficiency of monitoring in commercial lines. Nonetheless, evidence indicates that market discipline in commercial lines is stronger than in personal lines (Epermanis and Harrington, 2006).

In this context, we would also expect more market discipline in reinsurance than in insurance because reinsurance covers only commercial business, while insurance covers both commercial and personal lines. An implication for policymakers is that when comparing personal and commercial insurance, it appears that market discipline is weak in some areas and strong in others.

This last point is also true when it comes to legal form. Insurers listed on the stock market are subject to more extensive reporting requirements than are mutual insurers. Liu, Epermanis, and Cox (2005) document that agency effects are more common among mutual insurers, which generally have lower informational requirements than do stock insurers. These results can be interpreted to mean that relying on market discipline is appropriate in some areas, but that formal regulation will work better in others. In particular, formal regulation is likely to be the more effective course in the presence of informational deficits (i.e., with mutuals). Market discipline will be more effective when information is generally available (i.e., with stocks).

When it comes to facilitating market discipline, the availability and quality of information is crucial. In this context, an important result from the experimental literature (Wakker, Thaler, and Tversky, 1997; Zimmer, Gründl, and Schade, 2009) is that if all necessary information is available, customers will discipline insurance companies by changing their demand. However, more information is not necessarily better information. In a theoretical world, Holmström (1979) shows that in moral hazard problems more information about the agent is never detrimental to the principal and, under mild assumptions, is always actually beneficial. In the "real" world, however, things can be quite different, especially when the cost of information is taken into consideration. Furthermore, more information can be useful only if it is consistently accessible and provided in a standardized form so that market participants can understand it and make appropriate comparisons between insurers. Standardization, consistency, and accessibility are thus important requirements for effective market discipline.

In conclusion, an effective market discipline framework needs to encompass the following. Stakeholders need to consider themselves at risk and they need to be able to observe risk efficiently, i.e., at reasonable costs. Reasons why risk sensitivity might be limited include guarantee schemes, anticipation of "too-big-to-fail" effects, compulsory insurance and judgment-

proof buyers, and product and business complexity. Even if stakeholders consider themselves at risk, monitoring will be hampered when the necessary information is too difficult and/or too costly to obtain. Furthermore, adverse selection could occur if some stakeholders have more information than others. Only if stakeholders consider themselves at risk and are able to observe risk efficiently will market discipline work. Market discipline will then manifest in either a reduction in willingness to pay (price effect) or in a reduction in demand for insurance from a particular provider (quantity effect). This might result in an influencing effect that can manifest directly, by managers shifting their risk exposure, or indirectly, by regulators acting on the signal.

4 Conclusions and future research

Market discipline focuses on the risk sensitivity of customer demand for insurance products and on investor willingness to pay for equity and debt. Evidence from the banking sector shows that market discipline can work very efficiently. However, the banking sector is different from the insurance sector in some aspects, so not all findings from banking may be generalizable to the insurance industry.

There are not enough insurance sector market discipline studies to conduct an in-depth impact assessment, but those that do exist indicate that market discipline appears to vary in terms of strength between the German insurance market (Eling and Schmit, 2011) and the U.S. market (Epermanis and Harrington, 2006). Furthermore, there are important drivers of (standardization and accessibility) and impediments to (market distortions such as guarantee funds) market discipline that regulators should keep in mind when attempting to enhance it. If market participants are not aware of risk and/or are unable to evaluate risk at a reasonable cost, there will be no market discipline.

There are many avenues future research can take. There is a great need for empirical tests of the risk sensitivity of policyholder demand, especially for countries other than the United States. Regarding potential investor-driven market discipline, it might be interesting to analyze spreads of credit default swaps, data that are available, at least for large insurers and reinsurers. For large insurers and reinsurers listed on stock markets, analyzing stock prices might be useful. It also would be interesting to see how risk sensitivity varies across countries, by comparing data from different regions and countries, and across different legal forms, by comparing mutual and stock insurer data. Such empirical tests could then be compared with results from other insurance and banking studies.

Another interesting task would be to measure the influence of market discipline in insurance with the methodology employed by Bliss and Flannery (2002). We also need more theoretical studies on market discipline in insurance, e.g., models that analyze the implications of market discipline on competition or models on the role of franchise value in insurance and how this is

affected by risk. These theoretical models could then be tested with empirical data to increase our knowledge of market discipline in the insurance industry.

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