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IS THE CAPITAL STRUCTURE LOGIC OF CORPORATE FINANCE APPLICABLE TO INSURERS? REVIEW AND ANALYSIS

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Abstract. Since the financial crisis of 2008, next to banks, insurers have received increasing attention from researchers and regulators because of their crucial role in the financial system. A key point for a stable insurer is its capital structure, i.e. the choice between equity, debt and provisions in financing its operations. Based on earlier work a quickly developing literature has directly applied capital structure theories (in particular trade-off and pecking order) from corporate finance to insurers' financing choices. Corporate finance concepts used herein however, are developed for industrial firms. In this paper we provide an overview of the literature on the capital structure of insurers, but contribute by systematically clarifying how to account for the specificities of insurers when transferring the trade-off and pecking-order logic from an industrial to an insurer context. This way, we add several new insights on an insurer's choice between equity, financial debt and provisions. In particular, we are able to explain why, as compared to industrial firms, insurers use less financial debt, and why insurers focus so strongly on self-financing. Finally, we identify multiple avenues for future research.

Keywords. Capital structure; Insurance; Pecking order theory; Trade-off theory

1. Introduction

Ever since the financial crisis, next to banks, the awareness of the role of insurers in the economy has intensified. It is widely accepted that insurance firms contribute to economic growth by the efficient distribution of risks through risk transfers while they add to financial stability by providing long-term

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financial resources to the economy (e.g. De Weert, 2011; Insurance Europe, 2014; Swiss Re, 2014). Swiss Re (2014) reports that in 2013 premiums written worldwide amounted to approximately 4.6 trillion US dollars representing about 3621 US dollars per person in the developed markets and 192 US dollars per person in the emerging markets. Their investments in financial assets amounted to approximately 27 trillion US dollars, or, in terms of magnitude, about 37% of worldwide GDP. The European insurance industry represents 35% of worldwide market share in terms of premiums, followed by the US with 30% market share (Insurance Europe, 2014).

An important element contributing to the stability of an insurer is its solvency. Not surprisingly, since the financial crisis there is heightened interest in this topic. A quickly growing strand of academic literature focuses on applying corporate finance capital structure theories to insurance companies. In fact, following the publication of Miller and Modigliani's (1958) capital structure irrelevance theorem, a lot of research attention in Finance has been devoted towards the explanation of the choices firms make in financing their operations, that is, their capital structure. While the existing empirical literature for non-financial firms is abundant, until recently insurance companies (and banks) are often left out of the discussion (Cheng and Weiss, 2012). Although the effort of translating corporate finance concepts – that were developed for industrial companies – to insurance firms has contributed to our understanding of the forces that shape insurer solvency, the arguments are usually scattered across different studies and remain incomplete.

In this paper we review the latter literature and simultaneously develop several new insights on insurer capital structure by bringing together scattered arguments and linking them systematically to those in corporate finance. As our review necessarily brings together several strands of literature, we split up our analysis in several steps. First, we recall the logic of the static trade-off and pecking order capital structure theories in corporate finance. After providing information on the typical business model of an insurance firm, we review the theoretical literature as well as the empirical research on the applicability of the corporate finance logic to the insurance industry. By systematically exploring the link with corporate finance capital structure theories, we clarify a number of phenomena within an insurer's capital structure that are observed and documented in the insurance literature but are usually merely attributed to the deviating business model of the insurance industry. Specifically, we are able to explain why, as compared to industrial firms, insurers use less financial debt. In fact researchers in insurance management tend to ignore financial debt altogether and focus entirely on provisions and capital (see e.g. Doff, 2011; Cheng and Weiss, 2012). Next, in a similar vein our arguments further clarify why insurers focus so strongly on self-financing in practice. In line with the insurance literature, our logic also suggests that relative to industrial firms, capital structure choice in insurance firms is likely to be more complex in the sense that some relationships are more strongly driven by endogeneity while some extra costs and benefits have to be taken into account. We further explore these latter complexities by reviewing several sub-literatures focusing on the interactions between capital structure and insurer business plans (i.e. investment decisions), risk exposure versus capital structure, reinsurance versus capital structure and underwriting cycles.

The remainder of this paper is organized as follows. The second section provides an overview of corporate finance theories. Section 3 provides a discussion of how these corporate finance theories on capital structure are applicable to the special setting of insurance companies. Next, Section 4 addresses the typical interactions between capital structure and business plans within the insurance industry. Section 5 concludes and discusses some avenues for future research in insurance management.

2. Capital Structure Theories

The choice of capital structure (i.e. the way firms finance themselves) has been a main topic of research in corporate finance. Although some considerable disagreement remains, many important insights on

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the subject have been gained. Building on the seminal work by Miller and Modigliani (1958), a huge literature that tries to explain capital structure choices has emerged. Elaborate surveys can be found in Harris and Raviv (1991), Myers (2001) and Frank and Goyal (2008) among others. The major part of this debate revolves around the trade-off theory and the pecking order theory.[1] Below we briefly discuss these theories, which are developed from the perspective of a typical industrial company. Nevertheless, as we will see below, by going back to the foundations of the logic and applying these to insurers, relative to the literature, extra insights are gained.

2.1 *Trade-Off Theory in Corporate Finance*

The trade-off theory is built on the assumption that firms pursue an optimal target financial mix that trades off the marginal benefits and marginal costs of leverage. The starting point is the logic of Miller and Modigliani (1958) that was originally developed presuming that firms operate in perfect capital markets, but which was afterwards adjusted to take into account market imperfections as well as agency costs. Specifically, and this was fundamental, in their 1958 article Miller and Modigliani separate investment and financing decisions. They achieve this by taking the industrial investment decisions of a firm as given (i.e. predetermined) so that the capital structure is determined in a next stage. However, once the industrial investments are fixed (including also managerial effort), the cash flows that remain after payment of suppliers, workers and required reinvestments are necessarily also fixed since sales, production costs (not including financial costs such as interest) and reinvestments are all part of the industrial investment plans. After every stakeholder – except for the providers of finance – is paid and after required reinvestments are taken care of, the free cash flows can be paid out to suppliers of capital, that is, equity holders and providers of financial debt. As these available free cash flows do not change by changing the capital structure, the total of the proceeds received by all security holders together does not change either under varying financial structures. Therefore, according to Miller and Modigliani (1958), the total value of the firm – being the total market value of all (equity and debt) securities through which the firm finances itself – does not change as a function of the capital structure.

However, through imperfections in real life capital markets, the capital structure does affect the total amount of cash flows that is available for security holders. A first important such imperfection is corporate taxes. Because, contrary to equity, the remuneration of financial debt may be subtracted from taxable corporate income, the use of debt reduces the outflow for taxes and hence increases the total amount of cash flows that is available for distribution to all security holders. If this would be the only market imperfection, Miller and Modigliani (1963) showed that companies should maintain 100% financial debt financing. To explain why firms continue to opt for an important fraction of equity in their financing mix, the literature has proposed offsetting costs. Kraus and Litzenberger (1973) and Bradley *et al.* (1984), for example, develop models where the tax advantages of debt are balanced with bankruptcy costs. As a result, total firm value is supposed to be a concave function of leverage while the capital structure that maximizes total firm value becomes the optimal or target financial structure (e.g. Kim, 1978; Altman, 1984).

In a second step the trade-off theory recognizes that, contrary to the perspective of Miller and Modigliani, corporate investment plans and financial structure may interact to some extent. Specifically, Jensen and Meckling (1976) introduce the 'agency' perspective as another potential source of costs and benefits to be taken into account when choosing the optimal capital structure. The introduction of agency costs enables to explain why companies used debt before the latter was given a beneficial tax treatment relative to equity and therefore complements the 'tax-bankruptcy' point of view explained above. The agency theory posits that separation between ownership and control causes a conflict of interest between managers and shareholders. This conflict can be interpreted as a moral hazard problem. It is the consequence of the fact that managers only receive part of the benefits from their efforts if they

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own less than 100 percent of equity. The agency conflict can be alleviated by increasing debt for several reasons. First, keeping the absolute amount of investment in the firm by the manager fixed, an increase in the fraction financed by debt results in an increase in the manager's ownership fraction, which in turn enhances the alignment of the manager's interests with those of external shareholders (Harris and Raviv, 1991). Next, the free cash flow hypothesis by Jensen (1986) implies that increasing leverage mitigates agency conflicts because servicing the debt decreases surplus cash available to managers which reduces the potential for overinvestment in bad projects.

However, due to the fact that claims of debt holders to assets have legal priority over the claims to shareholders, also the relationship between owners and debt holders is characterized by agency conflicts. As shareholders only receive the remaining market value of the firm after all debt holders are repaid, two agency problems accompany the increase of leverage, that is, debt overhang and asset substitution. The debt overhang or underinvestment problem identified by Myers (1977), causes shareholders to refrain from adding extra equity, the reason being that funds of the new shareholders will serve mainly to benefit the debt holders. Shareholders are thus unlikely to inject capital, even when it may enhance overall corporate value and firm survival.

The concept of asset substitution, also known as the problem of risk shifting, was developed by Jensen and Meckling (1976) and Galai and Masulis (1976). They argue that because owners are residual claimants and have limited liability, which gives them the right to pay off policyholders and take over the remainder of the assets, a company's equity can be viewed as a European call option on its assets with strike price equal to the value of the liabilities (Merton, 1974). As the value of a call increases with the volatility of the underlying asset, managers, acting in the best interest of shareholders, have an incentive to take on risky projects, especially when the potential return is high with a low rate of success. Indeed, if the project fails, debt holders bear most of the costs because of the owners' limited liability; when the project is successful, however, only the shareholders reap the benefits.

2.2 *Pecking Order Theory in Corporate Finance*

Myers (1984) and Myers and Majluf (1984) developed the pecking order theory based on Donaldson's (1961) earlier findings on financing choices. According to this theory, informational asymmetries between the firm's managers and its providers of financing cause external financing to be more costly than internal financing sources. Information asymmetries arise because managers have better information than external investors about the true underlying value of assets in place and the firm's investment opportunities. Furthermore, it is presumed that, as management acts in the interest of the investors that currently own shares, they are only willing to issue shares if, on the basis of their superior information, they estimate that the shares are overpriced and refrain from doing so if the reverse holds. As a result, on the announcement of a new share issue, investors adjust their beliefs and the share price drops. In turn, this phenomenon is likely to cause a preference of internal over external financing sources to the point that firms may even underinvest when internal funds are in short supply (Danthine and Donaldson, 2005). Myers and Majluf (1984) contend that firms can reduce this underinvestment problem if they use external financing sources that are less susceptible to underpricing because they contain little information on the underlying value of the firm's equity and hence, when used, do not cause a downward update in investors' expectations. This results in a so called 'pecking order' in managers' preferences for financing sources. They first use up retained earnings, followed by 'safe' debt. In a next step, they move on to risky debt that (implicitly) encompasses more equity-like features. Finally, when debt capacity is reached managers move on to equity as a last resort. This implies that according to the pecking order theory, no optimal target debt–equity ratio (cfr. Trade-off theory) exists while capital structure is the result of the accumulation of past financial deficits (Shyam-Sunder and Myers, 1999; Myers, 2001).

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3. An Insurer's Capital Structure

3.1 *An Insurer's Balance Sheet*

The business model of an insurance firm is quite different from the business model of the companies that are implicitly borne in mind in the theories discussed above. Contrary to industrial firms that upfront have to make important investments in industrial assets and working capital components like inventories and accounts payable, insurers receive upfront a premium (i.e. insurers have an inverted production cycle). To be able to meet future claims, insurance firms are required by regulation to invest in a portfolio of financial securities. Depending upon the regulation, either the actuarial value (i.e. expected future value) or the fair value (i.e. market value or best estimate) of future claims shows up as technical provisions on the liability side of the balance sheet. While the preceding capital structure theories emphasize on the use of financial debt versus equity, in the insurance literature it is typically posited that financial debt is limited implying that the difference between the portfolio and these provisions is basically financed by equity. As a result, the discussion in the insurance literature on capital structure emphasizes on equity versus technical provisions (e.g. Baranoff *et al.*, 2008; De Weert, 2011; Doff, 2011; Cheng and Weiss, 2012; among others).

A first key difference with the industrial capital structure is that in an insurance company the roles of customer and financier are merged, since policyholders supply financing to the company through their premium payments. Hence, because the insurer becomes indebted to the policyholders, once premiums are collected, customer interaction happens with the liability side of the balance sheet. By contrast, in a typical industrial enterprise operations are asset driven and customers do not become debt holders.[2] A second important difference is that in an insurance firm, the assets mainly consist of a portfolio of mostly tradable financial securities. As we will discuss below these two differences cause technical provisions to (largely) drive out financial debt, and simultaneously create an extra cost on the use of equity. As a first step, we show that using the classical logic of corporate finance, technical reserves are expected to (largely) drive out financial debt. In a second step, we review the insurance literature that typically (implicitly) pits equity against technical reserves and add a number of insights to this discussion. More specifically, we show that our adaptation of traditional capital structure theory for insurers is able to explain that even without pro-equity regulation, insurance companies have a tendency to make limited use of financial debt as a financing source.[3] Although this result has often been observed in studies on the capital structure of insurance companies, to our knowledge it has never been thoroughly argued how this observation fits in the capital structure theories. It also offers extra insights pertaining to the importance of the endogenous relationship between capital structure and other corporate decisions, and relative to industrial firms, it indicates, in line with, for example, Staking and Babbel (1995), Cummins and Nini (2002), among others, that extra costs and benefits need to be taken into account when evaluating capital structure decisions in the insurance industry.

3.2 *Financial Debt versus Technical Provisions: Some Additional Insights*

3.2.1 *Insurance-Based Trade-Off Theory*

When applying the logic of the trade–off theory to insurance firms, it is not a priori clear why relative to equity, insurers use limited financial debt (see e.g. Cummins and Lamm-Tennant, 1994 and Baranoff *et al.*, 2008, for some data on the use of financial debt). Specifically, when we consider the first step of the trade-off theory – tax advantages are balanced against bankruptcy risk – we presume that business plans are given. In the context of insurance firms this would imply that underwriting and investment activity in securities are fixed (e.g. Eling and Marek, 2014). This implies that total assets and provisions are fixed,

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Assets	Liabilities
	Equity
Surplus of financial securities over technical provisions	Financial debt

Figure 1. Simplified Balance Sheet of an Insurance Company 'Corporate Finance Style'.

and hence that the problem of capital structure reduces to a financing of the difference between assets and provisions.[4] As reflected in Figure 1, the classical choices here would be between equity and financial debt.

Indeed, given the same business plan, the traditional logic of trading off the tax advantage of financial debt versus the cost of bankruptcy applies equally well in this context. The same holds when evaluating the agency aspects of the capital structure choice. Just as in the case of an industrial firm, financial debt may discipline managers, while it may cause underinvestment problems and asset substitution when the company becomes overly debt-financed. However, more than in traditional industrial activities, in the case of an insurer, there is likely to be an important interaction between the business plan and the financing choice.[5] In particular, financial debt may be pitted against provisions in the different trade-offs that drive the capital structure as discussed above in Section 2. Specifically, given a choice for a certain level of expected bankruptcy costs, insurers may trade-off extra provisions against less financial debt. Reducing financial debt to the advantage of incremental provisions while keeping all else fixed has the advantage that it creates more insurance business for the same level of investments in the securities portfolio. Assuming that insurance business is profitable, this implies that more profitable business projects can be undertaken. As the extra provisions are usually tax deductible (Bradford and Logue, 1999), the former also offers a tax advantage which is at least as important as the tax advantage offered by the deductibility of the interest on financial debt.[6,7] Furthermore, concerning the agency aspects of the capital structure, provisions can take over the role of financial debt. Just as in the case of the latter, the risk of bankruptcy entailed by provisions may discipline management and reduce agency costs. On the other hand, likewise financial debt, provisions may also cause problems of underinvestment and asset substitution. Hence, from the perspective of the trade-off theory, the first argument predicts that provisions drive out financial debt while the agency arguments remain similar in the case of provisions as compared to financial debt. So based on the classical trade-off arguments, one would expect that insurers make little use of debt financing.

Taking into account the fact that regulators typically impose that the claims of financial debt holders are junior to those of the policy holders, there is one insurance-based argument in favour of the use of financial debt though. Figure 1 shows that the resources from financial debt are invested in the asset portfolio that serves as a guarantee to pay out policy holders. Hence, when the asset portfolio becomes relatively small as compared to potential claims, an increase of the asset portfolio through infusion of financial debt may – in a tax-friendly way – help to reduce the risk that policy holders walk away. However, this action may increase the insurance firm's overall likelihood of bankruptcy and hence the risk of losing its franchise (i.e. going-concern) value. Therefore, one would expect insurance firms to opt for this solution mainly when the franchise value – and the profitability of its insurance business – is low. In fact, Harrington and Niehaus (2003) in their discussion of the tax cost of insuring tail risk consider the use of financial debt as a cost-mitigating factor. However, they also indicate that there may be an interaction between franchise value and financial debt, in the sense that the latter may erode the former. In sum, the trade-off logic suggests that also without pro-equity solvency regulation, financial debt is unlikely to be an important source of financing.

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The preceding discussion implicitly presumes that, like most industrial firms, the insurer takes the form of a stock company. However insurers are also often organized as a mutual. Within a mutual insurance company, as opposed to a stock-owned insurance firm, the policyholder is also owner, as well as customer and financier. In turn this has implications for agency problems. As discussed above, in stock firms, owners have an incentive to engage in asset substitution to the detriment of policy holders at low levels of capital. Because the role of policy holder and owner is merged within the mutual organizational form, the latter problem is eliminated. However, this comes at the cost of enhanced agency issues between owners/policyholders and management because the rights of mutual owners are usually more restricted than the rights of common stock holders (Harrington and Niehaus, 2002). From that perspective (i.e. more agency problems between managers and owners/policy holders but no conflicts between policyholders/debt holders and owners), the trade-off theory would predict more use of debt as compared to a stock company to mitigate managerial agency costs. However, as compared to the latter it is even less likely that the debt would take the form of financial debt issued to third parties, ceteris paribus. For if a mutual insurer uses such financing it suffers relatively extra costs by reintroducing a conflict of interest between debt holders and owners/policy holders.

Overall, the preceding discussion suggests that insurance firms are subject to similar trade-offs compared with industrial firms when making a choice between equity and financial debt, except that presently financial debt has to compete with another liability type in the form of technical provisions. As a result, if underwriting is profitable, insurers have a preference for provisions instead of financial debt.

3.2.2 *Insurance-Based Pecking-Order Theory*

Also from the perspective of the pecking order theory, one would expect less use of financial debt in an insurance company, as compared to industrial firms. First, as mentioned before, industrial firms often have to make important investment outlays in industrial assets before they can realize sales and cash flows. Insurers, being service providers, have less of a problem on that score. As a result, since they do not have to finance important amounts of inventories or accounts receivables, one would expect less financing deficits, ceteris paribus. On top, as mentioned before, insurers have an inverted production cycle in which they are paid upfront for their services. Overall, one would expect less need to issue financial debt (e.g. Baranoff *et al.,* 2008). Second, issuance of financial debt may easily encounter important asymmetric information problems. Specifically, Cummins and Nini (2002) point out that the implications of the pecking order theory depend primarily on the degree of asymmetric information in the insurance industry. While traditional companies only encounter asymmetric information in the assets, Zhang *et al.* (2009) argue that banks and insurers are subject to asymmetric information in both assets and liabilities. Morgan (2002) concludes that if one looks at disagreements between rating agencies, insurers are even more opaque than banks. Information asymmetries related to assets remain relatively manageable for insurers, however, since their assets consist mainly of marketable securities. Technical provisions on the other hand, are essentially estimated amounts and are thus surrounded by a great deal of uncertainty. The latter therefore represent the most important source of asymmetric information in this setting. In fact, overall, the insurance literature stresses the importance of asymmetric information problems in the acquisition of external financing (e.g. Harrington and Niehaus, 2002; Zhang *et al.*, 2009; Cheng and Weiss, 2012). Combining these asymmetric information problems with the fact that regulation typically implies that financial debt is subordinated to the claims of the policyholders, one would expect that an insurer (a stock company or a mutual alike) easily passes into a situation where financial debt is considered risky by investors. In that case, similarly to equity, issuance of financial debt also encounters asymmetric information problems making it costly to use that type of financing. As risky debt, like new external equity, quickly becomes subject to important asymmetric information problems, the pecking order perspective also predicts little use of financial debt. The latter in turn implies that in their pecking order,

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Assets	Liabilities
	Equity
Financial securities	Technical provisions

Figure 2. Simplified Balance Sheet of an Insurance Company 'Insurance Style'.

insurance firms become very dependent upon internal funds, as, in comparison to a typical industrial firm, the second layer of financing in the pecking order – sufficiently safe financial debt – is very limited.[8] In fact, the empirical findings discussed below support the preceding argument and show the important degree of self-financing among insurers in practice.

3.3 *Technical Provisions versus Equity*

As mentioned above, the capital structure in the insurance literature focuses on the balance between equity and the claims of policy holders, i.e. technical provisions (Cheng and Weiss, 2012; Fier *et al.*, 2013; among others). Our preceding logic supports this perspective. For comparability reasons with traditional corporate finance measures, we define capital structure as equity to total assets (e.g. Baranoff and Sager, 2002).[9] Below we give a concise overview of the discussion in the insurance literature by comparing their arguments with those of corporate finance models described in Section 2.

3.3.1 *The Trade-Off between Technical Provisions and Equity*

The logic of the trade-off theory for insurers is typically developed with the 'insurance style' balance sheet representation of Figure 2 in mind.

The insurance literature recognizes similar advantages and disadvantages of maintaining equity as discussed in the trade-off theory (i.e. taxes versus bankruptcy risk versus agency problems versus debt overhang and asset substitution) but develops these within the specificities of the insurance context and supplements them with several insurance-specific viewpoints concerning lines of business (life insurance versus property–liability insurance), ownership structure (stock company versus mutual) or regulation. As will be seen below, overall the different elements of the trade-off logic remain except that their relative importance may vary across lines of business and ownership structure, possibly leading to different optimal levels of capital structure across insurance firms. Simultaneously, capital regulation seems to be of a second order importance in determining capital structure.

First, the insurance literature recognizes that, due to double taxation of investment income (i.e. at the insurer's level as well as at the level of the insurer's shareholders), there is a tax cost to the use of equity (Cummins and Grace, 1994; Bradford and Logue, 1999; Cheng and Weiss, 2012; among others). This is then traded off against a lower bankruptcy risk (e.g. Cummins and Nini, 2002; De Weert, 2011; Cheng and Weiss, 2012; among others). Important differences in this trade-off occur when comparing the riskiness of the liabilities of life insurance versus non-life insurance. The long coverage period of life insurance vis-à-vis non-life insurance enhances even more the relative predictability of life insurance (Hull, 2012). Consequently, as also observed in practice, the capitalization in the life industry should be substantially lower than in the non-life industry (e.g. Cummins and Sommer, 1996; Baranoff and Sager, 2002).

Second, the ownership literature (stock companies versus mutual) mainly stresses the relative differences in importance of managerial agency costs (i.e. moral hazard and adverse selection problems) versus debt overhang versus asset substitution problems, which in turn lead to differences in optimal capital structure. When the insurance firm takes the form of a stock company, the literature argues that just as in

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the case of industrial firms, equity may be subject to managerial agency costs as managers may abuse their inside knowledge of the firm (e.g. Fields and Tirtiroglun, 1991; Boubakri, 2011; among others). However, likewise industrial firms, too little equity may cause debt overhang and asset substitution problems. In turn, because the role of debt holder and customer is merged within insurers, preceding issues may trigger another problem, that is, when an insurer is perceived as becoming too risky it may lose business as customers start to walk away or it may be forced to charge lower premiums to stop the latter from happening (Cummins and Danzon, 1997; Cheng and Weiss, 2012). On the other hand, as discussed above, in the mutual organizational form the agency costs related to debt overhang and asset substitution are eliminated at the cost of enhanced agency issues between owners/policyholders and management. This trade-off between agency costs therefore suggests that mutual insurers should be less capitalized as compared to stock company insurers. However, this is not borne out by the empirical findings. One possible explanation offered by the literature is that, in order to survive competitive pressures, the mutual type of insurer is likely to choose a portfolio of insurance products and activities in which there is less leeway for managerial discretion (Mayers and Smith, 1988). This argument is in line with those of Fama and Jensen (1983) and Mayers and Smith (1981) who suggest that as different organizational forms entail different costs and benefits, their operational activities should also differ. As discussed in Section 3.3.2 below, difficulties in acquiring extra outside equity may offer another explanation.

A final insurance-specific viewpoint within the trade-off logic of capital structure is regulation. On this score the literature is rather limited. A number of papers take the view of solvency being a measure of soundness of the insurance firm and link this directly to regulation. In an early study Cummins *et al.* (1995) document for US property–liability insurers that the ratio of minimal required regulatory capital to actual capital is a poor predictor of bankruptcy. Consistent with preceding findings, Munch and Smallwood (1980) document that the imposition of minimum capital requirements reduces bankruptcies among US property–liability insurance firms mainly through limiting the entry of small risky companies in the market. For an international sample, Gaganis and Pasiouras (2013) find no robust relationship between more stringent capital requirements and the soundness of insurers measured as distance to default. In the same vein, the empirical literature discussed in Section 3.4 below indicates that forces similar to those of industrial firms are important drivers of capital structure, and this independent of regulation. Furthermore, insurers tend to operate well above their capital requirements (e.g. Shim, 2010 for US property–liability insurers; De Haan and Kakes, 2010 for Dutch insurers, among others), suggesting a weak link between capital requirements and actual target capital structures. Another element that is of interest to observe is that, as is discussed in Section 3.4 below – likewise industrial firms – the firm specific determinants driving the targets also capture elements of risk. Consequently, although in the sample period of De Haan and Kakes (2010) Dutch insurance firms were not subject to risk-based capital regulation, these companies acted as if they were. Nevertheless, regulation seems to be important for low capitalized firms, as the findings in preceding studies suggest that regulation pressures the latter companies to speed up adjustment to their target capital structure.[10]

What is less explicitly recognized in the insurance literature is the fact that, because insurers usually invest their equity mainly in a portfolio of tradable financial securities, this adds an extra cost to the use of equity. In fact, in sufficiently efficient securities markets, the investment in financial securities tends to constitute a negative net present value project as systematically realizing a higher return than commensurate with the portfolio's risk is difficult to achieve (e.g. Schwert, 2003). Moreover, managing such a portfolio entails costs for the insurer like administrative fees or taxes on investment income. This is contrary to an industrial firm that invests most of its equity in (industrial) positive net present value projects. Nevertheless, the latter may also maintain important liquid reserves under the form of a portfolio of tradable securities and short-term financial investments (e.g. Bates *et al.*, 2009). In corporate finance a recent 'cash' literature studies the advantages and disadvantages of this latter corporate policy. So far the findings are that these portfolios usually are valued at a discount that may range between 10% and 60%

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implying that on its own such an investment indeed has a negative net present value (see e.g. Pinkowitz *et al.*, 2006; Faulkender and Wang, 2006; Dittmar and Mahrt-Smith, 2007; among others).[11,12]

3.3.2 *Pecking Order and Technical Provisions versus Equity*

On this score we can be short. As discussed above, the insurance literature stresses the importance of asymmetric information problems linked to the technical provisions (and the underwriter portfolio). Therefore, the logic of the pecking order theory also applies to insurers (e.g. Cheng and Weiss, 2012; D'Arcy and Lwin, 2012). Thereby, the insurance literature focuses on the preference for the use of internal funding and, as mentioned before, disregard financial debt as a next step in the pecking order.

The literature has tried to identify what types of insurers are most likely to encounter problems in acquiring extra outside equity. A relatively important sub-literature studies either the organizational form or the ownership structure from that perspective. Concerning organizational form, as compared to stock companies, the pecking order logic is expected to be more relevant in the case of mutual insurance companies causing them to hold higher levels of capital (Froot and Stein, 1998; Harrington and Niehaus, 2002). For, as argued in Harrington and Niehaus (2002) or in Fields and Tirtiroglu (1991), acquiring external equity is extra costly to mutual insurers as the latter are unable to access the capital market easily. Concerning ownership structure, subsidiaries of (financial) groups have the opportunity to access the internal capital market in times of need. Therefore, as compared to stand-alone firms they hold lower levels of capital (Powell *et al.*, 2008; Fier *et al.*, 2013).

3.4 *Trade-Off versus Pecking Order: Empirical Evidence for Insurers*

The empirical literature that evaluates the trade-off versus the pecking order logic in insurer's capital structure is still small but quickly developing. Cheng and Weiss (2012) offer the most comprehensive empirical study. For a sample of US property–liability insurers they test a partial adjustment model which includes, next to typical variables that proxy for the trade-off of advantages and disadvantages of equity, a financial deficit variable. According to the pecking order theory, changes in capital structure are directly related to the latter. They find that trade-off considerations dominate those of the pecking order theory. From that perspective, they also document that elements associated with agency costs like lines of business (short or long tail) and organizational form (mutual or stock) prove to be significant drivers of target capital ratios. Furthermore, elements associated with the risk of an insurance firm like insurer size, diversification or reinsurance usage are determinants of firm's target capital ratios as well. These findings and types of drivers are in line with earlier studies on insurers (Cummins and Nini, 2002 for US property–liability insurers, De Haan and Kakes, 2010 for a global sample of Dutch insurers, among others).[13] Nevertheless, commensurate with pecking order considerations, insurers have a strong preference for using retained earnings so that capital structure is sensitive to financing deficits. This is also confirmed by Shim (2010) for US property–liability insurers, and the above mentioned studies of Cummins and Nini (2002), De Haan en Kakes (2010), among others. Furthermore, Harrington and Niehaus (2002), in their earlier study of mutual versus stock company insurers provide evidence of similar pecking order elements as in Cheng and Weiss (2012). If the fact that they encounter relatively higher costs in raising capital is important, mutual insurance firms should maintain higher solvency ratios. Moreover, the latter should also be more sensitive to income. These predictions are indeed supported. In view of our earlier discussion of the limited menu available to insurance companies when it comes down to the pecking order, this is not surprising. Fier *et al.* (2013) give further support to the existence of target solvency ratios by studying US subsidiaries active in property–liability insurance of (holding) groups. They document that also these subsidiaries have targets and moreover actively use the opportunities of less costly internal capital market financing to manage deviations from this target. Overall, the evidence indicates that insurers have a target

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solvency ratio but simultaneously also suffer from important costs in raising equity. As they make limited use of financial debt, the latter implies that internal funds are extremely important in the management of their capital structure.[14]

4. Interactions between Capital Structure and Business Plans in the Insurance Sector

Although the previously discussed trade-offs (i.e. taxes versus bankruptcy costs versus managerial agency problems versus debt overhang and asset substitution) seem to correspond to those in corporate finance, the insurance literature suggests that through the nature of the insurance business model there likely exists a stronger interaction between capital structure and operational choices as compared to industrial firms. Specifically, as discussed in Section 3.1. above, when an insurance firm sells an underwriting product (i.e. part of the business plan) this automatically affects capital structure through the creation of extra liabilities (i.e. technical provisions). This is generally not the case for industrial firms. Furthermore, because of the reversed production cycle customers pay upfront so that they become debt holders and are therefore generally more affected by firm bankruptcy than in the case of an industrial company where typically the product is delivered first and customers only pay at that time or afterwards. These elements of the business model of an insurance firm bring the interaction between financing and business plans to the forefront, leading to the view that the choice of financial structure is a complex, multidimensional decision (Staking and Babbel, 1995). Extensive sub-literatures studying the direct interaction of business plans and capital structure concern the relationship between the risk imbedded in the business plan and capital structure on the one hand and the link between capital structure and reinsurance on the other. Another important sub-literature studies the presence of activity cycles in the insurance industry; several of the theories explaining this phenomenon build on the fact that customers become debt holders.

4.1 *Insurer Capital Structure and Risk Embedded in the Business Plan*

A relatively recent but already extensive literature relates the business risk of an insurer with its capital structure. Following earlier work for insurers (e.g. Harrington and Nelson, 1986; Staking and Babbel, 1995) and for banks (e.g. Shrieves and Dahl, 1992), several authors like Cummins and Sommer (1996), Baranoff and Sager (2002; 2003) among others, investigate how the capital structure interacts with the choice of business risk. This research has produced two main competing hypotheses, that is, the so-called finite risk paradigm on the one hand and the excessive risk paradigm on the other.

The finite risk paradigm proposes that insurers choose capitalization and business risk to attain solvency risk targets. The latter implies that more risk in one area of choice is compensated by less risk taking in the other. Therefore, high capitalization and business risk should be positively related. The logic of the finite risk paradigm finds supportive arguments in agency theory, transaction cost economics, and in bankruptcy cost and regulatory cost avoidance. Specifically, the transaction cost economics argument posits that incomplete contracts create uncertainty that leads to conflicts among stakeholders. Product specificity is closely related to incomplete contracts and hence creates uncertainty. Firms can reduce this problem by using equity (see e.g. Williamson, 1988; Kochhar, 1996; Baranoff and Sager, 2002). Similarly, separation between ownership and management creates conflicts of interest and, in view of incomplete contracts, therefore also more uncertainty. Again, the latter is resolved by either using more equity (Kochhar, 1996; Baranoff and Sager, 2002) or engaging in more standard – and hence less risky – product lines (e.g. Mayers and Smith, 1981, 1986; Lamm-Tennant and Starks, 1993; Cummins and Sommer, 1996; Pottier and Sommer, 1997).[15] Finally, insurance firms seek to limit bankruptcy costs and regulatory costs in order to limit overall risk (e.g. Cummins and Sommer, 1996; Baranoff and Sager, 2002; among others).

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By contrast, the excessive risk paradigm posits that insurers do not seek to limit overall risk. As a result, low levels of capital may be associated with an aggressive business policy, so that business risk and the level of capitalization may be negatively related. One cited reason for such behaviour refers to the existence of guaranteed funds provisions (in the United States) that create moral hazard at low levels of franchise value (Lee *et al.,* 1997). Another reason concerns the earlier discussed notion of asset substitution (in the framework of the trade-off theory). As argued above, in view of the option feature embedded in equity, there may be an incentive to engage in risk seeking and risk shifting at low levels of franchise value.

Most of the empirical literature considers US insurers and supports the finite risk paradigm (e.g. Harrington and Nelson, 1986; Cummins and Sommer, 1996 for property–liability insurance, Baranoff and Sager, 2003 for life insurers). However, some studies point to mixed results (e.g. Baranoff and Sager, 2002).[16]

Related to the risk/capital structure discussion is the effect of regulation on previously discussed choices. A few studies link capital structure and risk taking to regulation. Specifically, Shim (2010) studies the effects of capital-based regulation on the insurer's capital structure and risk taking behaviour for a set of US property–liability insurers. As mentioned before, this research shows that regulatory pressure has a positive effect on changes in an insurer's capital for low capitalized firms. However, regulatory pressure is also positively related to increases in portfolio risk, indicating that in line with the risk-shifting problem discussed earlier, undercapitalized insurers may be tempted to increase risk in order to generate higher returns to make up for capital shortage. Nevertheless, results overall are in line with the finite risk paradigm as insurers' capital and risk choices prove to be interdependent and change in the same direction to limit the probability of default.[17] The results in Cheng and Weiss (2013) for US property–liability insurers confirm preceding findings. Moreover, the sample of their paper covers a period before and after the introduction of the risk based capital requirements in the United States. They report that before the introduction of these requirements the positive relation between capital and risk was not consistently significant suggesting that this regulation may have contributed to the prevalence of the finite risk paradigm.[18]

4.2 *Insurer Capital Structure and Reinsurance*

Through reinsurance, a primary insurer resells part of the underwriting risks, and therefore impacts on the business plan. Moreover, reinsurance and capital structure are related. The literature studying this relationship builds upon the insights from corporate finance concerning the link between hedging and capital structure (see Monda *et al.*, 2013 for an overview on risk management motives). These studies hypothesize a positive relationship between leverage and reinsurance based on bankruptcy cost, agency cost as well as risk bearing arguments (Shiu, 2011), in line with the trade-off logic developed above. The bankruptcy cost hypothesis states that reinsurance can shield insurers from unexpected losses in either underwriting or investment operations, reducing the probability of insolvency (i.e. bankruptcy costs). As highly levered insurers are already faced with increased bankruptcy costs, reinsurance will be more important as leverage increases. The agency cost hypothesis on the other hand also puts forward a positive relationship between leverage and reinsurance because the use of reinsurance may alleviate underinvestment problems. As managers, acting in the interest of shareholders, have the incentive to reject risky positive NPV projects of which the benefits mainly accrue to policy holders, shifting the risk towards a third party by reinsuring can balance the appropriate risk levels between shareholders and policy holders. Again, this solution will be more important in highly levered insurance companies. Finally, the risk bearing hypothesis postulates that insurers tend to use reinsurance against the costs associated with catastrophic outcomes as their leverage increases (Adams, 1996). In line with these arguments, Garven and Lamm-Tennant (2003) show on a set of US property–liability insurers, that more reinsurance

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is used when leverage increases. Cole and McCullough (2006) find a similar result for US insurers. Powell and Sommer (2007) further provide evidence that also internal capital markets play a role in the leverage-reinsurance relationship. On a set of US property–liability insurers, they find that internal as well as external reinsurance is positively related to leverage. Finally, Shiu (2011) finds a positive impact of leverage on reinsurance activity on a set of UK non-life insurers.

Conversely, the renting capital hypothesis proposes that reinsurance can serve to some extent as a substitute for equity, as reinsurers – specialists within the insurance market – basically rent out capital to primary insurers (Shiu, 2011). In view of the important information asymmetries between insurers and investors concerning the quality of underwriting portfolios, the cost of renting capital from reinsurers may be lower than the cost of issuing extra equity. As a result reinsurance may be the preferred alternative (Adiel, 1996; Chen *et al.*, 2001). The preceding argument implies that there is also a feedback effect from reinsurance to leverage. The latter is borne out by Shiu (2011), who reports for a sample of UK non-life insurers a two-sided interaction between leverage and reinsurance, that moreover is consistent with the reinsurance motives discussed above.[19] Other evidence of a reverse relationship can be found in Plantin (2006), who shows theoretically that reinsurance and capital structure are jointly determined, and Adams *et al.* (2008), who find on a set of UK life insurers that reinsurance expands debt capacity.

4.3 *Capital Structure and Insurance Cycles*

A clear example of the dependence of insurers on internal funding to build capital can be found in the theories that explain the underwriting cycle, that is, the cyclical manner in which prices and supply of insurance in the property–casualty (i.e. non-life) industry tends to rise and fall. Although this literature presumes that insurers have target capital structures, the central importance of the reliance on internal funds to rebuild equity also supports elements of the pecking order theory. Basically, these theories start out from the notion that it is costly for insurers to issue equity after a loss or negative investment shock because of asymmetric information and other market imperfections (Winter, 1994; Cummins and Danzon, 1997; among others). In turn, because of interactions between financing and business plans, this temporary lack of equity – that first needs to be rebuild through internal funds – results in higher prices and/or less insurance supply. Models mainly differ in the way these interactions are modelled and therefore result in different predictions about the relationship between the price of insurance and firms' bankruptcy risk over the cycle. As such, these models (indirectly) also take into account an interaction with the policy holder, which in view of the fact that the roles of policy holder and debt holder are merged, is important in understanding the functioning of insurers. Specifically, Winter (1988) and Gron (1994) propose the capacity constraint theory, Doherty and Posey (1997) the implicit contract theory and Cummins and Danzon (1997) the risky debt theory. Although much of the observed cycles in underwriting profits have been shown to be caused by simple reporting lags and accounting conventions, hard and soft markets seem to follow each other. During a hard market insurance prices increase and less coverage is available; during soft markets prices decrease and coverage is more easily available (e.g. Doherty and Kang, 1988; Lamm-Tennant and Weiss, 1997; Chen *et al.*, 1999). In the capacity constraint theory, a loss or a negative shock causes a depletion of the capacity of insurers to grant insurance, if they wish to keep bankruptcy risk within bounds. As a result prices for insurance products rise while coverage is relatively scarce. As capital is rebuilt through internal funds, insurers are capable of increasing their supply of coverage and the price of insurance decreases. Although prices may rise and fall, in this model, markets clear. This is not the case in the implicit contract theory. Although the latter's logic starts from the same driving mechanisms as Winter (1988) and Gron (1994) (i.e. shocks in capital cause limitations on provision of coverage), long-term contracts that aim at dealing with asymmetric information cause parties ex ante to agree on a menu of price-quantity pairs that are consistent with overall truth telling in the insurance market. This menu has the feature that after a shock in the insurer's capital, the insurance market shifts

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to a high-price/low-quantity pair causing the impression that supply is rationed. Both theories predict that prices and capacity to insure (hence also capital) are inversely related. Finally, in the risky-debt theory, optimal capital structures of insurers are driven by policy holders' demand for safe insurance. Because of asymmetric information, demand for insurance is imperfectly elastic while it is negatively related to insurer default probability. As endogenous insurer insolvency risk is not trivial, prices are inversely related to bankruptcy risk (and hence are positively related to capital). Although the empirical support for preceding models is mixed, they offer a logic for observed capital build up and maintenance of financial slack by insurers (e.g. Doherty and Posey, 1997; Cummins and Danzon, 1997; Doherty and Phillips, 2002; Weiss, 2007; among others). In fact, Weiss (2007) argues that the evidence may be consistent with the idea that the first two theories hold for the market as a whole (as a time series relationship) while the risky debt theory could explain cross-sectional differences at a certain point in time.

5. Conclusions and Avenues for Future Research

Although capital structure is a topic that has been examined extensively in the corporate finance literature, insurance firms are almost always excluded from the discussion. The insurance literature has filled this gap with theoretical as well as empirical research on leverage decisions in the insurance industry. Although the merit of this research is that it translates corporate finance concepts and theories to an insurance environment, the arguments are usually scattered across different studies. This paper tries to bring together all these insights and investigates to what extent traditional insights from corporate finance do translate to insurance companies in order to explain observed differences in capital structure. By focusing on the trade-off theory and the pecking order theory – the two main theories in corporate finance – several new insights are obtained and placed alongside existing ones into the framework offered by corporate finance. Specifically, to the best of our knowledge novel to the literature, we were able to explain how the limited use of financial debt and the strong dependence on internal sources of funding, observed in the insurance literature, is a consequence of insurance-specific aspects that influence the trade-off between the costs and benefits of holding capital as well as the translation of pecking order arguments within an insurance environment. Simultaneously, our logic implies that the study of capital structure within insurance firms is likely to involve more outspoken endogeneity issues as compared to traditional industrial companies, because in insurance firms business plans and financing decisions are more likely to interact. It also implies that it may be of interest to link capital structure to the recent cash literature in corporate finance since equity – or the surplus of assets over provisions - in insurance firms typically is largely invested in a portfolio of securities while the cash literature studies the advantages and disadvantages of industrial firms maintaining important portfolios of securities. Finally, it also implies that overall evaluation of the capital structure of an insurer is more complex as compared to an industrial firm because more costs and benefits have to be taken into account.

Because of their likely importance, this review provides an overview of recent insights in the interactions between capital structure and insurer business plans. On the one hand, it addresses the multidimensionality of the financing choice by insurance management where risk exposure as well as capital structure are endogenously determined. On the other hand, the fact that this risk/capital relationship can always be adjusted through the reinsurance channel, has led to extra insights on capital structure strategies in the insurance literature. Finally, also the more recent insurance sub-literature on underwriting cycles has been reviewed.

Several important avenues for future research emerge from the arguments that we have presented. First, as evident from the review above, most studies on insurers' financial management have been conducted on US data, with only a handful of studies using either international evidence (Fields *et al.*, 2012) or European evidence (Osipov, 2011). Using European data however can offer a strong contribution to the

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literature as it has the additional advantage that the EU increasingly provides a level playing field for competition and regulation (i.e. via uniform solvency rules for EU insurance companies).

Second, although the use of financial debt is largely ignored in the insurance literature on financial policy, the fact that in some empirical studies proportions of up to 10% have been found (see e.g. Cummins and Rubio-Misas, 2006 for the Spanish insurance industry and Bikker and Gorter, 2011 for Dutch insurance firms) deserves further attention. More specifically, it would be interesting to explore the determinants of financial debt usage and the particular circumstances under which insurers tap into this financing source. Next to an empirical approach, another way to do this would be to translate the trade-off and pecking order logic into a (dynamic) contingent claims model (see e.g. Doherty and Garven, 1986 for early work within an insurance context and Strebulaev and Whited, 2012 for a recent overview within a corporate finance context) that allows for studying debt source questions within insurance firms.

A third promising research avenue is the dynamics of internal capital markets in the insurance industry. Especially, since a considerable number of insurance companies are part of a larger financial group, the impact of group structure on the insurers' financial decisions deserves further attention. Some empirical studies already show that internal capital markets play an important role in the reinsurance behaviour (Powell and Sommer, 2007) or investment behaviour (Powell *et al.*, 2008) of affiliated firms. Other aspects of insurance specific financial decisions that are potentially influenced by internal capital markets, like leverage dynamics and the use of financial debt within the group, are far less understood.

A fourth aspect of the insurance literature that could benefit from additional insights from corporate finance is the relationship between financial decisions and product market strategies (Chevalier, 1995). Again, the competitive environment within the insurance industry is in itself not a new topic (Rees and Kessner, 1999; Osipov, 2011). However, as it is already established that insurers' capital decision is a multidimensional optimization process balancing risk, return and regulation, it would be interesting to add competition to the equation.,

Fifth, the cash literature in corporate finance can offer interesting insights as cash reserves are influenced by firm specific governance as well as institutional governance (Pinkowitz *et al.*, 2006). This raises the question to what extent corporate governance influences the capital structure of insurance firms. For insurance companies are heavy regulated while their equity is mainly invested in cash and cash equivalents, which, in turn, suggests similarities with the so called excess cash reserves in the corporate finance literature.

Finally, as a sixth avenue, a more thorough investigation of the extra complexity of the choice of capital structure in an insurance firm relative to an industrial corporation is likely to lead to interesting extra fundamental insights in the financial policy of an insurance firm.

Notes

1. Other capital structure theories are left out of the discussion based on reasons of irrelevance (e.g. market timing motives) or parsimoniousness (e.g. signaling motives as in Ross, 1977). The market timing theory by Baker and Wurgler (2002) for instance, is not appropriate for insurers because many firms in this industry are not publicly traded (Cheng and Weiss, 2012).
2. Although seemingly entirely different from traditional industrial leverage interpretation, insurance policies can be looked at as contingent debt financing (Baranoff *et al.*, 2008). The loan proceeds which have to be repaid by the insurer, contingent on the occurrence of a loss, are represented by the premiums. But, because actual payouts deviate widely from the premiums collected from one individual, the debt's face value is stochastic in nature. On top, the policyholder can only become a creditor, in legal terms, when an actual loss occurs.
3. In some countries like for example the United States, issuing financial debt is highly regulated and insurers need permission to issue these instruments which always has to be junior to policy holders'

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claims (Cummins and Lamm-Tennant, 1994). By contrast, the Solvency-regulation in Europe allows insurers to issue financial debt, but, likewise the United States, it has to be junior to policy holders' claims (e.g. De Weert, 2011). In fact if certain conditions are met certain types of (hybrid) financial debt may be included in the calculation of Tier 1, Tier 2 or Tier 3 Capital under Solvency II (see e.g. Doff, 2011).

4. It is implicitly assumed that due to regulation or imperfections in the market for insurance products, a surplus of financial securities over technical provisions is needed for insurance firms to be able to operate. It is also presumed that due to such imperfections insurance firms can be profitable (e.g. Mayers and Smith, 1981; Williamson, 1988). In that sense, it is presumed that the standard model of arbitrage pricing of insurance products does not perfectly holds (e.g. Myers and Cohn, 1987).
5. The insurance literature pays significant attention to the interaction between capital structure and investment decisions (see Section 4 on the capital/risk issue). However, the current argument is new to the literature.
6. Contrary to provisions, in the case of financial debt, not the extra principal amount on the books is tax deductible but only the interest. When financial debt is issued at market conditions, at the time of issuance, the present value of all future interest payments is smaller than the principal, except for perpetual debt. In that case both amounts are equal. Hence the present value of the tax advantage (which is equal to the corporate tax rate times the present value of interest payments) is also smaller than corporate tax rate times principal, except in the case of perpetual debt.
7. Note that in the preceding argument, as financial debt is reduced with the amount Δ, while provisions are increased for the same amount, the surplus of financial securities over provisions also decreases with Δ. Although in the preceding argument expected bankruptcy costs were kept unchanged, the risk position of the policyholders may change.
8. This argument has not been developed in the literature as yet. Note that it implicitly presumes that the insurer carries a sizeable amount of provisions on its books. In view of the fact that these provisions belong to the core business, this assumption is likely to be met in practice.
9. Several different measures of capital structure are used in the insurance literature, going from the traditional leverage definition of liabilities over capital (e.g. Fier *et al.*, 2013) over more definite proxies of technical reserves such as premiums written over capital (e.g., D'Arcy *et al.*, 2012) to risk-adjusted measures of capital (e.g. De Haan and Kakes, 2010; Cheng and Weiss, 2012).
10. In an empirical study Gropp and Heider (2010) investigate whether and to what extent the drivers of bank capital structure would be different from industrial firms. They apply the standard methodology from corporate finance to an international sample of non-financial firms and a sample of banks and report that findings are remarkably comparable between non-financial companies and banks. Their findings suggest, in line with De Haan and Kakes (2010), that regulatory capital requirements are not binding. As a result they report that capital regulation was of a second-order importance in determining capital structure. Gropp and Heider (2010) argue that banks may be optimizing their capital structure much like non-financial firms and create an outcome whereby usually capital requirements are not binding. Consistent with this idea Nier and Baumann (2006) document for an international sample of banks that the disciplining pressure of financial markets has a significant positive influence on capital. Similarly, Flannery and Rangan (2008) study large US banks and report that none of them was constrained by *de jure* regulatory capital requirements.
11. Preceding argument and comparison with the cash literature in corporate finance is to the best of our knowledge novel to the insurance literature.
12. The overall idea that insurer's equity is costly is not new. In fact, a sub-strand of literature studies the relationship between profitability and equity and documents varying outcomes in terms of over or under-utilization of capital by insurers (e.g. Cummins and Nini, 2002; Shim, 2010; among others). Indirect evidence on this score is offered in Cummins and Lamm-Tennant (1994) who study the cost

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of equity in relation to capital structure and Staking and Babbel (1995) who evaluate the relationship between capital structure and an adapted Tobin's Q measure.

13. Overall, where comparison is relevant, preceding findings are in line with empirical results for industrial firms (Titman and Wessels, 1988; Harris and Raviv, 1991; Rajan and Zingales, 1995).
14. To be able to test simultaneously for pecking order and for the trade-off theory, many studies incorporate dynamic elements in their tests. For, following the corporate finance literature, the logic that it is costly to adjust capital structure and hence that understanding the dynamics of adjustment could contribute valuable information to capital structure theories has received increasing attention. See for example Cheng and Weiss (2012), De Haan and Kakes (2010) and Fier *et al.* (2013).
15. Note that transaction costs economics and agency theory lead to different predictions. Agency theory, and especially the free cash flow argument of Jensen (1986) suggests that the use of debt reduces conflicts because it puts management under more pressure to perform. By contrast, Kochhar (1996), taking the view of transaction cost economies, argues that the use of debt enhances conflicts between stakeholders because it adds to uncertainty.
16. A quickly growing literature studies the interaction between corporate governance and risk choices of insurers. For an overview we refer to Boubakri (2011).
17. Instead of the relationship between capital structure and solvency regulation, Klein *et al.* (2002) investigate the relationship between capital structure and price regulation of insurance products. They report a positive link between leverage and regulation, indicating that insurers have a tendency to become more levered when the government regulates prices.
18. The banking literature reports a positive relationship between capital and risk adjustments as well. Starting from the seminal paper of Shrieves and Dahl (1992), Jacques and Nigro (1997), Aggarwal and Jacques (2001) among others, find support for the idea that banks that increase their capital buffer also increase their risk appetite. More recently Jokipii and Milne (2011) find evidence that this relationship may be cyclical whereby periods with a positive relationship may be succeeded by periods where a negative relationship dominates. It may be of interest to check whether this would also be the case for insurance firms.
19. A growing body of papers studies mechanisms to share risks with investors in the financial markets (e.g. cat bonds in Cummins, 2008; insurance derivatives in Shiu, 2011). These mechanisms are often off balance sheet and fall outside the scope of this review.

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