Cross-sector diversification in financial conglomerates: simulations with a fair-value assets and liabilities model [*]

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1. Introduction

One of the major recent developments in the financial services market is the combination of banks and insurance firms into financial conglomerates (FCs). In the past, many countries pursued a policy of prohibiting concentration of power in (excessively) large financial groups. However, many of these restrictions have been lifted in the light of, or in anticipation of, liberalisation and deregulation of financial markets, international financial and economic integration (particularly in the EU), increased competition from non-banks and the blurring of sectoral borders. Since the early 1990s, banks and insurance companies in the Netherlands have been allowed to merge, which has resulted in a few large FCs, most prominently ING and Fortis. In 1999, the Glass-Steagall Act was repealed, which had for a long time prevented firms from combining banking and insurance activities in the US, and in the runup to this rescission procedure, the Citigroup-Traveller combination was formed. Similar large financial groups have also emerged in other countries (e.g. Dresdner-Allianz and Crédit Suisse-Winterthur), albeit in more limited numbers. Moreover, many countries have seen a number of smaller or even

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unqualifiedly small FCs established. Whereas many banks in Europe have combined banking and securities activities for many years, such institutions are new to the US now that the ban has been lifted. In the US, the term FC is used to refer to such institutions as well.

FCs are usually created through mergers between banks and insurers or through acquisition. There are many incentives for such cross-sector mergers. Life insurance firms often have large funds available for investment and seek favourable investment opportunities, whereas banks may see promising investment opportunities but have insufficient resources at their disposal. Another factor encouraging cross-sector mergers is the possibility to use each other's selling channels. For instance, after a cross-sector merge, bank branches can easily sell insurance products of the FC, whereas insurance agents can sell bank products of the FC. The scope effect, integration of banking and insurance services into new single products, provides another stimulus. A final reason, taking centre stage in this article, is diversification of risk and hence of both profits and solvency. And of course all the standard arguments in favour of mergers also apply, such as positive scale effects, higher efficiency, larger market shares and power, entry to new products and regions and higher prestige for top-ranking management.[1]

Owing to their size, the larger FCs are of major importance for financial stability. This is especially true in the Netherlands, where FCs take a central position in the financial landscape; in 2000 they handled 91% of overall banking activities, 73% of insurance transactions and 57% of securities transactions. The size of the FCs prompts the question of whether or not these conglomerates are more stable than their constituent parts. This could be the case when typical bank and insurance shocks are for the greater part uncorrelated or – even better – negatively correlated, so that diversification takes place. If, on the other hand, contagion risk plays a major role, e.g. if both components are threatened with loss of reputation should problems arise in one of the constituent parts, financial stability would suffer from these cross-sector mergers. Closely related to this is the too-big-to-fail issue: is the moral hazard risk larger for the large financial groups?

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[1] See, for instance, Dermine (1999), Berger, Demsetz and Strahan (1999) and Groeneveld (1999).

When the constituent parts of FCs expect support from the other subsidiaries should they run into serious problems, they may behave more riskily than otherwise, again bringing on the moral hazard risk. Regulatory arbitrage is an additional risk in FCs. A crucial question is how large these extra risks for FCs loom in comparison with the diversification effect: is the net effect positive or negative?

For supervisory purposes, the banks and insurance firms in an FC remain legal entities, each of which has to satisfy the same supervisory requirements applying to stand-alone banks and insurance firms, respectively. The minimum capital requirements are based on the so-called simple-sum-plus approach,[2] where the simple sum of separate minimum capital requirements for banks and insurance firms is assumed to be adequate for the FC. Of course, the various types of additional risk for FCs mentioned above are tied in with the question of whether this assumption of adequacy holds.

In a number of larger financial institutions, firm-wide risk measurement and management are currently undergoing significant growth. Recent methodological advances in measuring individual risk types, such as credit and operational risk, and sharply improved techniques for gathering and analysing information, are making truly firm-wide risk measurement systems feasible. An example of such a system is an economic capital model (ECM), used to determine the total amount of capital needed to cover all risks, as perceived by the institution.[3] However, a number of conceptual and practical difficulties still need to be resolved before ECM results may be considered sufficiently reliable, for instance, for supervisors to be able to use them in assessing diversification effects (see Bikker and van Lelyveld 2002).[4] Practical difficulties arise especially where ECMs seek to aggregate risks across portfolios, business units and, above all, across sectors. Kuritzkes, Schuermann and Weiner (2002) observe that the coherence

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[2] Special rules apply to avoid 'double gearing' (counting capital issued by the FC for both the bank and the insurance firm) or 'excessive leverage' (issuing debt by the FC and using the proceeds as equity for the regulated subsidiary). See Ecofin (2002) for the EU's more extended coming new regulatory rules on FCs.

[3] The theoretical model of firm-wide risk management of Froot and Stein (1998) stresses the need to take all correlations (and hence diversification) between all individual investments into account.

[4] Bikker and van Lelyveld (2002) explain the difference between economic and regulatory capital.

in the portfolio is often modelled on three levels: the portfolio, the business unit and the holding level. For the holding or cross-sector level correlations, financial institutions do not have the data required to obtain meaningful estimates. For want of anything better, they rely on 'human judgement' or the consultant's perception of 'industry practice'. Some institutions set correlation values at rather conservative levels, whereas others use rough approximations such as correlations between – baskets of – appropriate shares. As correlations determine the diversification effects, they are crucially important for determining the eventual level of economic capital.[5] In practice, large diversification effects are found at the portfolio level (80% to 90%), smaller ones at the business line level (around 40%), whereas minor effects (5% to 10%) are *assumed* at the cross-sector level (Kuritzkes, Schuermann and Weiner 2002).

I conclude that cross-sector diversification is a major argument for mergers between banks and insurers, crucial for financial stability issues, essential for adequate solvency requirements, and of pivotal importance for firm-wide risk measurement and management and in ECMs. However, it is very difficult to quantify this type of diversification, as scant data, if any at all, are available to estimate cross-sector correlations. As mentioned above, correlations between – baskets of – appropriate shares may serve as a rough approximation. Bikker and van Lelyveld (2002) use an option-pricing model to estimate the relative riskiness of banks, insurance companies and their (fictitious) combinations. In order to estimate cross-sector diversification effects, this article develops a simple assets and liabilities model (ALM), using actual balance sheet data of banks and insurance firms, but applying fair-value revaluation rules. This ALM allows for estimation of the effects on income and wealth of stochastic shocks on financial institutions and determines the corresponding correlations between bank and insurance activities. As the ALM is based on balance sheet data, I apply it to the financial institutions of one country (the Netherlands). As far as the structure of the aggregated balance sheet and the (relative) sizes of its items are comparable, the results may *grosso modo* also

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[5] An issue is whether correlations should reflect normal conditions like those reflected in the building blocks of the ECM, or stress conditions under which capital is really needed to absorb losses.

be informative for the other countries. In any case, the proposed method can be applied to any country.

The scheme of this article is as follows. Section 2 discusses the various arguments for special minimum required capital rules for FCs. Section 3 develops the applied asset-liability model for the Netherlands. Section 4 presents the effects of interest rate shocks under an accrual accounting regime, whereas Section 5 shows interest rate shock results under a fair-value accounting regime. Section 6 determines share price change effects and provides an overview of the various simulations. The last section rounds off with a summary and conclusions.

2. Capital requirements for financial conglomerates

In most countries, capital requirements for FCs are based on a so-called silo approach, i.e. the simple sum of capital requirements for banks and insurance firms.[6] The requirement that separate bank and insurance firms within the FC be working in distinct limited liability corporation structures constitutes a legal firewall. Separate minimum capital requirements hold for the bank and for the insurance firm, as if they were independent institutions. In determining the optimal level of economic capital, however, the FCs themselves will be inclined to consider the total risk the FC is facing, including diversification effects, rather than the simple sum of bank and insurance requirements.[7]

Apart from a reduction in risk and required capital due to diversification, there are several reasons why FCs may also be more risky (see Table 1). In principle, an FC has the ability to shift certain activities from, say, one of its banks to one of its insurance firms, if the respective insurance capital requirements are lower. Such regulatory arbitrage is particularly conceivable where the regulatory framework

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[6] Besides, rules apply to FCs which do not directly regard capital requirements; see also footnote 2.

[7] In integrating bank and insurance risk, fundamental and as yet unsolved measurement problems emerge, such as a common unit of risk and a common time horizon.

for banks and insurance firms use different methods for measuring risk and determining capital requirements. An example is the transfer of credit risk from banks to insurers through credit derivatives. This could even be the case if the regulatory frameworks were to be fully harmonised (after solving the fundamental measurement problems in integrating bank and insurance risk mentioned above), as different reasons for supervision may lead to different capital requirements. In any case, the regulatory framework would lower the capital levels of FCs compared to the levels of their constituent parts. Therefore, an add-on (or other measures) for regulatory arbitrage in FCs would be called for.

TABLE 1

ARGUMENTS FOR SUPERVISION OF FINANCIAL CONGLOMERATES

Banks	Financial conglomerates
bank runs – deposit insurance (moral hazard)	diversification (–)
lender of last resort (moral hazard)	contagion risk (+)
consumer protection	supervisory arbitrage (+)
financial stability	TBTF moral hazard risk (+)
Insurance firms	cross-sector moral hazard (+)
consumer protection	

TBTF = Too-big-to-fail.

FCs may find themselves in a special position when their legal firewalls crack or are ignored by the public. This can be the case when financial difficulties in one of the subsidiaries in one sector have contagion or reputation effects on another subsidiary in a different sector, especially when they use the same brand name. In that case, the FC may be more vulnerable than its constituent subsidiaries. Contagion problems also affect non-regulated entities in an FC. If these entities can expect support when needed, a moral hazard problem arises, as they could be tempted to take on more risk than they would otherwise have done. Non-regulated entities would in a sense lean on the deposit insurance and/or the ignorance of policyholders (the so-called free-rider behaviour). Bank and insurance subsidiaries themselves may also expect to be bailed out by the holding company in case of financial stress and hence behave more riskily within an FC than as stand-alone institutions. The possible contagion risk and, say, cross-sector

moral hazard risk also argue for a minimum required capital that is higher than the simple sum of an FC's financial components and that also includes capital requirements for non-regulated entities.[8]

Related to this contagion problem is the too-big-to-fail (TBTF) issue, yet another moral hazard problem. Big financial institutions with a large impact on financial stability may expect a rescue operation to be undertaken by the lender of last resort when they encounter severe difficulties. This TBTF-problem could be another argument for additional capital requirements for FCs, which by their very nature tend to be large, size rather than structure being the important point.

The literature provides also sources of additional risk (or opportunities) in diversified firms of a more general nature. Theories on efficient internal capital markets typically suggest that diversification creates value. By forming an internal market where the internally generated cash flows can be pooled, diversified firms can allocate resources to their best use (see Li and Li 1996, Matsusaka and Nanda 1997 and Stein 1997). Others found that resource allocation in diversified firms does appear different from that in focussed firms and seems to ignore traditional market indicators of the value of investment such as Tobin's q (see Lamont 1997 and Shin and Shulz 1998). Berger and Ofek (1995) find that investment by diversified firms in segments that have low q is correlated with the discount at which these firms trade. Rajan, Servaes and Zingales (2000) assert that agency cost models and influence cost models, which explain potential investment distortions in diversified firms, fell short in explaining the observed investment misallocation. Therefore, they present a model where inefficient investment is explained by internal power struggle in diversified firms, supported by empirical evidence. In short, investment misallocation may be an additional risk in the FCs.

It might be thought rational for a bank to support an insurance firm of the same FC financially, or *vice versa*, in spite of the legal firewalls, in order to reduce contagion risk and to preserve sharehold-

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[8] An integrated capital requirement regime for FCs would also raise practical problems, as supervision of insurance firms is based on host country control, whereas supervision of banks is based on home country control. As capital requirements of insurance firms are not based on an international agreement (such as the Basel Accord for banks), domestic and foreign insurance divisions face different regulatory treatment.

ers' interests.[9] Any firewall is likely to have holes in it that make cross-sector support possible. The question arises how circumvention of legal firewalls in an FC would affect financial stability and consumer interests. Given the different arguments for regulation, I encounter rather complicated trade-offs when considering the effects of cross-sector support. No final conclusions regarding the desirability or undesirability of this kind of intra-group support can be drawn unless and until it is possible to weigh up the arguments for regulation as described above.

A certain degree of cross-sector support may already occur within the current limits of legal firewalls, in cases where capital in excess of the minimum requirements for each of the two sectors is held at the holding level and is used to cover losses where necessary.[10] The possibility of cross-sector support raises the question, central to economic capital models (ECMs), as to what diversification effect will occur for the FC as a whole. In the case of adverse (i.e. compensating) shocks, cross-section support would be more acceptable from a supervisor's point of view, because the financial soundness of the FC is not at stake. Alternatively, when shocks tend to have similar effects on several subsidiaries, the contagion risk argument for additional minimum capital gains weight.[11] The next section further investigates this issue of diversification or correlation of risk across sectors.

In determining an FC's economic capital, the diversification effect is an argument for holding less capital than would be required under the simple-sum rule of economic capital for subdivisions. However, from a regulatory point of view, the additional contagion risk, regulatory arbitrage, the increased TBTF-problem and other moral hazard issues constitute arguments for additional minimum capital requirements, if these partly or fully outweigh the diversification benefits. In extreme cases, the risk an FC is facing could even outstrip the simple sum of risks faced by its components.

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[9] See Rule (2001) for a description of the various channels that are employed.

[10] Note that there are limits set on surplus capital shifting. For instance, a bank in the Netherlands will need a *vvgb* (declaration of no objection) from the supervisor to distribute supernormal dividend to the holding company.

[11] One stipulation is that diversification effects should remain robust under stress where – contrary to normal conditions – correlation coefficients tend to approach one – see footnote 5.

3. An ALM model for banks and life insurers

The balance sheets of banks and life insurers are counterparts to each other in the sense that bank assets have a longer maturity than bank liabilities, whereas for insurers it is the other way around. This creates asymmetry in the sensitivity to interest rate shocks of these institutions, in particular for changes in the slope of the yield curve. This asymmetry is often mentioned as an argument for the existence of negative correlation between the interest rate risk run by banks and insurance firms, or in terms of Kuritzkes, Schuermann and Weiner (2002), of cross sector diversification. On the other hand, both sectors invest in shares, participations and subsidiaries, which contributes to a positive correlation. This section develops a strongly stylised ALM based on banks' and insurance firms' balance sheet data. In this model, I consider life insurers only, as property and casualty (P&C) insurers have only limited balance sheet sizes, so that interest rate and asset price risk play just a minor role.[12] Moreover, the main risk types P&C insurers run are P&C risk, operational risk and business risk, which are assumed to be poorly correlated, if at all, to the risk run by banks and life insurers.[13] For the same reason, I ignore non-regulated entities. Note that these activities with uncorrelated risk would con-tribute to further diversification at the holding level.

My model simulates the balance sheet values in a stochastic environment, where values of interest rates and asset prices are subject to shocks. Economic capital models or the ALMs of individual banks, insurance firms and FCs are able to provide a much more detailed description of the dependence of the balance sheet items on such external shocks, as they have more information available. However, only a few FCs are able to model interest rate and asset price shocks for both their banks and insurance firms simultaneously. In particular, I do not have sufficient data on the off-balance sheet positions of the banks.

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[12] In the Netherlands, the aggregated balance sheet total of P&C insurers in 2000 is only 80 billion guilders against 541 billion guilders for life insurers, where net premium income has a similar size (36.5 versus 52.5 billion guilders), see PVK (2001a and 2001b).

[13] That is, uncorrelated with interest rate and market price risk, central in this analysis, as well as credit risk, life risk and the operational and business risk banks and insurers run.

However, my simple stylised model can provide a general picture of the diversification effects in FCs with respect to shocks in interest rates and asset prices.

My model exercises are based on the aggregated balance sheets of domestic bank activities of the five largest commercial bank conglomerates in the Netherlands (covering 79% of all Dutch domestic banking activities) and of (all) domestic insurance activities of Dutch insurance firms.[14] To illustrate my model, the Appendix provides stylised versions of the aggregated balance sheets used in the calculations. As an alternative, the calculations have also been executed with the consolidated data of all the Dutch banks, hence including the foreign activities. The analyses on an aggregated level provide *average* effects of interest rate and asset price shocks on the profit or wealth of banks and insurance firms and their mutual interdependence. My ALM model distinguishes a large number of interest rates. A set of interest rate equations, presented in the Appendix, link these rates to two core rates: the short-term rate (reflecting monetary policy) and the long-term rate (reflecting capital market conditions). The value of each balance sheet item is linked to one – or more – of the interest rates, or to an asset price. Where useful and possible, balance sheet items have been split using internal data. Many of these interest-link equations are based on distributed lags (DLs) of interest rates, the length of which reflects the maximum maturity of the respective balance sheet item (see also the Appendix). These equations take lags in interest payments into account as well. For banks, the average lag of the interest rates is set to reflect the average duration found in the interest rate risk surveys of de Nederlandsche Bank (DNB; the Dutch banking supervisor). Similar information and details on the (distribution of the) remaining length of life insurance contracts are obtained from insurance firms.

An initial complication in incorporating banks' and insurers' balance sheets into one model is the difference in accounting rules. Dutch banks use the Dutch accounting authority's rules for their annual public statement and quite similar supervisory rules for their reports to their supervisor. The value of the trading portfolio – which

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[14] Bank supervision is based on home control, whereas insurance supervision is based on host control. Therefore banks publish consolidated figures, including domestic and foreign activities, whereas (Dutch) insurance firms only publish domestic figures.

in Dutch banks is small compared to the banking book portfolio – is recorded at market prices. Bonds and promissory notes are recorded at their nominal value. In principle, other financial assets are booked at acquisition values, downwards adjusted if necessary, whereas participations show up at the lowest of acquisition values and market prices. Subsidiaries are recorded at net wealth or revenue value, whereas real estate investment is booked at market prices, but after deduction of depreciations.[15] In the near future, the EU will implement a new IASB (International Accounting Standards Board) accounting regime for banks, which relies more on market values.

Valuation rules in the insurance sector vary from firm to firm. In general, insurers record shares, other non-fixed income securities and real estate investment at market prices. This also holds for investments at the risk of policyholders or insured thrift clubs. The valuation of life insurance liabilities (technical life insurance reserve) is based on a fixed 'calculation interest rate' of 3%. Investment in fixed-income securities stemming from insurance policies based on a guaranteed expiration benefit or sold at a 'level of interest rate' discount[16] are recorded at redemption value.[17] For insurance balance sheets items I use actual values as far as possible.

For my simulations, I have to bridge the different accounting regimes. For asset price scenarios, I assume that the shock effects are based on (changes in) market value. This does not reflect current accounting practice, but is in line with economic theory. For interest rate scenarios, I distinguish two regimes for presentational reasons. First, an accrual accounting regime, where the value of the fixed-income securities and the technical life insurance reserves remain unchanged, so that the shock effects reflect only changes in net interest income. Secondly, a fair value type of accounting regime, where all interest rate sensitive balance sheet items, including saving accounts and technical provisions on life insurance policies are marked-to-market (as will be explained below). The regimes thus distinguished reflect two extremes encompassing the actual regime.

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[15] Subsidiaries are investments with control, but not necessary *full* control.

[16] In Dutch: rentestandskorting.

[17] The difference between the actual interest rate at the moment of the sale and the 'calculation rate' 3%, which determines the insured nominal amount (endowment insurance or annuity) can be used for a discount off the single premium insurance policy or for a rise in the guaranteed expiration benefit.

I checked the model with an *ex post* forecasting test. For banks I compared predicted paid and received interest with actual values. For insurance firms, I forecasted and compared investment revenues and funding costs to actual outcomes on a balance sheet item basis since realisations are known in greater detail for insurers (PVK 2001b, Table 24).

4. Interest rate shocks under an accrual accounting regime

This section assumes an accrual accounting regime, where the only changes are on net interest income.[18] I evaluate the following four interest rate scenarios: *i*) a 2 percentage point short-term interest rate rise where the long-term rate is defined by the model,[19] *ii*) a 2 percentage point short-term interest rate rise with a fixed, unchanged long-term rate, *iii*) a 2 percentage point long-term interest rate rise,[20] and *iv*) a 2 percentage point increase in the yield curve's slope, caused by a 1 percentage point increase in the long-term rate and a 1 percentage point fall in the short-term rate. For the Netherlands, these shock sizes are realistic: over the last two decades, the average absolute annual change in the short and long rates amounted to more than 1 and 0.75% respectively, and over two-year periods 1.75 and 1.25% respectively. All shocks are once-off events (i.e. not repeated) but permanent, unexpected and occurring early in the year.

For banks and insurers, Table 2 shows the net interest income in the base line scenario and presents the changes in net interest income, all in billions of guilders, in the four interest rate scenarios considered.[21] As part of the investment of insurance firms is purely at the policyholders' own risk (the so-called unit-linked insurances), I do not incorporate the corresponding changes in net interest income in these

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[18] These changes in net interest income are identical to those in a fair-value accounting regime. The latter regime also considers revaluation effects.

[19] Note that the long-term rate of the euro depends in part on its short-term rate.

[20] Which does not affect the short-term rate.

[21] The base line scenario consists of imaginary model predictions for 2001-05 for unchanged balance sheet items in an environment without (new) shocks. This base line scenario shows changes in the interest rates due to the dynamic structure of the various interest equations.

TABLE 2

THE EFFECTS OF 2 PERCENTAGE POINT INTEREST RATE SHOCKS ON NET
INTEREST INCOME OF DOMESTIC ACTIVITIES OF BANKS AND INSURERS
(in billions of guilders)

Year	1	2	3	4	5	Total
Banks						
Net interest income in base line	30.6	28.3	28.0	29.0	30.0	
Changes in net interest-income						
Short-term interest rate rise						
(free long rate)	–3.2	–4.6	–3.4	–1.3	1.1	–11.5
Short-term interest rate rise						
(fixed long rate)	–3.2	–5.3	–6.5	–6.8	–6.9	–28.8
Long-term interest rate rise	1.4	5.5	7.9	10.5	13.4	38.7
Steeper slope yield curve	2.3	5.4	7.2	8.7	10.1	33.7
Insurers						
Net interest income in base line	20.9	20.9	21.1	21.5	21.8	
Changes in net interest-income						
Short-term interest rate rise						
(free long rate)	1.5	1.8	2.7	3.8	4.7	14.6
Short-term interest rate rise						
(fixed long rate)	1.5	1.5	1.5	1.5	1.5	7.6
Long-term interest rate rise	0.6	2.2	3.3	4.1	4.9	15.1
Steeper slope yield curve	–0.4	0.3	0.9	1.3	1.7	3.8

shock effects. The table presents the yearly effects, as they would show up in the bookkeeping, and which illustrate the dynamic nature of the model. In reality, new shocks may occur and banks and insurers may change their balance sheets, blurring the original impulses. All presented effects assume that the behaviour of banks and their customers remains unchanged.[22] Of course, banks, insurers and customers might react to changed interest rate conditions, in general reducing the shock effects, but probably only slightly for reasons of continuity and lacking alternatives. In any case, banks and insurers have to accept the inescapable losses or gains, as shown here but made most clear from fair-value accounting. Furthermore, it should be emphasised that my analysis does not include off-balance sheet positions. Hence, my model ignores full or partial coverage of interest rate mismatches of banks or insurers by, say, interest rate swaps, and also disregards speculative positions of banks or insurers on future interest rate developments.

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[22] Banks can adjust the allocation of their asset and the composition of their funding, whereas customers can reduce their lending and hold more or less monies on deposits. However, the simulations use balance sheet items constant over time.

In the first three years, a 2% rise in the short-term-interest rate would eat into the net interest income of banks, as funding costs would rise (see first row of Table 2). As the long-term interest rate rises, too, in accordance with the underlying term-structure relationship, banks will receive additional interest revenues from lending and investment, gradually rising over time due to the longer maturity and, hence, later interest rate adjustment of these assets. After four years this would compensate for the higher funding costs. In a simulation where the long rate would remain unchanged, further flattening the yield curve, the full funding cost rise shows up (see second row). The effect rises over time as part of the deposits have a fixed interest rate for up to 5 years. A rise in the long-term rate has purely favourable effects, gradually growing over time, as more new loans and securities yield revenues based on the new interest rate level (see third row). According to my model, the short-term interest rate is not affected by the long-term rate and so remains unchanged in this scenario.

For insurers, all scenarios with rising interest rates are favourable, as investment dominates funding by far, in spite of the fact that the higher rates feed through with substantial delays. For banks and insurers, the effects of a long-term interest rate rise are similar and hence correlated, whereas for the short-term interest rate rise they diverge, indicating negative correlation. In the latter case, a hypothetical FC would encounter a strong diversification effect. The last simulation exercise, a steeper slope of the yield curve, has favourable interest revenue effects for both types of institutions, gradually increasing over time (see fourth row). However, the effect for banks is far stronger, owing to the lower short rate.[23] The first-year effect for insurers is negative, as the short-rate drop makes itself felt directly, whereas the long-rate hike affects interest income with more delay.

Table 3 presents the simulation results of Table 2 scaled by profit before taxation. The effects in percentages of profits indicate how sizeable the observed changes in net income are for banks and insurers, normally hidden from view, as day-to-day interest rate shocks follow an erratic pattern. In order to obtain further insight into the diversification effects of FCs, the lower part of Table 3 calcu- lates the effects of imaginary mergers of (all) banks and insurers, as

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[23] By approximation, the changed yield curve slope simulation is equal to the third shock minus the second one, both divided by two.

THE EFFECTS OF 2 PERCENTAGE POINT INTEREST RATE SHOCKS ON PROFITS
OF BANKS, INSURERS AND (IMAGINARY) FINANCIAL CONGLOMERATES

Year	1	2	3	4	5
Changes in profit (%)					
Banks					
Short-term interest rate rise					
(free long rate)	–18	–26	–19	–8	6
Short-term interest rate rise					
(fixed long rate)	–19	–30	–37	–39	–39
Long-term interest rate rise	8	31	45	60	77
Steeper slope yield curve	13	31	41	50	58
Insurers					
Short-term interest rate rise					
(free long rate)	20	23	36	49	61
Short-term interest rate rise					
(fixed long rate)	20	19	20	20	20
Long-term interest shock	8	28	43	53	64
Steeper slope yield curve	–6	4	12	17	22
Imaginary financial conglomerates (FCs)					
Short-term interest rate rise					
(free long rate)	–7	–11	–3	10	23
Short-term interest rate rise					
(fixed long rate)	–7	–15	–20	–21	–21
Long-term interest shock	8	30	44	58	73
Steeper slope yield curve	7	23	32	40	47
Changes in profit of FCs compared to banks (index)					
Short-term interest shock					
(free long rate)	0.37	0.43	0.13	*	*
Short-term interest shock					
(fixed long rate)	0.37	0.50	0.53	0.54	0.54
Long-term interest shock	0.99	0.97	0.98	0.97	0.95
Steeper slope yield curve	0.57	0.74	0.78	0.80	0.81

* This index is less useful where the denominator – change in bank profits – is close to zero.

suming that banks and insurers within an FC continue to operate in-
dependently from each other as before, but pool their profits on the
holding level.[24] It is clear from the first four FC rows that the impact
of short-term shocks on the profit of the FC is far smaller, compared
to the profits of their components, reflecting the negative correlation
between banks and insurers (due to different funding behaviour). The
long-term shock effects for the FC are slightly smaller than for their

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[24] In fact, the aggregated balance sheets of banks and insurers are added together.

constituent banks, but somewhat greater than for their insurers. For the yield curve shocks, a similar conclusion may be drawn, be it that the differences are larger.

The diversification effects can be illustrated best by expressing the changes in profits of FCs as shares of those of banks (last four rows).[25] Changes in profits, however, are lower for FCs than for their constituent banks in all cases, due to the two well-known facets of diversification. On the one hand, profit shocks are smaller where correlations are negative, as for short rate shocks (the 'hedging' effect) and, on the other hand, profit shocks for FCs tend to be lower, as they are the weighted average of the two underlying profit shocks (the 'levelling out' or 'spread' effect of averages).[26]

The considerable diversification effects suggest that a hypothetical merger is rewarding. However, two remarks should be made here. First, the diversification effects of Table 3 do not imply any kind of synergy; investors could also achieve these gains by holding both bank and insurance shares in their portfolio. Second, the diversification effects suggest some gain in terms of financial stability, as insurers can absorb bank shocks and *vice versa*.[27] However, in principle, legal firewalls between banks and insurers may limit financial cross-sector support. In practice, nevertheless, such firewalls may prove less robust under crisis conditions.

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[25] This index is less meaningful where the denominator – change in bank profits – is close to zero, as for the 4th and 5th year in the first row. For similar failures, an alternative index – changes in profits of FCs as shares of those of *insurers* – would be less useful.

[26] This can be illustrated as follows, assuming that x and y are stochasts with zero expectation;

$$\text{var} [\alpha\, x + (1-\alpha)\, y] = \alpha^2\, \text{var}(x) + (1-\alpha)^2\, \text{var}(y) + 2\, \alpha\, (1-\alpha)\, \rho\, \sqrt{[\text{var}(x)\, \text{var}(y)]}.$$

For, say, $\alpha = 0,5$, and var $(x) =$ var (y), this implies

$$\text{var} [(x+y)/2] = 0,5\, (1+\rho)\, \text{var}(x) <\ \text{var}(x),$$

where the inequality holds, as long as $\rho < 1$. For $\rho = 0$, the variance of the average is half the variance of x or y. In our case, $\alpha = p\,/\,(p+q)$ stands for the share of bank profits in the FC profits, $(1-\alpha) = q\,/\,(p+q)$ for the share of insurance profits, $x = X/p$ is the profit shock of banks and $y = Y/q$ stands for the profit shock of insurers (p and q are profits of banks and insurers, respectively, and X and Y are net interest income shocks of banks and insurers, respectively). Thus a linear combination of shocks has a lower variance than its components (the more so the lower r is), and hence, given the zero expectations of x and y, this combination is likely to be closer to zero than its components, and thus the index is likely to be below 1.

[27] An alternative view is that financial conglomerates harm financial stability, as banks can be dragged down by severe problems of insurers.

5. Interest rate shocks under a fair-value accounting regime

Under fair value accounting, assets are valued at market prices. This approach immediately takes into account changes in all future interest flows, such as described in the former section. Approximating a fair value regime, I use a broad-brush approach for my balance sheets. In the case of an interest rate hike the value of a fixed rate instrument diminishes with the net present value of all future interest rate differences.[28] This section presents the effects of a 2 percentage point rise in all interest rates, where the current level of the long-term rate is 5%. Other fixed-income securities, including credits, have been treated more or less like bonds. This is not apparent for credit loans, where in general no market prices are observed and uncertainty may exist about creditworthiness. Moreover, many credits have embedded options such as early settlement or renegotiation of the interest rate.[29] Of course, such options only come into the money when the interest rate declines, and are irrelevant to my scenario of an interest rate rise. For most long-term fixed income assets, I assume a term structure of 12 years and a duration of around 3 years (or in the case of mortgages close to 5 years), in line with interest rate risk reports of banks in the Netherlands. This generates discounts of 5 to 7% (see the Appendix). The revaluation of liabilities has been treated likewise, as is obvious for fixed-income time deposits and debentures. Of course, the discounting of debt is favourable for the wealth of the bank or the insurer. Serious difficulties arise in revaluation of the various savings accounts and demand deposits or current accounts. The interest rates on these accounts are not very sensitive to movements in model rates. Therefore, the 'value' of these accounts rises as this cheap debt becomes relatively cheaper. Naturally, the savings account holders have the permanent option to move their funds to other, more rewarding investment. However, as most of the accountholders do not use this

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[28] Comparing the lower interest rate of an existing bond with the higher interest rate of a newly issued bond.

[29] Other counterparties do not have these options, for instance, because they cannot find another bank willing to lend, their creditworthiness has declined since the loan was granted, or a penalty clause applies (as in the case of most mortgages).

option under the current rates, I assume that many of them will not do so under the higher rates.[30]

Valuation of the insurers' balance sheet has been dealt with in a similar way, taking into account that part of these assets are held at the policyholders' own risk. One problem here is how to revalue the technical provision for life insurance policies. Formally, the technical provision for life insurances is based on a certain 'calculation' rate, which remains unchanged when market rates move. The required funds to cover the liabilities of the policy portfolio (or the debt) decrease. However, when interest rates rise, it is easier to satisfy the corresponding liabilities or to make a profit on this portfolio.[31] Based on a gradually declining term structure of 40 years for the technical life insurance reserve (in line with situations observed in large insurance companies), an interest rate rise from 5 to 7% would imply a reduction in required reserves (or investment) of more than 13% (see the Appendix).[32] However, part of the policies have profit sharing. In the Netherlands, this is typical for individual policies involving payment of premiums (where profit-sharing is used annually to raise the insured capital) and for part of collective policies (where profit-sharing is used annually to lower premiums).[33] Most of the other policies have a fixed 'interest rate level' discount in advance, while the rest have no profit sharing at all. Based on figures of the shares of individual policies and of policies with annual premiums, I assume that half of the total profit is shared, i.e. half of the policies would collect all related gains on investment, or all policyholders would share half the gains and profit on investment. Further on, I shall relax this assumption. As in the earlier simulations, I calculate the effects of interest rate changes, assuming unchanged behaviour of banks and insurers. Of course, gains and losses due to unexpected market price changes can never be wholly avoided (except by hedging).

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[30] Which is in line with the assumed duration of these accounts in the interest rate risk reports of banks.

[31] 'Interest rate discounts' and 'return guarantees' for policyholders are not taken into account as they are fixed. I ignore optionality in the policy portfolio, and in particular the possibility to surrender. In general, surrender is not profitable, as the insurers discount the surrender value and its tax treatment may be unfavourable.

[32] This reduction does not apply to technical provision for life insurance reserve for those policies whose policyholders themselves bear the risk of the related investment.

[33] An alternative is that profit sharing is saved and used for an additional final payment, as is common in, e.g., the UK.

THE REVALUATION EFFECTS OF A 2 PERCENTAGE POINT INTEREST RATE RISE
ON THE FAIR VALUE BALANCE SHEETS OF BANKS, INSURERS AND
(PRO-FORMA) FINANCIAL CONGLOMERATES

	Banks	Insurers	Financial conglomerates	FC compared to banks (index)
Profit in 2000	17.5	7.7	25.2	
Capital and reserves, end 2000	93	62	155	
Revaluation effect, billions of guilders	–32.7	13.7 (18.4)	–19.0 (–14.3)	0.58 (0.44)
Idem, in % of profit	–186.4	177.9 (238.4)	75.4 (–56.9)	0.40 (0.31)
Idem, in % of capital	–35.1	22.1 (29.6)	–12.3 (–9.3)	0.35 (0.26)

Note: Figures between brackets refer to 33% instead of 50% profit sharing by policyholders.

Table 4 presents the simulated revaluation results of a 2 percentage point interest rate rise. Due to, amongst other things, the optionality embedded in credit loans and savings accounts, these effects would differ from a similar interest rate fall, since the effects are asymmetric. Obviously, the revaluation effects of the interest rate shock are large, dwarfing the effects on net interest income in Table 2. I will compare these effects below. The major impact of the interest rate rise on banks is the drop in market value of their assets. Although the fair value of their debt also falls significantly (which reflects a certain degree of hedging of interest rate risk), a large net loss remains, significant in terms of both profits and capital. This mirrors the fact that banks transform short money into long money. For insurers, the opposite is true: although the value of their investment portfolio declines, the reduction in the burden to meet their policy obligations outweighs this by far, reflecting the fact that insurers transform short- or medium-term investment into long or extremely long-term investment. These results indicate the significant diversification gains of a pro-forma merger between banks and insurers (or, more general, of existing FCs) with respect to revaluation resulting from an enduring interest rate shock. This is best expressed in the last column of Table 4, where the shock effects on the pro-forma FC are compared to the effects on banks. The joint revaluation effect for FCs is only 60% of the revaluation effect for banks. Expressed in percentages of profit or capital, the diversification effect is even higher.

The diversification effect of revaluation is very strong, due to the observed negative correlation for revaluations. Of course, the pre-

cise figures depend on the relative sizes of the 'merged' sectors and on the underlying assumptions, as illustrated by the following sensitivity analysis. We have so far assumed 50% profit sharing by policyholders. However, firm data on profit sharing are lacking. Were I to assume that all policyholders would share only one third of the gains and profit on investment (or that half of the policyholders would collect two thirds of the related gains on investment), the figures in brackets in Table 4 would apply. The diversification effect would be even stronger, illustrating both the potential diversification and the sensitivity of this assumption.

6. Overview of interest rate and share price change effects

The net interest income or accrual accounting effects of Table 2 and the revaluation or fair value effects of Table 4 complement each other in the sense that they do not overlap. The additional net interest income would show up under each accounting regime, reflecting the higher income from new investment or from current investment but with adjusted interest rates, as well as the higher cost of new funding or current funding but with adjusted interest rates. So, under the fair value regime this effect should be added to the revaluation effect. Note that the revaluation effect appears immediately, but is followed subsequently by gradual opposite moves in the value, so that the total effect fades away over time. This is similar to the behaviour of bond prices: they fall after an interest rate rise, but recover over time, up to the notional amount. Therefore, in the long run, only the (cumulative) net interest income effect remains.

Table 5 gives an overview of the various simulations. The first six columns are based on Tables 2 through 4 and show the effect of a combined short and long-term interest rate rise of 2 percentage points on net interest income (i.e. the sum of simulations 2 and 3). In the first year, a clear diversification effect occurs, as the effects are negatively correlated; in fact, the effects almost cancel each other out. In the subsequent years the diversification effect diminishes until in the final year the positively correlated long-term effect dominates, resulting in equal effects on banks and insurers in Dutch guilders. As ob-

TABLE 5

OVERVIEW OF INTEREST RATE AND SHARE PRICE CHANGE EFFECTS

Year	Interest rate rise of 2 percentage points							Share price drop of 25%
	1	2	3	4	5	Total	Revaluation[a]	
In billions of guilders:								
Banks	−1.8	0.2	1.4	3.7	6.5	9.9	−32.5	−26.5
Insurers	2.1	3.7	4.8	5.6	6.4	22.7	13.7	−22.8
FC	0.3	3.9	6.2	9.3	12.9	32.6	−19.0	−49.3
In % of profit:								
Banks	−11	1	8	21	38		−186.4	−151
Insurers	28	47	63	73	84		177.9	−295
FC	1	15	25	37	51		−75.4	−195

[a] Figures refer to 50% profit sharing by policyholders.

served above, the revaluations in bank and insurance balance sheet items show a strong diversification. The final column presents the marked-to-market effects of a 25% fall in shares prices and the value of participations and subsidiaries. Share prices have, over the last two decades, generally been rising, but price declines of around 25% occurred in 1987, 2001 and 2002. The respective losses for banks and insurers are positively correlated; naturally, the same would hold true for gains from share price rises.

Of course, there is a vast range of other shocks that could affect banks and insurers. Some are likely to be positively correlated, such as higher wages, lower demand due to business cycle downturns, lower real estate prices or extreme events, and would thus contribute little to diversification. Other shocks are likely to be uncorrelated and would therefore contribute more to diversification – such as losses from operational risk, unfavourable developments in lapses, mortality, longevity, morbidity and disability expectancies and tax rules with respect to life insurances or interest rates.[34] Another example would be that an increase in credit losses due to business cycle deterioration is likely to hurt banks much more than insurers.

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[34] There may be negative correlation and stronger diversification when unfavourable tax rule changes for life insurance products cause a shift from investment in these products towards savings.

The simulation model is based on many assumptions, the data used are not representative for all FCs, and the results should therefore be evaluated with caution. Nevertheless, the results do provide ample evidence that part of the risks within an FC – particularly the short-term interest rate movements – are negatively correlated and that the diversification effect of the combination of bank and insurance activities may be considerable, depending on the origin of changes and the accounting regime employed. This result is in line with that of Boyd, Graham and Hewitt (1993) and Templeton and Severiens (1992), who use different models to assess the magnitude of diversification. This outcome is reassuring in the sense that this diversification gain compensates for increased risk of financial stability and contagion as discussed in Section 1.

7. Summary and conclusions

Financial deregulation, international integration, increased competition and blurring of sectoral borders have given rise to the creation of various large cross-sector financial conglomerates, consisting of banks and insurance firms. The current regulatory capital regime for these FCs is the simple sum approach, which regards banks and insurers separately and ignores cross-sector diversification of risks. As this type of diversification is difficult to measure, industry and regulators have only a vague notion of its magnitude. The present article addresses this issue by offering an empirical analysis based on a fair-value type asset and liability model, which identifies diversification effects for FCs under various shocks. This analysis reveals for the Netherlands that diversification effects are very strong for interest rate shocks. In an accrual accounting regime, which regards changes in income flows, the diversification is greatest for short-term interest rate shocks, due to negative correlations between the effects on banks and on insurers. In a fair value accounting regime, the effect of an interest rate shock on the FC's wealth – and hence diversification – is even stronger, not only because future changes are taken into account immediately, but because of the negative correlation effects of (both shorter and) longer term interest rate shocks on the values of banks and on insurers.

Changes in share prices hit banks and insurers in much the same way, so shares do not contribute to the diversification of risk in FCs. Other potential shocks on FCs have not been investigated, but the degree of correlation between their effects on either banks or insurers is expected to vary from negligible correlation, contributing to cross-sector risk diversification, to positive correlation, with little or no contribution to diversification. On the whole, my empirical evidence brings to light that diversification effects in FCs are substantial and probably somewhat larger than the 5-10% suggested by Kuritzkes, Schuermann and Weiner (2002).[35] This is important information for both senior and risk management of financial conglomerates and for regulatory purposes. However, the evidence so far is insufficient to merit conclusions regarding the minimum capital requirements that would support changing or relaxing the current simple sum approach. After all, there are other non-negligible risks run by FCs to consider, namely contagion risk, regulatory arbitrage and cross-sector, TBTF moral hazard risks and investment misallocation, which have yet to be quantified.

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[35] Similar empirical evidence is provided by the option-pricing model for estimating the relative riskiness of banks, insurance companies and their (fictitious) combinations, developed by Bikker and van Lelyveld (2002).

APPENDIX

A simple ALM simulation model

The ALM simulation model is based on expanded versions of the balance sheets in the table below.

AGGREGATED BALANCE SHEETS OF DUTCH BANKS
AND INSURANCE FIRMS
(domestic, 2000)

Banks		Life insurance firms	
Assets	*Billions*	*Assets*	*Billions*
Cash	19	Deposits	9
Short-dated government paper	7	Mortgage loans	62
Banks	334	Other loans	55
Loans and advances to government	11	Bonds	93
Loans and advances to private sector	999	Shares	78
Interest bearing securities	209	Investment in affiliated undertakings	12
Shares	53	Investment in land and buildings	28
Participations	53	Other financial investment	12
Property and equipment	22	Investment for policyholders' own risk [a]	156
Other assets	12	Debtors	19
Prepayment and accrual income	32	Other assets	6
		Prepayment and accrual income	10
Total	**1,751**	**Total**	**540**
Liabilities		*Liabilities*	
Banks	485	Total debt	46
Savings accounts	309	Other liabilities	16
Other funds entrusted	470	Accrual and deferred income	9
Debt securities	179	Capital and reserves	62
Other liabilities	81	Technical provisions	
Accrual and deferred income	40	Life insurance policies	262
Subordinated liabilities	37	'Own risk' life insurance policies [a]	145
Other provisions, capital and reserves	150		
Total	**1,751**	**Total**	**540**

[a] The investment risk is borne by the life insurance policyholders.

In addition, the model contains the following interest rate and discount equations. The interest rate equations are based on, among others, Bikker *et al.* (1994), van Els and Vlaar (1996) and DNB (2000), where necessary adjusted for the introduction of the euro. Some of the interest rates are base rates, which may be liable to surcharges, depending on, e.g., credit risk.

Interest rate equations:[1]   *describing:*

$rd_t = 0.8\ rd_{t-1} + 0.15\ (0.3\ rs_t - 0.1\ rs_{t-1})$ demand deposits

$rsa_t = rsa_{t-1} + 0.25\ (0.33\ (rs_t - rs_{t-1}) +$
$+\ 0.67\ (rl_t - rl_{t-1})$ savings accounts $<$ 10,000 Dfl

$rsa1_t = rsa1_{t-1} + 0.5\ (0.33\ (rs_t - rs_{t-1}) +$
$+\ 0.67\ (rl_t - rl_{t-1})$ savings accounts $>$ 10,000 Dfl

$rt_t = 0.5\ (rs_t + rl_t)$ time deposits

$rb_t = 0.8\ rl_t + 0.2\ rs_t$ bank debt

$rl_t = 0.5\ rl_{t-1} + 0.5\ rs_t + 0.5$ long-term interest rate

$rm_t = rl_t + 1$ mortgages

$rl_t^* = 0.02\ rl_t + 0.21\ rl_{t-1} + 0.17\ rl_{t-2} +$
$+\ 0.15\ rl_{t-3} + 0.13\ rl_{t-4} + 0.11\ rl_{t-5} +$
$+\ 0.09\ rl_{t-6} + 0.07\ rl_{t-7} + 0.05\ rl_{t-8}$ distributed lag rl

$rt_t^* = 0.2\ rt_t + 0.4\ rt_{t-1} + 0.3\ rt_{t-2} + 0.1\ rt_{t-3}$ distributed lag rt

$rsa_t^* = 0.5\ (rsa_t + rsa_{t-1})$ distributed lag rsa

$rsa1_t^* = 0.5\ (rsa1_t + rsa1_{t-1})$ distributed lag rsa1

$ro_t^* = 0.1\ rl_t + 0.3\ rl_{t-1} + 0.2\ rl_{t-2} +$
$+\ 0.15\ rl_{t-3} + 0.15\ rl_{t-4} + 0.1\ rl_{t-5}$ distributed lag of government bonds

$rh_t^* = ro_t^* + 1$ distributed lag rh

$rb_t^* = 0.8\ rl_t^* + 0.2\ rs_t$ distributed lag rb

Discount equations:

$D(T) = \Sigma_{t=1,...,T}\ w(t)\ r\ \{[1-1/(1+d)t]/$
$d + 100/(1+d)t\}$ weighted sum of discounts for various T's and weighting schemes w(i). The weighing scheme is parameterised on the interest rate risk reports submitted to DNB.

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[1] An n-year lag is denoted by the subscripted t–n. The short rate and the long rate are rs and rl, respectively.

$$D(40) = \Sigma_{t=1,...,40}\ (41-t)/82)\ r\ \{[1-1/(1+d)t]/$$
$$d + 100/(1+d)t\}$$

weighted sum of discounts for technical provisions for life policy holders

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