Regulatory Capital Standards for Property and Casualty Insurers under the U.S., Canadian and Proposed Solvency II (Standard) Formulas

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REGULATORY CAPITAL STANDARDS FOR PROPERTY AND CASUALTY INSURERS UNDER THE U.S., CANADIAN AND PROPOSED SOLVENCY II (STANDARD) FORMULAS

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Abstract

The solvency regulation of European Union insurers is scheduled for a significant overhaul with the expected implementation of Solvency II in October 2012. In comparison to the Solvency I regime under which EU insurers are currently being regulated, Solvency II is a more comprehensive and risk-sensitive framework in the same vein that the Basel II capital accord for the banking industry is a vast improvement over its predecessor, the Basel I accord.

The main goals that we seek to accomplish in this paper are the following:

1. To comparatively outline the main elements of each of the current U.S., Canadian and proposed Solvency II standard formula regulatory capital regimes for property and casualty insurance companies.
2. To support the use of economic valuation principles in the solvency assessment of a property and casualty insurance enterprise using illustrative regulatory capital calculations of a model private automobile-liability insurance portfolio under the three capital standards.

1 INTRODUCTION

The solvency regulation of European Union insurers is scheduled for a significant overhaul with the expected implementation of Solvency II in October 2012 [e.g. Linder and Ronkainen, 2004, Eling et al., 2007, Vaughan, 2009]. In comparison to the Solvency I regime under which EU insurers are currently being regulated, Solvency II is a more comprehensive and risk-sensitive framework in the same vein that the Basel II capital accord BIS, Basel Committee on Banking Supervision [2006] for the banking industry is a vast improvement over its predecessor, the Basel I accord. Further, the total balance sheet economic capital approach of Solvency II allows insurers to determine their own statutory capital needs using internal models that have been vetted by the supervisor. As an alternative, insurers can also use a simplified but relatively crude Solvency II standard formula [see European Commission, 2008].

In Canada, public insurance companies are set to adopt International Financial Reporting Standards (IFRS) as of January 1, 2011. Since the IFRS are based on fair-value principles [see International Accounting Standards Board, 2004, 2007], regulatory capital requirements in Canada are being reviewed to accommodate the new accounting framework. In the U.S., there are also various initiatives underway to revamp and modernize the solvency regulatory system. In particular, the Solvency Modernization Initiative of the National Association of Insurance Commissioners (NAIC) aims to create a state-of-the-art solvency surveillance system for U.S. based insurers. In the EU, efforts to finalize the Solvency II framework for implementation are continuing. Various consultation papers on level-2 (L2) implementation measures were issued in 2009 and the Committee of European Insurance and Occupational Pensions Supervisors (CEIOPS) has since issued its final advice pertaining to the implementation issues of the Solvency II framework that were the subject of the consultation. A fifth quantitative impact study (QIS 5) is also being planned as Solvency II regulators make final preparations for the implementation of the new regulatory reforms in October 2012.

In this paper, we will review the current statutory capital standards for property and casualty insurance companies in Canada and the U.S., and compare them to the corresponding requirements under the proposed Solvency II standard formula that will apply to insurers in the European Union. Understanding the differences among the three regulatory capital frameworks will allow the solvency regulator of a given jurisdiction to benchmark the competitiveness (or conservatism) of their capital requirements given the reality of global insurance and capital markets. Insurance companies can use the knowledge that is gained from a critical comparison of the regulatory capital formulas in the optimisation of their global capital management/deployment strategies. Further, insurers in Canada and the U.S. can use the Solvency II standard formula balance sheet as a proxy for the future IFRS balance sheet (after the IASB Phase II insurance project is completed) to obtain preliminary indications of changes that could be expected if and when the International Financial Reporting Standards are eventually adopted in their respective jurisdictions.

In fulfilling their mandate, the statutory solvency regulators in Canada and the U.S. currently rely on financial statements that are based on statutory accounting principles that significantly deviate from economic valuation principles. For example, under the current U.S. NAIC statutory accounting practices (prescribed and permitted), the general approach for a property and casualty (P&C) insurer is to book undiscounted claim reserves on the annual statutory financial statement. In Canada, accepted actuarial practice for estimating P&C claim liabilities requires the valuation actuary to discount expected future claims and expenses using the expected investment return on the asset portfolio that is backing the liabilities. It is a primary goal of this paper to demonstrate fundamental weaknesses of the U.S. and Canadian statutory accounting approaches as they relate to the solvency assessment of a given P&C insurance company. The advantages of an economic valuation framework for all the on and off-balance sheet assets and liabilities of an insurance company are numerically illustrated by comparing the solvency capital requirements of a model automobile insurance portfolio under the three regulatory regimes. The comparative analysis will be restricted to a comparison of the minimum quantitative capital requirements only, and will not consider other aspects of the regulatory capital regimes (e.g. Pillar II and III requirements, quality of capital, etc). While there are strong arguments in favour of market-consistent valuation techniques in the solvency assessment of a P&C insurance company, there are also

significant implementation hurdles in deriving market-consistent estimates of general insurance contract liabilities [see PricewaterhouseCoopers, 2004, Towers Perrin, 2004]. However, the compelling advantages of the economic valuation approach that are outlined in this paper suggest that market-consistent valuation is a worthwhile goal to pursue for any solvency regulator of insurance companies.

According to the 2008 P&C Risk-Based Capital Report by the U.S. NAIC, non-life underwriting risk is the single largest risk exposure of the U.S. P&C industry and it represents approximately 80% of the industry's aggregate solvency-risk capital requirements [see National Association of Insurance Commissioners, 2008, page 19]. The analysis in this paper is therefore deliberately focused on the solvency capital requirements for non-life underwriting risk rather than closely examining each component of the comprehensive regulatory capital formulas.

While there remains some open issues under the Solvency II proposal, it appears that the preliminary calibration of the non-life underwriting risk capital formula results in relatively conservative solvency capital requirements for the model automobile insurance portfolio that we considered when compared to the corresponding requirements in Canada and the U.S.. It is possible that the differences in solvency capital requirements are due to the unique features of each insurance market. However, the magnitude of the difference is very significant to still suggest that the preliminary calibration of the Solvency II standard formula is conservative.

In comparing the structure of the regulatory capital formulas, the relative simplicity of the Canadian framework (for example, no recognition of company-specific experience and line of business diversification benefits) is seen to come at the expense of having solvency capital requirements that are not closely tailored to the specific risk profile of an arbitrary insurer. When regulatory capital requirements do not adequately approximate the true underlying risk profile of an insurer, they can be gamed or arbitraged, with a consequent decrease in the security of the policyholders' benefits, among other negative effects.

The remainder of the paper is structured as follows. Section 2 provides an overview of the regulatory capital requirements for property and casualty insurers under the current U.S. RBC and Canadian (Minimum Capital Test) regimes, as well as requirements under the proposed Solvency II standard formula. In Section 3, we compare the statutory solvency balance sheets and capital requirements of a model auto-liability insurance portfolio under the three regulatory capital regimes and we outline some arguments to support the use of an economic-value or market-consistent based balance sheet as the primary tool in the solvency assessment of a P&C insurance company. A further comparative analysis of the non-life underwriting risk capital formulas in terms of their ability to fully reflect the unique risk profile of an arbitrary P&C insurer is conducted in Section 5. Finally, the main conclusions of the paper are outlined in Section 6.

2 OVERVIEW OF REGULATORY CAPITAL STANDARDS FOR PROPERTY AND CASUALTY INSURERS

In this section, an overview of the capital requirements for property and casualty insurers under each of the current U.S. and Canadian regulatory regimes, and the proposed Solvency II standard formula will be presented. The description of the Solvency II standard formula is primarily based on the QIS 4 technical specifications

[see European Commission, 2008] and the final advice on level-2 (L2) implementation measures that was issued by the CEIOPS in 2009.

2.1 CANADA: MINIMUM CAPITAL TEST FOR FEDERALLY REGULATED PROPERTY AND CASUALTY INSURANCE COMPANIES

The Office of the Superintendant of Financial Institutions (OSFI) is the regulator of federally registered property and casualty insurance companies in Canada. With effect from 2003, OSFI and the Canadian Council of Insurance Regulators (CCIR) agreed to harmonize the solvency testing of federally and provincially licensed P&C insurers.

2.1.1 Valuation of Assets and Liabilities

The statutory financial statements for federally regulated property and casualty insurers in Canada are prepared in accordance with Canadian GAAP. Accepted actuarial practice in Canada requires that the amount of policy liabilities (i.e. claim liabilities + premium liabilities) should be discounted for the time value of money, using the expected investment return rate on the supporting assets as the discount rate.

The claim liabilities are determined as the sum of the following:

- Case reserve estimates
- Provision for development on reported claims, including claim adjustment expenses
- Incurred but not reported claims (IBNR), including claim adjustment expenses

The method used to calculate the claim liabilities should be appropriate to the circumstances of the case. In practice, the actuary would usually consider several methods in arriving at the final estimate of claim liabilities. The amount that is ultimately reported on the Canadian GAAP financial statements is management's best estimate, which may or may not be the same amount that has been calculated by the actuary (it may also not reflect the time value of money).

The amount of the premium liabilities (after deducting any deferred policy acquisition expense asset) should be equal to the present value, at the balance sheet date, of cash flow on account of premium development and of the claims, expenses, and taxes to be incurred after that date on account of the policies in force at that date or an earlier date [Actuarial Standards Board, 2009].

For a given assumption, Subsection 2250 of the Consolidated Standards of Practice (CSOP) specifies that the actuary should select a margin for adverse deviation that is within the range defined by the low margin and the high margin for that assumption. The low and high margins for those assumptions for which a margin for adverse deviation should be included in a valuation of policy liabilities are shown in Table 1.

The financial statement treatment of invested assets under Canadian GAAP depends on their classification as either held-for-trading (HFT) or available-for-sale (AFS)

Table 1: Valuation Margins for Policy Liabilities (Canada)

Assumption	**Low**	**High**
Claims development (% of claim liabilities excl. PfADs)	2.5%	15%
Reinsurance recoverables (% of liabilities for reinsurance ceded)	0%	15%
Investment return rate	50 basis points	200 basis points

under section 3855 of the CICA Handbook. Both HFT and AFS assets are recorded at their fair value on the financial statements. However, unrealized investment gains and losses on AFS assets are recorded in Accumulated Other Comprehensive Income (AOCI) rather than included in earnings.

2.1.2 Regulatory Capital

The Minimum Capital Test For Federally Regulated Property and Casualty Insurance Companies (MCT) guideline [Office of the Superintendent of Financial Institutions, 2008] outlines the regulatory capital framework, using a risk-based formula for minimum capital required, and defines the capital that is available to meet the minimum standard. The risk-based capital adequacy framework assesses the riskiness of assets, policy liabilities, and structured settlements, letters of credit, derivatives and other exposures, by applying factors to various balance sheet amounts. Property and casualty insurers are required to meet a capital available to capital required test.

There are two important triggers or levels of capital based on the MCT. The regulatory minimum MCT ratio for a property/casualty insurer is 100%. OSFI expects each insurer to establish a target capital level, and maintain ongoing capital, at no less than the supervisory target of 150% MCT. However, the Superintendent may, on a case by-case basis, establish in consultation with an institution an alternative supervisory target level based upon an individual institution's risk profile.

A P&C insurance company's minimum capital requirement is the sum of:

1. Asset depreciation risk: The capital factor for each asset is applied to the balance sheet amount of the asset and depends on the type of asset and/or its credit rating. There are three rating categories that are used for assigning capital factors to assets: Government Grade, Investment Grade, Not-Investment Grade.

2. Risks associated with policy liabilities: Possible inadequacy in provisions for Unpaid Claims, Unearned Premiums, premium deficiencies. Margins on Unpaid Claims and Unearned Premiums are applied to the net amount at risk (i.e., net of reinsurance, Salvage and Subrogation, and Self Insured Retentions) by class of insurance. The Unearned Premiums margin is applied to the greater of the net Unearned Premiums or 50% of the net written premiums in the last 12 months. The applicable risk (capital) margins are shown in Table 2. The risk margin on premium deficiencies is 8%.

3. Catastrophe Reserves and Additional Policy Provisions

Table 2: Margins on the Unearned Premium Reserve and Unpaid Claims (Canada)

Class of Insurance	**Margin on Unearned Premiums**	**Margin on Unpaid Claims**
Personal property and commercial property	8%	5%
Automobile - Liability and personal accident	8%	10%
Automobile Other	8%	5%
Liability	8%	15%
Accident and Sickness	Varies	Varies
Mortgage (federal companies only)	Varies	15%
All others	8%	15%

4. Margin for Reinsurance Ceded to Unregistered Reinsurers.

5. Capital for Structured Settlements, Letters of Credit, Derivatives and Other Exposures

6. Total Capital Required of Regulated Financial Institution Subsidiaries

The definition of available capital involves certain deductions, limits and restrictions. The quality of available capital is assessed based on considerations such as its permanence, its being free of mandatory fixed charges against earnings and its subordinated legal position to policyholder obligations.

In addition to meeting the minimum capital requirements specified above, the Appointed Actuary is required to conduct dynamic capital adequacy testing (DCAT) on an annual basis. DCAT is an exercise that is meant to identify plausible adverse scenarios that could potentially jeopardize the financial health of the insurer. Usually, the base scenario will be consistent with the insurer's business plan, and accordingly, will reflect anticipated new business. Generally, the forecast period for a property and casualty insurance business is three fiscal years. The actuary would also detail the necessary actions to reduce both the likelihood and severity of any identified plausible threat to the insurer's solvency in the DCAT report.

2.2 U.S. NAIC RISK BASED CAPITAL FORMULA

In the United States, the National Association of Insurance Commissioners (NAIC) creates model laws for the regulation of insurance companies. Through an accreditation system, the member states will adopt versions of the model laws and this effectively promotes harmonization in regulation among the states.

2.2.1 Valuation of Assets and Liabilities

The statutory valuation of P&C liabilities in the U.S. is primarily principles-based [e.g. Casualty Actuarial Society, 1988, Actuarial Standards Board, 2007]. The description contained in this section is primarily based on the document titled " P&C Actuarial Issues Associated With Implementation of NAIC Accounting Practices

and Procedures" that was created by the Committee on Property and Liability Financial Reporting of the American Academy of Actuaries [see Committee on Property and Liability Financial Reporting of the American Academy of Actuaries, 2000].

Statutory Statement of Accounting Principles 55 of the NAIC states that "Management shall record its best estimate of its liabilities for unpaid claims, unpaid losses and loss/claim adjustment expenses for each line of business and for all lines of business in the aggregate." The actuary's role is to opine on the reasonableness of the recorded claim liabilities in the aggregate [see American Academy of Actuaries, 2008].

Generally, reserves are not discounted for the time value of money with the exception of those reflecting fixed and reasonably determinable payments, such as those emanating from workers' compensation tabular indemnity reserves or long term disability claims.

Various analytical techniques can be used to estimate the liability for IBNR claims, future development on reported losses/claims and loss/claim adjustment expenses. No single projection method is inherently better than any other in all circumstances. The results of more than one method should be considered.

A Premium Deficiency Reserve (PDR) must be established if anticipated losses, LAE and maintenance costs exceed the recorded unearned premium reserves and contingency reserve. Decisions regarding business grouping and consideration of investment income must be made, and likely will have significant impact on the company's recorded PDR. Deficiencies from one grouping shall not be offset by anticipated profits from another.

Unlike U.S. GAAP, the NAIC statutory accounting framework requires policy acquisition costs to be immediately charged to income and not deferred.

The valuation of assets should conform to the statutory accounting practices that have been prescribed or permitted by the state in which the insurance company is incorporated. The NAIC Accounting Practices and Procedures Manual has generally been adopted as a component of prescribed or permitted practices by the states. The Securities Valuation Office (SVO) of the NAIC values all the securities held by most insurers in the U.S. on a uniform basis. The methods that are primarily employed to value assets are market value, amortized cost, equity method, and book value (cost). Investments in bonds are generally carried at amortized cost or values as prescribed by the state. Intangible assets, furniture and equipment, unsecured receivables and deferred taxes that are not realizable within a year are examples of assets that are considered nonadmitted and therefore not shown in the balance sheet. There are also quantitative restrictions on certain investments such as limits on lower-rated securities and foreign investments.

2.2.2 Regulatory Risk Based Capital (RBC)

The U.S. RBC system defines the minimum regulatory capital for an insurer. It is not designed to measure the economic capital or optimum capital level of the regulated insurance company.

$$\text{Total RBC After Covariance} = R0 + \sqrt{R1^2 + R2^2 + R3^2 + R4^2 + R5^2} \qquad (1)$$

Where

- $R0$: Asset Risk - Subsidiary Insurance Companies
- $R1$: Asset Risk - Fixed Income
- $R2$: Asset Risk - Equity
- $R3$: Asset/Credit Risk - (Recoverables, Reinsurance)
- $R4$: Underwriting Risk - Reserves
- $R5$: Underwriting Risk - Net Written Premium (NWP)

The Authorized Control Level RBC (ACL RBC) is then defined as 0.5×Total RBC After Covariance.

Generally, the RBC formula determines regulatory capital for a given risk by applying an RBC factor to an exposure amount obtained from the annual statement. The formulas for calculating the underwriting risks are provided below.

Underwriting Risk - Net Written Premium (NWP)

$$\text{CRBC} = \frac{\text{CALE}}{\text{IALE}} \cdot \text{IRBC} \cdot \frac{1}{2} + \text{IRBC} \cdot \frac{1}{2} \tag{2}$$

where:

- CRBC is the Company-specific RBC Loss and Expense Ratio
- CALE is the Company Average Loss and Expense Ratio (last 10 years)
- IAEL is the Industry Average Loss and Expense Ratio provided by the NAIC (last 10 years)
- IRBC is the Industry RBC Loss and Expense Ratio

$$\text{NWP RBC}(R5) = \text{CY NWP} \cdot \max((\text{AdjINCOME} \cdot \text{CRBC} + \text{CUER}) - 1, 0) \tag{3}$$

where:

- CY NWP is the current year's net written premium
- AdjINCOME is the adjustment for investment income that is determined using a 5% discount rate
- CUER is the Company-specific Underwriting Expense Ratio

Additionally, if applicable, some discounts are applied to the Written Premium RBC for loss sensitive business and diversification by line of business. The formula for calculating the discount for diversification by product line using the Premium Concentration Factor (PCF) is given by equation (4).

$$\begin{aligned} \text{PCF} &= \left(\frac{\text{NWP (for the largest business line)}}{\text{Total NWP}}\right) \cdot 0.30 + 0.7 \\ \text{NWP RBC Discount} &= (1 - \text{PCF}) \cdot 100\% \end{aligned} \tag{4}$$

Underwriting Risk - Reserves

$$\text{CLRBC} = \frac{\text{CDF}}{\text{IADF}} \cdot \text{ILRBC} \cdot \frac{1}{2} + \text{ILRBC} \cdot \frac{1}{2} \tag{5}$$

where:

- CLRBC is the Company Loss and Expense RBC percent which is an equally weighted average of industry and company experience
- For each line of business, the Company Development Factor (CDF) is the ratio of the sum of developed incurred losses and defense and cost containment expenses for prior accident years evaluated as of the current year to the sum of their initial evaluations
- IADF is the Industry Average Development Factor provided by the NAIC for each business line
- ILRBC is the Industry Loss and Expense RBC percent that is provided by the NAIC

$$\text{LAE RBC}(R4) = \text{LAE} \cdot (((\text{AdjINCOME} \cdot (1 + \text{CLRBC})) - 1) \tag{6}$$

where:

- LAE RBC is the Loss and Expense Risk Based Capital
- LAE are the loss and expense reserves
- AdjINCOME is the adjustment for investment income that is determined using a 5% discount rate

Additionally, if applicable, some discounts are applied to the Loss and Expense RBC for loss sensitive business and diversification by line of business. The formula for calculating the discount for diversification by product line using the Loss Concentration Factor (LCF) is given by equation (7).

$$\begin{aligned} LCF &= \left(\frac{\text{LAE for the largest product line}}{\text{Total LAE}}\right) \cdot 0.30 + 0.7 \\ \text{LAE RBC Discount} &= (1 - \text{LCF}) \cdot 100\% \end{aligned} \tag{7}$$

Excessive Premium Growth Risk

Under the U.S. RBC formula for property and casualty insurers, an additional underwriting risk charge is levied on those insurers with gross premium growth rates exceeding 10% per year (calculated over 3 years). The RBC factors that are applied to the loss and expense reserves (LAE RBC Factor) and net written premium (NWP RBC Factor) to reflect the increased risk from excessive premium growth are calculated as follows:

$$\begin{aligned} \text{RBC AGRF} &= \text{SAGR} - 10\% \\ \text{LAE RBC Factor} &= 0.45 \cdot \text{RBC AGRF} \\ \text{NWP RBC Factor} &= 0.225 \cdot \text{RBC AGRF} \end{aligned} \tag{8}$$

where:

- RBC AGRF is the RBC Average Growth Rate Factor
- SAGR is the insurer's Selected Growth Rate in gross premiums over 3 years

Calculation of the U.S. RBC Ratio

The RBC ratio is determined by comparing the insurance company's Total Adjusted Capital (TAC) to the ACL RBC. If the RBC ratio falls below one of five predefined levels, a certain regulatory "action level" will be triggered. For example, an RBC ratio of 100% is defined as the Authorized Control Level. If the RBC ratio falls below 70%, the state insurance commissioner should seize control of the insurer. The level of RBC is calculated and reported annually.

2.3 EUROPEAN UNION SOLVENCY II STANDARD FORMULA

The Solvency II Directive was adopted by the European Parliament and Council in 2009. It outlines the high-level principles that underpin the Solvency II framework. The main goal of Solvency II is to harmonize the solvency regulation of insurance companies that conduct business in the EU member states and to protect the policyholders of the insurance companies.

Fundamentally, the Solvency II supervisory framework is based on a three-pillar approach similar to the banking industry's Basel II [BIS, Basel Committee on Banking Supervision, 2006]. The three supervisory pillars are [see Sharara et al., 2010]:

- Pillar 1: Quantitative requirements for measuring capital adequacy
- Pillar II: A supervisory review process including review of risk management practices
- Pillar III: Increased transparency and reporting requirements

2.3.1 Valuation of Assets and Liabilities

Under Solvency II, assets and liabilities should be valued using economic principles [European Commission, 2008]. Whenever possible, assets and liabilities should be marked-to-market. In the instances when marking to market is not possible, mark to model approaches should be used. Marking to model is any valuation which has to be benchmarked, extrapolated or otherwise calculated from a market input. The economic valuation of assets and liabilities of insurance companies is consistent with the current direction of the International Financial Reporting Standards (IFRS) [see International Accounting Standards Board, 2004, 2007].

Insurance liabilities are assessed at their current exit value, which is the value at which they "could be transferred, or settled, between knowledgeable willing parties in an arm's length transaction" [see European Commission, 2008, page 13]. They should be valued in a prudent, reliable and objective manner. Hedgeable components of the liability cash flows are carried at the market price of the hedge portfolio of liquid financial instruments. If the hedge portfolio is such that the remaining basis risk is immaterial, the cash flows can be considered hedgeable. Liability cash flows that are not hedgeable are determined as the sum of the best-estimate liability (BEL) and a cost-of-capital risk margin (CCM). The BEL is defined as the probability-weighted average of the present value of all future liability cash flows using the relevant risk-free interest rates. The BEL should be assessed using a relevant and reliable actuarial method. Ideally, the method should be part of actuarial best practice and should sufficiently capture the technical nature of the insurance liabilities. The CCM is the present value of the cost of meeting future solvency capital requirements to support the run-off of the insurance portfolio. It is calculated using equation (9) below:

$$CCM \quad = \quad i_{ccr} \cdot \sum_{t=1}^{T} SCR(t-1) \cdot \exp(-r(t) \cdot t) \tag{9}$$

where

- $SCR(t)$ is the (projected) solvency capital requirement in year t with respect to operational and underwriting risks on existing business, and counterparty default risk with respect to reinsurance ceded (i.e. it is assumed that there is no material market risk or risk of default of the counterparties to financial derivative contracts related to the insurance obligations) [see European Commission, 2008, page 26].
- i_{ccr} is the fixed cost of capital rate
- $r(t)$ is the risk-free interest rate for maturity t
- T is the run-off period for the liability cash flows

The cost-of-capital rate is the assumed required return on capital by an insurer/reinsurer who will assume the insurance portfolio upon the default of the insurer. It is assumed to be the same for all insurers, regardless of the business mix. In the Fourth Quantitative Impact Study (QIS 4) [European Commission, 2008], the cost of capital was fixed at 6% per annum but the final value has yet to be determined.

For the purpose of setting the best estimate assumptions, the insurance portfolio should be segmented into homogenous risk groups. Further, the calculation of the cost of capital risk margin requires that the portfolio be segmented into lines of business that could be transferred to a third party.

2.3.2 Regulatory Risk Based Capital

General structure

Solvency II will establish two levels of capital requirements:

- Minimum Capital Requirement (MCR) - If available capital falls below this threshold, the insurer's license will be revoked.
- Solvency Capital Requirement (SCR) - The target level of capital below which the regulator will take corrective action to restore the financial health of the insurer.

The SCR may be calculated using the prescribed standard model or a company's internal model subject to supervisory approval. Conceptually, the economic balance sheet of the insurer is projected one year into the future with respect to both new and old business under the Solvency II framework. Over the one-year horizon, assumed changes in the asset and liability risk factors (e.g. interest rate and equity returns) are modeled and their impact on the economic balance sheet is measured. The SCR corresponds to the 99.5% Value-at-Risk of the change in economic surplus over the one year horizon.

The SCR standard formula is divided into the life and non-life underwriting, market, counterparty default and operational risk modules which are each further divided into component sub-risks. For example, the non-life underwriting risk module consists of the following sub-risks: premium and reserve risk, and catastrophic risk. The market risk module includes the interest-rate risk, equity, credit-spread risk, forex and property risk sub-modules.

The Solvency II standard formula applies a combination of stress tests, scenarios and factor-based capital charges to determine the solvency capital requirements for the individual risks in the formula. In a bottom-up capital calculation, the standard formula then uses prescribed correlation matrices to aggregate component risks within each major risk-module and across the major risk-modules. The general formula that is used to combine capital requirements for component risks at each aggregation level is as follows:

$$SCR = \sqrt{\sum_i \sum_j \rho(i,j) \cdot SCR_i \cdot SCR_j} \tag{10}$$

where

- SCR_i is the solvency capital requirement for risk i.
- $\rho(i,j)$ denotes the correlation between risks i and j.

In addition to the benefits from diversification across major risk types that are accounted for under Equation (10), the standard formula also allows for reduced capital requirements for risk management techniques such as reinsurance and capital market hedging programs. The solvency capital requirement for each risk SCR_j is generally based on the net impact of a given change in the risk factor on the total economic balance sheet, after allowing for the benefit of the insurer's risk-hedging techniques.

Non-Life Underwriting Risk Module

The non-life underwriting risk module consists of two sub-modules: (1) premium and reserve risk and (2) catastrophic (CAT) risk.

Under the QIS 4 specification of the Standard formula, geographically diversified insurers or reinsurers would be assessed lesser amounts of solvency capital for each

line of business that was geographically spread over many territories. However, due to perceived problems with implementation, the CEIOPS in its final advice on L2 implementation measures has recommended the removal of the explicit calculation of geographic diversification benefits from the standard formula. Notwithstanding this recommendation, the calculation of the geographical benefits as described in QIS 4 is provided in the following section for information purposes.

Premium and reserve risk sub-module

In general, for a given line of business (LOB), the solvency capital requirement for non-life premium and reserve underwriting risk is determined as follows:

$$NL_{pr,lob} = V_{lob} \cdot \rho(\sigma_{lob}) \tag{11}$$

where

- $NL_{pr,lob}$ is the capital charge for premium and reserve risk
- V_{lob} is the volume measure for the LOB
- $$\rho(\sigma_{lob}) = \frac{\exp\left(N_{0.995} \cdot \sqrt{\log\left(\sigma_{lob}^2 + 1\right)}\right)}{\sqrt{\sigma_{lob}^2 + 1}} - 1 \approx 3\sigma_{lob} \tag{12}$$

  where

  - σ_{lob} is the standard deviation of the overall combined ratio ((claims + expenses)/V_{lob}) for the LOB
  - $N_{0.995}$ is the 99.5% quantile of the standard normal distribution
  - Assuming a lognormal distribution of the underlying risk, $\rho(\sigma_{lob})$ produces capital charges consistent with a one-year 99.5% confidence level

For a non-life insurer that does business in multiple geographic regions, we define the premium and reserve risk volume measures ($V_{p,lob,j}$ and $V_{r,lob,j}$ respectively) for each region j as follows:

- $V_{r,lob,j}$ is the best estimate of claim reserves for region j
- $V_{p,lob,j} = \max(P^t_{w,lob,j}, P^t_{e,lob,j}, 1.05 \cdot P^{t-1}_{w,lob,j})$, where $P^t_{w,lob,j}$ and $P^t_{e,lob,j}$ are the region-specific estimated net written and net earned premiums in the following year, respectively, and $P^{t-1}_{w,lob,j}$ is the net written premium in the previous year.

The premium and reserve risk volume measures ($V_{p,lob}$ and $V_{r,lob}$) for each LOB are obtained by summing the region-specific volume measures as follows

$$V_{p,lob} = \sum_j V_{p,lob,j} \tag{13}$$

$$V_{r,lob} = \sum_j V_{r,lob,j} \tag{14}$$

The standard deviation of the overall combined ratio (for premium and reserve risk) for the LOB is calculated by aggregating the standard deviations for premium risk

($\sigma_{p,lob}$) and reserve risk ($\sigma_{r,lob}$) as in equation (15).

$$\sigma_{lob} = \frac{\sqrt{\sigma_{p,lob}^2 V_{p,lob}^2 + \sigma_{r,lob}^2 V_{r,lob}^2 + 2\alpha V_{p,lob} V_r \sigma_{r,lob} \sigma_{p,lob}}}{V_{p,lob} + V_{r,lob}} \tag{15}$$

where α is the prescribed correlation between the premium and reserve risks.

As noted before, geographical diversification benefits were recognised under the QIS 4 specification of the Solvency II standard formula. The approach that was used in QIS 4 to allow for geographical diversification in the formula for required capital (see equation (11)) is described by equations (16) and (17).

$$DivIndex^1 = \frac{\sum_j (V_{p,lob,j} + V_{r,lob,j})^2}{(\sum_j (V_{p,lob,j} + V_{r,lob,j}))^2} \tag{16}$$

$$V_{lob} = (V_{p,lob} + V_{r,lob}) * (0.75 + 0.25 * DivIndex) \tag{17}$$

Finally, for a non-life insurer with several LOBs, the volume and standard deviation measures for determining the required capital of the overall insurance portfolio consistent with equation (11) are obtained as follows:

$$V = \sum V_{lob} \tag{18}$$

$$\sigma = \frac{\sqrt{\sum_{a,b} \rho(a,b) \sigma_a \sigma_b V_a V_b}}{V} \tag{19}$$

where

- V is overall volume measure for the insurance portfolio, and the summation is over the LOBs
- $\rho(a,b)$ is the prescribed correlation between lines of business a and b

In conclusion, we note that the QIS 4 Solvency II standard formula for non-life premium and reserve risks offered opportunities to reduce capital requirements due to diversification of the insurance portfolio by geographic area and by line of business. Further diversification benefits are available if the assumed correlation (α in equation (15)) between the premium and reserve risks is less than 1. However, as noted at the beginning of this section, CEIOPS has since advised that the geographical diversification benefits should be removed from the standard formula.

Catastrophic risk sub-module

CAT risk sub-module calculates the required capital for extreme or infrequent events not adequately captured in the premium and reserve risk sub-module.

There are two alternative approaches for calculating the CAT risk capital charge:

1. Standard formula

[1] Herfindahl index for premiums and reserves

Table 3: CAT Risk Factors by Line of Business

LOB_t	Factor c_t
1. Motor - third party liability	0.15
2. Motor, other	0.075
3. Motor, Aviation & Transport	0.50
4. Fire	0.75
5. Third-party liability	0.15
6. Credit	0.60
7. Legal expenses	0.02
8. Assistance	0.02
9. Miscellaneous	0.25
10. Reinsurance (Property)	1.50
11. Reinsurance (Casualty)	0.50
12. Reinsurance (Motor, Aviation & Transport)	1.50

2. If regional scenarios for catastrophes (man-made and natural) are provided by the local supervisor, they are used to determine the capital charge rather than the standard formula. Optionally, the regulated insurer can use personalized scenarios.

In this section, we will only provide an overview of the standard formula for the CAT risk capital charge. The required capital for CAT risk using the standard formula is defined as follows:

$$NL_{CAT} = \sqrt{(\sum_{t\neq 3,4,10,12} (C_t \times P_t)^2 + (C_3 \times P_3 + C_{12} \times P_{12})^2 + (C_4 \times P_4 + C_{10} \times P_{10})^2)} \tag{20}$$

where NL_{CAT} is the capital charge for non-life underwriting CAT risk, and P_t is the net written premium for the individual LOB t (see table below for the number and factor corresponding to each LOB) in the following year.

Total Solvency Capital Requirement for Non-Life Underwriting Risk

Given the solvency capital requirements for premium and reserve risk (SCR_{PR}), and catastrophic risk (SCR_{CAT}), the aggregate solvency capital requirement for non-life underwriting risk is calculated using equation (21).

$$SCR = \sqrt{\sum_i \sum_j \rho(i,j) \cdot SCR_i \cdot SCR_j} \tag{21}$$

where

- SCR_i is the solvency capital requirement for risk i=PR or CAT.
- $\rho(i,j)$ denotes the correlation between risks i and j.

	US	Canada	EU
ASSETS			
Deferred Policy Acquisition Expenses(DPAE)	0	1,484,000	0
Government Bonds	40,000,000	40,000,000	40,000,000
Total Assets	**40,000,000**	**41,484,000**	**40,000,000**
LIABILITIES			
(Discounted) Best Estimate Unpaid Claims	12,545,000	12,545,000	12,545,000
Anticipated Investment Premium		(0)	
Liability Margin	943,000	1,255,000	907,000
Total	**13,488,000**	**13,800,000**	**13,452,000**
Premium Liability	8,732,000	8,732,000	7,148,000
Total Liabilities	**22,220,000**	**22,532,000**	**20,600,000**
Statutory Available Capital	**17,780,000**	**18,952,000**	**19,400,000**

Table 4: Statutory Solvency Balance Sheets of Model Insurance Portfolio

3 A COMPARISON OF THE STATUTORY SOLVENCY BALANCE SHEETS OF THE MODEL P&C INSURER

In this section, we will compare the Solvency II balance sheet of a model private automobile liability insurance portfolio with the corresponding balance sheets under the statutory accounting frameworks in Canada and the U.S.. The statutory solvency balance sheets of the model insurance company are shown in Table 4. The goal of the comparison is to articulate some of the significant benefits of using economic valuation principles in the solvency assessment of a property and casualty insurance company.

The illustrative balance sheets were prepared using cumulative (private auto-liability) net paid-loss triangle data of a major U.S.-based property and casualty insurer as shown in Part 3 of the 2008 NAIC Schedule P. The associated age-to-age development factors that were computed from the cumulative paid loss-development triangle are shown in Table 7 of the appendix. A tail-factor of 1 was assumed in the valuation so no payments were considered beyond 10 years.

Additionally, the following assumptions were needed to perform the calculations that are presented in this section:

- We did not consider the fact that the Part 3 Schedule P data is on a net of reinsurance basis to be material since our analysis is meant to be illustrative only.
- Projected cash flows using the chain-ladder actuarial technique and the loss development triangle data in the appendix are reasonable estimates of the "best estimate" (i.e. probability weighted average) cash flows under the Solvency II framework. In estimating the future payments, we mechanically applied the volume-weighted averages of the age-to-age factors in the appendix to the cumulative paid loss and expense amounts at the statement date.

However, strictly speaking, Article 76 of the Solvency II Directive requires a stochastic approach to the estimation of claim reserves since the "best estimate" liability is defined as a probability-weighted average of discounted cash flows. Further, in practice, several methods are often employed to estimate claim reserves so as to minimize model and parameter risk, and the result of the actuarial analysis is normally a range of reasonable values for the claim reserves rather than a point estimate.

- The invested assets of the model insurer consist entirely of very short duration government bonds (with a duration of 1). The government bonds are assumed to be valued at market under all three regulatory regimes.
- Net Written Premium (assumed equal to Net Earned Premium (NEP)) of $17,463,000. For convenience, we assumed that the insurer issues only one-year policies.
- Unearned Premium Reserve (UPR) = 50% × Net Written Premium (NWP). It is also assumed that there are no premium receivable assets.
- Deferred Policy Acquisition Expenses (DPAE) = 17%×Net Written Premium. We assumed that the entire amount would be admitted on the Canadian statutory balance sheet with a capital factor of 35%.
- (Discounted) Loss and Claims Expense Ratio = 90%
- 5% p.a. flat risk-free yield curve on the balance sheet valuation date.
- 10% margin for claims development under the Canadian valuation framework for claim reserves. Note that we have assumed the Canadian liability valuation to be based on accepted (Canadian) actuarial practice, which requires that reserves should reflect the time value of money. No investment risk premium (above the risk-free rate) was assumed in the Canadian liability valuation shown in Table 4.

A review of Table 4 shows that the amount of the insurance company's statutory available capital under Solvency II is greater than the corresponding amounts under the U.S. and Canadian statutory accounting frameworks. The reasons for this difference in available capital are explained below:

- The components that make up the amount of the insurance company's obligations with respect to the existing policies are shown in Table 4. In general, each claim liability amount can be viewed as the sum of the discounted best-estimate liability (DBEL) of $12,545,000 plus an explicit or implicit margin.

  Based on the stated assumptions, including a flat risk-free yield curve of 5% p.a. at the statement date, the cost-of-capital margin under Solvency II is less than the corresponding margins under the other two approaches. As already explained, the risk margin under Solvency II reflects the market price of non-diversifiable/non-hedgeable risks and is calculated using the cost of capital formula outlined in Section 2.3.1. The calculated margin under the U.S. regulatory measurement approach is the implicit margin that results from booking

undiscounted claim reserves on the statutory solvency statements[2]. Therefore, the U.S. claim reserves have an implicit margin which would increase for longer-tail lines, and higher prevailing interest rates. The Canadian GAAP liability valuation margin for claim reserves is a subjective input of the actuary that must fall between 2.5% and 15% (of the best estimate assumption) in accordance with accepted Canadian actuarial practice. As noted already, we used a margin of 10% to calculate Canadian claim liabilities in Table 4.

It is clear that the relative size of the claim liability margins depends on the level of interest rates, duration of the liabilities, and in the case of the Canadian statutory valuation, the professional judgement of the actuary, among other factors. To illustrate the dependence of the claim liability margin amounts and other balance sheet entries, on the level of interest rates, we show the variation of the amount of statutory available capital for each jurisdiction by interest rate in Figure 1. The amounts of available capital in Figure 1 are based on an assumed constant market value of the government bond assets of $40,000,000 under all interest rate scenarios. The capital amounts are expressed as percentages of the sum of the assumed undiscounted best-estimate claim reserve ($13,488,000) and the net written premium($17,463,000). The graph makes use of the following labels to denote specific cases for the Canadian valuation, which are necessary to portray the subjective elements of the liability valuation approach:

CAN1: The variation of statutory available capital assuming a 2.5% claims development margin and 0% investment risk premium (i.e. expected portfolio rate net of risk-free rate).

CAN2: 15% claims development margin and 0% investment risk premium

CAN3: 2.5% claims development margin and 3% investment risk premium

CAN2: 15% claims development margin and 3% investment risk premium

Figure 1 shows that the amount of statutory available capital under the U.S. solvency assessment framework does not change with the level of interest rates. In reality, as the level of interest rates increases, the amount of available capital should increase to reflect the higher yielding investment opportunities in the marketplace (under the assumption of a constant market value of the government bond portfolio). Figure 1 illustrates that this is indeed the case for the Canadian and Solvency II valuation systems that reflect the time value of money in their estimation of claim reserves.

Therefore, under an environment of higher prevailing interest rates, the size of the implicit claim reserve valuation margin under the U.S. system is increased but it is not recognised as an additional solvency buffer for regulatory capital purposes. The implicit and opaque nature of the U.S. claim reserve margin makes it difficult to reliably compare the relative solvency strength of different insurers, and it renders the U.S. statutory solvency balance sheet very risk-insensitive in that respect. The relatively risk-insensitive U.S. statutory balance sheet increases the likelihood of type I (false-positive) and type II

[2]In the U.S., discounting of statutory claim reserves is allowed for certain coverages and in certain states. Tabular discounting is used in lines such as Workers' Compensation where settlement involving pension payouts are common. Non-tabular discounting is also possible for long-tail lines such as Medical Professional Liability. However, these are exceptions rather than the general rule.

Table 5: Balance Sheet Exposure to Interest Rates/Inflation Risk

	Δ in rate	Δ Assets	Δ Liabilities	Δ Net
EU	+ve	-ve	-ve	depends
CAN	+ve	-ve	-ve	depends
U.S.	+ve	-ve	none/+ve	-ve

(false-negative) errors in flagging financially troubled insurers. Table 5 summarises the solvency balance sheet impact of an increase in real interest rates or inflation on the statutory surplus/capital position of an insurance company with inflation-sensitive claim liabilities.

On the other hand, the Canadian statutory accounting framework has the potential to produce a multiplicity of potential claim liability estimates for a given amount of future insurance obligations due to the subjective nature of the actuary's professional judgement that is required to estimate certain valuation assumptions such as the claims development risk margin and the expected return on the portfolio investments. The potential range of the liability estimates can be inferred from Figure 1. Therefore, since the amount of available solvency capital of the insurer is a subjective assessment to a certain (significant) degree, the comparison of solvency strength among regulated insurance entities is made more challenging.

- Under Solvency II, the premium liability reflects the future economic profit in the year in which the business is written. The premium liability amount of $7,148,000 reflects the best estimate of expected claims in respect of the unexpired risks of existing policies, based on an assumed (discounted) combined loss ratio of 90%. Conversely, the Canadian and U.S. statutory accounting regimes require the insurer to hold the Unearned Premium Reserve (UPR) of $8,732,000 to support the unexpired risks. The amount of the UPR is simply an accrual accounting artifact that has been designed to properly measure the incidence of investor profit. In the case where the UPR is measured to be inadequate to pay the associated future benefits and expenses, a premium deficiency reserve (PDR) would be normally set up using the applicable rules of the accrual accounting system.

  The expected future economic profits of $1,584,000 ($8,732,000 - $7,148,000) that are not recognized on the balance sheets of the Canadian and U.S. insurer are therefore, effectively, implicit solvency margins that are not counted as regulatory capital in the solvency assessment of the regulated insurance enterprise. This lack of transparency in determining the actual amount of the insurance company's obligation (versus investor capital) with respect to unexpired risks, complicates the relative comparison of solvency strength among insurers and leads to a solvency balance sheet that is risk-insensitive.

- Accepted Canadian actuarial practice for claim liability valuation requires that the expected future insurance claims and expenses be discounted at the expected portfolio rate of return. As noted earlier, the valuation actuary should exercise his or her professional judgement in choosing a margin for the expected portfolio return rate assumption that is between 50bp and 200bp. Because the investment return margin depends on the manner in which the investment assets are deployed, and the actuary's professional judgement, the universe of

calculated claim reserves for given insurance obligations can be very broad. This potential variability in liability estimates was illustrated in Figure 1.

In addition, the use of a solvency liability measure that depends on the configuration of the invested asset portfolio presents the possibility of insurers gaming the solvency capital requirements through the use of creative or opportunistic investment strategies. If the increased risk from adopting a riskier investment strategy is not adequately penalized with a commensurate increase in the investment risk valuation margin, there will be a perverse incentive for the regulated insurance entity to increase the risk profile of its asset portfolios and strategies. Effectively then, under the Canadian statutory solvency framework, any positive net investment return margin that is assumed in the claim liability valuation is a free-lunch of some sort which represents the incremental risk of the investment strategy that has not been discounted in the valuation process. Figure 1 illustrates the variation of statutory available capital under the Canadian framework assuming two levels of investment risk premiums (0% and 3%). The amount of statutory available capital for different levels of assumed risk premium can be inferred from the graph.

4 STATUTORY CAPITAL REQUIREMENTS FOR THE MODEL AUTO-INSURANCE LIABILITY PORTFOLIO

In the previous section, we examined the variation of statutory available capital of the model auto-liability insurance portfolio by the level of interest rates. In this section, we will review illustrative calculations of statutory capital requirements under the proposed Solvency II (standard formula), and current Canadian Minimum Capital Test and U.S. NAIC risk based capital standards. The calibrations of the Solvency II standard formula that were used in the illustration reflect the final advice of the CEIOPS on level-2 implementation measures that were issued in 2009.

Figure 2 shows the statutory capital requirements by risk component of the model insurance portfolio that is illustrated in Table 4. The following notes apply to the risk capital components that are illustrated in Figure 2:

- Catastrophe risk is shown net of diversification benefits, reflecting the 0.25 correlation that is assumed to exist between this risk and premium and reserve risk
- Interest rate risk is also shown net of diversification benefits, reflecting the zero correlation that is assumed between this risk and the non-life risk module.
- Capital against the Canadian GAAP Deferred policy acquisition expense asset is assumed to be held at 35% of the balance sheet amount.
- The amount for miscellaneous risks under the Canadian formula reflects the 50% loading for unquantifiable and other risks that are not explicitly addressed under the Canadian MCT formula.

Analysis of Figure 2 leads to the following observations:

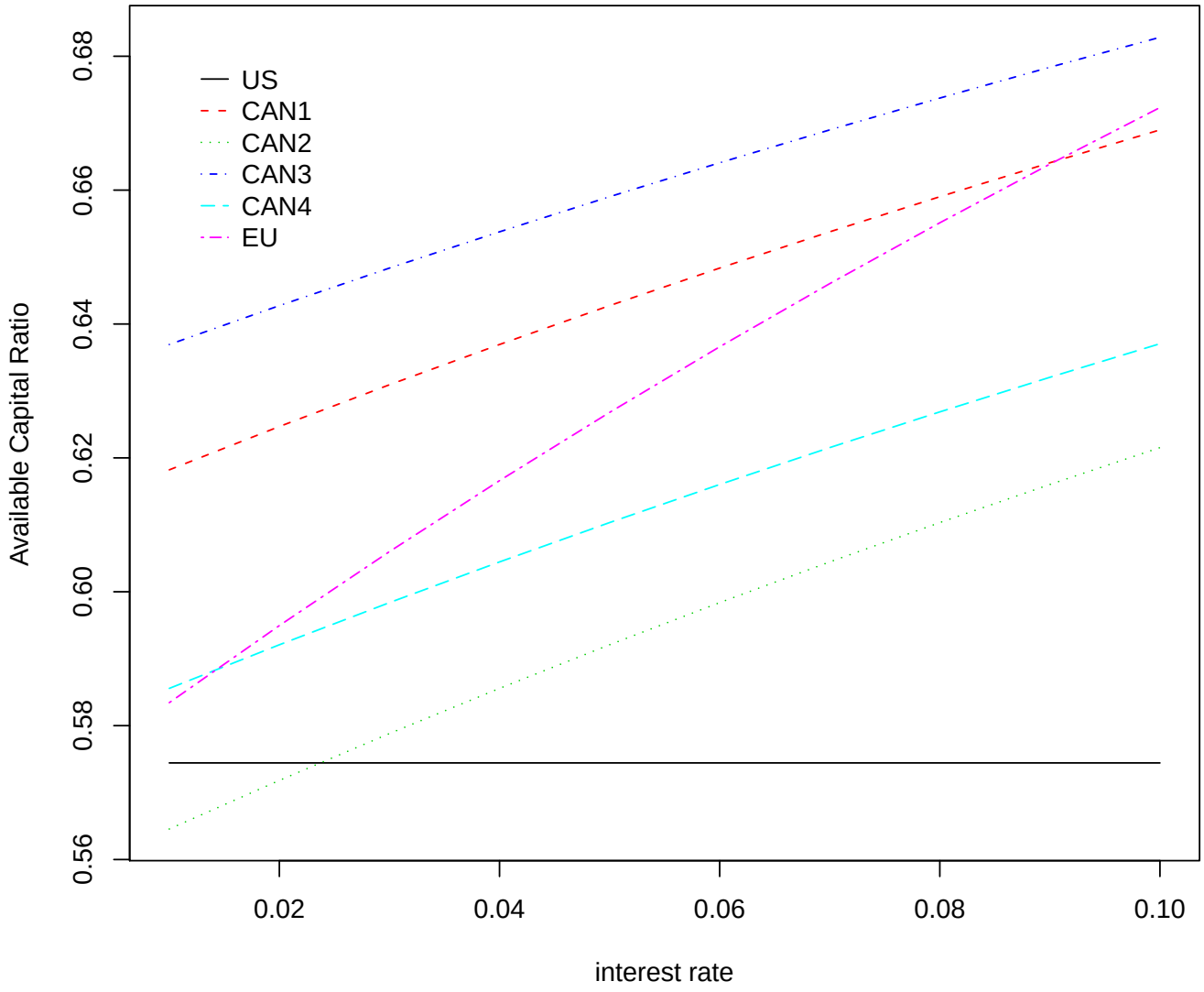

Figure 1: STATUTORY AVAILABLE CAPITAL

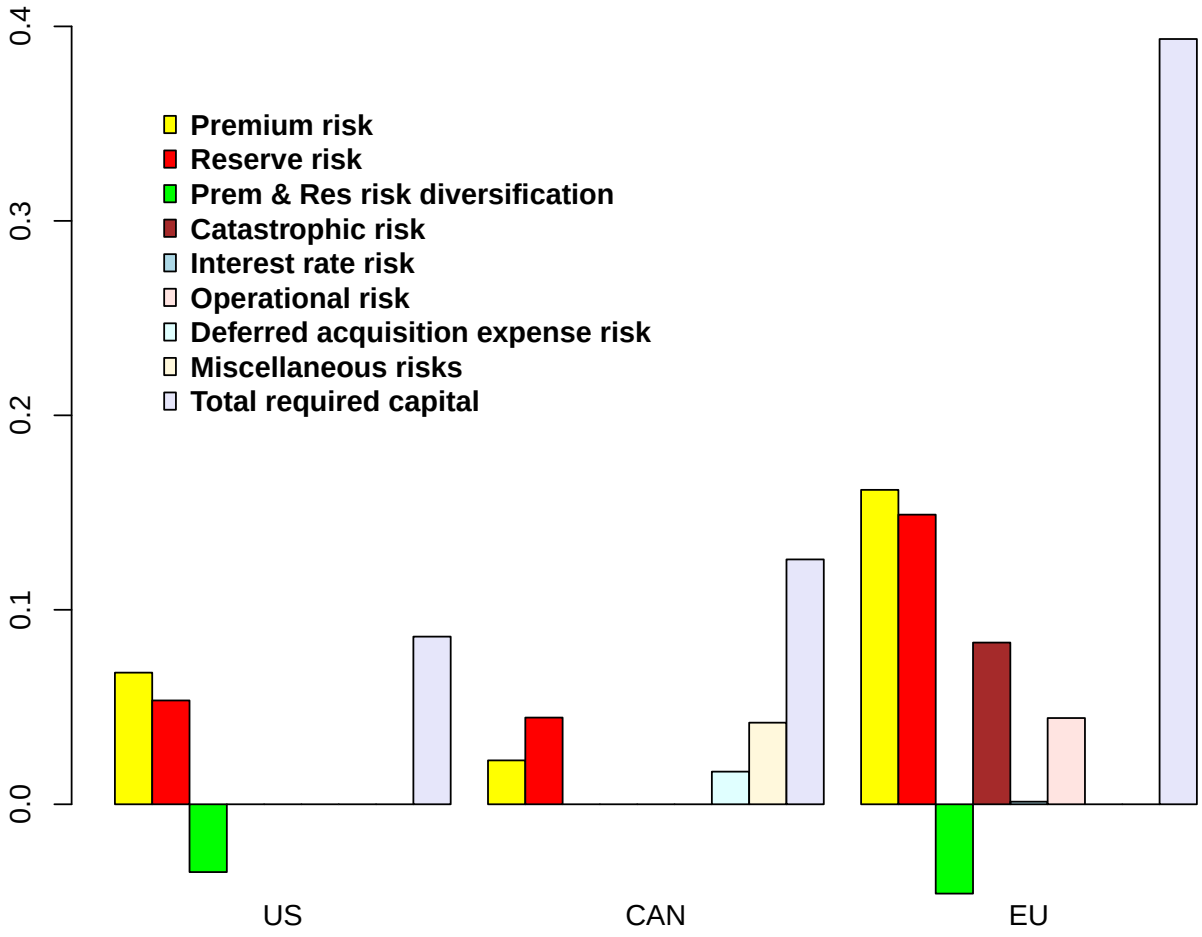

Figure 2: STATUTORY CAPITAL REQUIREMENTS BY COMPONENT

- The Solvency II capital factors for premium and reserve risk appear to be very conservative, though a definitive comparison is not possible since the calibrations may reflect differences in insurance markets. We have summarised the measures of risk exposure that are used in calculating each regulatory capital amount in Table 6 so that it is easier to understand the sources of difference among the regulatory capital formulas. For example, one reason for the much lower amount for premium risk under the Canadian regulatory capital standard is the much smaller risk exposure amount. Under the Canadian framework, Table 6 shows that the premium risk exposure is based on the unearned premium reserve at the balance sheet date (or 1/2 of previous year's net written premium if greater) with respect to existing business only, that is, there no risk recognition of premium risk on anticipated new business or renewals in the coming year. Additional information on the formulae calibration is provided in Table 8 in the appendix

- Under the Solvency II and U.S. regulatory capital formulas, insurers will obtain a benefit of diversification that will not be available to insurers operating in Canada. The assumed correlation between premium and reserve risks is 0.5, and is the basis of the Solvency II standard formula results presented above. Premium and reserve risks under the U.S. RBC formula (see equation (1)) are effectively assumed to be uncorrelated. However, to some limited extent, the diversification benefits that are available under the U.S. and Solvency II standard formulas appear to be offset by generally higher capital factors for premium and reserve risk.

  Although not illustrated in Figure 2, it is also important to note that the Canadian MCT formula does not give explicit credit for line of business diversification benefits. Solvency II aggregates the individual line requirements using equation (10) to determine the overall non-life insurance underwriting risk capital requirement. The diversification benefit by line of business under the U.S. RBC formula is determined at the portfolio level using the premium and loss concentration factors as described in equations (4) and (7) respectively. The U.S. diversification benefit for premium and reserve risks is capped at 30% of the overall premium and reserve risk requirements respectively.

- A catastrophe risk charge does not exist in the U.S. RBC formula for non-life business but an explicit charge using internal models is currently under consideration [see Vaughan, 2009, page 12]. In Canada, regulatory capital requirements for exposure to earthquake risk (where applicable) are determined in accordance with OSFI's earthquake exposure sound practices guideline. The Solvency II Factor approach for catastrophe risk was described in Section (2.3) and is the basis of the catastrophic risk capital amount shown in Figure 2.

  The Solvency II net catastrophic risk capital in Figure 2 is shown net of diversification benefits (based on final advice of CEIOPS on L2 implementing measures, the prescribed correlation between CAT and premium and reserve risks is 0.25). Figure 2 reveals that this component of overall risk capital requirements can be very significant. The catastrophe capital factors for other perils and lines of business can be very severe. However, as already stated, insurance companies will be primarily required to use standardised scenarios, if available, or will have the option to use partial internal models.

- As explained in section 2.2, the U.S. RBC formula includes a capital charge for

excessive premium growth which is not included in the Canadian or Solvency II standard formulas. This additional risk capital requirement was not applicable to the model insurance portfolio.

- Solvency II includes an explicit charge for operational risk, while the Canadian and U.S. formulas do not. The capital charge for operational risk in Figure 2 was calculated using the formula calibration based on the final Level-2 implementation measure advice of the CEIOPS as follows:

  $$\text{Operational risk charge} = \min(0.3 \times \text{BSCR}; \max(0.038 \times \text{Earned Premium}; 0.036 \times \text{TP}))$$

  where:

  - BSCR is the Basic Solvency Capital Requirement i.e. the sum of all the risk charges including diversification credits, and before adjustments for the risk reduction arising from future profit sharing and deferred taxes (which are not relevant for this paper).
  - Earned Premium is the total non-life earned premium (gross of reinsurance) in the year following the valuation date
  - TP are the non-life Technical Provisions on the valuation date with a floor of zero.

- Solvency II also includes a charge for interest rate risk (mismatch) while the other jurisdictions do not. It is important to note that interest-rate mismatch risk is measured using a total balance sheet approach, and therefore includes risk on surplus assets (i.e. risk on assets in excess of supporting assets). The Solvency II net interest rate risk capital in Figure 2 is almost negligible since it is shown net of diversification benefits (based on final advice of CEIOPS on L2 implementing measures, the prescribed correlation between market and non-life risks is 0.25). The interest rate risk capital requirement (before diversification) was calculated as the change in the value of the net assets (assets less liabilities) of the model insurance portfolio due to a shock of 77% to the assumed parallel risk-free yield curve of 5% at the valuation date (The 77% shock is consistent with the QIS 4 calibration for a 2-year maturity rate).

- The statutory capital requirements in Canada include a significant amount of capital designated as miscellaneous risks. Miscellaneous risks include risks that are not amenable to quantification such as strategic and liquidity risks, and perhaps the increased insolvency risk from volatile global financial markets in recent years.

The regulatory capital requirements in Figure 2 were prepared assuming a flat risk-free yield of 5% p.a.. In Figure 3, we show that these solvency capital requirements are relatively insensitive to changes in the level of prevailing interest rates.

Figure 4 shows the variation of the amount of free capital (that is, the amount of statutory available capital in excess of statutory capital requirements) that is available to the shareholders of the regulated insurance entity under each regulatory capital regime. The amounts of free capital that are available to the insurer's shareholders mirror, to a large extent, the amounts of statutory available capital in Figure

Table 6: NON-LIFE UNDERWRITING RISK EXPOSURE

Risk	US	CAN	Solvency II standard formula
Premium Risk	NWP in the following 12 months	greater of Unearned Premium Reserve or 50% of NWP in the previous 12 months plus Premium Deficiency Reserve, if any	greater of next year's NWP or Earned Premium or 105% of previous year's NWP
Reserve Risk	Statutory Reserves (undiscounted)	Canadian GAAP claim liabilities (discounted at portfolio return rate)	Solvency II best estimate(discounted at risk-free rates)
Catastrophe Risk	N/A	Earthquake Risk-Probable Maximum Loss (500 year return period)	Net Written Premium (standard formula)

1. The risk-insensitive nature of the U.S. statutory valuation framework is again evident in Figure 4. The subjective features of the Canadian valuation framework, including the allowable anticipation of a positive net investment risk premium in the determination of claim reserves are illustrated in terms of their impact on free capital.

Free capital as defined herein, is the amount of money that can be withdrawn from the company by shareholders through dividends or share buy-back programs, and as such, it has significant and immediate implications on the realistic solvency position of the company. On the other hand, free capital is also a very important company valuation metric for the insurance company's shareholders. It is imperative therefore, that the solvency assessment of the insurer be based on valuation principles that meet the objectives of transparency and objectivity to the greatest extent possible. The valuation principles should reflect the economic reality of the subject insurer so as to ensure that the amount of money that is deemed to be available for distribution to shareholders is indeed over and above that needed to appropriately limit the insolvency risk to an acceptable minimum level so as to provide adequate protection to the policyholders of the insurer.

5 RISK SENSITIVITY OF THE NON-LIFE INSURANCE CAPITAL REQUIREMENTS

In the following analysis, we will note summarily, additional features (i.e. further to those already discussed in previous sections) of the Canadian, U.S. NAIC and Solvency II (standard) capital formulas that relate to their ability or inability to capture the unique risk profile of a given P&C insurer i.e. their risk sensitivity. A capital adequacy assessment system that is not sufficiently risk-sensitive can be arbitraged or gamed by insurers if they are able to increase their risk-exposure without a commensurate increase in solvency capital requirements. As mentioned before, the primary reason for the adoption of Basel II in favor of Basel I by the

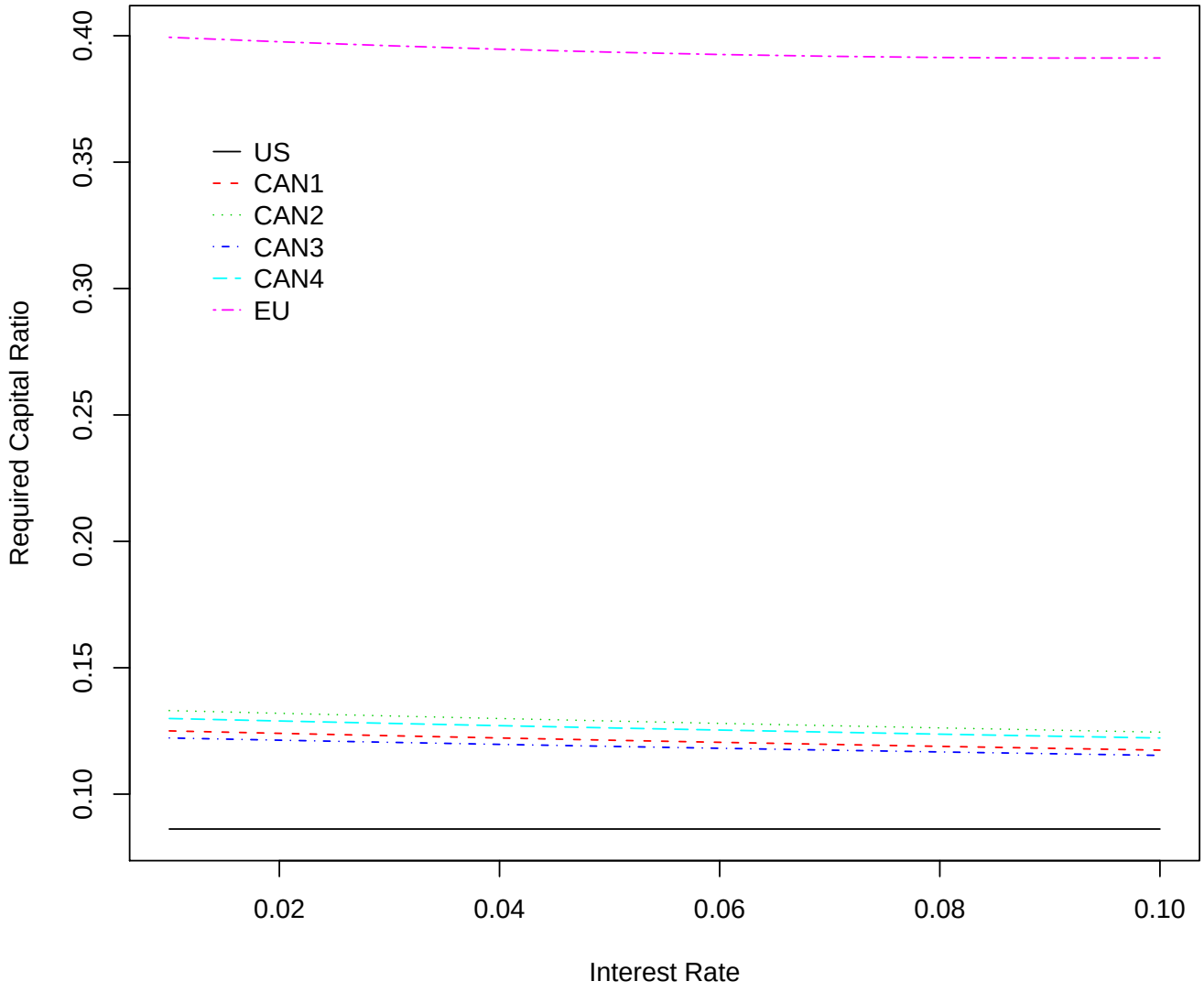

Figure 3: STATUTORY CAPITAL REQUIREMENTS

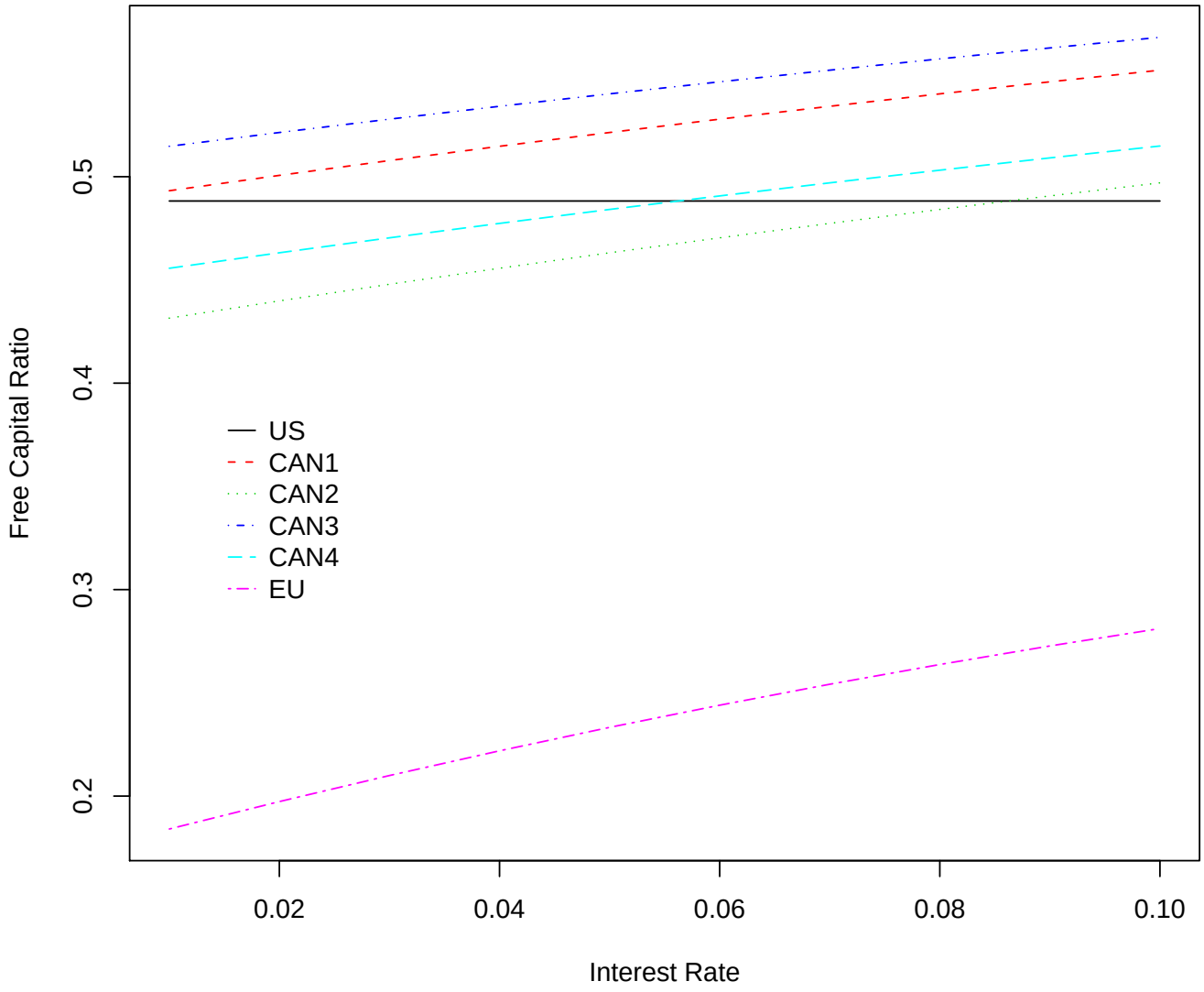

Figure 4: FREE CAPITAL

banking industry was the need for a more risk-sensitive regulatory capital adequacy system, and the need to minimize the opportunities for regulatory capital arbitrage that were possible under Basel I.

The following is a brief commentary on the features of the regulatory capital formulas that relate to their risk-sensitivity:

- The three regulatory capital regimes are based on different risk classification schemes. The Canadian Minimum Capital Test (MCT) is based on the 7 lines of business that are shown in Table 2, while the Solvency II standard formula relies on the 12 LOB classifications in Table 3. The U.S. P&C RBC formula, makes use of a total 19 LOB classifications, and hence is more granular and risk-sensitive in that respect, possibly reflecting a more heterogenous insurance market. As mentioned in Section 2.2, the U.S. P&C RBC formula also provides discounts for loss-sensitive business.

- Another aspect of the regulatory capital formulas in which they differ is the degree to which company-specific experience or data is incorporated in the determination of capital requirements. The Canadian MCT does not allow for company-specific experience. The Solvency II standard formula previously allowed for company experience according to the specifications of the QIS 4. However, in its final advice on L2 implementation measures, the CEIOPS has decided that there should be no allowance for company experience in calculating capital requirements for both reserve and premium risk, at least for now, due to noted concerns of whether companies would be able to obtain data of sufficient and credible quality. In contrast, as stated previously in the relevant sections, the U.S. RBC formula uses equal weights for industry and company-specific experience in the calculation of premium and reserve risk. The U.S. RBC formula specifies that data standards have to be met before company-specific experience can be used to determine solvency capital requirements.

- Underwriting cycles are a unique feature of the P&C insurance industry that present a unique pricing risk. During soft market periods, there is a general tendency for insurers to experience underwriting losses because of the fierce competitive pressures.

  As shown in Tables 6 and 2, the Canadian MCT does not require capital for premium risk on anticipated new business. Note however, that the Dynamic Capital Adequacy Testing conducted annually by Canadian P&C insurers can be an appropriate platform to analyse such risk over the typical 3-year forecast horizon. However such (Pillar 2) considerations are beyond the scope of this paper. On the other hand, both the U.S. and Solvency II premium-risk capital formulas use an exposure measure for premium risk that anticipates new business in the following year. To the extent that the premium base with respect to new business is significantly underpriced, as is more probable during a soft market, it is likely that the capital requirements for premium risk under the U.S. and Solvency II formulas will be understated. In a hard market, the converse will be true since the same formulas will require insurers to hold more capital, all else being equal. The result is that the capital requirement formulas will exacerbate the underwriting cycles, that is, they will be pro-cyclical (in the underwriting cycle sense). In the case of the U.S. P&C RBC approach,

it appears that the solvency regulator can allow for underwriting cycle risk in the formula capital requirements by adjusting the IRBC factor (i.e. Industry RBC Loss and Expense Ratio) in Equation 2 such that the peaks and troughs of the underwriting cycle are minimized.

6 CONCLUSION

In this paper, some of the important differences among the regulatory capital regimes were explained and illustrated by way of a numerical example. Some of the regulatory capital arbitrage opportunities that can arise for international insurers seeking to optimize the use of scarce capital resources can be identified based on the presentation in this paper. Given the increasingly globalized nature of insurance and capital markets, it is also imperative for solvency regulators in Canada, U.S. and the EU to critically review the calibration of the capital adequacy requirements for insurers operating in their jurisdiction against those of other jurisdictions to minimize opportunities for regulatory capital arbitrage, thereby safeguarding the interests of the policyholders of the regulated insurance entities.

The benefits of using a market-consistent balance sheet in the statutory solvency assessment of a given property and casualty insurer were also outlined in this paper. A market-consistent balance sheet provides a realistic and relatively more objective picture of the actual solvency position of an insurance company at any given point in time. It allows the supervisor to have meaningful information on the actual trends in the insolvency risk profile of the regulated insurance company. In sharp contrast, the statutory accounting balance sheets under the U.S. and Canadian regulatory regimes are either risk-insensitive, opaque, relatively more subjective, or include anticipated investment risk premiums that have not been fully discounted in the liability valuation process. These characteristics of the U.S. and Canadian statutory accounting systems will increase the likelihood of type I (false-positive) and type II (false-negative) errors in flagging financially troubled insurers on a realistic basis.

Finally, the preliminary calibration of the Solvency II non-life underwriting risk capital formula appears to be relatively conservative when compared with the corresponding requirements in Canada and the U.S.. It is possible that the differences in solvency capital requirements can be partly explained by a consideration of the unique features of each insurance market. It is important to note that since the analysis contained in this paper was focussed on a specific line of business and did not consider diversification across lines of business, the conclusion that the Solvency II preliminary calibration appears to be much more conservative might not apply in the case of a very well diversified insurer, since in that particular case, diversification benefits will be significant, and will therefore need to be factored into the comparison. The formulas for determining the line of business diversification benefits for a given property and casualty insurer under each of the U.S. RBC and the Solvency II (standard formula) standards were provided. As already discussed in the paper, the Canadian Minimum Capital Test does not provide for line of business diversification benefits. Relative to the Canadian capital standard, therefore, the relative conservatism of the Solvency II calibration would diminish as the regulated insurance company becomes more diversified.

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Table 7: NET CUMULATIVE PAID LOSS AGE-TO-AGE DEVELOPMENT FACTORS FOR MODEL INSURANCE PORTFOLIO

	2/1	3/2	4/3	5/4	6/5	7/6	8/7	9/8	10/9
1999	1.66942	1.18740	1.08423	1.03946	1.01978	1.01008	1.00458	1.00282	1.00218
2000	1.68934	1.16834	1.07839	1.04162	1.01855	1.00912	1.00480	1.00280	
2001	1.65554	1.16104	1.08023	1.03970	1.01887	1.01001	1.00541		
2002	1.60713	1.16033	1.07778	1.03983	1.01997	1.01017			
2003	1.60297	1.15933	1.08357	1.04316	1.02116				
2004	1.61433	1.16394	1.08903	1.04532					
2005	1.61360	1.17183	1.08828						
2006	1.62106	1.17331							
2007	1.63761								
2008									

APPENDIX I: DATA

REGULATORY CAPITAL CALCULATION ASSUMPTIONS OF MODEL AUTO- INSURANCE PORTFOLIO								
UNITED STATES NAIC				CANADA				
					PREMIUM	0.0800		
RESERVE RISK CALCULATION					RESERVE	0.1000		
INDUSTRY AVERAGE DEVELOPMENT	1.0030							
COMPANY DEVELOPMENT	0.9864							
INDUSTRY LOSS & EXPENSE RBC %	0.2210			SOLVENCY II				
ADJUSTMENT FOR INVESTMENT INCOME	0.9270			(standard deviation)	PREMIUM	0.1000		
				(standard deviation)	RESERVE	0.1250		
PREMIUM RISK CALCULATION					CAT RISK	0.4000		
INDUSTRY AVERAGE LOSS & EXPENSE RATIO	0.8310							
COMPANY AVERAGE LOSS & EXPENSE RATIO	0.8596			COST OF CAPITAL RATE		0.0600		
INDUSTRY LOSS & EXPENSE RATIO	1.0140							
COMPANY UNDERWRITING EXPENSE RATIO	0.1700							
ADJUSTMENT FOR INVESTMENT INCOME	0.9210							

Table 8