UPDATE ON ACTUARIAL DENSITY AND ACTUARIAL PENETRATION

June 22, 2022
AGENDA

Introduction
Background
Data
Results
Conclusions
I often say that when you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind.
The concepts of insurance penetration and insurance density motivated our original analysis presented in 2014.

The usual definitions are as follows:

<table>
<thead>
<tr>
<th>Insurance penetration</th>
<th>the amount of insurance premium divided by the Gross Domestic Product (GDP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insurance density</td>
<td>the amount of insurance premium divided by the population</td>
</tr>
</tbody>
</table>
# Introduction

We are using the following concept names and definitions:

| Actuarial economic penetration | the number of actuaries divided by the GDP |
| Actuarial density              | the number of actuaries divided by the population |
| Actuarial insurance penetration| the number of actuaries divided by the amount of insurance premium |
Consistency with International Actuarial Association (IAA) goals:

**Impact, Assure and Advance**
Introduction

The IAA’s Membership in 1998

Source: IAA. With permission from the IAA Secretariat.
In 2022 the IAA represents 75,000+ actuaries in 115+ countries

Source: IAA. With permission from the IAA Secretariat.
Background

Other actuaries have considered the same or similar concepts:

We believe that the analysis in our update extends the concepts and their usefulness.
Background

Healthcare experts have considered the same or similar concepts:

- Mukhopadhyay et al
- Dewan et al
- Kanmounye et al
- Massenberg, Saluja, Jenny et al

We believe that workforce analysis can be used in other professions and careers.
Data elements used:

- Number of Actuaries by FMA
- Insurance Premium
- Population
- GDP (US $ and PPP basis in Int $)

Calculations made:

- GDP per Capita
- Actuarial Insurance Penetration
- Insurance Density
- Insurance Penetration
- Actuarial Density
- Actuarial Economic Penetration
Number of Fully Qualified Actuaries ("FQAs").
Number of Members with Actuarial Credential ("MWACs")

The IAA provided data by Full Member Association ("FMA") regarding the number of FQAs and MWACs from 2001 to 2021.

In 2019 the IAA introduced MWAC as a more useful measure than FQA for the determination of IAA membership fees and Council voting rights.

We are using the IAA data as the count of the number of actuaries in a country or region.

Our sample contained data from 61 countries with all data elements.
Special treatment of number of actuaries by FMA:

- More than one FMA, used the number of actuaries in the largest FMA.
- Determined USA number of actuaries by combining CAS and SOA numbers then subtracting out the number of actuaries from Canada.
- We used the number of actuaries from Canadian Institute of Actuaries (CIA) without adjustment.
- More than one FMA, used the sum of the number of actuaries from two association.
## Distribution of Actuaries – 2001 to 2021

<table>
<thead>
<tr>
<th>Countries</th>
<th>Number of Actuaries 2001</th>
<th>Number of Actuaries 2011</th>
<th>Number of Actuaries 2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latin America</td>
<td>813</td>
<td>1.615</td>
<td>1.659</td>
</tr>
<tr>
<td>English Speaks Countries</td>
<td>17.252</td>
<td>39.074</td>
<td>60.667</td>
</tr>
<tr>
<td>Euro1</td>
<td>6.962</td>
<td>10.602</td>
<td>15.784</td>
</tr>
<tr>
<td>Euro2</td>
<td>389</td>
<td>914</td>
<td>1.536</td>
</tr>
<tr>
<td>Asia</td>
<td>1.405</td>
<td>3.281</td>
<td>7.557</td>
</tr>
<tr>
<td>Africa</td>
<td>-</td>
<td>52</td>
<td>156</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>26.821</strong></td>
<td><strong>55.538</strong></td>
<td><strong>87.359</strong></td>
</tr>
</tbody>
</table>
## Distribution of Actuaries – From 2001 to 2021

<table>
<thead>
<tr>
<th>Countries</th>
<th>Number of Actuaries (%) 2001</th>
<th>Number of Actuaries (%) 2011</th>
<th>Number of Actuaries (%) 2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latin America</td>
<td>3%</td>
<td>3%</td>
<td>2%</td>
</tr>
<tr>
<td>English Speaks Countries</td>
<td>64%</td>
<td>70%</td>
<td>69%</td>
</tr>
<tr>
<td>Euro1</td>
<td>26%</td>
<td>19%</td>
<td>18%</td>
</tr>
<tr>
<td>Euro2</td>
<td>1%</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>Asia</td>
<td>5%</td>
<td>6%</td>
<td>9%</td>
</tr>
<tr>
<td>Africa</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>
Data

Distribution of the number of actuaries

- English Speaking: 69%
- Europe: 20%
- Other: 11%
Published by Swiss Re in its *Sigma Publication* in US $ from 2001-2020 separately by country and for the life and non-life sectors.

May be understated when government agencies or corporations have significant premium.

In 2020, country with the most premium is USA, with nearly $2.6 trillion, followed by China with nearly $0.7 trillion.

Country with the least premium is Lithuania, with approximately $520 million total premium.
GDP data published in *Sigma* without an adjustment for PPP.

Most GDP is for USA, with more than $20 trillion, followed by China, with more than $14 trillion.

Least GDP in our sample is for Iceland, with approximately $22 billion.

**Purchasing Power Parity (PPP)**

For 2020, we obtained PPP data for GDP from The World Bank and performed a comparison of the results. We used GDP in international dollars with a PPP adjustment that takes into account differences in costs for products and services across the range of countries.

Most GDP_PPP is for China, with more than $24 trillion, followed by USA, with more than $20 trillion.

Least GDP_PPP is for Iceland, with approximately $20 billion.
Data by country from *Sigma* for 2001-2020.

China and India have populations greater than 1.3 billion.

Cyprus and Iceland have populations of approximately 1.2 million and 370,000, respectively.
Data

Algebraic relationships hold:

- \( \text{Actuarial economic penetration} = \text{Actuarial insurance penetration} \times \text{Insurance penetration} \)
- \( \text{Actuarial density} = \text{Actuarial insurance penetration} \times \text{Insurance density} \)
- \( \text{Actuarial density} = \text{Actuarial economic penetration} \times \text{GDP per capita} \)
## Data

The ranges for the derived variables are as follows:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Actuarial density</strong></td>
<td>from 0.06 per million for Nigeria to more than 220 per million for United Kingdom and Ireland</td>
</tr>
<tr>
<td><strong>Actuarial economic penetration (Nominal)</strong></td>
<td>from less than 10 Actuaries per trillion USD of GDP for China, Egypt, Colombia and Nigeria to more than 5,400 Actuaries per trillion USD for South Africa and the United Kingdom</td>
</tr>
<tr>
<td><strong>Actuarial insurance penetration</strong></td>
<td>from less than 2 Actuaries per billion USD of premium for China and Colombia to more than 50 for Australia, Kazakhstan, Lithuania and Croatia.</td>
</tr>
<tr>
<td><strong>Actuarial economic penetration (PPP)</strong></td>
<td>from less than 4 Actuaries per trillion USD of GDP_PPP for Nigeria, Colombia, Egypt and Pakistan to nearly 3,200 for Canada and 5,000 for United Kingdom.</td>
</tr>
</tbody>
</table>
Results

Actuarial Density by year (number of actuaries by 1 million people)
Results

Actuarial Insurance Penetration (number of actuaries by 1 billion premium)
Results

Actuarial Economic Penetration (number of actuaries by 1 billion GDP)

<table>
<thead>
<tr>
<th>Year</th>
<th>Actuary Economic Penetration</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>0.880</td>
</tr>
<tr>
<td>2002</td>
<td>0.892</td>
</tr>
<tr>
<td>2003</td>
<td>0.835</td>
</tr>
<tr>
<td>2004</td>
<td>0.774</td>
</tr>
<tr>
<td>2005</td>
<td>0.756</td>
</tr>
<tr>
<td>2006</td>
<td>0.775</td>
</tr>
<tr>
<td>2007</td>
<td>0.711</td>
</tr>
<tr>
<td>2008</td>
<td>0.701</td>
</tr>
<tr>
<td>2009</td>
<td>0.925</td>
</tr>
<tr>
<td>2010</td>
<td>0.909</td>
</tr>
<tr>
<td>2011</td>
<td>0.869</td>
</tr>
<tr>
<td>2012</td>
<td>0.864</td>
</tr>
<tr>
<td>2013</td>
<td>0.888</td>
</tr>
<tr>
<td>2014</td>
<td>0.899</td>
</tr>
<tr>
<td>2015</td>
<td>0.991</td>
</tr>
<tr>
<td>2016</td>
<td>0.887</td>
</tr>
<tr>
<td>2017</td>
<td>0.866</td>
</tr>
<tr>
<td>2018</td>
<td>1.036</td>
</tr>
<tr>
<td>2019</td>
<td>1.079</td>
</tr>
<tr>
<td>2020</td>
<td>1.116</td>
</tr>
</tbody>
</table>
Results

Actuarial Economic Penetration (number of actuaries by 1 billion GDP_PPP)
Results

Actuarial density by region/linguistic

Individual Country Reports (n = 67)
Results

Actuarial Density distributed geographically
Results

Actuarial economic penetration PPP by region/linguistic
Actuarial Economic Penetration distributed geographically
Results

Actuarial Insurance penetration by income level
Results – relationship between the variables

2021 Number of Actuaries vs. 2020 Population
Results – relationship between the variables

2021 Number of Actuaries vs. 2020 GDP
Results – relationship between the variables

2021 Number of Actuaries vs. 2020 GDP_PPP
Analysis

2021 Number of Actuaries versus Total Insurance Premium

[Graph showing the relationship between 2021 Number of Actuaries and Total Premium 2020 (in million).]
Analysis

2021 Number of Actuaries versus 2011 Number of Actuaries
Results

Graphs show clustering near the origin with the extreme x- and y-values almost appearing as outliers rather than actual data points.

Considering the rank of the variables, the pattern is clearer. We have removed the effects of a large range between the lower and the higher values of each variable.

Look at the graphs on the next slides, considering the ranks of each variable.
Results – relationship between the variables

2021 Number of Actuaries versus 2020 Population
Results – relationship between the variables

2021 Number of Actuaries versus 2020 GDP
Results – relationship between the variables

2021 Number of Actuaries versus 2020 GDP_PPP
Results – relationship between the variables

2021 Number of Actuaries versus 2020 Total Insurance Premium
Results – relationship between the variables

2021 Number of Actuaries versus 2011 Number of Actuaries
Conclusions

The graphs of the number of actuaries versus population, GDP, and total insurance premium show a generally increasing relationship. There is considerable dispersion from a strictly linear relationship.

There are unexpected results in which countries with a low to medium number of actuaries have high actuarial density (Croatia, Cyprus) or actuarial penetration (Croatia, Slovenia, Cyprus). Other countries like Brazil and India have a much larger number of actuaries but lower actuarial density and actuarial penetration.

The analysis shown in our presentation is an update to previous analysis and will lead to further analysis investigating correlations and paving the way for a robust regression model for the number of actuaries in a country for a given year.
Conclusions

Clearly, there are other important factors, such as regulation, structure of insurance and pension systems, cultural, social and so on, which can impact specific countries in different ways and will influence the future number of actuaries. In addition, in a globalizing world, there may also be significant supra national influences to consider.

However, we believe that further study of the actuarial profession both on the comparative regional or global basis and locally for a particular association will yield results and insights beneficial for our future professional success. There can be implications for actuarial associations, educators, regulators and the risk-taking entities themselves.
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